JAPAN INTERNATIONAL COOPERATION AGENCY
MINISTRY OF HEALTH
NATIONAL CENTER FOR ENVIRONMENTAL
HEALTH AND WATER SUPPLY

THE STUDY ON
RURAL WATER SUPPLY AND
SANITATION IMPROVEMENT IN
NORTH-WEST REGION IN
THE LAO PEOPLE'S DEMOCRATIC REPUBLIC

OPERATION AND MAINTENANCE MANUAL AND TRAINING TEXT

MARCH 2001

JAPAN TECHNO CO., LTD.
Tokyo, Japan

IRC International Water
and Sanitation Centre
The Hague, The Netherlands

World Health Organization
Geneva, Switzerland

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The Study on Rural Water Supply and Sanitation Improvement in North-West Region of Lao PDR

Operation and Maintenance Manual and Training Text

Introduction

This document is provided for the Study on Rural Water Supply and Sanitation Improvement in North-West Region, a development study of Japan International Cooperation Agency (JICA). The Study will focus on capacity building of Provincial and District level staff in Luang Namtha and Bokeo Provinces in the water and sanitation sector. This manual and text can serve as a tool for achieving the following goals:

1. To educate the villagers on operation and maintenance of rural water supply facilities, such as gravity fed system, handpump equipped borehole and other VLOM (village level operation and maintenance) suited facilities.

2. To train potential trainers through TOT (training of trainers) on operation and maintenance for rural water supply and sanitation, so that they can transfer the acquired knowledge to the next generation of potential trainers.

We would like to acknowledge the use of materials of IRC International Water and Sanitation Centre in collaboration with the World Health Organization (WHO). The following papers are referred to as the main source of reference for this manual and text:

1. "Making Your Water Supply Work, Operation and Maintenance of Small Water Supply Systems" by Jan Davis and Francois Brikke, IRC International Water and Sanitation Centre, The Hague, The Netherlands, 1995.

2. "Management of Operation and Maintenance in Rural Drinking Water Supply and Sanitation, A Training Package (Draft)" prepared by Francois Brikke, Operation and Maintenance Network of the Water Supply and Sanitation Collaborative Council, IRC International Water and Sanitation Centre, The Hague, The Netherlands, World Health Organization, Geneva, Switzerland, 1999.

The document is divided into two sections as follows:

Section I	**Operation and Maintenance Manual** - To be used as a reference manual during education and animation to villagers on proper operation and maintenance
Section II	**Operation and Maintenance Training Text** - To be used as material for training on operation and maintenance

The JICA Study Team hopes this manual and text will contribute to the sustainability of the Lao people to foster a sense of true ownership. Moreover, we believe this document will enhance further development of the villagers, especially those with low incomes and living in the remotest areas of the study target area where varied ethnic minority groups are making their living.

SECTION I

OPERATION AND MAINTENANCE MANUAL

PART I

THE CHALLENGE OF OPERATION AND MAINTENANCE

Chapter 1: Concepts and Trends

The first pararaphs will review the main concepts of operation and maintenance (O&M), the link between O&M and sustainality as well the main constraints and benefits of O&M.

The chapter is ending with an overview of the main trends in O&M presently encountered in the water supply sector.

1.1 What is Operation and Maintenance?

Operation

Operation refers to the everyday running and handling of a water supply. This involves several activities:

- Major operations required to convey safe drinking water to the users, e.g. starting and stopping a motorized pump, the supply of fuel and the control of valves.
- The correct handling of facilities by users to ensure long component life, e.g. the handling of a rope and bucket at a well, handpump use, and the use of taps at a standpost.

The proper operation of a supply results in its optimum use and contributes to a reduction in breakdowns and maintenance needs.

Maintenance

Maintenance refers to the activities required to sustain the water supply in a proper working condition. Maintenance can be divided into:

- Preventive maintenance - regular inspection and servicing to preserve assets and minimize breakdowns.
- Corrective maintenance - minor repair and replacement of broken and worn out parts to sustain reliable facilities.
- Crisis maintenance - unplanned responses to emergency breakdowns and user complaints to restore a failed supply.

Maintenance costs money and a policy of crisis maintenance alone may appear cheap in the short term. However, continuing crisis maintenance leads to frequent breakdowns, an unreliable supply, poor service levels, and a lack of user confidence. Reliance on crisis maintenance may ultimately lead to complete system failure.

Rehabilitation entails the correction of major defects and the replacement of equipment to enable a facility to function as originally intended. Rehabilitation becomes necessary when it is no longer technically feasible or economically viable to maintain a facility in good working order. Maintenance will become uneconomic if the long term cost of rehabilitation and subsequent operation is more favourable than continued repair and maintenance.
Water supply statistics often give the number of people served by improved water supplies. Unfortunately, the actual number of people served is far less because many supplies do not function reliably due to the neglect of operation and maintenance. Unless operation and maintenance is properly implemented then continued investment in the development of water supplies is not worthwhile.

1.2 Operation and Maintenance and Sustainability

Sustainability is a widely used term which has a variety of meanings depending on the context in which it is used. A drinking water supply is sustainable if:

- the water consumed is not over-exploited but naturally replenished
- facilities are maintained in a condition which ensures a reliable and adequate potable water supply
- the benefits of the supply continue to be realized over a prolonged period of time.

Water supply projects are not to be seen as an end in themselves but as the initiators of a range of benefits which continue long after projects have been handed over. Figure 1 shows several possible lines of development of a project. Community based projects may take longer to develop but allow time for the factors which determine sustainability to be identified. Appropriate measures can then be taken to develop effective O&M. In the past, relatively short-term agency managed projects have often neglected critical aspects of O&M development.

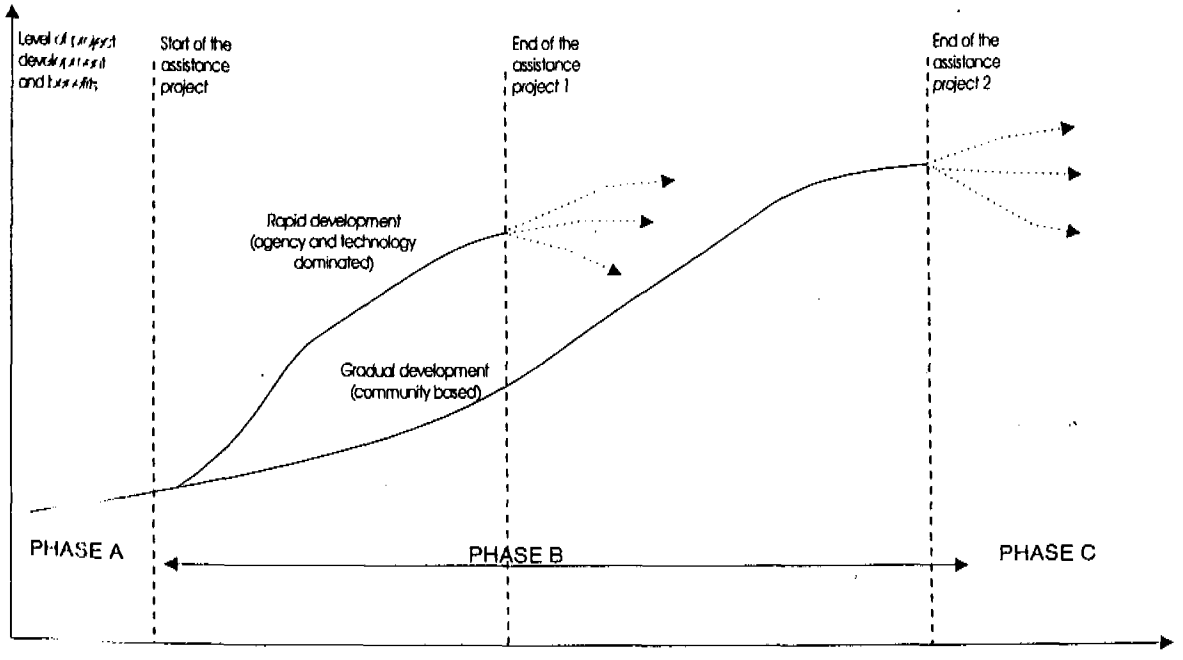


Figure 1: Realizing and sustaining benefits over time.

In order to sustain benefits in Phase C, factors influencing sustainability and operation and maintenance will have to be developed and/or strengthened already during the implementation Phase B, and in some cases supported and monitored even during Phase C. It is quite clear that factors influencing operation and maintenance will have to be planned for in Phase A, before the start of the implementation of the projects. Indeed, these factors could have an important impact on the technology selection, as well as on operation and maintenance.

Some benefits, such as health improvements, may take a considerable period of time before they are realized. Other benefits, such as easier access, may be realized on completion of construction. A benefit such as access to greater quantities of water may decline from an initial high level but still continue as an overall benefit compared to a previous supply. It is clear that the benefits of water supplies cannot be sustained without effective O&M.

The following key elements of sustainability are mutually supportive of effective O&M :

- **An enabling environment**
  An environment which encourages sustainable systems through appropriate legal provisions, regulations, education, information and other similar incentives.
- **Felt need and health awareness**
  The existence of a genuine appreciation of the advantages of safe water supplies so that users support O&M.
- **Strong institutions**
  Water agency and community structures with established legal status, clear responsibilities, adequate financial support, good organization and the representation of all users, including women and poorer households.
- **Supportive attitudes**
  A commitment by the water agency and community to share responsibilities, establish clear ownership and contribute to the financial support of services.
- **Expertise and skills**
  A clear identification of O&M needs and the training of agency staff and community members in the necessary skills.
- **Appropriate service level**
  An affordable and manageable service level which can be upgraded later as the socio-economic situation improves.
- **Appropriate technology**
  Practical, affordable and acceptable technology.
- **Materials and equipment**
  Items such as spare parts must be available to keep systems functioning.
- **Support services**
  O&M support systems must be effective.
- **Financial matters**
  Factors such as capacity and willingness to pay, as well as cost sharing and community financial management, are likely to influence the financial sustainability of the systems. Finance becomes more and more relevant, especially in a context where communities are being empowered with new financial responsibilites.

(Ngumbu, 1990)

The New Delhi Statement (1990), which tried to draw lessons learned from the International Water and Sanitation Decade (1980-89), emphasized four guiding principles for sustainable development:

1. Protection of the environment and safeguarding of health through the integrated management of water resources and liquid/solid wastes.
2. Institutional reforms promoting an integrated approach and including changes in procedures, attitudes and behaviour, and the full participation of women at all levels in sector institutions.
3. Community management of services, backed by measures to strengthen local institutions in implementing and sustaining water and sanitation programmes.
4. Sound financial practices, achieved through better management of existing assets, and widespread use of appropriate technologies.

Finally, there is a wide tendency to make people aware that they should pay for the services they use, which could influence the financial sustainability of water supply systems, and at the same time give more responsibility in terms of ownership to communities. In other words, water is no longer a free good as it has been considered in the past in many countries, as a gift of God or a public responsibility of the governments. However, it should be clear that the price consumers are paying corresponds to the added value of providing a better service of water supply to them.

1.3 The Constraints on Effective Operation and Maintenance

Numerous reports reflect the record of poor operation and maintenance and the following list highlights the main constraints.

- The low profile and hence low priority given to O&M by policy makers.
- There is a need for clear policies, appropriate legal frameworks and a well defined division of responsibilities to support O&M in the sector. Centralized government departments are often unable to respond efficiently to the maintenance of scattered rural supplies. Governments, therefore, need to adopt workable policies which devolve responsibility to autonomous agencies and communities.
- Political interference makes sustainability that much more difficult to achieve. The political decision to provide free water means users do not contribute funds for the upkeep of supplies. Political influences can determine technologies (e.g. tied to aid) or result in sub-standard systems. Such influences can be reduced by devolving management responsibilities away from government.
- A focus on capital construction and expansion by governments and external support agencies neglects the maintenance of existing supplies.
- Overlapping responsibilities of staff and departments can divert skills, funds and equipment away from O&M. This often happens when operational staff are redeployed to construction work as a new project is started. New projects benefit while existing projects are neglected.

- Inappropriate design and technology choice creates unnecessary operation and maintenance difficulties and increases costs. Initial design must consider long term O&M. Poor design is often compounded by inadequate supervision of construction.
- A lack of community involvement in project development can lead to inappropriate designs. Poor user understanding of how to correctly operate systems can result in the misuse and damage of facilities.
- Some communities are disadvantaged by their remoteness or difficult access. This adds to the cost and problems of maintenance and requires special attention.
- There are often inadequate data for planning O&M. Data are required, for example, on the cause of breakdowns and the maintenance and repair costs involved. O&M can then be planned based on field experience.
- The state of national and regional economies can have a crippling effect on O&M as high inflation and fluctuating exchange rates can significantly increase O&M costs. For example, the operation of powered pumps and maintenance crew transport is especially affected by fuel price increases.
- Water supply facilities are often poorly managed. Some of the management constraints, such as unskilled staff, may be a result of underfunding but are often also due to poor management. O&M responsibilities are rarely delegated to individuals and this can result in a lack of sense of responsibility for the proper use and upkeep of facilities. Management supervision of operation and maintenance may be virtually absent in many cases.
- A lack of training and understanding of maintenance procedures leads to the poor performance of O&M staff (operators, mechanics, caretakers, etc.).
- Insufficient and inefficient use of funds for O&M restricts the availability of spare parts, tools and the recruitment and training of competent staff. A lack of accountability in many maintenance departments leads to inefficient use of maintenance funds.

(McPherson, 1990; Ittissa, 1991; Wyatt, 1988; Roark, 1993)

Table 1: Overview of major constraints concerning O&M as reported by twelve countries in the Harare subregional O&M Workshop (Brikké, 1994)

Zambia Poor statistics of rural areas; overlaps in responsibilities; many actors involved; taking over by communities has been difficult; each one has its own technology; lack of coordination; standardization of Mark II did not succeed; communities do not contribute much apart for labour and materials; lack of skills and capacity of the communities; no standardization or interchangeability between different technologies; lack of clear strategy for water and sanitation; poor training policy; no comprehensive data on rural systems.	**Zimbabwe** Going through various stages of implementation of new concept of community management and decentralization; no policy on finance; lack of cost recovery system; community-based repairs established but communities are not managing, although they are provided with parts and training; maintenance of piped schemes very expensive, and lack of guidelines.
Tanzania Despite changes of policy introduced since 1990, people still used to old policy of free water and government intervening for all O&M; funding is a problem; some projects have still high technology, with high O&M costs; economic decline; inadequate priority setting of activities by the Government; poor data on O&M; lack of involvement of communities; lack of trained personnel; inadequate health education	**Mozambique** New approach of decentralized maintenance; AFRIDEV introduced, but failed due to drought; training and participation of communities is alright, but spare parts provision is inadequate, and the organization of collecting funds for maintenance is not working well; the number of pumps installed has increased, but it is difficult to know how many are functioning; because of war, many people went to the cities; lack of accurate information.
Malawi Community participation has declined, mainly due to urban migration; water quality is poor; use of slow sand filters not adequate; vandalism; government owns piped schemes and has problems of cost recovery, since not enough has been budgeted.	**Swaziland** Inadequate supplies; communities have little trust in their committees; inaccessibility; revenue collection difficult; collapse of pit latrines; lack of data; inadequate training of communities for management.
Nigeria Breakdowns are quite rampant; general unsustainable environment for O&M because of unstable politics and down turn of economy; inflation offsets the system even at rural level; cost sharing concept not yet clear and accepted; investments in the water sector are not looked in a wider perspective of general rural or urban economic development.	**Ghana** Despite national policy change with intensive educational campaign and a demand driven approach, collection of tariffs is difficult, and recovery insufficient; community management still needs to be pursued and the availability of spare parts is not yet efficient; in general, lack of coordination; overloading of sanitation facilities, because of population growth; priority setting of resource allocations not adequate.
Kenya Law on water use not adapted to real situation; despite a certain subsidization from the Treasury, cost recovery is not enough; high costs of spare parts; difficult to maintain adequate stocks of spare parts; passive community involvement in management of WS; lack of qualified operators; shortage of sufficient funding to finance regular rehabilitation/augmentation of water schemes; many water supplies were designed in the early 1970s; in slums poor access to adequate means of excreta disposal;	**Lesotho** Problems in implementing cost recovery policy, especially when sanctions have to be applied; question of village water ownership surfaces; Communities ignorant of their roles in community management; communities left to operate and carry small repairs and government has the responsibility of big repairs; lack of commitment on sanitation by Government; regarding urban water supply : lack of land management, inadequate policies and poor enforcement of available legislation, and staff movements resulting in a negative capacity building. Environmental hygiene greatly influenced by lack of hygiene education.
Namibia Country has very recently adopted a new policy aiming to decentralize O&M activities and make people pay for certain services. Cost recovery is not developed properly; difficult to assess new approach because too recent, but O&M was too centralized in the past and costs of maintaining were too high for the government alone to bear; lack of trained personnel; inappropriate technology.	**Botswana** Less constraints compared to other countries, except : poor data collection; poor management; not a lot of trained staff; insufficient funds for recurrent expenditures; sanitation is a bit neglected and no one is directly involved

1.4 The Benefits of Effective Operation and Maintenance

Effective O&M benefits users, water agencies and countries as a whole. Benefits include improved health and wellbeing, and social, economic and financial advantages.

User benefits

- Improved health through a constant, reliable supply of safe water of sufficient quantity for essential hygiene measures.
- A nearby improved supply can often save water collectors time and energy. Women often shoulder the burden of collecting water and use the time and energy they save in several ways: they spend more time with the family; rest from other tiring work; and become involved in economically productive activities. A broken down supply can mean a loss of these important benefits.
- Involvement of the users in O&M activities can reduce their dependency on external assistance. Technical and management skills within the community can be enhanced through appropriate training. These can have broad benefits for other community development projects and in commercially productive activities, such as transport maintenance and the operation of grain mills.



Figure 2: Good operation and maintenance can make a difference.

Water agency benefits

- A reliable water supply encourages users to pay for their supply. This provides the agency with the revenue to fulfil their responsibilities.
- An effective O&M system which also involves the users reduces the day-to-day burden of routine servicing and maintenance often carried out by the water agency alone.

National benefits

- The government and country benefits because the existing stock of infrastructure is maintained and preserved. New developments then increase the number of water supply systems rather than merely keep pace with the existing coverage.

- Effective O&M means that designers do not have to over-compensate for expected poor O&M. The higher capital cost of such an approach can be avoided if planners initially establish an effective O&M strategy.
- Functioning water supply schemes contribute to a healthier and more productive population which benefits everyone.

The benefits of a new O&M strategy

In Sudan, a wateryard is a borehole supply providing water for drinking and animal watering. Wateryards are owned by the government and managed by the National Rural Water Corporation (NRWC). Due to the economic hardships experienced by Sudan, NRWC does not receive sufficient funds to properly operate or maintain the wateryards. The result has been that many of the yards do not function well, if at all.

In 1986 the World University Service of Canada (WUSC) began to work closely with the NRWC to develop a new O&M strategy in a limited trial programme. It was based on a partnership between the user community and the NRWC. Water rates were collected and paid into a community bank account. The community paid the NRWC for operation and maintenance services.

A legal Operation and Maintenance Agreement was established in June 1988. A further decree was passed in 1990 which allowed wateryard revenues to be retained in the provinces. Significant aspects of the O&M Agreement were:

- the establishment of a community revolving fund
- the fixing of the water rate at a realistic level
- joint management of the revolving fund by WUSC, NRWC and the community
- the establishment of community water committees
- the establishment of record keeping to monitor revenues and operational data. e.g. operating times, fuel consumption
- a preventive maintenance strategy supported by the training of community operators and regular inspections by NRWC
- the regular monitoring of performance by water committees
- the establishment of an operation and maintenance service group to provide maintenance services.

The trial was carefully monitored and the following initial benefits identified:

- the O&M costs were fully recoverable
- prior to the trial, users were paying two to three times more than the trial water rate due to the 'unofficial' system that had developed to keep the wateryards functioning
- additional revenue paid to NRWC could be used by them for the expansion and rehabilitation of other systems.

The trial of a planned, cooperative O&M strategy demonstrated clear benefits to the users, the water agency and the government.

(McPherson, 1990)

1.5 Trends

The growing emphasis on O&M is not unique to rural water supplies but reflects the changes that are occurring generally within developing countries. Many of the trends follow on from declining investment in infrastructure. In the absence of new investment, the only affordable option is to maintain what currently exists (Wyatt, 1988).
The major trends in O&M are summarized below and discussed in more detail in the following chapters.

Water is an economic good

Water supply is a service, and just like any service it involves manpower, repairs, spare parts, energy, etc. These are not free, therefore in order to provide a safe and sustainable water supply, a cost recovery system has to be introduced. Governments are facing the greatest difficulties in meeting recurrent costs, and the tendency is to make beneficiaries pay for the water they use, in order to recover partially or totally the costs of supplying this service, and to give to the communities more responsibility in the actual management of the water supply system.

Decentralization, collaboration

The users of water supplies are often the only viable source of funding for the regular maintenance of supplies. Users will only pay for a service if it is reliable and meets their needs. Hence there is a trend towards the greater involvement of communities in determining the level and type of service they want and can afford, and in the management of O&M by the users themselves.

The transfer of responsibilities for the financing and control of O&M to communities requires the loosening of centralized control by government departments. Hence, there is a trend towards decentralization and greater collaboration between government departments, external support agencies and water supply users.

The 'New Delhi statement'

At the New Delhi Global Consultation on water supply and sanitation in 1990, the Collaborative Council Working Group on Operation and Maintenance made a statement which recognized the need for fundamental changes required by agencies if water systems are to provide sustainable services:

- agencies should change their orientation to see their primary role as provider of a service and ***not*** the constructor of physical works
- agencies should become autonomous in efficient and transparent management and financing of services
- agencies should provide integrated water and sanitation services only in response to the effective demand of the consumer.

The integration of health, water and sanitation activities

An integrated O&M strategy in which the concerns of water, sanitation, hygiene education and waste disposal are tackled together is part of an overall concept of balanced development which is gaining acceptance. Effective O&M encompasses the maintenance of systems, promotion of the safe and efficient handling of water from source to home, and measures to prevent the contamination of water sources.

Environmental concern

For a water supply to function, the water supplied must remain potable and the source must continue to be sufficiently recharged to meet the demand. O&M, therefore, now tends to encompass the protection of the environment to ensure that the quality of source water does not deteriorate or quantity decline. The careful management of water sources and catchments as an O&M activity can help to achieve this.

Women's involvement and gender awareness

In an endeavour to involve the whole community, the role of women has become more prominent. As the principal users of rural water supplies, women are encouraged to participate in decision making and take active roles in management and maintenance activities.

Involving women more should not, however, lead to increased physical work for women or greater demands on their time as they already work longer hours than men in carrying out household and subsistence chores. A gender approach to maintenance and maintenance management ensures that work, authority and benefits are more equally shared with men. If women have to do the work alone, conflicts arise and maintenance and villagers suffer in the end.

Human resources development

As a consequence of greater community involvement, there is a shift in O&M responsibilities from skilled professionals to previously untrained community members who are expected to provide an improved O&M service. Such a radical change of roles requires corresponding changes in personnel support and training.

Water agency personnel need to be aware of their agency's changed role from constructing and running systems to providing supervisory, inspection and training services to communities and the private sector. Engineers need to be able to integrate the 'software' of communication and organizational skills with the 'hardware' of technical knowhow.

Private sector involvement

The private sector has always had a role to play in the design and construction of rural water supplies or in providing equipment, materials and skills for construction, operation and maintenance. An even greater private sector involvement in O&M is now being promoted.

Appropriate and affordable technology

Much greater attention is now being given to choosing technology according to the capacity of a community to operate, maintain and finance a system.

As long ago as 1981, the UNDP/World Bank Handpump Project introduced the term VLOM - Village Level Operation and Maintenance - to promote the development of handpumps that could be operated and maintained by the community. The concept can be equally applied to *all* water supply technologies. The VLOM guidelines recommend that the hardware should be:

- easily maintained by village caretakers or artisans with few skills and tools
- manufactured in the country of use to ensure the availability of spare parts

- robust and reliable under communal operating conditions
- standardized to take advantage of economies of scale, common skills training, user familiarity and the availability of spare parts
- low in capital and recurrent costs.

(Arlosoroff et al, 1987)

The trend now is to offer communities a range of water supply options from which to choose based on the technically feasible options suited to the local conditions.

Improving effectiveness

There is a trend to be more concerned with the effectiveness of a water supply in achieving overall aims. This is not indicated by numbers of schemes built but in terms of what people do. People's behaviour is a good indicator of change. Therefore, there is a greater emphasis on how supplies are managed, operated, maintained and utilized to achieve the desired benefits such as improvements in health, increased production, and reductions in women's workload (Glennie, 1994).

National policies

Many national policies still lack clear strategies on how to develop effective O&M. Revised water tariffs and more accountable systems for the recycling of revenue to support O&M activities have been gradually introduced where national policies have reflected the need to generate recurrent revenue. However, practice can often lag behind policy. Continuing economic crises forces ministries to reduce expenditure, especially on recurrent costs, and hence on O&M.

Revision of donor policies

Donor agencies have begun to implement well-defined policies to ensure O&M is a central concern of the programmes they support. The extent of policy implementation can be assessed through evaluation. The sharing of these findings helps programmes plan for effective O&M (SIDA, 1993). Participatory evaluations, in which donors, agency staff and users are all involved, assist in the orientation of all concerned to the needs of O&M.

Leading donors have supported the promotion of measures to assess O&M problems and potential solutions through sponsorship of and participation in workshops and conferences (McPherson, 1990). Donors have sponsored studies into O&M practices and issues. This has resulted in a growing range of literature (see the references at the end of this paper).

PART II

OPERATION AND MAINTENANCE REQUIREMENTS

Chapter 2: General Requirements of Operation and Maintenance Strategies

2.1 Critical Factors

The most appropriate operation and maintenance strategy for a particular supply will depend on a range of factors:

- **Technology**
  complexity, familiarity, standardization, spares availability and skills required
- **Demography**
  scattered or dense population; numbers of people served
- **Environment**
  effect on the water source; effect on materials and equipment
- **Accessibility**
  main road or remote water supplies
- **Cost**
  total cost of O&M and the cost per individual user - what are users willing and able to pay?
- **Management**
  level of community organization and cohesion; existing management structures and skills; efficiency of support agency management
- **General economy and level of development**
  inflation; stability of prices; fluctuation in incomes; availability of skills, tools, equipment and services
- **Government policy and legal framework**
  Government-promoted O&M strategies; legal ownership; accountability and the allocation of responsibilities.

2.2 People and Organizations

Who is required to support operation and maintenance?

It is useful to identify the wide range of actors - people and organizations - involved in O&M.

- **the community**
  users (women, men; young and old), user groups, community leaders, water committees, village councils, caretakers, mechanics, operators,
- **the government and public authorities**
  local, district, regional and national officials,
- **water agency and associated support agencies**
  managers, maintenance teams, inspectors, trainers, and social, financial and health extension workers

- **private sector**
  local entrepreneurs, local artisans, shopkeepers, wholesalers, manufacturers of equipment and spare parts, bankers, consultants, contractors
- **NGOs (non-governmental organizations)**
  local, national and international NGOs
- **external support agencies**
  multilateral and bilateral aid agencies, development banks.

The community

The many individuals and groups of people in a community will all have their own views on the requirements of O&M and their role as users, operators and managers. A general 'community view' may not highlight critical factors which ultimately determine O&M effectiveness.

Waterpoints are used by women for both domestic and productive uses whereas men utilize waterpoints mainly for productive activities. Productive activities include animal raising, vegetable and fruit growing, brewing, post-harvest processing, pottery and cloth dyeing, among many others. The various uses have an economic value which may be competitive and can sometimes lead to conflict. Users, as individuals or groups, who have an economic interest in a water supply will be economically interested in effective O&M. They may be ready to financially support O&M but they may also be keen to keep payment to a minimum, or even avoid payment. Firm management is often an important requirement.

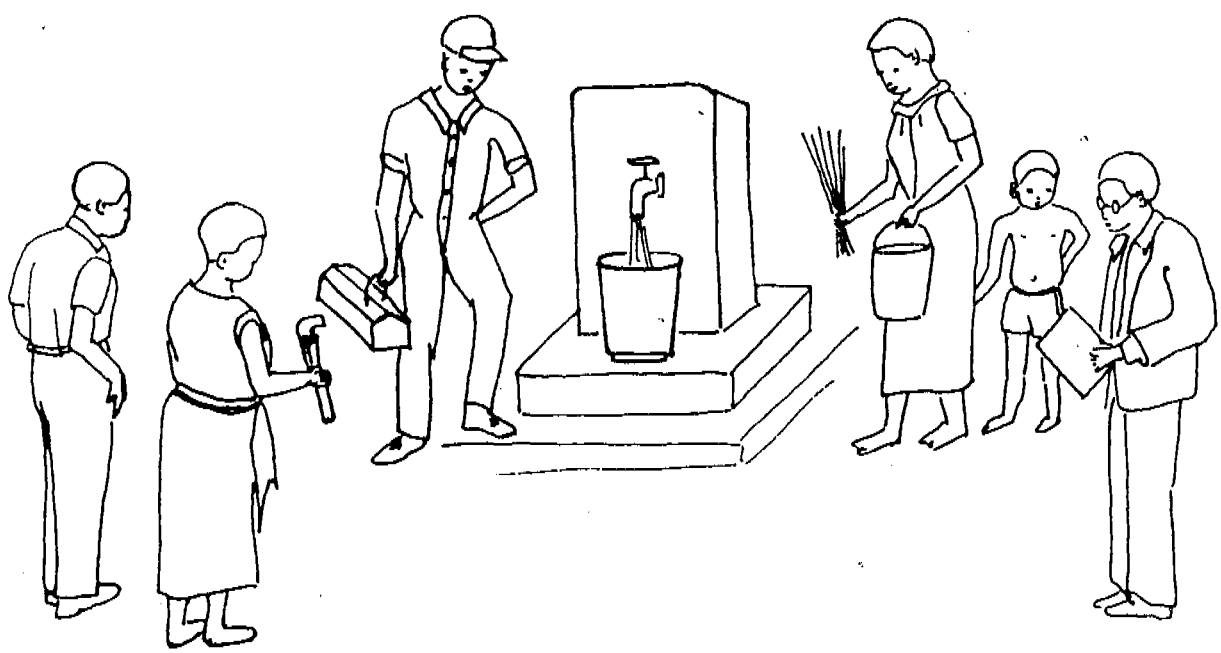


Figure 3: Various members of the community are involved in O&M.

Users have a responsibility to operate a facility correctly. An understanding of the correct way to handle taps, waterpoints, pumps, etc. should not be assumed and raising awareness of the implications of misuse is sometimes necessary.

A water committee is a formal association representing users for the purpose of managing a local water supply system or point source. The important role and function of water committees in O&M are considered in detail in 3.4 'Community management'.

Caretakers, attendants and operators are men and women chosen by the water agency or community to operate and maintain water supply facilities. A participatory selection process using agreed criteria gives a clear idea of the tasks involved so that a reasoned choice can be made of the best man or woman for each job.

Typical caretaker selection criteria

- Good motivation
- Authority and respect to control use of facilities
- Able to carry out maintenance and small repairs after training
- Good communication with women and men about water use and hygiene
- Living near the water facility
- Seldom absent for long periods
- Likely to remain in the community
- Completes training successfully
- Able to keep records - not always a requirement but level of literacy to be stipulated if necessary.

Individual responsibilities need to be clearly defined and understood. The method of compensation or remuneration should aim to promote efficient operation and maintenance so that a supply keeps working, rather than one which pays more favourable rates for repair work.

The important supportive role of governments, the private sector, NGOs and external support agencies are considered in Part IV.

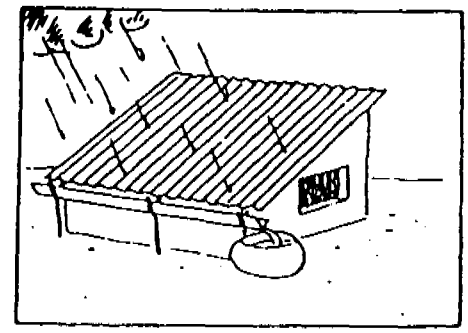
Chapter 3: Technical Requirements

3.1 Water Supply Options

The degree to which the above factors influence the sustainability of a supply will depend on its O&M requirements and the circumstances in which the supply has to function. As circumstances vary considerably from one water supply to another, it is clearly not possible here to give a definitive list of requirements for each supply option. Therefore, the examples which follow give a selection of water supply options and outline factors which particularly affect O&M. The options reflect an increase in management complexity from the household level to schemes serving several communities.

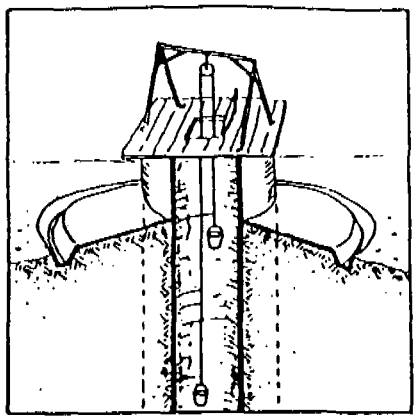
The selection of a water supply option is a collaborative effort involving all the partners in a scheme.

Table 2: O&M factors and requirements for rooftop rainwater harvesting



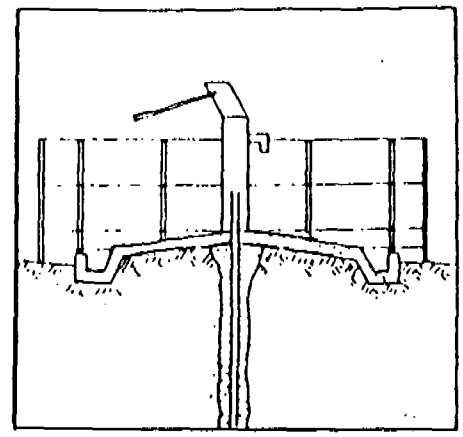
O&M Factors		*O&M Requirements*
Technology	tank material	Steel requires periodic corrosion protection. Ferro-cement and cement mortar require less attention
Environment	regular rainfall	Small leaks are not necessarily critical. Systems to deal with dust settlement are not essential and are therefore simpler to operate and maintain.
	intermittent rainfall	Systems must be well maintained and operated to collect rain whenever it falls and to minimize water loss from leaking tanks and taps.
Cost	recurrent cost	Recurrent costs are generally low. Having reserve O&M funds for household systems is not critical but is necessary for extensive institution systems.
Management	household	Household management and user responsibility is clear. Funds for maintenance come from the household.
	institution	Institution management must be made clear and institution funding allocated for maintenance. O&M responsibility for an institutional system is not as strong as for a household system. Supervising correct use is a part of O&M.
General economy and level of development		No fuel and few materials required for maintenance. Subsidized roofing material prices may assist O&M
User education		The use of stored water may be restricted to drinking water only, depending on the season. Users, especially women, to be made aware of how long water for different uses can be met from stored tank water and the implications for health.

Table 3: O&M factors and requirements for protected well at the sub-village level



O&M Factors		O&M Requirements
Technology -	a simple pulley, rope and bucket	Basic local skills and materials for periodic repair or replacement are needed.
	windlass system	Windlass may be too slow to operate when serving many people - strict supervision necessary.
	rope pump	Understanding of operation and basic skills required to repair and maintain.
Demography -	people far from a well may not use it as frequently as those nearby	Ownership and responsibility for O&M need to be clearly defined.
Environment -	Open wells are susceptible to groundwater pollution and surface contamination	Hygienic operation and regular monitoring are essential to maintain water quality. A safe method of access and dewatering is necessary for cleaning. Wells may need deepening as the water table lowers.
Flooding		Raise or site wells above the flood line.
Accessibility -	the level of external support	Minimum external O&M support required therefore suitable for remote communities.CostLow O&M cost unless deepening or re-lining required.
Cost		Low O&M cost unless deepeninf or re-lining required.
Management		Good community organization necessary to maintain well in a satisfactory hygienic condition. The division of O&M responsibilities by gender is critical.
Government policy and legal framework -	well ownership	Clarification of who owns the well and therefore who has responsibility for O&M: the government or users?

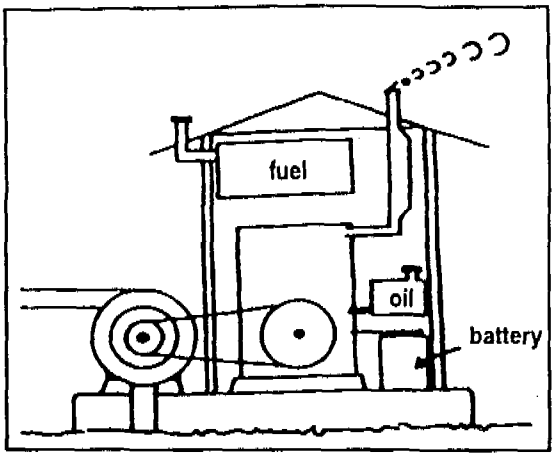
Table 4. O&M factors and requirements for handpump at the village or user group level



O&M Factors		O&M Requirements
Technology -	VLOM* design	Training of local caretakers/mechanics. Availability of spares locally. Back-up support for major repairs. Women tend to be more conscientious in doing preventive maintenance and small repairs than men.
Demography -	population	Adjust maintenance schedule to handpump usage which depends on the population served.
Environment -	Lowering water table due to general aquifer exploitation	Cylinder setting depth may need to be lowered by adding rising main pipes. Suction pumps may need to be replaced by medium lift pumps.
Flooding		Raise or site pumps above the flood line.
Accessibility -	back-up support	Communities which are difficult to reach or have poor access to spares and repair expertise need special consideration.
Cost -	spare parts and preventive maintenance	Communities need to budget for ongoing maintenance and keep a reserve of funds for irregular expenditure. Training, appropriate financing, financial management and stock control is necessary.
Management -	who? how?	Define the handpump user group (whole village, section of village) and who takes the management decisions - men, women or a sharing of decision making?
General economy and level of development		Spare parts: price stability and reliable delivery system.
Government policy and legal framework -	handpump ownership	Clarification of who owns the handpump and therefore who has responsibility for O&M.

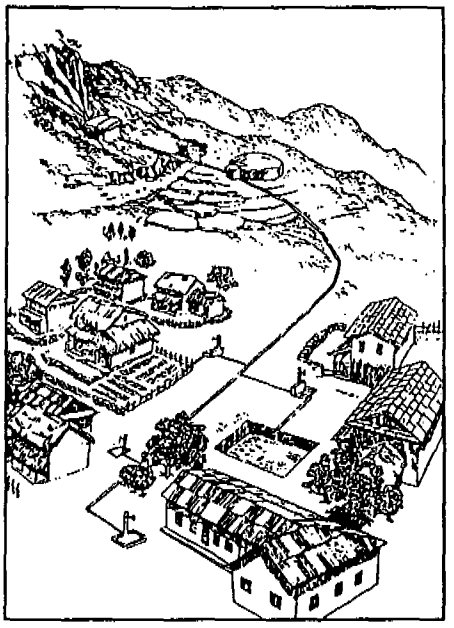
* VLOM - Village Level Operation and Maintenance

Table 5: O&M factors and requirements for motorized pump at the village level



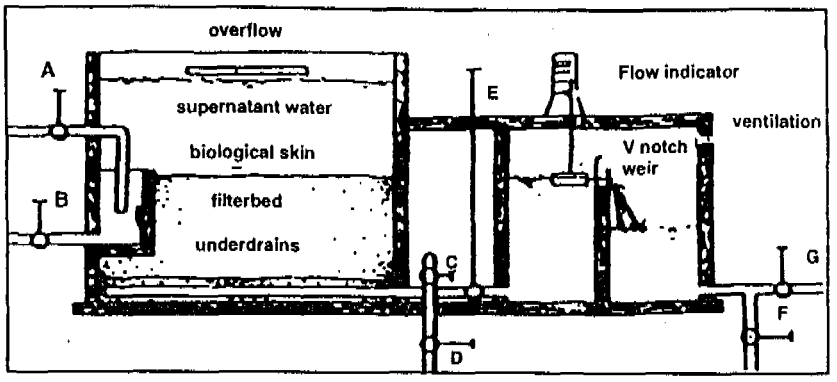
O&M Factors	O&M Requirements
Technology - technical skills and spare parts	Training of pump operator/mechanic in use and servicing. Availability of reliable spares and fuel supplies. Back-up support for major repairs.
Environment - lowering water table due to general aquifer exploitation	Pump setting depth may need to be lowered by adding rising main pipes. Monitoring of groundwater level.
Extensive animal watering at a single waterpoint can lead to environmental degradation.	Control agreements with animal owners and herders.
Accessibility - back-up support	Communities which are difficult to reach need special consideration. Motorized pumps may be inappropriate.
Cost - spare parts, preventive maintenance and eventual replacement	Communities need to budget for ongoing maintenance. They need to be able to raise funds quickly in emergencies for irregular expenditure as reserve funds in high inflation economies depreciate quickly. A method of funding future pump and motor replacement is necessary.
Management - who? how?	Clear management procedure. Who takes the decisions - men, women or a sharing of decision making? Management skills training required: costing, budgeting, revenue collection, very basic accounting. Women often make good treasurers.
General economy and level of development	Spare parts: price stability and reliable delivery system.
Government policy and legal framework - pump ownership	Clarification of who owns the pump and therefore who has responsibility for O&M.

Table 6: O&M factors and requirements for gravity piped system serving several communities



O&M Factors	O&M Requirements
Technology - operational understanding and technical competence	Training of system operators in use and servicing; spares available locally; back-up support for major repairs.
Environment - water catchment	Agreements and action to protect water catchment. This may affect women and men differently and the concerns of both must be considered.
Wastewater	Drainage and control of wastewater at waterpoints.
Cost - maintenance and extensions	Cost per user is low compared to hand or motorized pumped supplies but cost of funding future extensions of the piped distribution may be high - accurate budgeting required.
Management - who? how?	Complex management requires clear agreements at the different levels: overall scheme, village, and waterpoint. Management skills training in costing, budgeting, revenue collection and basic accounting.
Government policy and legal framework - scheme ownership	Clarification of who owns the scheme, or each part of the scheme, and therefore who has responsibility for O&M.

Table 7: O&M factors and requirements for VLOM water treatment - slow sand filtration



O&M Factors	O&M Requirements
Technology - operational understanding and technical competence	Training of operators. Back-up support for major repairs.
Cost - maintenance and extensions	Community support for periodic cleaning of the filter. Irregular funding for maintenance of equipment (valves) and structure (cement). Method of funding future increased treatment capacity.
Management - who? how?	Clear definition of operation and management responsibilities. Management skills training: budgeting, revenue collection, basic accounting. Careful monitoring of the treatment process by an independent agency.
Government policy and legal framework - ownership and technical competence	Clarification of who owns the scheme, and therefore who has responsibility for O&M.

3.2 Identification of Technical Requirements

It is useful to have a systematic procedure to identify the technical O&M requirements of a variety of water supply options when choosing new schemes, or to analyze existing schemes. A standard procedure enables comparisons to be made. It shows what is involved in O&M so that both the users and support agency can decide either the most appropriate option, in the case of a new scheme, or the changes required to improve the sustainability of an existing scheme.

One systematic approach to the identification of O&M technical requirements can be broken down into four stages :

1. **Description of the scheme**
   The major components of a scheme are described in which the essential aspects relevant to O&M are identified.

2. **Description of O&M activities**
   O&M activities are described in a schedule so that the type and frequency of activities can be clearly seen.

3. **Description of O&M requirements**
   The personnel, training, materials, equipment and funding requirements are identified. Responsibility for meeting the requirements can be allocated between the partners.

4. **Identification of tasks**
   Tasks can be categorised into the different functions comprising O&M. Certain O&M tasks will be more critical than others for the sustainability of a scheme and they can be rated according to their importance. This enables priorities to be set either for comparison or for action (WHO and IRC, 1993).

The tasks are categorized as follows:

- supervision and monitoring
- operation
- preventive maintenance
- minor repairs
- major repairs.

An example of the procedure applied to a community managed handpump and a gravity system with standposts is given in the Appendix.

The following critical technical requirements need to be addressed if the most appropriate water supply technology is to be chosen:

- **Skills**
  The technology must be suited to the existing skills among women and men. If the skills do not exist then either skills training must be arranged or, if this is not feasible, the technology must be revised.

- **Tools**
  Operation and maintenance tasks must be capable of being carried out using tools which are commonly available and can be handled by men and women as required. (For example, The Afridev handpump spanner provides greater leverage when loosening than when tightening nuts). If specialist tools are required they must be provided and be capable of reproduction locally. Dependency on highly specialized tools is not sustainable.

- **Standardization**
  Technology should be standardized as far as possible. Standardization leads to familiarity among users and maintenance personnel. Spare parts can be ordered and stocked in bulk and shared between communities. Skills training can be standardized and very specific. Maintenance tool kits can be standardized and limited to the essential tools required. The private sector is more interested in standard items which can be efficiently marketed.

- **Spare parts**
  Spare parts are so important to O&M that they are considered separately in the following section.

- **Consumables**
  Consumables - such as chemicals and fuel - must be available, affordable and of a quality which maintains acceptable system performance.

The above technical requirements are all pre-conditions for the local management of water supply operation and maintenance whether by a water agency or a community. Compared to individual communities, an agency often has better access to skills and services and a system of spare parts, materials and equipment supply. Therefore, when planning the handover of a water supply it is essential to identify each specific requirement so that the agency can continue to provide back-up support in critical areas.

In some cases, existing technology has been modified so that O&M activities can be carried out by the community. The development of the India Mark III handpump is an example.

Development of the India Mark III handpump

In India (c.1989) over 1.3 million India Mk.II deepwell handpumps served over 260 million people with safe water. Field experience had demonstrated that the handpump was durable but it was not easy to maintain. It relied heavily on a centralized mobile maintenance team comprising a vehicle equipped with special tools, heavy spares (pipes and connecting rods) and a team of three or four semi-skilled fitters to service the below-ground parts. An extensive project was undertaken to modify the standard India Mk.II handpump to make it more reliable and easier to service at the village level.

The research and development efforts resulted in a VLOM derivative of the India Mk.II known as the India Mk.III deepwell handpump. An essential feature of the new design allowed the extraction of the piston and foot valve without having to remove the rising main. This enabled repairs on the below-ground parts to be carried out at the village level by one caretaker with the help of another pump user.

In a report on the pump's development it was concluded that 'the shifting of most of the repairs to the village level will result in substantial financial savings and reduction in downtime which in turn will result in considerable financial and economic benefits'.

3.3 Spare Parts Requirements

The spare parts problem

The lack of spare parts has been a major constraint in the sustainability of water supplies. In some cases it has led to the complete abandonment of schemes. The problem is in large part due to the policies pursued by donors. In many cases, political considerations have required hardware to be purchased from the donor countries. Many donors, however, are only involved in the construction phase and do not make provision for the continuing supply of spare parts following handover. Some donors have attempted to overcome the problem by supplying a stock of spares at the time of installation. But this is only a short term remedy. Stocks do not get replenished due to the lack of a supply system and a lack of foreign exchange.

Even where donors have been receptive to the purchase and installation of equipment already used within a country, there has often been no consistent government or water agency policy on standardization. The outcome is a wide range of equipment for which the

stocking of a comprehensive range of spare parts is virtually impossible for an underfunded water agency. Therefore, spare parts availability and supply is a major consideration if water supplies are to be sustainable and suitable for community management.

Spare parts supply and demand

Spare parts are all those materials and goods that are necessary for the efficient and sustainable operation of the technical components of a water supply. This is a broad definition which includes mechanical and electrical parts and also tools, fuel, lubricants and chemicals.

Spare parts availability should be one of the main factors which decides the suitability of a particular technology or scheme. The mechanism for spare parts supply must be investigated, established and assured before deciding on a scheme. Very often, however, the question of spare parts arises only after the technology has been selected and installed, putting sustainability at risk.

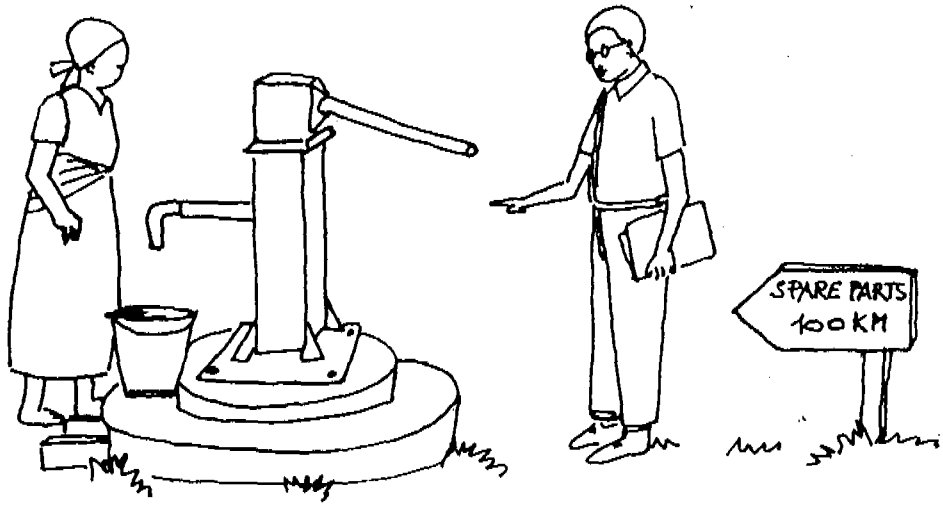


Figure 4: Are spare parts always available within an acceptable range ?

Assessing spare parts requirements

The community will need to know how much their water supply will cost to run and this will be determined partly by the demand for spare parts. Estimates may be based on previous experience, or on manufacturers' guidance. Care must be exercised in using manufacturers' figures as the need for parts will vary according to circumstances. For example, a diesel generator's air filter will require more frequent changes in a very dusty environment compared to standard conditions. The degree of usage, the care with which the equipment is used and the effectiveness of preventive maintenance will all have an impact on spare parts requirements.

A supply system will need to be identified which should include storage for fast moving parts (parts that are regularly used). An estimate of the parts required will indicate storage needs, frequency of purchase and allow a budget to be drawn up.

Subsidized parts

Subsidized spare parts may be helpful in the development of community managed maintenance. However, communities who are not fully prepared for the full cost of running their supply may run into difficulties if subsidies are withdrawn. Therefore, donors and external support agencies who do subsidize parts are not necessarily helping the long-term ability of communities to operate and maintain their own supplies.

Standardization

There are several important benefits that follow from the standardization of equipment:

- Maintenance personnel become familiar with equipment, spares and tools. Preventive maintenance needs become well understood.
- Common use of the same item of equipment encourages agencies and shopkeepers to store and supply spare parts as there is a guaranteed demand.
- Parts can be interchanged which makes the sharing of stocks possible and storage more economical.
- Users become familiar with the best way to operate equipment to give a longer life.
- The training of maintenance personnel can be standardized.

However, there are also several constraints to the adoption of standard equipment. Donor preference has already been mentioned. Projects funded by donors are often obliged to accept donated equipment which often originated in the donor country. This can build up problems for the future due to the large range of spares that must be acquired and stocked to support each donor's project.

Lack of a national policy does not help. If governments establish specifications with which equipment should comply, then standardization could be enforced. This would require donors to accept such stipulations.

For the formulation of a national policy on the standardization of specific equipment it is necessary to present possible options to the actors involved and reach agreements.

In 1993, a handpump standardization workshop was convened in Phnom Penh to recommend a set of standard handpumps for installation in Cambodia. All the main external support agencies and government departments responsible for the water sector attended. There had been concern among some agencies that with a large number of agencies becoming active in the water sector many different pumps might be introduced into the country. The workshop finally recommended the adoption of three different pumps based on lift requirement: low, medium and high lift pumps (UNICEF and OXFAM, 1993).

The introduction of standard equipment which is new to the country must be well planned so that sufficient support in terms of training and spare parts is provided.

It had been planned to introduce Afridev handpumps into small pilot areas in Mozambique. Based on the results of the pilot trials, installation of the pumps would be gradually extended to other parts of the country. However, due to a severe drought it was decided to import a large number of Afridev handpumps to replace worn out pumps and quickly install pumps on old and new waterpoints. Community workers and users were trained to install and maintain the pumps but difficulties were experienced in quickly establishing a spare parts distribution system. (Elias, 1993).

Local manufacture of spare parts

The supply of spare parts is substantially improved if they are manufactured within the country of use. This is a principal guideline of the VLOM concept. Therefore, equipment should be designed so that wearing parts are simple to manufacture from widely available materials.

Local manufacture can be stimulated through mobilizing local entrepreneurship and ensuring the right environment. Local businesses will need the appropriate licences for the import of raw materials and tax policies should encourage rather than inhibit local industry. Manufacturers in other sectors can be encouraged to consider production, e.g. plastics manufacturers, foundries and steel fabricators.

Local manufacture is reliant on raw materials supply, consumables (e.g. welding rods) and machinery. The initial selection of technology needs to take these factors into account. Material substitution can be investigated, for example, hardwood bearings in place of plastic.

Output should satisfy demand. Demand may vary but a stock of parts can act as a buffer to meet uneven demand. However, this requires capital for materials, labour and overhead costs and storage. This will require an injection of funds at the beginning of production to establish a stock for distribution. A government subsidy or donor grant can provide the initial kick-start.

To ensure the compatibility and reliability of parts it may be necessary for the government to institute standards and an inspection procedure. This happened in India, with UNICEF support, and the result was a widespread uptake of the standard India Mk.II handpump which is fully specified by the Indian Standards Institution.

Developing local production

The local production of India Mk.II handpumps was supported by UNICEF and it has been one of the successes of the rural water supply programme in India. By 1990 there were 45 approved manufacturers of the handpump in India with a capacity of 300,000 pumps per year. The advantages of developing local production were:

- Pumps available at short notice.
- Competitive prices.
- Spare parts easily available all over the country.
- Export of pumps worldwide earning foreign exchange.
- Employment created.
- Implementation of the rural water programme accelerated.

(McPherson, 1990)

A spare parts supply network

An important link in the supply of spare parts is the distribution system which gets the parts from the supplier to the user. To establish an efficient system a careful identification of potential businesses and outlets is necessary, for example shops, government agencies, local enterprises, extension agents and travelling artisans.

A supply system will include the holding of stocks at different levels to meet uneven demand. Adequate stocks at the village level are cost efficient and advisable if sufficient funds are available.

Spare parts monitoring and feedback

Monitoring of the purchase and use of spare parts can give useful indications of the performance of systems. If spare parts are not being purchased then systems are probably no longer working.

The frequency of part replacement may be allied to preventive maintenance schedules. Therefore, if the minimum number of planned part replacements have not been carried out then a preventive maintenance strategy is not being followed and further checks may need to be made.

The frequency of repairs and parts replaced need to be compared to previous experience and manufacturers' recommendations. Large discrepancies may indicate under-use, misuse, poor manufacture or that a change in the recommendations is required. Feedback to manufacturers on the use and weaknesses of spare parts can help to influence future design and manufacture.

The monitored costs of spare parts will aid in future budgeting. The economic life of a piece of equipment (a pump, diesel engine, etc.) is determined when the spare part and other maintenance costs exceed the cost of equipment replacement. Regular monitoring will allow decisions to be made on the timing of rehabilitation or equipment replacement.

Chapter 4: Financial Requirements

4.1 What are Funds Needed for?

Funds are needed to recover capital and recurrent costs.

Capital costs

Capital costs refer to the cost of construction, extension, rehabilitation and replacement of schemes. Capital funding must be sufficient to construct maintainable supplies. Cost cutting by constructing sub-standard supplies can be counter productive in the long term as poorly constructed systems will be more expensive to operate and maintain. External donors or the government have been the traditional sources of capital funds but there is now a trend towards asking the community to contribute too.

Recurrent costs

Recurrent costs are those incurred in the operation and maintenance of schemes. Examples include:

- fuel for powered pumps
- payment of caretakers and pump attendants
- spare parts for minor repairs and preventive maintenance
- important repairs
- extension or replacement
- monitoring
- transport.

The recent trend is to ask the users to pay for many of the direct and local-level costs of operation and maintenance. Additional funds are also required to provide agency support, e.g. payment of extension staff, training and monitoring. Therefore, even though a community may contribute to cover all the direct O&M costs of their supply, funds may still be required to cover the agency costs of O&M support. The support costs have been subsidized by the government and external agencies in the past. For sustainability, full coverage of O&M costs is the eventual goal for which communities will need to contribute both the direct and support costs of O&M, especially if replacement costs have to be included.

Table 8 summarizes the community contributions made to cover capital and recurrent costs for a selection of schemes in different countries.

Table 8: Community contributions to capital and recurrent costs of rural water supplies

LOCATION AND TYPE OF SCHEME	CAPITAL COSTS	RECURRENT COSTS
CAMEROUN Gravity-fed piped scheme from protected spring	Capital and labour contribution equal to 20% of total capital cost Trench and pit digging Carrying local materials (sand and stones) Cash contributions: CFA 500 per man and CFA 200 per woman	All recurrent costs paid by community, in accordance with service level: CFA 500 per taxpayer per year for standpost; CFA 5000 per year per house connection; CFA 100,000 per year per institution. Community contributions cover full costs of village plumber, spare parts and operating costs, at less than cost of service from state water corporation.
GUATEMALA Piped schemes with gravity feed or hydraulic ram, handpump schemes, and rainwater harvesting	Cash contributions for initial downpayment Repayment of community loan supplemented by agency donation Trench and pit digging Carrying local materials (sand and stones)	Users make monthly payments which cover all operation and maintenance costs, including employment of a local plumber. Community water boards form local associations to provide mutual assistance in solving problems of operation and maintenance, and local management.
HONDURAS Borehole wells, communal tank networks, independent communal tanks served by tankers	Payment of a cash contribution (30% of development costs) Repayment of a loan into a revolving fund for remainder (70%) Provision of unskilled and semi-skilled labour for construction Provision and carrying of local materials Funding of paid unskilled labour as substitute for own labour	Payment of a monthly fee in accordance with service level: US$1.75 for use of a standpost; US$3.00 for a yardtap. Monthly payments include costs of water board staff and hiring of a plumber.
INDONESIA Piped schemes and rainwater harvesting, public bathing facilities	Full cost met by most communities in most cases Combination of cash and in-kind payments + loans and credit Individuals contribute according to socio-economic status Poorest members often exempt from payments Grant assistance may be arranged if communities have difficulties Provision of local materials + skilled and unskilled labour	Full costs met through user fees, depending on service level and system costs: range from US$5.00 to US$50.00 per household per year. Funds also raised through local revolving funds, lotteries, credit systems, entertainments, etc.
PAKISTAN Gravity-fed piped scheme from protected spring, with yardtaps	Villagers contribute to a common fund to support the work of the Village Organization (VO) as a precondition for support Aga Khan Rural Support Programme secures loans or grants Provision of local materials and labour Additional funds raised by fining those who don't meet communal labour obligations Village funds hire local plumbers to help in scheme construction	Users meet costs of operation and maintenance through continuing contributions to the village fund. Additional funds raised through the imposition of fines for improper use or wastage of drinking water. Village funds used to hire local plumber for repairs as necessary Individuals are personally responsible for maintaining pipes and taps for their own yard connections.
UGANDA Borehole wells with handpumps, protected springs, gravity-fed piped schemes	Community contribution based on negotiation with no set formula Cash contributions usually cover only a small part of costs Provision of local materials and labour Funds may come from cash collections, donations from prominent individuals, auctions, lotteries, raffles, or local taxes	Users pay fees to cover costs of spares and payment of pump mechanic. Volunteer caretakers "paid" by being exempted from communal labour obligations. Additional funds raised through the imposition of fines.
YEMEN Piped schemes based on boreholes with motorized pumps	Communities must have a reliable water source, usually a borehole, before the project begins. This is secured either by the community's own efforts or by requesting assistance from the government or a donor Communities meet about 30% of scheme development costs through labour and other in-kind contributions	Users pay a monthly metered charge, which is enough to cover the costs of fuel, oil, spare parts, and the salaries of scheme operators. When a major breakdown occurs, special collections are made to pay for the repairs.

4.2 Why Should Users Pay?

Recurrent funding for operation and maintenance has generally been insufficient to protect the capital investments made in water supply schemes. The result has been a high percentage of poor and broken down supplies. As a consequence, rather than substantially increase the percentage of people supplied with safe water, new supplies have hardly been able to maintain coverage. The continued provision of free and subsidized services in the absence of sufficient funds to cover recurrent costs is not sustainable.
The case for user payment derives from several interconnecting arguments:

- the capital funds which are currently made available are inadequate to provide a safe water supply for everyone
- the public funds which are currently made available are inadequate to meet the full recurrent costs
- subsidies reduce the decision making power users might have if they were paying for their service
- subsidies discourage cost-efficiency and the development of low-cost solutions
- many poor people already pay high rates for services and evidence suggests they would be willing and able to pay for improved services
- properly regulated user charges would allow the provision of better services at a lower cost to the poor
- payment may increase the commitment of users to the sound management and use of systems
- user payments maximize the use of available resources
- user payments result in the maintenance of a good standard of service.

(adapted from Briscoe and de Ferranti, 1988; Katko, 1990)

Many people are already paying a high price for poor quality and poorly delivered water services. In some cases, users are having to pay government water rates plus the extra costs of 'unofficial' maintenance to keep systems functioning (McPherson, 1990). High rates are also paid to water sellers where improved delivery systems do not exist or have broken down (Evans and Appleton, 1993). An improved service paid for by the user could mean that, in many cases, people ultimately pay less for a better service.

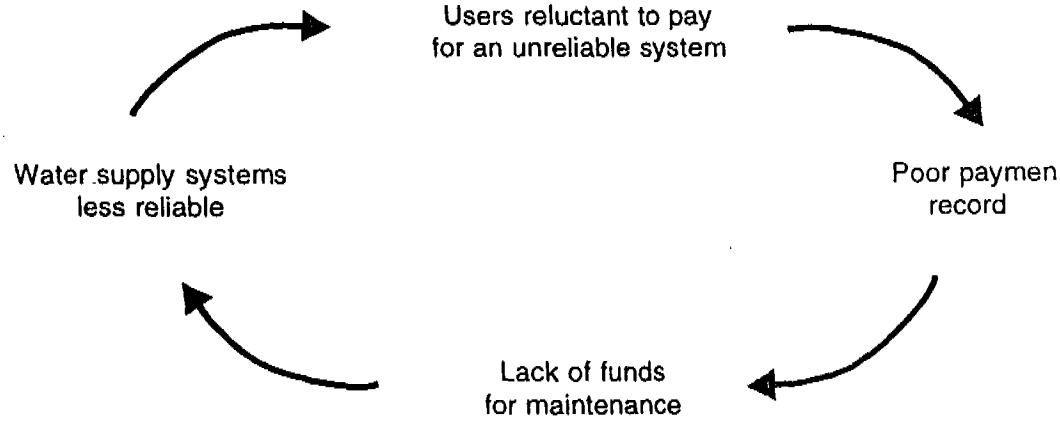


Figure 5: The vicious circle of underfunded and poorly maintained water supplies.

4.3 Ability and Willingness to Pay

O&M costs can only be recovered from users if they are both able and willing to pay for a water supply. It has been said that people should not have to pay more than 3 to 5% of their income for water and sanitation services. Actual payments vary greatly (Evans, 1992). A higher percentage of income expended on water will mean other important needs may not be fully met. Therefore, great care is required when setting user contributions.

Even if users can afford to pay O&M costs they may still be unwilling to pay. People will want to weigh the cost of an improved supply against a range of factors before committing themselves to paying.

Some important factors which influence the willingness of users to pay are listed below.

- **Income**
  If users cannot afford to pay they will clearly be unwilling to pay.

- **Service level**
  Users may be able and willing to pay for a handpump but not for a more expensive yard tap. On the other hand, users may only be willing to pay for a higher service level.

- **Standard of service**
  People are unlikely to pay for a poor service.

- **Perceived benefits**
  Agencies and donors may see the most important outcome of a safe water supply in terms of health benefits. However, users may place a higher priority on the more immediate social and economic benefits. Perceived benefits may vary within a community. For example, men may be attracted by the commercial opportunities of greater quantities of water whereas women may be more interested in the greater convenience of a supply. Some people may stand to gain more than others and this can result in a variable willingness to pay within the same community.

- **Opportunity cost of time**
  In the majority of situations it will be women's time that will be saved by an improved supply. Men and women may value the time saved in collecting water differently and women may be more willing to pay than men.

- **Acceptability of the existing source**
  If users perceive their existing source to be acceptable they may be unwilling to pay for a new supply.

- **Confidence in the service agency**
  Past disappointments have often undermined people's confidence in existing agencies and new initiatives. Users must have confidence that whatever they pay will be used by the management body to provide an acceptable service. An open and clear financial management system will help to instill trust and encourage payment.

- **Community cohesion**
  Individuals in a divided community (due to ethnic, clan, class, political, or leadership divisions, for example) may be unwilling to pay into a common fund.

- **Policy environment**
  Previous policies have encouraged the belief that access to safe water should be free. People may be unwilling to pay for something which they feel should remain free.

- **Perception of ownership and responsibility**
  People may be unwilling to pay for the upkeep of a facility which they feel belongs to the government. Such a feeling may persist even when a system has been formally handed over to a community.

- **Institutional framework**
  Community management structures which either bypass traditional authority or do not give users a reasonable say in the running of schemes may not be supported.

Although people may want a water supply, there are a complex range of issues which decide whether they are ultimately willing to pay for one. It is particularly important to identify who 'they' refer to. Women are often responsible for the provision of water in the household and the burden of water payments may fall on them. Therefore, payment studies must carefully consult the actual people who are going to have to make a decision on payment rather than approach the often more accessible male leaders in a community.

People may be willing to pay but they may be unable to afford the immediate combined capital and recurrent costs to get started. In such a situation, the availability of loans and credit can facilitate the initiation of a scheme. Agreement may be reached among users to exempt the poorest and seriously disadvantaged from payment.

4.4 Cost Sharing

Cost sharing involves negotiation on both capital and recurrent costs between the partners in a scheme. Community management usually involves the community and at least one other partner: a government agency, a non-government organization or, in some cases, private contractors or suppliers. Capital costs are often subsidized by government or a donor to initiate a programme. The recurrent costs of services provided by a support agency, such as training, supervision and inspection, may be shared with the agency. To maintain standards, governments may have to fully fund some of these activities, such as sanitary surveys and water quality testing.

The costs of employing a plumber or mechanic and travel for someone to purchase spares and consumables may be expensive for one community. It can be more efficient and cost effective for several communities to share these costs.

Table 9: Division of operational and financial responsibilities of administrative tasks for most water supply systems (Frey, 1993, WASH Technical Report no.93)

Example: Administrative Tasks for Most Water Supply Systems		
Tasks	Operational Responsibility (Who will do it?)	Financial Responsibility (Who will pay for it?)
1. Conduct technical and economic studies of the most appropriate water system designs.	1. Government agency with community input	1. Government
2. Analyze operations and maintenance tasks for use in planning and budgeting.	2. Government agency with community input	2. Government
3. Prepare annual budgets and estimates of longer-term financial needs.	3. Community with agency support and government Agency, for respective tasks	3. Community and government agency
4. Select and appoint operators/contractors for routine or special O&M.	4. Community with agency support	4. Community
5. Develop and evaluate technical and management training for water system operators.	5. Government agency with community input	5. Government
6. Provide ongoing technical and management training to operators.	6. Government agency and community	6. Government agency and community
7. Delegate task responsibilities, supervise and pay operators/contractors.	7. Community	7. Community
8. Keep archives, inventories, and log books.	8. Community	8. Community
9. Develop and evaluate financial and management training for community managers.	9. Government agency with community input	9. Government
10. Provide ongoing financial and management training for community managers.	10. Government agency and community	10. Government agency and community
11. Collect water fees and manage revenue.	11. Community	11. Community
12. Make payments for purchases, loans, or other obligations.	12. Community	12. Community
13. Keep accounting records.	13. Community	13. Community
14. Make visits to nonpayers or other problem households.	14. Community	14. Community
15. Respond to user complaints.	15. Community	15. Community
16. Organize and conduct general meetings for discussions, elections, etc.	16. Community	16. Community
17. Organize training and information on hygiene education.	17. Government agency with community input	17. Government
18. Develop information and materials on hygiene education.	18. Community and government agency	18. Government
19. Organize community contributions for upgrading or extending the system.	19. Community	19. Community
20. Report urgent problems to support agency.	20. Community	20. Community
21. Provide technical and management support to community managers.	21. Government agency	21. Government
22. Report periodically on O&M and administration to government agency.	22. Community	22. Community
23. Collect, analyze, and interpret monitoring results, and plan and conduct follow-up support or training if necessary.	23. Government agency	23. Government

4.5 Sources of Funds

The method of funding O&M must be appropriate to the type of supply and the socio-economic circumstances of the users.

Methods of funding

In northern Ghana, the operation and maintenance of communal open wells in remote villages required intermittent funds to replace worn buckets and rope. Regular charges for water were inappropriate as sufficient funds could be raised when required through household collections. Both men and women contributed as individuals.

In a commercial tea and coffee growing area of Kenya, the Murugi-Mugomango Water Society managed a gravity piped water supply and recovered operation and maintenance expenses by metering all yard connections and charging a monthly water tariff based on the volume of water used. Revenue was deposited in the Society account at a nearby rural bank. A bill collector and accountant were employed to collect and oversee the finances.

(Davis, Garvey and Wood, 1993).

Methods of raising funds for O&M are summarized in Table 10.

The success of community fund raising depends on existing practices within the community, leadership, trust and continuing confidence in the management of funds. The timing of fund raising may be critical in agricultural communities with marked variations in seasonal income.

A community revolving fund can be used to replace direct charges for water. Initially, a maintenance fund is established through a fund raising activity. Part of the fund can then be used to give loans to individuals or households. Repayment with interest increases the total value of the fund. Limiting the number of loans at any one time can help to put pressure on defaulters by members of the community who also want to take out loans. To be successful, a revolving fund must be responsibly used and well managed (IRC, 1989).

There may be informal methods of raising funds from wealthier individuals. Successful traders and farmers may be able to give loans to be paid back out of community funds, with or without interest. This type of informal credit is not suitable for the regular funding of preventive maintenance but it may hasten the response to corrective maintenance needs or finance the modification or extension of a supply.

The management of funds encompassing cost estimation, budgeting, tariff setting and the handling of funds are considered in chapter 3, 'Financial management'.

Table 10: A summary of operation and maintenance funding methods

Type of funding	*Method*
Community funds	
Voluntary fund raising	Funds for simple water systems may be collected periodically when required through meetings, household collections and festivals or on a regular basis.
Community income	In communities with their own sources of income, such as communal farms, a proportion of income may be set aside for O&M.
Cooperative funds	Profit from a production co-operative or a village revolving fund is used.
Water rates	
Flat rate	Users pay a flat rate per person, or per household, for a public standpost or private tap connection.
Graded rate	In communities with significant differences in water use and benefits, users may pay different rates on a graded system.
Water metering	Connections are metered and users pay per household (private taps) or per user group (public taps).
Water selling	Water is sold from metered taps at set prices by concessionaires, paid operators or by user groups (such as women's associations).
	Coupons are bought by users and exchanged for a fixed volume of water, e.g. a bucket coupon.
Taxation	There are various forms of local government taxation for general services out of which funds for water supply O&M can be allocated.
	Community taxes can be raised through local taxation of agricultural produce leaving the area, road tolls, a tax on businesses using water, etc.

Micro-credit

A micro-credit system could be useful not only in the case of initial capital investment, but also for the following activities:

- cash advance when problems of cash flow (in the case ofseasonal incomes for instance)
- financing of big repairs or unforeseen expenses
- repalcement, rehabilitation or extension costs
- rotating fund for spare parts and tools acquisition.

The implementation of a micro-credit system will depend on the needs and the local capacity to manage such a system. Some basic elements should be highlighted as pre-conditions for the setting up a micro-credit system:

- Confidence - among users of the system is the foundation of the system.
- Capacity to pay - the capacity to pay or reimburse loans must be well evaluated, taking into account various scenarios of reimbursement patterns.
- Building on existing structures - if possible, build on existing traditional groups, or women / rural small associations.
- Expertise - the setting up of a micro-credit system need the support of specialists.
- Step-by-step - the setting up of micro-credit system can be done gradually, as a step-by-step process.

Other possible sources of financing

Local authorities, municipalities, districts have an income through local taxes or through allocations from thre regional or national level. Some of these funds can be used for recurent expenses, but they will be submitted to a general municipal or district policy.

Regarding external funds, most donors do not want to be involved in the financing of operation and maintenance, unless it is in the case of capacity building exercises.

Other national or local credit organizations can have a role in the source of financing. Their usefulnees will depend on the importance of the scheme and the level of development of the country.

Chapter 5: Health and Environmental Requirements

5.1 Hygienic Operation and Use

The advantages of a well-maintained, safe supply of water can be drastically reduced if the collected water is not subsequently handled and used hygienically. The hygienic handling and use of water is an important part of O&M in its broadest sense.

Hygiene may be more important in the operation and maintenance of some systems than others. Users can follow simple agreed operational rules as shown by the following examples.

Use of an open well

To maintain the quality of open well water, the correct use of a bucket and rope lifting system is important. There are various combinations of lifting systems using communal or household buckets. Each system has its merits and drawbacks regarding hygiene. What is important in many cases is not so much the type of system but agreement by all users on how to operate it so that water quality can be preserved.

User operation of a standpost supply

Unsafe and insanitary conditions due to the careless handling of water at the standpost must be avoided. Typical rules that consumers and users agree on through consultation include :

- wash hands and containers before collection
- avoid spillage, but if it does occur, direct all wastewater to the drainage channel
- do not leave taps open when there is no flow as water will be wasted and create insanitary pools when flow recommences
- do not leave taps running unattended
- do not drink water directly from the tap
- do not allow cattle and other animals within the fenced area of the standpost.

(adapted from IRC, 1993b)

The hygienic transport and use of water from the source to the point of final use is important for all supplies. For example, the coverage of containers during carrying and storage and the prevention of contamination through touching the collected water. Raising awareness of the need to take measures to safeguard water is an important part of community action. Hygienic operation and water use can be promoted by all O&M personnel. For example, a standpost caretaker's role often includes promoting the careful and hygienic use of taps.

The user is responsible for how the water is used and the engineer has a responsibility to design and construct a system which encourages hygienic use and which can be maintained in a hygienic condition.

5.2 Environmental Protection

The state of the environment can directly affect the quality and yield of a water source. Therefore, in its broadest sense, maintenance of a water supply includes the protection of the water source environment.

Protection of the environment to maintain water quality

This means the protection of surface water catchments and groundwater sources at both the local level and beyond. At the local level there should be procedures to ensure that the positioning of latrines and the agricultural use of chemicals (fertilizers, pesticides and herbicides) do not result in the pollution of water sources. Land-use can affect the quality of surface water sources, especially upstream of supply intakes. A change in land-use from forest to cultivated farms can give rise to high turbidity levels due to the fine soils washed into water courses by rainfall runoff. High turbidity can result in blocked pipelines and valves as well as in a drastic reduction in water quality. Sedimentation and filtration processes cannot always cope with the higher loads and operations become strained.

Participatory activities on how men and women use water catchments and waterpoints help to raise awareness of how water is contaminated. This can be a good start to jointly addressing problems which can be solved locally.

Community monitoring of sources and their catchments can help to alert users and the relevant authorities to the dangers of contamination.

Partner agencies can raise awareness of the potential problems through participatory activities and provide practical advice on environmental protection. Periodic monitoring by government inspection agencies through a combination of sanitary surveys and water quality testing is an important aspect of O&M.

At a wider level, community sources need to be protected from industrial pollution through the enactment and enforcement of appropriate legal provisions. Communities have a role in monitoring polluters and lobbying for effective control measures. If measures are not taken to control pollution then the consequences can be very serious as the following example shows.

> In Tamil Nadu, an immense growth in the tanning industry has resulted in polluted groundwater far from the tanning sites. Percolating effluent reaches the water table after being discharged from the tanneries into dry river beds. Groundwater contamination is known to spread up to 5km from a discharge site and as there are many scattered tanneries the effect is widespread. The tanning process uses many chemicals including heavy metals such as cadmium, arsenic and chromium which can all be toxic to people in sufficient concentrations. Many community wells are contaminated as a result of the tanning practices (Muthu, 1992).

Management of the environment to maintain water yield

Deforestation and the burning of grassland removes the absorptive capacity of land to retain and slow the drainage of water. The resulting rapid runoff and reduced groundwater recharge can result in water sources drying up. The pressures on land for many communities makes it difficult to enforce measures to manage and protect water catchments. Communities need advice on the effects of land-use changes and what can be done to

protect water supplies. As part of village management training, some projects include the promotion of measures to protect the water source and the catchment area (IRC, 1993a).

Management of water-use to avoid the over exploitation of water resources

The over exploitation of groundwater sources by both manual and motorized pumping for agricultural purposes can result in declining groundwater levels. If measures are not taken to limit water abstraction then the effect on domestic wells can be disastrous, as described in the following example.

> The large scale use of groundwater for irrigation in Bangladesh resulted in a significant lowering of the water table before the monsoon season. As a result, in the early 1980s many suction pumps supplying water for domestic use were unable to function as the water table fell below the maximum suction lift of about 7.5 metres (Kjellerup, 1989).

Therefore, monitoring to detect early signs of the significant long term lowering of groundwater levels is an important aspect of O&M. Groundwater levels can be monitored locally by the community as part of regular O&M activities. The government or responsible water agency can monitor regionally and nationally.

PART III

DEVELOPING AND MANAGING OPERATION AND MAINTENANCE

Chapter 6: Operation and Maintenance Development

6.1 The Partnership Approach

Management models

Management models range from highly centralized government systems to localized community management. Several models lie between these extremes. Typically, O&M management systems comprise stratified levels of maintenance and repair bodies. A common model has a central government agency at the first tier, a second tier regional government or private body and a third tier community organization. Traditional water supplies are managed by a single tier system of community management.

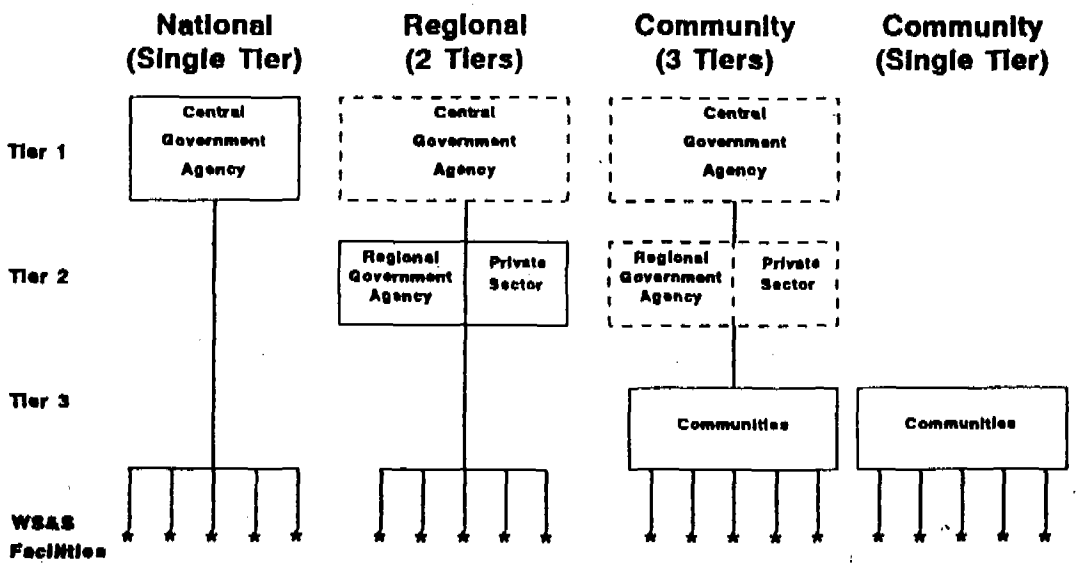


Figure 6: Management models and tiers of responsibility (Roark, P. et al., 1993).

A three tier maintenance system

Zimbabwe has adopted a three tier maintenance system:

- at village level where the community is involved in basic and preventive maintenance of their water source through an elected Waterpoint Committee (WPC), which includes voluntary pump caretakers
- a mobile Pump Minder (PM) operating at ward level (sub-district) assisting WPCs and having responsibility for up to fifty water points
- a skilled District Maintenance Team (DMT) equipped with transport and tools to back-up the Pump Minders and WPCs.

(Cleaver, 1991)

It is clear from past experience that, in many cases, centralized government controlled systems of management have not always been able to sustain supplies. This chapter advocates the revision and adaptation of centralized systems of operation and maintenance to decentralized management partnerships.

The following factors relating to centralized management often contribute to O&M failure:

- an overdependence on government agencies who do not have the resources to keep supplies functioning
- user expectation that government provides all the necessary services and funding required to maintain supplies
- user non-payment for water services
- a lack of user involvement in decisions concerning their own water supply.

Attempts have been made to adapt existing centralized management systems to overcome some of the above problems by adding a 'community participation' element. But 'community participation' has often merely referred to contributions of labour for construction rather than the comprehensive participation of a broad range of community members in decision making and long term management. The expression also suggests that the community is taking part in an agency project. Perhaps what is really required is more accurately described as 'agency participation' to support a community service. The 'partnership approach' refers to a more equal and supportive relationship between the community and external organizations.

An agency-community partnership means joint decision making and management from the start of a project. This is essential if the choice of technology and scheme design is to meet the community's needs, expectations and capacity to operate and maintain a system in the long term. The partnership, therefore, starts at the beginning of a project and continues through every stage of the project cycle, from feasibility through construction to the management of operation and maintenance.

The division of partner responsibilities

Partnership should be seen as a flexible and evolutionary process, requiring continual dialogue. The sharing of costs and responsibilities will vary according to the type and stage of development of the partnership. Some communities will want and be able to manage a major share of the responsibilities from the outset. Others will need to start with a low level of responsibility and gradually build their expertise and confidence.

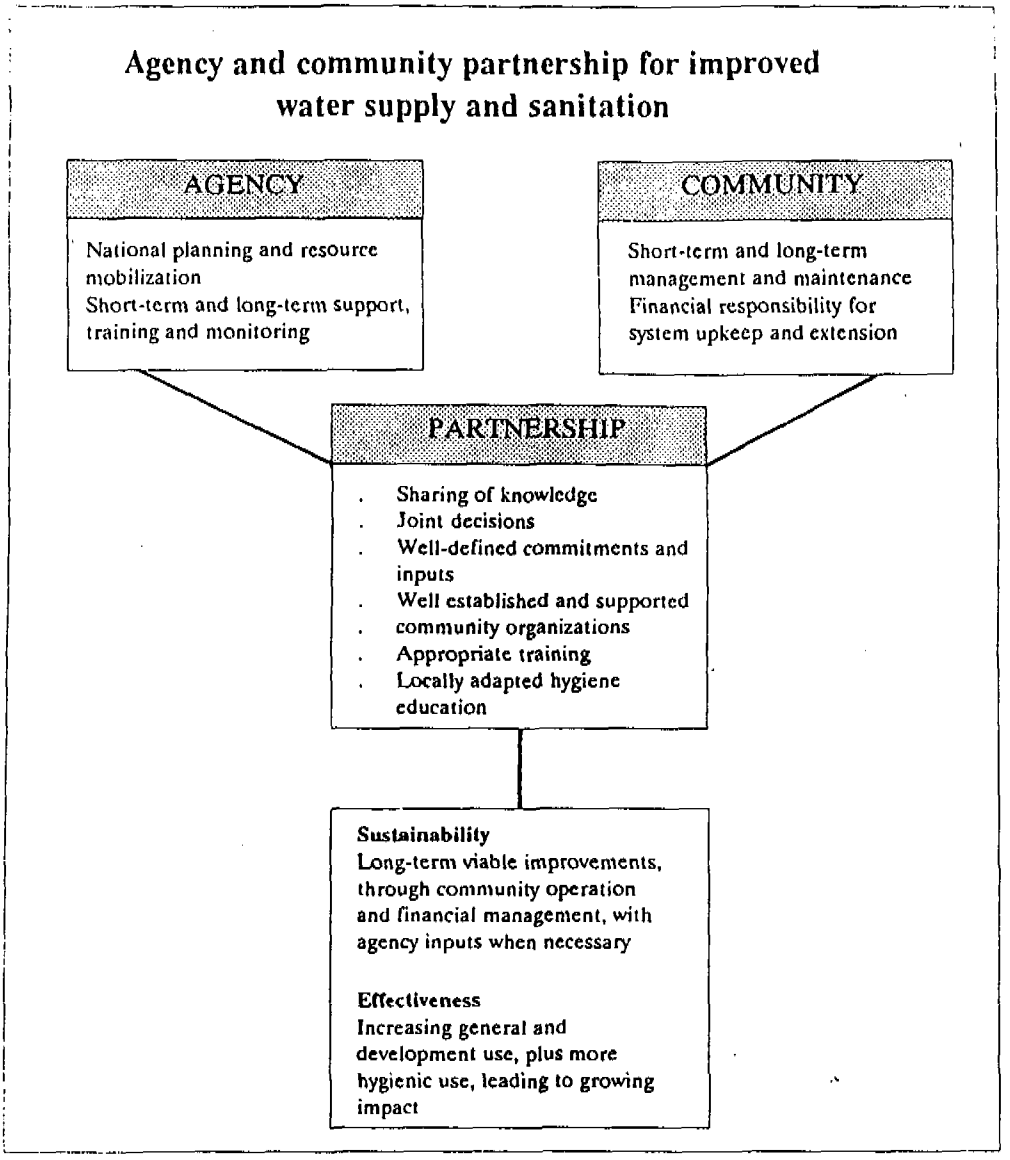


Figure 7: Agency and community partnership (IRC, 1991).

Benefits of the partnership approach

The benefits of the approach are clear:

- Technologies can be chosen based on community awareness of their advantages and disadvantages.
- Different communities have different expectations and capabilities. Even within one community there will be differences. The partnership approach allows time and opportunities for people's views to be considered in relation to the long term feasibility of operating and maintaining supplies. Differences in service levels and ability and willingness to pay can be accommodated in scheme designs, and so on.
- In the process of implementing a water supply project the various management, technical and financial skills required by members of the community can be identified and specific training programmes established.
- The general enhancement of community skills, knowledge and capabilities will benefit other development activities. This 'capacity building' is a principal aim of the partnership approach.

Implications for the water agency

This different approach has several implications for a water agency:

- The aim is to replace unsustainable government subsidized O&M services by externally supported community management. This is expected to eventually reduce government expenditure per operational water supply.

> In Benin, for example, the replacement of a centralized handpump maintenance system with a community based approach reduced agency maintenance costs by 16% per year after an initial investment for community support of 13% of total construction costs (IRC, 1988).

- Agency staff will need to adjust their attitudes. Staff will no longer be making all the decisions themselves and giving instructions. They will need to listen to people's views and ideas. They will need answers to questions communities ask on O&M costs, reliability, service levels (e.g. the cost of house connections), and so on. Compromises will need to be made between the technical efficiency of a scheme and the non-technical factors influencing the wishes of the users.
- The new roles of community liaison, training, hygiene promotion and financial advice require personnel with the requisite skills. This may mean the appointment of new staff, the secondment of staff from other government departments, the contracting of consultants and private sector advisers or the retraining of existing staff.
- The multidisciplinary approach requires the integration of professionals from non-technical fields and closer cooperation with other government departments. This in itself is a challenge as existing practice does not always provide for the easy integration of different disciplines and government departments.
- Training on gender awareness and gender skills and the employment of female field staff will help to encourage and enable women in communities to participate in the partnership.
- Agency targets and staff achievements should no longer be measured in terms of systems built but in the capacity of communities supported by the agency to maintain and use their water supplies efficiently.

An essential condition for the partnership approach to succeed is that agency support must be timely and reliable.

6.2 Developing an Operation and Maintenance System

There are two levels at which the development of an O&M system needs to be considered:

- the programme, perhaps country, level
- the individual project level.

This paragraph proposes a generalized systematic approach to the development of an O&M system at the programme level. The subsequent section considers the planning of O&M at the project level.

Experience shows that non-technical issues play a considerable role in determining the effectiveness of O&M. Therefore, personnel involved in O&M assessment and development should cover a range of relevant disciplines: social development, health, management, as well as engineering. It is important that the process is consultative and carried out in partnership with the operators and users of schemes.

Developing O&M at the programme level

Review

The first stage is a review and analysis of the present approach to O&M as applied to all schemes within a programme. This entails identification of the problems and constraints related to organization, finance, personnel, logistics and technology.

Identify the cause and effects of poor O&M within each scheme. Review the analysis and possible solutions with key personnel and organizations. Establish guiding principles and decide on the general approach to be promoted.

Development

Analyze the O&M requirements for the proposed water systems. Identify the activities and actors to fulfil the different O&M roles. Consider the implications in terms of organization, management, financing, logistics, technology, training and gender. Compare the feasibility of the proposed system in relation to the existing legal and political framework and the prevailing and likely future economic conditions.

Consult with the different actors on their roles and activities. Adjust the proposed system so that it is feasible and replicable throughout the programme. Present the O&M system for discussion with all the main parties involved, including national and local government departments, policy makers, the private sector and representatives of the users.

Testing

Select areas for pilot projects to test the feasibility of the O&M system. Conduct training for the people involved, including key agency staff, community representatives, and people and businesses in the private sector. Take the gender implications of training into account as regards who is able to attend - women and men. Ensure training methods and materials are adapted to different literacy levels and local language variations.

Test the O&M system in the selected areas. Monitor and evaluate the functioning and long term sustainability of the O&M system and adapt it where necessary. Present the findings of the test phase to the main parties involved. On the basis of the findings and feedback received, decide how to apply the system further to the whole programme. If necessary, make submissions for alterations to policy and the legal framework.

Expansion

Make three-year and long term plans for expansion of the O&M system. Identify the implications of the changing roles of personnel and organizations with particular reference to technology selection, community management, gender balance, agency support, monitoring, and spare parts production, distribution and sale. Identify the training needs and

establish training programmes for those involved. Publicize and communicate the plans for the new approach and its implications to all those concerned through seminars, workshops, meetings and the media.

Apply the O&M system to all new projects and introduce it in existing systems. Adapt the system to take account of regional and local conditions. Monitor the performance of the system and adapt it as necessary. Changes can be introduced as part of regular (three or five year) rolling plans.

Developing O&M at the project level

There are two different starting points for developing O&M at the project level:

- A completely new scheme
- An existing scheme with inadequate O&M.

- **New scheme**
  A new scheme will pass through a series of stages in a project cycle before it is commissioned as a functioning water supply. A principal aim of the partnership approach is for the community and agency to work together at every stage so that the community can manage O&M from the first day of commissioning.

  The critical factors which affect O&M at each stage of the project cycle are indicated in Table 11.

  The project cycle includes the selection of a water supply, service level and O&M management system best suited to a particular community. A proposed outline selection procedure is shown in Table 12.

Partnership planning

The partnership approach to planning has been successfully followed in the Community Self Financing of Water and Sanitation Systems (CSFW) project promoted by the NGO CARE in Indonesia. CARE outlines various water supply options for the community who then make their choice of system. The village water committee is then assisted to design and cost the system and develop a resource mobilization and construction plan. The plan is considered by the community at a meeting before a formal agreement is signed between the three partners: the community, the Government of Indonesia and CARE. A village sub-committee is trained on the prevention of water-related diseases and how to conduct a hygiene and sanitation survey. Based on the results of the survey a public health education campaign is planned.

(Sucipto and O'Brien, 1992)

Table 11: Incorporating O&M issues at each stage of the project cycle

STAGE OF THE PROJECT CYCLE	ACTIVITIES	O&M ISSUES
INITIAL CONTACT	Establish a committee	Commitment to long term management of O&M.
ASSESSMENT	Needs assessment	Water quality and quantity to be supplied. Level of service required and desired. Degree of hygiene promotion for men, women and children. Priority of a water supply against other needs. The particular needs of women as traditional managers of domestic water.
	Resource assessment	Male and female leadership and user support for community management. Legal framework for community management. Existing management structures. Existing interest, management expertise, technical skills and organizational capacity among women and men. Funding for both capital and O&M costs. Existing water resources and potential for development. Knowledge of water and health issues among women, men and children.
IDENTIFICATION SELECTION & PROPOSAL See Table 4	A comparison of water supply options. Selection of a supply and O&M management system following consultation between the partners. Proposal for a plan of action.	Can the proposed scheme meet the needs within the available resources? That is: Chosen technology - familiarity, complexity, skills, spare part supply, reliability, suitability, gender sensitivity. Cost - total and individual user cost of O&M, regular and intermittent payments. Share of costs and O&M responsibilities with the partner agency. Can funding cover costs ? O&M time frame - time for training, user Impact on the environment and implications for O&M. Impact on women and men and their roles in O&M.
IMPLEMENTATION	Design, construction, community mobilization, training, health and hygiene promotion, fund raising.	Community involvement (women and men) in: • Detailed design - to ensure workable operation and maintenance. • Construction - familiarization with the scheme. • Hygiene promotion - water handling and use. • Training - O&M technical and managerial skills acquisition, gender awareness.
MANAGEMENT	Management of O&M.	Operation and maintenance of the water supply. Collection of O&M funds. Liaison with the partner agency. Optimizing the handling and use of water. Planning future modifications and extensions.
MONITORING & EVALUATION	Regular monitoring of O&M activities. Joint evaluation exercise by the O&M partners.	Is the water supply functioning reliably, how is it being used, and is this expected to continue? Is the O&M partnership functioning satisfactorily and is this expected to continue? Impact of O&M on health, the environment, women, men and children.

- **Existing scheme**
  An existing water supply may require redesigning to match the capabilities of the partners involved in O&M management. The project cycle followed will be similar to developing a new scheme. Freedom to choose a viable O&M system will be constrained by the system that already exists. The protection or rescue of former investment may be a high priority.

After a review of multi-village piped water supply schemes in Tanzania, operation and maintenance was found to be too complex. It was decided to re-design the schemes to serve single villages only and simplify the management of O&M. There were also good technical and economic reasons to choose single village, small-scale schemes: the system hydraulics is simplified and peak demand is not so high, therefore pipe diameters and tank capacities can be smaller.

Problem analysis

The identification of the social and technical problems which caused system failure should provide a starting point for the rehabilitation of a scheme and improvements to O&M management. Both the community and agency need to identify the problems together as they may have very different perceptions of the reasons for failure.

Risk analysis

If a risk analysis is carried out for each water supply option then an attempt can be made to anticipate factors which may change and affect O&M. This will not be easy, especially in unstable economies where inflation and the availability of imported equipment and spare parts are difficult to predict. However, a comparison of schemes can indicate the degree of risk attached to each option.

If such a risk analysis had been carried out prior to implementation on the multi-village piped water supply schemes in Tanzania, described above, the weak points and chances of failure might have been anticipated. If the economic cost of failure and other risks had been deemed too high then single-village schemes might have been implemented from the beginning.

Table 12: An outline procedure for the selection of a water supply and associated O&M

STEP	*DECISIONS*	*CONSIDERATIONS*
1	Choice of technology	Existing and potential water sources. User preference by gender. Service level. Skills and spare parts availability. Cost. Reliability.
2	Initial degree of community management	Sharing of management responsibilities between the partners. Skills availability. Capacity to organize and integrate functions. Cost of management. Risk of management failure. Women's involvement.
3	Division of costs	User (women and men) ability to pay. User (women and men) willingness to pay. Availability of subsidies. Other external financial support.
4	Is the technology and service level manageable, affordable and agreed between partners?	
	return to step 1 — NO	
	YES	
	Formal agreement on a plan of construction and O&M management	

Chapter 7: Operation and Maintenance Management

7.1 Community Management

All communities comprise a diverse range of people categorized according to ethnicity, socio-economic status, religion, politics, trade, age and gender. One of the challenges of O&M management is to enable all the people within a community to organize and work effectively together.

Community cohesion

The degree of community cohesion can be a critical factor in determining the type of water supply and how it should be executed and managed. For example, a divided community may not work happily together on the management of a common piped distribution system whereas separate handpumps for each group might be acceptable. But more positively, the management of a water supply might provide the opportunity for previously divided communities to work together.

Demography

Rural communities can be compact villages or scattered settlements. The distribution of people in a community can have an important influence on the choice of water supply technology and the character of the O&M management system. For example, in a village which has developed along the line of a road, a handpump is only likely to serve a limited number of people. Therefore, only a small section of the village may be interested in its management and in paying O&M contributions. This is likely to be the same for a borehole drilled on the edge of a large village or within a widely scattered settlement. If the small user group is unable to fund handpump O&M then a technology requiring lower cost maintenance might be more appropriate - a protected well, for example.

Piped supplies are often attractive to users because of the reduction in effort and time required to obtain water. However, residents near to a spring source may be reluctant to participate or contribute to a scheme if there appear to be no extra benefits. In some cases they are not served at all as the spring water is often piped directly to the main settlement downhill.

Scale and the number of communities served

The management of a large scheme supplying several sections of a village or several communities is clearly far more complex than the management of a single well. As far as capital costs are concerned, it may be more cost-effective to supply a large number of people with an extensive distribution network than to have several smaller pipe networks supplying individual groups or communities. However, extensive distribution schemes are only appropriate if all the communities can work effectively together. Furthermore, it cannot be assumed that the operation and maintenance of large schemes will be as cost-effective as small community managed schemes. The example of multi-village schemes in Tanzania which had to be redesigned as single-village systems was mentioned earlier.

Collaboration between communities

Communities can benefit by working with others in loose cooperation or in formal associations. Success in one project can lead to success in others and the multiplier effect in a region can be significant.

> In Guatemala, 'micro-regional organizations' have been formed following the support of several communities by a Guatemalan NGO, Agua del Pueblo. Each community's knowledge and experience is shared through organized training programmes. This strengthens their efforts and has allowed them to negotiate with other bodies at a local and national level. Through their strong organization, communities have been able to expand their activities beyond O&M management into cereal crop, coffee and fruit production (Gonon, 1992).

All partners have a role in promoting greater mutual support among communities to realise the many potential benefits of working closer together.

Traditional management systems

People have always managed their traditional water sources. Single point sources will usually have rules for the control and use of water. Complex forms of management may have been established for critical, heavily used or extensive supplies. Rules and widely understood agreements on the use of water for drinking, washing, animal watering and farming can be identified and acknowledged during the early assessment and planning stages of a project. Women are often the managers of traditional sources and they can, if given the opportunity, explain the existing management system, its merits and drawbacks, and how they feel it can be integrated into the operation and maintenance of an improved supply.

Traditional agreements on ownership and access to wells often define who owns a well and is responsible for its upkeep. In many societies access to a well for drinking water cannot be refused, although its use for other purposes may be restricted. This may be an important issue when introducing charges for an improved water source.

The degree of user representation through traditional community decision-making bodies will determine the extent to which all members of a community can be involved. Outsiders must be careful not to miss the informal consultation mechanisms that lie behind many formal bodies, for example, the informal representation of women's views through women's networks and leaders.

Some projects have attempted to by-pass traditional leadership structures which have appeared unrepresentative to agency staff. This has sometimes created problems.

> In some piped water supplies in Malawi tap committees were elected without the involvement of local leaders. Subsequent disputes over communal water points were referred by tap committees to the government extension workers who had helped to establish the committees. Village headmen and party leaders had previously been responsible for settling disputes and so they felt their authority was being eroded through being bypassed in this way. As a result, many tap committees relied on support from the extension workers as little support was given by local leaders. This arrangement did not encourage sustainable community management (Ndoya et al., 1992).

The management of O&M must be adapted to community structures and community structures must be supported to cope with O&M.

7.2 Community Management Committees

Support agencies often require communities to establish water committees for the management of new water supplies on the assumption that existing or alternative forms of organization are inappropriate. This may be the case in many situations but experience also suggests that whilst the establishment of a water committee can be of great value, existing structures and committees may either do the job just as well or so heavily influence the workings of a water committee that there can be little distinction between them. Therefore, consider carefully the need to create a water committee.

Water committees

Committees often enter into a formal written management agreement with the partner agency (often the government water authority) and sometimes a third sponsoring partner, such as an NGO. Agreements define the roles and responsibilities of each partner. An agreement is often made at the beginning of a project to include each phase of the project cycle through implementation to the final management of a supply. In a true partnership all partners will participate in the drawing up of the agreement. However, standard agreements are often used. This is convenient for the support agency but leaves little scope for individual community negotiation. Long agreements in legal language are better avoided.

It has been noted that in some instances the construction phase of a project necessitates a large water committee to deal with the many different aspects of implementation. On completion of construction, however, it might be more effective to re-form into a smaller committee for the management of O&M (Hussain, 1992).

Committees may be freely elected, nominated, or formed by the community with or without the encouragement of an external agency, water agency or local government administration (See below). Committees normally comprise a chairperson, secretary, treasurer and ordinary members. The handpump or tap caretakers or pump operators are often included as automatic members. Committee rules may stipulate a minimum number of women members.

The tasks of a water committee normally include the following :

- to represent the community in contacts with the partnership agency and the government,
- to organize and manage the collection and use of O&M funds,
- to organize and supervise O&M activities - operation, preventive and corrective maintenance,
- to keep accurate records of payments and expenditures,
- to promote the hygienic and effective use of facilities,
- to keep users informed of the O&M activities and finances.
  (IRC, 1991)

Tap committees represent user groups within a community. They are also variously called neighbourhood, standpost, or user committees, and are the lowest level of user representation within a scheme. A tap committee's role is to manage the use and maintenance of a facility, such as a standpost, and provide advice and feedback on

operation and maintenance to the water committee. They may be responsible for the collection of water rates within the user group.

In extensive piped distribution schemes it is usual to have an overall management committee at the head of a hierarchy of committees and sub-committees representing each community, standpost or user group.

Internally and externally organized committees

There are important differences between an externally organized committee, created through the intervention of government or an external support organization, and an internally organized committee created from within the community. These differences affect O&M as described in a review of water committees in Central and South America (Espejo, 1989).

Where the government agency or contractor was mainly involved in the organization and planning of construction work the water committees were simply created as a convenient means of administering the schemes. In some cases the committees were formed after construction, and administrative responsibilities were then handed over. This resulted in the implementing agency, often a contractor, making the decisions concerning construction of the scheme with the community participating only as unskilled labour. Subsequent O&M was either continued by the implementing agency or handed over to the community who had received little preparation for the task.

Training activities tended to favour the training of government personnel rather than committee members. Where the training of community members had taken place it tended to be a one-off event and of short duration, just a few days.

The lack of participation of communities and their poor preparation for O&M had several adverse effects. O&M committees were not established, users did not agree with the externally set fees and sometimes fees were not paid.
In comparison, the initiators of internally organized committees could be community members, local organizations, neighbourhood associations or interest groups, such as women's groups. The main motivation for the formation of water committees was an awareness of the need for water and a strong community interest. Internally organized committees are generally better motivated but many require external support, by government or another agency, if they are to be successful.

Gender aspects of committee management

A balance of men and women on committees may help to achieve, but not necessarily ensure, an equitable division of work and responsibilities between men and women. The aim is to avoid either men or women doing all the work or making all the decisions. Gender often plays a role in the division of tasks. A man usually chairs a committee but a woman may be secretary or treasurer. Widespread experience indicates that women treasurers often perform better than men but appropriate training is required.

> The Kochogo/Kakola project in Western Kenya is run through committees in which women form over 50% of the members. Women are trained in operation and maintenance of the installed Afridev handpumps. Women's groups are taught basic book-keeping to register project revenues which are used for maintenance or banked for later use (Mwangola, 1991)

Common problems associated with management by committee

There are common problems associated with management by a committee which may be overcome by appropriate and timely agency support. They include:

- Committees fulfil their responsibilities during the construction phase but fail to continue their work after commissioning.
- Committees only become active when there is a breakdown. In the time between breakdowns committees feel there is no need to meet or even collect maintenance fees.
- Committees tend to break up shortly after their formation due to a lack of regular activity.
- Forceful personalities dominate the committee.
- Unlimited terms of membership result in reduced interest and participation by some members. (Elected fixed term membership might overcome this problem).
- The handling of funds can be a focus for conflict. In a survey of the problems affecting tap committees in Malawi, the committee position with the highest drop out rate was that of treasurer. It was explained that treasurers were often suspected of embezzling funds and to avoid being accused of malpractice many left the committees.
- Conflict between the decision making role of the committee and the authority of traditional leaders.
- Over-dependence on external support from agency extension staff.
- Internal community friction adversely affecting a committee's work.
- Overlapping of roles, especially the involvement of the chairperson and secretary in the handling of funds.
- A high turnover of male members compared to female members due to their greater mobility.

Espejo (1989), Ndoya et. al. (1992).

If these problems can be identified and overcome, the benefits to O&M are considerable.

Preconditions for community management

- There must be community demand for an improved system.
- The information required to make informed decisions must be available to the community.
- Technologies and levels of service must be commensurate with the community's needs and capacity to finance, manage and maintain systems.
- The community must understand its options and be willing to take responsibility for the system.
- The community must be willing to invest in capital and recurrent costs.
- The community must be empowered to make decisions to control the system.
- The community should have the institutional capacity to manage the development and operation of the system.
- The community should have the human resources to run these institutions.
- There should be a policy framework to permit and support community management.
- Effective external support services must be made available from governments, donors, and the private sector (training, technical advice, credit, construction, contractors, spare part provision, etc.)

(source : McCommon et al, 1990)

7.3 Financial Management

The constraints on effective financial management

The present trend in most developing countries is to transfer part of the responsibility of operating and maintaining water supply schemes from national or regional level to local or users level. This transfer is also concerning financial matters.

This situation means that actors have new roles and responsiblities, and communities have a greater role to play in the financial management of their schemes. The main constraint lies in the capacity and willingness to pay of the communities who are already facing important economic problems. The other contraint concerns the capacity to manage and the financial know-how of communities.

The more a water supply is dependent on imported technology and goods, the more it is susceptible to changes in the country's general economic position. The following extract from a project evaluation comments:

> All imported goods and materials purchased for the programme have to be paid in foreign currency. While in foreign currency terms prices remain stable, devaluation makes them increasingly expensive. Long term continued dependence on imported goods will lead to serious problems of sustainability as only 15% of procurement is done locally at present (Smet et al., 1993).

Within a national or regional economy there may also be seasonal price fluctuations. Adequate funds are necessary to take advantage of such fluctuations and this often means collecting funds in advance to use when prices are low. Although such a situation can work to the advantage of users it also adds to the complexity of managing O&M funds.

Replacement costs

In some cases, O&M funds are expected to pay for the complete overhaul and replacement cost of equipment when it wears out. The estimation of replacement costs is even more hazardous than making regular O&M estimates due to the longer time scales involved. Estimates can be made in hard currency of the eventual replacement or extension costs. The local currency equivalent can be adjusted as exchange rates alter over time to give an indication of the real cost to users who have to raise funds for replacement in their own currency. A mechanism to monitor and adjust replacement costs is necessary and is a service that a support agency can provide to users.

The cost of replacement is unlikely to be met out of a single fund-raising event and either regular contributions will need to be saved or a loan taken out to be paid back out of future water payments. Rural development banks, where they exist, are a possible source of loans.

Savings are problematic as their value must be protected and the interest earned on savings is not necessarily guaranteed to keep up with inflation. Many rural communities do not have ready access to banking or post office savings facilities. Some banks may not be sympathetic to a rural community's needs and credit unions, where they exist, may be more appropriate.

An alternative to simply leaving savings to gain interest is to use them to finance income generating activities. However, this is risky as careful management is required and investments may not be profitable. Additionally, the original intention of providing funds for O&M, and the replacement and extension of a water supply, can become obscured by other activities.

Recycling water rate revenue for O&M

A difficulty often experienced by a government water agency responsible for O&M concerns the recycling of revenue from water rates. Unless the revenue generated by water charges is directly allocated to O&M services, it joins the general pool of government, or departmental, funds. The reallocation of funds for O&M can be cumbersome and inefficient. In some cases funds may be diverted for other uses, such as the construction of new schemes. This may be acceptable if sufficient funds are available. However, where funds are limited, investing O&M funds for non-O&M uses can undermine the sustainability of both existing and new schemes.

Key factors in community financial management

Sufficient funds

Sources of funds were considered in section 4.5, 'Funding'.

- **Accountability**
  People must have confidence in the management of their funds. It is, therefore, imperative that the handling of funds is as transparent as possible and that simple, understandable, accounting procedures are followed. Bank account statements and the water supply financial accounts should be available for all to see. The establishment of an independent committee of user representatives to audit the accounts can help to reassure users that their money is being properly managed. Annual, or bi-annual, user group meetings can be an opportunity to show clear and simple statements of income and expenditure for schemes. For example, groups in Thailand use a schoolboard to publicly display statements.

- **Identifying costs**
  There is little data on the true costs of O&M. Much of the data presently available applies to agency managed schemes and it is difficult to separate agency overheads from individual scheme costs. However, O&M costs are essential for budgeting and users will want to know them. This is particularly important when moving from subsidized schemes to full cost recovery within the community as there will be a need to adjust tariffs according to expenditure. It is not unusual for users to over-estimate their contribution to schemes and people may resent being asked to pay more. Therefore, clear explanations of the cost of consumables, spares and staffing is needed.

- **Collection of payments**
  Contributions must be collected at times when people are able to pay and may therefore be irregular. The method of collecting charges should not be disproportionately costly compared to the revenue collected. There must be sanctions on those who do not pay.

- **Keeping money**
  Money needs to be kept safe. Where rural banks exist a village water account can be opened. Payment into a credit union may be an alternative. It will be inconvenient if a

community is far from a bank as money may be difficult to get hold of when needed quickly. In addition, travel and subsistence expenses to deposit and withdraw money can be high. Clearly, there are substantial risks and an additional responsibility if someone, usually the treasurer, has to personally keep O&M money. However, this is often the case. A fund can also reduce in value if kept without some form of inflation protection.

- **Fund administration**
  The administration of funds requires the issuing of receipts for payment and expenditure and the careful keeping of records. Dealing with a bank will add to the amount of administration. Financial reports are necessary to account for the use of funds and to give users feedback on how their money has been spent.

- **Financial and administrative skills**
  The administration of O&M funds will require men and women with administrative skills. In rural communities, people such as teachers and retired administrators have the necessary skills but are usually in demand for a range of duties. Experience has indicated that women generally make good treasurers. A role of support agencies is to provide appropriate training and initial supervision when needed.

- **Remuneration for maintenance work**
  Remuneration schemes should be arranged to give maximum reward for the minimum down-time. Regular preventive maintenance tasks are sometimes poorly rewarded compared to payment for major repairs. Such an arrangement does not encourage care of the system as it becomes financially more rewarding for a caretaker or mechanic to let the system deteriorate until it requires major repair work.

- **Smooth handover**
  Some schemes are supported by a donor from inception to operation. It is important that the handover phase, during which the donor withdraws support, does not leave a community with sudden financial obligations for which they have not been prepared and are not able to meet.

- **Accurate costing and appropriate tariffs**
  The estimation of O&M costs and the setting of appropriate tariffs are keys to sustainability and are considered in the sections that follow.

Estimating costs and budgeting

Accurately estimating the O&M costs of a new supply can be difficult without operational experience for guidance. A comparison with similar schemes already operating may give an indication of running costs. Cost factors based on past experience, or a percentage of the capital cost, are sometimes used to determine national or regional O&M rates but these are based on average costs and they can vary greatly between schemes. The comparison and use of cost data between countries is even more problematic because of distortions due to fluctuations in exchange rates, differences in the economic and physical environment and in cost estimation methods.

It is important, therefore, to keep accurate O&M records of existing supplies for the future estimation of their running costs.In a partnership between an agency and the community, each partner will share O&M costs. Examples of typical shared costs are shown in Table 13. The exact division between agency and community will depend on the partnership agreement.

The agency approach to cost estimation will be different from the approach taken by the community. The agency will be supporting a number of water supplies within its area of operation. The community will only be concerned with their individual supply, unless they collaborate with neighbouring communities to take advantage of economies of scale.

Table 13: Typical O&M costs shared by agency and community

Component of O&M	*Agency*	*Community*
Personnel	Management, technical, administrative and training staff. Extension staff, Inspectors, health promoters, rate collectors.	Caretakers, mechanics, operators, supervisor, administrator, rate collector.
Materials	Water testing consumables.	Spare pump and motor parts, fuel and oil. Replacement pipes, taps, buckets, rope.
Transport	Agency transport for field support staff.	Local transport (e.g. bicycle, bus fares, etc.) for caretakers/ mechanics, treasurer.
Private contractors	Repairs. Rate collection.	Private artisans. Accountant.
Other expenses	Office and administrative overheads	Stationary, repayment of loans, bank fees.

Estimating agency O&M costs

Personnel

- Identify the type and number of staff assigned to O&M.
- Estimate the proportion of time spent on O&M if staff also have other duties.
- Calculate the cost of wages, including overtime. Official government pay rates can be misleading as various other benefits may need to be included such as vacation and sick pay, field allowances and undisclosed unofficial payments. Estimates can be based on typical local rates for non-government work and the actual numbers of hours worked.

Materials

Most of the cost of O&M materials in community managed supplies are the responsibility of the community. Agency material costs will be those related to training, inspection and health promotion.

Transport

This includes the transport costs of trainers, extension staff, inspectors and health promoters. Define the transport needs for each O&M task by vehicle type, distance travelled and frequency of trips. Based on the needs, estimate the cost of fuel, oil, tyres, servicing and repairs, insurance, driver wages and an allocation for vehicle depreciation.

Private contractors

The extent to which an agency contracts private companies to carry out work on community schemes will depend on the terms of each community management agreement, agency policy and the availability of contractors. Contracts are often issued through a tendering procedure. Cost estimates based on unit prices given in tenders and contracts need to be checked against actual payments.

Other expenses

Administrative and overhead costs need to be apportioned according to agency activities. Depending on the scope of the analysis, office support services may not be included under O&M costs but under overhead costs in a broader financial analysis of the agency.

Estimating community O&M costs

Communities may need initial guidance by agency trainers on the estimation of costs and the preparation of a budget, followed by extension staff supervision.

Easily followed step-by-step procedures encourage maximum community involvement. The simple procedure suggested below might be followed by water committee members, operators and the community treasurer working together.

1. Identify the community O&M tasks.
2. For each task, identify the labour and material requirements.
3. Estimate the labour and material costs.
4. Investigate how costs might be reduced.
5. Produce a budget.

Costs might be reduced by the optimum use of local resources and by co-operating with other communities. Examples include:

- **Labour**
  Voluntary work, payment in kind through preferential rights and water for gardening or livestock.
- **Materials**
  Use of local materials, local replication of parts, bulk purchase with other communities.

If a new supply is being contemplated by a community they will want to compare the implications of different options. Technical and extension agency staff can advise the community on the technical viability of schemes and the capital, operation and maintenance costs involved. Estimating costs and drawing up a budget for each option is crucial to choosing a sustainable scheme and the community need to be fully involved in this process.

A community O&M budget

Expenditure on O&M will vary throughout the year and over longer periods. A community O&M budget, or money plan, aims to set out the expected maintenance costs so that sufficient funds can be raised in time to cover expenditure. An annual budget assists in spreading the cost of preventive maintenance throughout the year and indicates the level of reserve funds required to meet corrective maintenance costs as they arise. Corrective maintenance costs depend on a range of factors and they can vary considerably over time.

In a study of the maintenance of handpumps in Zimbabwe, the relationship between the age of a pump and the number of breakdowns was found to be complex. Several relatively new pumps had experienced multiple breakdowns while the rate of breakdowns levelled out for 'middle-aged' pumps. The rate only substantially increased for very old pumps. There are a number of possible explanations for this variation including differences in the quality of manufacture and installation, improving community commitment to maintenance and increasing familiarity with maintenance tasks over time (Cleaver, 1991).

Tariff setting

A water tariff is the rate at which users are charged for water. If cost recovery aims to satisfy an increasing demand for water then the tariff should reflect the cost of the expansion of water supply facilities as well as the costs of operation and maintenance. However, many water supply tariffs do not even achieve coverage of the current costs of O&M.

Some governments establish national or regional rates in countries with standardized water supplies incurring similar O&M costs. Alternatively, community management committees set their own rates.

To set a water rate, a community needs to estimate the costs of running their water supply and draw up a budget. This is followed by deciding how much and how often users need to be charged to match the budget. The choice of funding method - see Table 10 in chapter 4 - will depend on several factors including the spread of costs throughout the year, seasonal factors affecting ability and willingness to pay, and the merits of periodic contributions versus regular payments.

Agencies have an important advisory role in assisting communities to set an appropriate rate.

Community Development Assistants in the Morogoro/Shinyanga rural water and sanitation programme, Tanzania, were trained to provide village committees with practical assistance in setting a water rate. Three rates were considered:

- a flat rate per user household
- a flat rate per adult in each user household
- a graded rate for different households.

The different rates were compared and the final decision on the rate to adopt was made by the committee (IRC, 1989).

Flat rates per user household are relatively straightforward to implement. It is a fair system when there are no great differences in water use and distance from the households to the water collection points.

The advantage of a flat rate per adult user is that households with many adults pay a higher fee for using more water per household. This method entails additional administration.

Graded rates are appropriate in villages with considerable differences in water use between households. Some households may be wealthier and use more water. Others may use water for commercial activities - washing taxis or lorries, gardens for market produce, livestock watering, etc. Rates may be graded according to water use - e.g. payment per animal watered per year - or by classifying households into large, medium and small users. Lower rates may be charged to disadvantaged groups such as old people, female headed households and people with disabilities. The administration of graded rates is more complicated than a flat rate and agreement on the grading system with all concerned may be difficult.

Collecting money costs money and the cost of rate collection must be included when estimating overall O&M costs.

If in the past water has been heavily subsidized or free, a tariff to cover O&M costs must be introduced carefully. This will entail close collaboration with the community, clear explanations of the costs involved in running the water supply, and a tariff which may need to be introduced incrementally over time. If the system supplying the free water had been poorly run and payment promises a better service then willingness to pay can be high.

A new tariff may undercut the price of water previously set by water-sellers. This will be welcomed by consumers but not by the water-sellers who will lose business. Therefore, it is advisable to consider how to involve them in developing a supply and setting a tariff.

Tariff formulas

Various formulas can be used depending on what costs have to recovered. A set of formulas are presented here, which include gradually more and more elements, depending on what the community has decided to recover, (tariffs calculated on an annual basis). The choice of one tariff will depend on the technology used, but mostly on the capacity and willigness to pay of the communities. A cost sharing approach should still studied as far as possible :

MT (Minimum Tariff)

$$MT = \frac{\text{Operation costs + Administration costs + Maintenance costs}}{\text{No. of people served}}$$

Operation costs + Administration costs + Maintenenance costs = Functioning Costs (FC)

EM (Efficiency Tariff)

This tariff will include costs of replacement or extension of the services. A percentage can be estimated, which corresponds to the life cycle of the equipment; in this case we propose to estimate the replacement costs as a percentage of the functional costs (25 percent); this will depend on the technology and the dynamics of the community :

$$ET = \frac{\text{Functional costs + 0.25 of functional costs}}{\text{No. of people served}} = \frac{\text{1.25 of functional costs}}{\text{No. of people served}}$$

EEM (Environmental Efficiency Tariff)

This tariff includes the costs of the ecological impact of the use of the water supply system, and the protection of the water resource, in order to sustain the quality of the water supply over a long period of time :

$$EET = \frac{\text{1.25 of functional costs + Costs of protection environment (CPE)}}{\text{No. of people served}}$$

LEET (Leakage and Environmental Efficiency Tariff)

This tariff includes not only replacement and environmental costs, but also costs linked to leakages in the system. Leakages are very common, and they represent a loss of gain, which can be quite important (20 to 60 percent in some cases). As an illustration we have chosen in this example a leakage percentage of 25 percent of the functional costs:

$$LEET = \frac{\text{(1.25 of functional costs + 0.25 of functional costs) + CPE}}{\text{No. of people served}}$$

TET (Total Efficiency Tariff)

This tariff includes the recovery of all the above costs and the initial investment costs. This will depend on the agreement reached with the community. Some communities will have to borrow with an interest rate, some others will just reimburse a certain percentage of the initial investment. We have chosen in this example, that the community will reimburse 5 percent of the initial capital every year, such as IR (Investment Recovery = 5 percent of capital costs) :

$$TET = \frac{1.50 \text{ of functional costs} + CPE + IR}{\text{No. of people served}}$$

Additional costs, such as depreciation or inflation can be included in the TET, if the project decided to recover them as well.

Tariffs are set on an average yearly basis, however expenses do not follow such a regular pattern, and some financial adjustments might be needed in order balance income and expenses. Morevover, the pattern of expenses might vary from year to year. Indeed, in the first years, there might not be any important expenses, whereas after a while, important repairs and some replacement costs can be very high. It is hence advisable while planning for a tariff on an annual basis to plan for costs on a longer period, which could be the full life time of a particular equipment. Some regular adjustments might be needed in case of inflation.

The collection and management of funds

There are a variety of methods employed in collecting water rates:

- Visits by a rate collector to all registered households. There may be objections to male collectors visiting houses during the day when men are often absent. Therefore, there are often advantages in having women rate collectors as this may be more acceptable and suit an existing pattern of social visiting. A potential disadvantage, however, is that women may end up carrying the full financial burden of paying the rates from their own separate funds (Wijk-Sijbesma, 1989).
- A tap or pump caretaker collects from each user in the tap committee or user group and passes the funds to the scheme treasurer. In dispersed settlements it may be more efficient for the treasurer to collect funds from each caretaker.
- Users pay at a community or agency 'water office' or directly to the scheme treasurer.
- Seasonal collection may be more effective in agricultural communities. Demand for water is usually highest when traditional sources dry up. But this is often a time when the proceeds from harvesting have been spent and people have little to spare for water charges. A good time to collect money is immediately after harvesting.

Defaulters may be dealt with in the form of fines or, for yard taps, disconnection. Social pressures, such as publicly announcing defaulters, may be sufficient sanction in small communities. In some areas it may not be socially acceptable to deny someone use of a water supply. In such cases, penalties for non-payment may take the form of a denial of rights in community affairs and access to other community benefits.

There will often be a delay between the collection of funds and the need to spend them. An accumulation of funds can sometimes lead to pressure to spend them.

Although accounts have been opened, they are in effect not being used and a large amount of money is lying idle to the dissatisfaction of many villagers. ...many committees are reluctant to use the accounts because they have not received any clear advice on what else they could use them for. (Smet et al, 1993)

The problems related to using community funds for non-O&M activities have been mentioned previously. Appropriate advice and careful fund management is essential.

A procedure for registration, collection, keeping and spending funds is needed. Agency support and advice may be necessary. This is often a new activity for a water agency and may require a change in working methods. Extension staff trained in financial procedures may need to be recruited. Alternatively, it might be possible to collaborate with another agency which has the appropriate expertise, e.g. community development or a government department responsible for small industries.

The training of committee members and the treasurer in simple bookkeeping is an important aspect of community support. A straightforward system of issuing receipts and registering payments is often all that is required so that proper accounts can be kept. Adapt to the "cardboard box and school book" system if that is what the community uses. Good record keeping is important for public accountability and provides data for future budgeting.

Problem solving

Agency extension workers have a critical role in monitoring the progress of financial management. Common problems include:

- theft or fraud
- users refusing to contribute funds or pay water fees
- the cost of unexpected breakdowns, high spare parts expenses or capital replacement
- public accountability
- treasurer incompetence or dishonesty
- overlapping roles and conflicts among committee members.

Advice and encouragement from agency staff will be important. The aim should be to reinforce the capacity of communities to manage their own finances.

The treasurer's tasks

The Piped Supplies for Small Communities (PSSC) project in Zambia makes recommendations on the tasks to be carried out by the treasurer to try to avoid the misuse of community funds. These include simple but practical guidelines:

- The treasurer systematically registers all contributions and purchases in a cash record book.
- All receipts are kept in an envelope at the back of the record book or glued to the back pages.
- All payments have to be agreed by members of the committee.
- All deposits and withdrawals at the bank or post office savings account must be made by the treasurer with the chairperson and secretary as joint signatories to the account.
- The treasurer or committee must report to the whole community at agreed time intervals on income and expenditure and the state of the finances.

(Ng'ambi, 1991)

7.4 Monitoring and Evaluation

Monitoring and evaluation provide a systematic assessment of the functioning of an O&M system and its benefits to the community. Monitoring is the regular collection of information concerning performance. Evaluation uses monitoring and other data to provide an indication of performance, benefits and trends. Monitoring and evaluation are not ends in themselves. An essential outcome is that the findings are used to improve individual systems and general approaches to O&M at the programme level.

There are two levels at which the operation and maintenance of community water supplies are monitored and evaluated. Users monitor and evaluate their own systems at the community level, with possible back-up from extension agents. Support agencies and the government are concerned with a broader overall view of programme performance and monitor and evaluate at the programme level.

Monitoring

Guidelines for successful O&M monitoring:

- Keep it simple
- Do not collect more information than is really needed
- Collect information which is objectively verifiable
- Ensure the data collected can be processed and used within the time, human resources and budget available
- Aim for flexibility and avoid a top-down approach. Involve users and water committees in the process
- Develop performance indicators which are accepted and understood by all managers in the O&M system

An indicator shows the extent to which the objectives of a scheme, or schemes, are being achieved. There are three main types of indicator used in monitoring O&M:

1. **Performance indicators**
   These mainly relate to the functioning of schemes and the key components of an O&M system, such as the provision of spare parts. Each indicator has associated with it a performance target against which actual performance is compared.

2. **Managerial indicators**
   These combine performance indicators with data reflecting the use of human and other resources. For example, the cost of achieving a particular performance with a certain number of staff.

3. **Policy implementation indicators**
   These monitor progress towards achieving the overall desired impact or long term goal of a sustainable O&M system.

A recent WHO draft report for the assessment of the status of O&M details the following performance indicators for application to rural water supplies (Cotton et al., 1993):

Operational indicators

$$\text{Functioning supply points indicator (\%)} = \frac{\text{Number in working order}}{\text{Total number}} \times 100$$

The functioning supply points indicator shows how many waterpoints, standposts or handpumps, are delivering water. However, this must be further defined to establish what is meant by 'delivering water'. There is a big difference between a tap running full all day and a trickle for one hour. The indicator must be fully defined and understood for each situation.

$$\text{Reliability indicator (\%)} = \frac{\text{Functioning time}}{\text{Total elapsed time}} \times 100$$

The reliability indicator reflects the fact that a system which breaks down frequently, but can be quickly repaired, is 'more reliable' than a system which breaks down only once in a while but takes a long time to repair. What is important to the users is that a safe water supply is available for most of the time, no matter how often it breaks down.

Further operational indicators can be used to indicate reductions in the planned quantity of water delivered, the availability of water each day and water quality.

Financial indicators

It is often difficult to obtain accurate financial information. Subsidies may be difficult to quantify and records may be inadequate. In addition, the underfunding of O&M will mean that the funds allocated will not reflect the actual funds required for effective O&M.

The simplest indicators include:

- the payment by users of water tariffs,
- the amount of funds in the water account, versus what is needed
- level of expenses, by category.

Personnel indicators

Personnel indicators can be applied to indicate the numbers of operators, maintenance teams, pump mechanics, or personnel trained who are in post and are working. These indicators could be compared with performance indicators to monitor efficiency.

Materials indicators

Operation and maintenance requires a range of materials and indicators can show the availability or accessibility of items such as spare parts. Suggested indicators include: the time required to obtain a spare part; the number of items in or out of stock; the number of repairs awaiting spares, and so on.

Work control indicators

Work control indicator = Backlog of repairs or planned spare part replacements

The efficiency of maintenance personnel in responding to breakdowns can be shown by work control indicators. They refer to the time required to complete a repair or the number of items replaced on a preventive maintenance schedule compared to the number that should have been replaced.

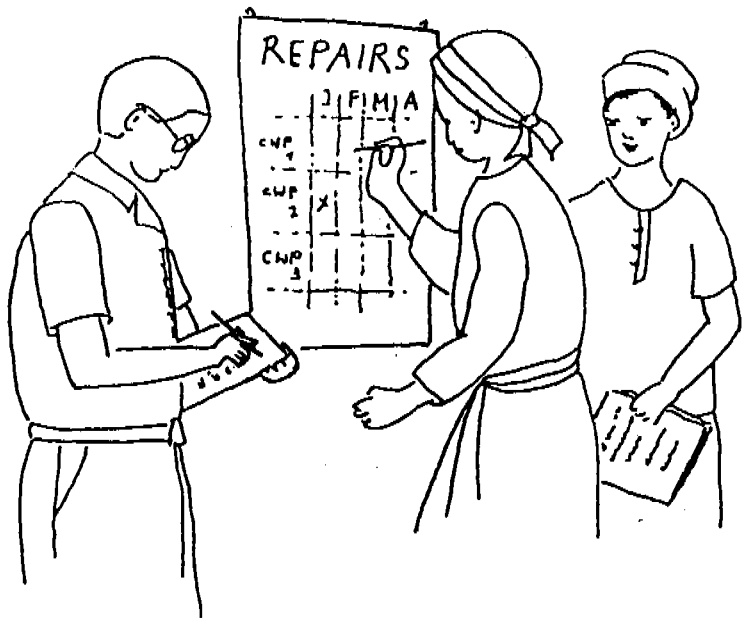


Figure 8 : Communities can be involved in monitoring activities.

Developing a monitoring system

A problem with many monitoring systems is that they are imposed from above by remote management and as a consequence they are often unrealistic to put into practice and they do not give the information required. A suggested approach towards improved O&M monitoring is to start with individual schemes to ensure that monitoring systems are appropriate to the needs of users and field level managers. Relevant field data can then be conveyed to managers and planners provided it is processed and combined with additional information concerning the use of resources.
The following steps for the development of a field level monitoring system are proposed:

- at the local level, identify the basic O&M tasks, to include key tasks such as the provision of equipment and spare parts
- identify the information needed to manage staff at the local level
- identify basic O&M performance indicators
- test the indicator on a small-scale for a limited period to ensure that the intended users of the information give feedback
- carry out an evaluation to verify the monitoring data is significant in reflecting the actual status of O&M
- adapt the indicators and apply on a larger scale
- begin to build up a management information system, including the development of management and policy implementation indicators where appropriate.

Using the information

Periodically collected information will indicate overall trends in the O&M management system. This will help to anticipate problems and point to areas which need specific priority attention.

Establish targets and compare monitored performance against them. An example of performance indicators and how a monitoring system can be planned is shown in Table 6.

Table 14: Extract from a plan for the monitoring of O&M performance

O&M Performance Indicators	*Targets*	*Who collects the data*	*Who verifies the data*	*Method of verification*
Functioning supply points (%)	Percentage of supply points functioning to exceed 90% by (date)	Users Operators	Extension agent Health dept.	Check data sheet with the actual situation in the village
Repair time	Maximum repair time reduced to 2 days in all villages by (date)	Operators Water committee member	Villagers Extension agent	Sample surveys
Essential spare parts available at the market price	Quantity of spare parts sold to exceed (no.) by (date)	Sales outlet - shopkeeper	Supplier Manager	Check supply figures

(Adapted from WHO, 1993)

'Safe values' can be established beyond which action must be taken. These trigger values prompt urgent action rather than allowing a situation to drift.

In all cases, the monitoring analysis can only be as good as the information received. It is important to check the reliability of records and the accuracy of data collected in the field. The percentage of replies not received can also be useful to monitor. Avoid a one way flow of information by providing feedback to the data collectors.

Standardized monitoring systems

A standard system of monitoring allows the performance of individual schemes and programmes to be compared. This is desirable within a country so that data can be easily consolidated and national trends, successes and problems can be identified.

At the international level, a Water and Sanitation Monitoring System (WASAMS) is being developed and applied in a number of countries by WHO and UNICEF. It is a monitoring system which focuses on selected performance indicators for collecting and managing data in the water and sanitation sector.
WASAMS is a computerized system designed to adapt to a country's administrative structure. This enables information collected at district, regional, provincial and national levels to be combined at each administrative level and forwarded for collation nationally. Summary reports can be generated for each level based on the entered data. There are five standard reports:

- population and system utilization
- coverage
- management - O&M costs
- number of people served
- funding.

Reporting

Reporting on the state of O&M is often neglected. This is partly due to its low profile but a lack of available reports in turn contributes to the low profile of O&M. Producing summary reports periodically, say bi-annually or annually, is a discipline which ensures monitoring data is analyzed regularly and trends do not go unnoticed. Reports help in the analysis of problems and help initiate action before the problems grow bigger. They also assist in the planning and design of new systems.

The type and content of reports will depend on the intended readership. Engineers will tend to want information on technical performance. Accountants will be concerned with revenue and costs. Community development staff will want to see how the formation and working of water committees has been progressing. The presentation of monitoring data in a graphical form can show trends clearly and make a greater impact. Visual information avoids jargon and can be more easily shared with a wide range of people.

Evaluation

An evaluation utilizes and supplements monitoring data to conduct a periodic review of O&M. It is also an opportunity to verify the validity of the monitoring system and the data that it produces.

Social and behavioural aspects cannot be dealt with effectively in a monitoring system but an evaluation can look at them in depth. These aspects include the interrelationships between O&M and other community activities, the dynamics within a community that affect O&M success, the inner workings of management committees and the broader community development goals which complement or can benefit from O&M management experience. The following is an example:

Annual surveys and mid-term evaluations

In the community managed rural water supply component of the South West Integrated Programme (SWIP) in Uganda, annual surveys are carried out to evaluate the status of water systems. The surveys are conducted using questionnaires to investigate the following:

- physical maintenance and construction workmanship
- community worker and water committee performance, constraints, drop out rate, financial arrangements, user complaints concerning taste, yield, breakdowns and basic health messages
- the Resistance (village) Council perception of pump mechanic and community management performance.

Major findings have shown:

- over 80% of water systems are operational
- downtime ranges from 7 to 10 days
- a low level of women's involvement
- community workers retained knowledge on basic health messages but were not transmitting them to the communities.

SWIP also conducts mid-term evaluations involving donors, government officials and consultants.

(Kiwe, 1992)

Wherever possible, a participatory approach should be employed to involve the users in evaluating their own O&M systems. There now exists a growing body of techniques which complement the more formal questionnaire approach of gathering information. Participants receive feedback which can be of immediate use in helping to improve O&M.

The overall outcome of an evaluation will be one of three possibilities:

1. The O&M system functions well and it should be continued
2. The O&M system requires modification to make it more effective
3. The O&M system does not function and major changes are required.

There are two options where major changes are required:

1. Make alterations within the existing structure.
2. Decide the existing O&M management structure does not work and overhaul it. This may mean moving away from a centralized management system to a community based approach.

PART IV

SUPPORTING OPERATION AND MAINTENANCE

Chapter 8: What Type of Support to the Communities?

8.1 Government Support

Governments provide the framework within which O&M policy is developed. The role of government is vital to create an 'enabling environment', one of the key elements of sustainability. An enabling environment can be fostered by appropriate legal provisions, regulations, education, training and information. If a supportive O&M policy is not forthcoming from central government then support for O&M at the local level will be considerably hindered.

Local government promotes an awareness of national policies and supports water user committees. However, many local government departments are under-resourced and are unable to give effective support. The degree of support may also be influenced by local politics.

Development of an O&M system and a legal framework

Changes may be necessary where existing legal frameworks hinder rather than encourage the establishment of autonomous bodies for the management of water supplies. Legal provisions may need to be amended to allow for the community administration of funds, the legal status of water committees, and the community ownership of water supply assets. The legal responsibility for maintaining a water service may need to be redefined.

> The government of Pakistan has established a National Rural Support Programme (NRSP). The basic principles behind the programme are the promotion and development of community based institutions - Village Organizations (VOs) - which are responsible for managing and maintaining their projects and affairs, including water supplies. The government has recognized VOs as legal entities in some parts of the country (Hussain, 1992).

Strong institutions

The partnership process means that even stronger institutions than at present are needed to promote and support community management. The recruitment and training of personnel and the organization of departments should all reflect O&M as a priority. Therefore, adequate funding is still required for agencies to be able to perform their essential supportive role.

Where reorganization may be necessary is in the promotion of basic health messages related to water. This has traditionally been undertaken by the Ministry of Health in many countries. Good coordination between agencies and a clarification of roles will be essential if government departments are to effectively coordinate their activities in the sector.

There is a need for the standardization of approaches rather than external agencies developing their own plans and working with different government departments:

Some donor projects finance a special support service in the Ministry of Water, Energy and Minerals, while others co-operate with the Ministry of Community Development, Women's Affairs and Children and the Ministry of Health. The national policy is not clear on the role of the Ministry of Community Development, Women's Affairs and Children. It describes its roles as strategy formulation and the training of villagers and water staff. It does not specify who will do the implementation of non-technical activities in the field (IRC, 1993a).

Without clear guidelines on who should be responsible for each non-technical input (which government agency, NGO or private sector participant), duplication of effort, non-standard approaches and perhaps even confusion can ensue.

Personnel attitudes

The partnership approach will also entail a change of attitudes among government personnel towards their maintenance activities and the communities they serve. This cannot be assumed. An internal report notes that in the partnership approach:

Staff do not give instructions and impose decisions but provide information and skills with which villagers themselves can take decisions, organize activities, monitor progress, etc. Many staff are not trained to work in this way and have a top-down attitude to village work. Participation is limited and often only consists of calling a meeting and having a discussion. Activities to change staff attitudes and improve skills occur but scope and impact is still small (IRC, 1993b).

Government monitoring of O&M

Governments will need to support O&M by ensuring that the O&M strategies adopted function well, and that standards are established and maintained. This will entail monitoring management systems, the quality and quantity of water being supplied, the efficient supply of spare parts and the appropriate choice of new schemes. Specific staff and funds will need to be allocated for the purpose.

It will be in a government's interest to ensure that new schemes will not put an undue burden on the country in terms of future foreign exchange requirements and external support needs, e.g. spare parts. This will mean the close monitoring of donor programmes.

Benin

The Republic of Benin (Le Ministère de l'Energie, des Mines et de l'Hydraulique) has established a comprehensive strategy for the development of rural water supply and sanitation which, if implemented, will have a major impact on operation and maintenance. The strategy is based on the following principles:

- Decentralization of the decision making process to the beneficiary communities through a programme of information, education and communication activities involving government and non-government organizations.
- Community contributions towards the initial capital cost of systems as well as future maintenance.
- Research into the reduction of construction and maintenance costs.
- Privatization of construction, operation and maintenance with a particular emphasis on the promotion of national consultants and small enterprises.

The Benin strategy aims for a radical and comprehensive change of approach from a centralized government dominated sector to decentralized, community based systems in which the private sector has a prominent role.

(Ministère de l'Energie, Bénin, 1992)

India

In guidelines for the implementation of an accelerated rural water supply programme, the Government of India Department of Rural Development recommends that state governments review and streamline maintenance arrangements. In particular:

- Develop O&M standards and allocate O&M funds accordingly to different water supply schemes.
- Analyze the overall cost effectiveness of alternative technologies taking into account O&M.
- Mobilize funds directly from the users.
- Involve the local government panchayats in O&M as much as possible.
- Train more women in O&M activities such as handpump maintenance, chlorination and water sample testing.

The implementation of the policy guidelines has varied from one state to another. In Uttar Pradesh, priority has been given to the installation of handpumps over powered pumps because they are cheaper to install and maintain and they do not depend on an unreliable power supply for their operation.

Water committees and women are beginning to be involved in:

Uttar Pradesh -	handpump maintenance and the upkeep of public taps.
Gujarat -	the upkeep of public taps.
Kerala -	the upkeep of public taps; the monitoring of tap performance.

Mechanisms are being developed for the raising of O&M funds in the piped water supply schemes supported by the Indo-Dutch rural water supply and sanitation programme. In Kerala and Gujarat, local government panchayats either pay for O&M services out of general taxes raised locally or all households are charged a water tax. However, this is only a start towards full local financing.

(IRC and DGIS, 1993)

8.2 External Support Agencies

External support agencies (ESAs) include multi-lateral and bi-lateral donor agencies and development banks. They are an important source of capital funds for the construction of new supplies and for rehabilitation work. For the investment of donor funds to be worthwhile, however, it is essential for donors to consider future O&M needs at the earliest stage of project formulation.

Funds, resources and time need to be allocated for full and proper consultation with the community, government departments and other donors during project formulation. Close co-ordination will help to standardize technology, tariffs, community management responsibilities and aid the exchange of past O&M experience for use in future planning. A prescriptive blue-print approach to community management is unlikely to be successful.

A rapid assessment of community management in the pilot district of Luwero found that communities had adopted innovative and ingenious systems which sometimes deviated from the original designs (Kiwe, 1992).

The traditional handover of donor projects in the past has often left both community and water agency with schemes which neither party was properly prepared to operate and maintain. By following a supportive approach both parties should be fully equipped and

prepared to continue O&M. It has been noted, however, that the continued presence of an agency in an area can lead to false expectations on the part of some communities:

"Babying" of communities should be avoided. This takes the form of agencies overstaying even after a reasonable community management capacity has been built. Agencies respond to "baby cries" from water committees with free spares, etc. In the process they create harmful dependency by failing to "wean" communities and letting them evolve their management capabilities and grow on their own (Kiwe, 1992).

There is a careful balance between support which builds and support which supplants community O&M ability.

The Canadian International Development Agency (CIDA)

CIDA first collaborated with the Ghana Water and Sewerage Corporation (GWSC) in 1974 to improve rural water supplies. Initially, community involvement was very limited. The technical aspects of the programme were dominant and cost recovery was not considered. The result was a poor operation and maintenance record.

Later, in the 1980s, CIDA promoted a policy in which users became involved in waterpoint care and maintenance and a water tariff was introduced. Most maintenance problems could now be handled by maintenance personnel. However, the revenue generated by the water tariff was inadequate to cover operation and maintenance costs.

Therefore, CIDA began funding a new strategy of community management. A project was designed to find out the extent to which communities were willing and able to assume the management of their water supplies and how much people could pay into maintenance funds.

The effect of CIDA's policy has been to improve the O&M component of the programmes it supports in Ghana.

(McPherson,1990)

8.3 Non-Governmental Organizations (NGOs)

Traditionally, local, national and international NGOs have worked closely with communities and have often provided an interface with government agencies and other bodies to facilitate the joint development of schemes. NGOs tend to be more flexible than formal water agencies which enables them to integrate, for example, hygiene promotion into long term O&M activities.

The NGO, Kenya Water for Health Organization (KWAHO), has worked closely with the Ministries of Culture and Social Services, Water Development, and Health in the development of community managed water facilities in Kwale District, Kenya. A particular aspect of the partnership has been the establishment of O&M funds by assisting communities to register themselves as legal self-help groups with the Ministry of Culture and Social Services. This has enabled communities to open bank accounts with communal banks or the post-office savings bank which are present in the district (Munguti, 1989). Many governments produce guidelines for NGOs working in their country. It is to the benefit of all concerned that small-scale NGOs work within agreed guidelines to ensure compatible schemes, tariffs and O&M procedures.

NGOs are seen to work in close contact with communities and some have specific expertise in the development of community management. However, many NGOs rely on external funding and if the form of O&M developed between an NGO and the community is also reliant on external funding then its sustainability may be jeopardized.

The potential for the involvement of local and national NGOs is reflected in the radical approach to project implementation and O&M proposed for Benin:

> The government strategy for the development of the rural water sector in Benin details the role of NGOs as important intermediaries between communities and the private sector. The close contact local and national NGOs have with communities enables them to pursue the promotion of environmental sanitation measures and the encouragement of communities to fund environmental improvements. In an arrangement with the department responsible for the implementation of water supplies, Les Services départementaux de l'Hydraulique (SH), an NGO will receive funds based on the number of contracts signed between communities and SH. The contacts made with communities are continued after construction in supporting O&M (Ministère de l'Energie, Bénin, 1992).

8.4 The Private Sector

There has been an increasing trend towards the greater involvement of the private sector in both the construction and upkeep of water supplies. This brings potential advantages of flexibility and cost effectiveness to operation and maintenance activities. However, private sector involvement may be limited by the poor profit margin in scattered rural communities. Where little or no competition exists, charges are likely to be higher, rather than lower. Therefore, the impact of the private sector will very much depend on circumstances.

In the absence of rigorous inspection and regulation there is a problem of private sector accountability. Communities who contract services from the private sector need to be sure that they get a job well done and at a fair price. To some extent, communities themselves can monitor the quality of work if they know what to look for and this may, initially, require external assistance. But if the private sector is to be promoted then safeguards must be instituted to ensure cost-effective minimum standards of work. Any such monitoring and regulation will have a cost which governments will need to meet.

The proposals for a radical approach to O&M in Bénin, referred to in the previous section, plans to use NGOs as intermediaries between communities and the private sector. NGOs are in a position to negotiate contracts and are, therefore, more able to exercise some supervisory control within an established framework. This way the arrangement has the potential to become partially self-regulatory.

Who constitutes the private sector?

The private sector encompasses a range of individuals and companies from the village blacksmith to international companies manufacturing pumps and diesel generators. They all have a part to play in supporting O&M.

Table 15: O&M support roles of actors from the private sector

Actors in the private sector	O&M support role
International and national manufacturers and suppliers	Design and manufacture pumps and other equipment for operation and maintenance at the village level. Supply spare parts and consumables (e.g. chlorine).
International and national consultants	Design schemes for community management. Develop community/agency managed O&M systems. Provide O&M training.
International and national contractors	Rehabilitate and extend schemes for community O&M. On-the-job training of O&M staff during construction.
Local contractors	Service and maintenance contracts. Major repair work.
Small-scale industries	Local manufacture of spare parts and tools.
Self-employed artisans in the formal and informal sectors	Local skills for preventive and corrective maintenance and repair work: mechanics, plumbers, builders, masons, blacksmiths, electricians, etc. Operation of facilities.
Administrators and accountants	Billing, rate collection, auditing of accounts.
Banks	Provide banking facilities for O&M funds. Provide credit facilities for irregular high cost items and for the expansion or modification of facilities.

The private sector at the community level

A strengthened private sector will give communities greater freedom to decide who they involve in O&M. Even within existing centralized maintenance systems the private sector has been involved in providing a range of support services.

> A review of pump maintenance in Baty District, Cambodia, suggests that pump maintenance is being 'privatized' within the existing government structure. The lowest tier of the maintenance system comprises a pump mechanic trained by the provincial maintenance team. Extra payments are being made to the pump mechanic for repairs and some spare parts can be obtained from the market. This is quicker and easier than following the official procedure (Davis, et al., 1992).

In the same programme, local bicycle repair fitters were supplying leather cup seals to the pump mechanic for India Mark II handpumps installed locally.

Large community schemes serving several communities may decide to contract operation and maintenance to individuals or private organizations. Alternatively, communities might operate a system themselves but arrange a preventive maintenance and repair contract with an external body. Small schemes are unlikely to provide enough work to employ full-time staff and may rely on local artisans for periodic maintenance.

Payment arrangements for private services must encourage preventive maintenance wherever possible:

The effectiveness of pump mechanics in the SWIP programme in Uganda presented a problem due to the method of payment. The pump mechanic was either paid by the users or the water committee for each repair made. There was no incentive to work on preventive maintenance as the mechanic was only paid when there was a breakdown. Therefore, the mechanic had an inherent interest in a continual cycle of broken down pumps. This did not encourage good workmanship and certainly discouraged preventive maintenance! (Kiwe, 1992).

Billing and rate collection can be contracted to the private sector. Payment for the service can be arranged as a proportion of the funds collected. This ensures that the cost of contracting the tasks is recovered and provides an added efficiency incentive.

In the Dominican Republic, commercial agents were employed to improve the collection of rates. Each agent was responsible for 15 piped water supplies which were each visited once a month. During the visit the accounts were checked with the treasurer and a meeting took place with the water committee to discuss problems or matters of interest. The agent then accompanied the treasurer or bill collector to visit households whose payment was in arrears. In 1975 this resulted in payment of 92% of the bills (Wijk-Sijbesma, 1987).

The private sector has a potentially crucial role in the provision of spare parts as the following extract from a programme evaluation noted.

Potential private sector roles must be more closely examined, beginning with the serious pursuit of the commercial production and distribution of spares by local industry and entrepreneurs. A national level initiative may be appropriate, given the widespread problem of spare parts availability and distribution in the country as a whole (Smet et al., 1993).

Chapter 9: Development of Skills and Awareness

9.1 Human Resources Development

Human resources development (HRD) entails the development of skills, the raising of awareness, confidence-building and the motivation of people. Training is an important and major component of HRD but it is not the only one. Improving access to information, recognizing people's endeavours and worth, and providing monetary and non-monetary incentives, such as promotion prospects, can all contribute.

Agency staff development

> **WANTED URGENTLY**
> OPERATION AND MAINTENANCE TECHNICIANS
> Skilled men and women required.
> Poor pay, few prospects, no recognition, inferior status and unsocial hours.
>
> (Kerr, 1982)

Government water agencies often have a surplus of staff in their departments but the majority are untrained or only semi-skilled. Staff who are suitably qualified tend to be few and often overburdened. This situation is partly due to the problem of attracting and retaining skilled staff. Little professional interest in O&M, poor salaries and low esteem have been responsible for the failure to retain managers, engineers, technicians and other skilled personnel. It is not uncommon to find a skilled worker's monthly salary in the public sector to be equivalent to a day's income for an artisan in the private sector (Wyatt, 1988).

Better qualified staff are often found in major urban centres. This results in an uneven distribution of personnel. In Tanzania it was observed that 'a major bottleneck to implementation by the districts is the shortage of suitably qualified staff at district level and the surplus of technicians at the regional level' (IRC 1993a). This has important implications for HRD.

Incentives for skilled staff are often restricted by rigid salary structures. Incentives are more easily paid on donor-supported construction programmes but the effect then is to divert much needed O&M staff away from their important tasks of running existing water supplies. Such incentives can harm O&M and be counter-productive in the long term. On the other hand, new projects with appropriate donor support can provide valuable experience to personnel and give the opportunity and funds for the further development of skills. Women are often less mobile than men and, therefore, the training of women may have a longer-lasting benefit.

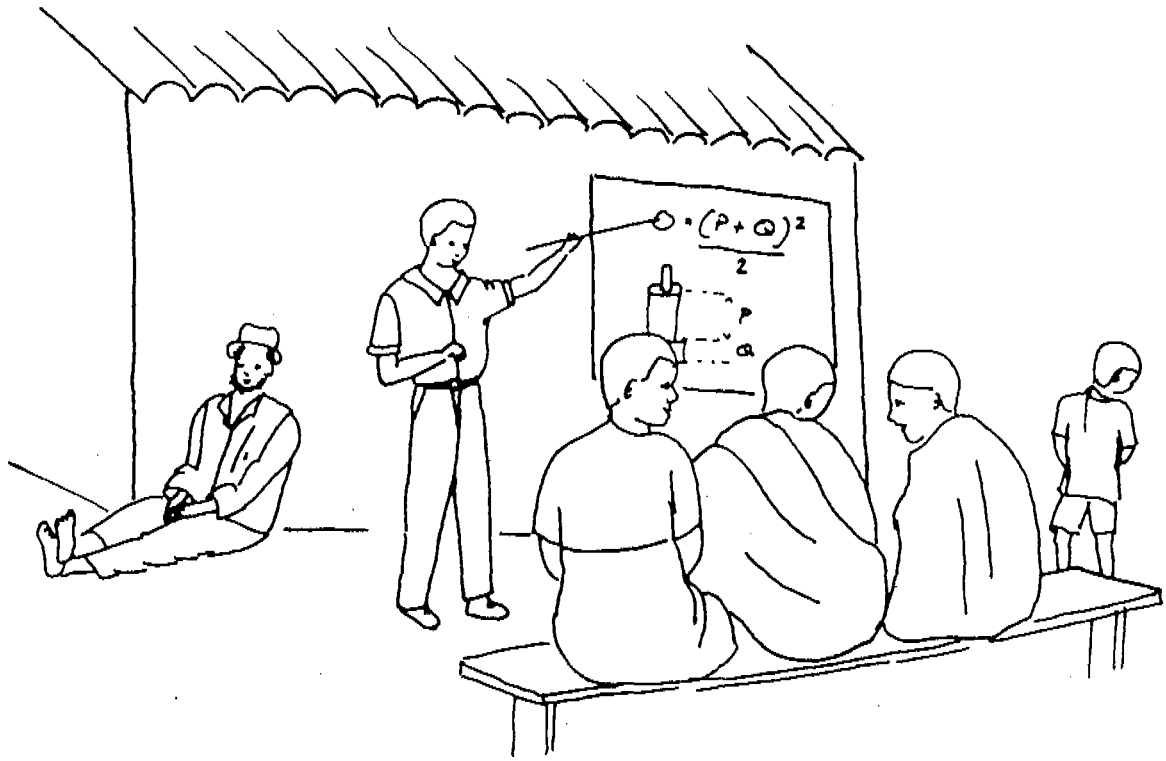


Figure 9: Are training activities always appropriate ?

Restructuring and training

Human resources development complements the restructuring of organizations. Job descriptions will need to be adapted and new performance criteria established. Agency staff - professionals, managers, technicians, extension workers - will need orientation to a partnership approach and extra skills will need to be acquired. Technical field staff, for example, are potential trainers themselves and may need to be sensitized to their expanding role as advisers rather than 'doers'. At the community level, committee officials, treasurers, operators, leaders and users will all need support to be able to participate and perform their new operation and maintenance tasks.

In the area of training, curricula may need adapting, documentation must be appropriate and available, trainers and suitable trainees need to be identified. Sufficient time must be allocated for training to be developed and for it to take place.

Training and education will vary for the different personnel in the O&M system:

- The incorporation of aspects of O&M in existing formal courses for technicians, engineers, trainers and managers.
- In-service or on-the-job training for existing and new personnel: technicians, mechanics, health and social workers, extension staff, accountants.
- Specific short courses held informally in rural communities and follow-up support for unskilled community personnel, committee members and artisans.

- Information campaigns aimed at all levels to promote the understanding of O&M needs, activities and strategies.

Training should be appropriate to the skills and abilities of the trainees - practical not theoretical - and timely so that people are prepared in advance for their future roles.

> Government policy states that it is the government's responsibility to supervise and train water committees created with government support. Existing training activities, however, address the personnel from government institutions more than the committee members. Training programmes also take place after the system has been constructed rather than before or during construction (Espejo, 1989).

Training of trainers

Training should aim to generate a 'multiplier effect' whereby everyone who is trained becomes a potential trainer themselves.

> In a dug-wells programme in northern Ghana, a core group of experienced wells supervisors worked with communities to construct village wells. A village supervisor was appointed by each community to work alongside the core supervisors during construction. The village supervisor gained knowledge and skills that were valuable in the future maintenance of the wells. Particularly competent village supervisors were recruited as core supervisors as the programme expanded and became trainers themselves (Author's own experience).

Training for women

Generally, women are good managers and approach maintenance conscientiously. But it is important to choose the right candidates and to adapt training and working conditions. Working jointly with a group of women is often a useful way of arriving at good candidates, establishing peer support for the job and obtaining help at home for candidates who have to go away for training (IRC, 1992).

The importance of adapting training to allow women to participate is illustrated by the following case from Ethiopia:

> An NGO financed training for community handpump caretakers during a two-week course at the water authority workshop in the regional capital. This excluded most women from being caretakers as it was unacceptable for them to be away from their homes overnight. Therefore, the approach was modified to encourage the training of women caretakers by bringing the trainers to the villages and replacing workshop-based technicians with trained women extension staff (Davis, Garvey and Wood, 1993).

9.2 Operation and Maintenance Information Management

O&M information management is the recording, documentation and dissemination of information relevant to O&M to support the sector.

There is a need to exchange information at a localized level - within a country or region - and globally. The kind of information is broad and includes performance and technical data,

skills needs and training, financing and costs, all related to O&M. The people who will use the information are professionals in the water sector involved in planning, design and management; policy makers, practitioners at the field level, community members involved in O&M management and the users of water supply facilities. The type of information, who will use it and how it might be made widely available is summarized in Table 17. The information categorization is not strict and one type of information will feed into another.

How can information on O&M be made accessible?

The lack of available detailed information on O&M and past operational experience is a major problem in planning and implementing effective O&M systems. Agencies do produce reports but they are often only available through informal contacts.

The difficulty of collecting O&M information and making it accessible is part of a wider problem of information management in the water and sanitation sector. Recognizing this gap, various attempts have been made to establish, or in some cases revive, national documentation centres (Parker, 1993). Government water departments or technical institutes have been seen as the natural focal points for information collection and dissemination. However, if they are to be successful they require adequate funding for personnel, materials, equipment and buildings.

A concern in sharing and comparing information between countries, programmes and individual projects from widely different situations is that different methods of analysis and compilation are often used and the data may not always be reliable.

The following extract from an evaluation report highlights the problem of inadequate information flow and the unreliability of data.

> 'The flow of financial information from the villages to the districts is poor, being largely based on visits by district staff, and on village plans. There is no routine system for collecting financial data from the village level. Because of these weaknesses, the figures appearing in the reports have to be treated with great caution' (Smet et al, 1993).

Fluctuations in exchange rates and the relative cost of materials also complicate comparisons between countries. Care must be exercised to ensure like is compared with like.

Information, Education and Communication (IEC)

As applied to O&M, IEC aims to create public awareness, provide encouragement and change behaviour in relation to the community management of O&M. Typical IEC information is listed in Table 16. IEC public information and campaign materials may be developed and produced locally by communities and partner agencies working together and then shared with other communities and disseminated at various levels.

Table 16: Framework for an O&M information system

What O&M information?	*Who will use the information?*	*How and where can it be accessed?*
Project and sector information General reports and statistics on the status and progress of O&M at project, regional and national level.	Planners and policy makers in government and external support agencies.	National information systems and international networks.
Management information Operational performance indicators: functioning supplies, reliability, maintenance response times, cost recovery. Coverage data, water demand and water use	Managers, administrators and planners of O&M systems.	Government water agency or water sector information network.
Administrative information: O&M personnel trained and in post, stocks of spares and spares supply system, number and activities of water committees.	Project staff	Agency reports.
Technical information VLOM technology, operation and servicing schedules of equipment and machinery, preventive maintenance schedules, O&M technical problems, availability and improvements to equipment, tools, materials and techniques.	Engineers, technicians, managers directly concerned with the implementation of O&M systems.	Agency technical reports, libraries and documentation centres in water technology institutes, manufacturers' literature.
Information for IEC* campaigns Operation and use of facilities, cost of O&M, fund-raising activities, savings and payment schemes, financial accounting, committee functions and procedures, agency support services, legal provisions related to O&M, health and hygiene promotion material.	The general public, policy makers, planners and extension agents.	Users of water facilities, support agencies, documentation centres.

* Information, Education and Communication

APPENDIX

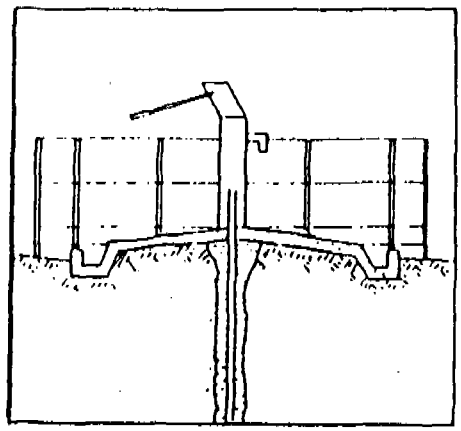
Examples of a systematic approach to identify the O&M technical requirements of a water supply scheme

Example 1

Borehole fitted with a handpump

Boreholes may be fitted with a variety of pumps. This example considers a small diameter borehole fitted with a fabricated steel, reciprocating handpump made in the country.

1. Description of scheme



The borehole

- The borehole has an internal diameter of 100mm.
- The total depth of the borehole is 55m; the average static water level is at 20m; and the pump cylinder is set at a depth of 35m.
- The borehole is drilled into stable fissured rock and therefore the casing extends from ground level for 5 metres until the stable rock is reached. There is no screen.
- The top of the borehole is sealed to prevent the ingress of surface water polluting the borehole.

The borehole surroundings

- The pump platform directs spilt water to a drain which carries water to a soakaway, 3 metres from the borehole.
- The handpump is mounted on top of the borehole in such a way that spilt water cannot pass back down into the borehole but drains away.
- The platform is designed for convenient operation of the handpump by users who are mainly women and children.
- The borehole site is surrounded by a fence with a gate.

The handpump

- The handpump is rigidly mounted on holding down bolts in the concrete platform.
- The handpump is of the reciprocating type with a lever arm which is operated in an up and down motion.
- The handpump is of the VLOM type in which the below ground moving parts (the piston and valves) can be withdrawn from the surface without removing the rising main.
- The rising main is made of PVC plastic

2. Description of O & M Activities

Daily

- Carry out an early morning test to check if the foot valve holds water in the rising main overnight.
- Check whether the pump delivery is normal or low.
- Check if the handpump is firmly fixed in place.
- Check for loose nuts and bolts on the handpump.

- Clean the platform and drain.
- Check the fence is in sound condition and the gate will close.

Weekly
- Carry out daily checks and in addition
- Tighten all the above-ground nuts and bolts with a spanner.
- Clean the accessible moving parts.

Monthly
- Carry out the weekly checks.
- Collect* and record contributions to the water committee.

Yearly
- Dismantle the pump head parts.
- Remove the connecting rods, piston assembly and foot valve.
- Inspect all the parts.
- Replace worn or defective parts.
- Replace piston seals.
- Straighten bent connecting rods, or replace.
- Replace rods with badly corroded threads.
- Replace corroded or missing connecting rod lock nuts.
- If connecting rods show severe corrosion, remove the rising main.
- Check the rising main and replace badly corroded pipes - check the threads in particular.
- Clean pipe threads and install the rising main.
- Re-assemble and replace the below-ground parts.
- Assemble the pump head.
- Check the pump operation and pump until the water delivered is clean.
- Record all significant actions.

Irregular
- Repair cracks with cement mortar in the pump platform and drain.
- If pump mounting bolts become loose in the concrete platform, remove pump, breakout old bolts, and remount in fresh concrete.
- Arrange to clean the borehole if the pump delivers cloudy water with silt.

* The time interval for the collection of payments will depend on local circumstances such as the seasonal income pattern.

3. Description of O & M Requirements

Labour

Unskilled
- Users can carry out the daily activities.
- Water committee to organise maintenance and collect, record and dispense funds for spares and repairs.

* The time interval for the collection of payment will depend on local circumstances such as the seasonal income pattern.

Semi-skilled
- Caretaker can carry out the weekly checks and carry out preventive maintenance on the connecting rods, piston assembly and foot valve.

Skilled
- Private or water agency mason for concrete work.
- Water agency maintenance team to carry out work requiring the removal of the rising main.
- Water agency to clean the borehole when necessary.

Materials & Equipment

Available within the community
- Sand for mixing cement mortar.
- Fencing materials.
- Brush for cleaning platform and drain.
- Record book and pen.

Available within the country
- Cement for platform repairs.
- Spare parts for pump repairs.
- Tools for preventive maintenance and repairs.
- Pipes for the rising main.

Only available from outside the country
- Vehicle for the water agency maintenance team.

Finance

Community funds
- Labour and materials for platform repair.
- Purchase of handpump spare parts.

Government funds
- Maintenance team.

4. Identification of Tasks

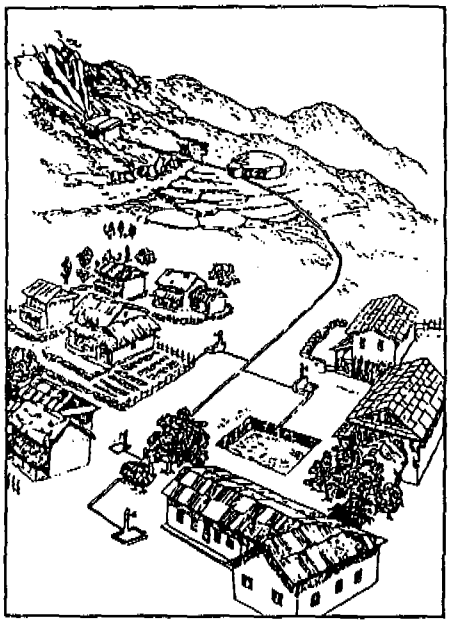
O&M TASKS: COMPONENTS	Supervision & monitoring	Operation	Preventive maintenance	Minor repairs	Major repairs
Borehole	*	--	--	--	**
Rising main	*	--	*	**	--
Handpump	*	**	**	*	**
Platform	*	--	*	*	*
Fence	*	--	*	*	--

** essential for sustainability
* preferable for sustainability
-- not relevant

Example 2

Gravity piped distribution of a spring supply to standposts

1. Description of scheme



Spring box

- A concrete spring box to protect the source.
- A delivery pipe to the gravity main.
- An overflow pipe to divert excess water away from the spring box.
- An access hole with inspection cover.

Reservoir

- A stone masonry, reservoir tank.
- A roof of corrugated galvanized steel sheet.
- Three pipes with an isolation valve on each:
  - inlet from the source;
  - outlet to the standposts;
  - washout.
- An overflow pipe.

Main distribution pipeline

- The pipeline material is a combination of PVC (for buried sections) and galvanized steel (for exposed sections, difficult terrain and connections to tanks and standposts).
- Pipe is buried to a depth of 0.6 metre.
- Valve boxes protect control valves at the reservoir, on each branch of the system, and at each standpost.

Service pipes

- The service pipes to each standpost are galvanized steel.
- A valve on the service line isolates the flow to each standpost.

Standposts

- The standpost comprises an upright galvanised steel pipe encased in a concrete pillar.
- A concrete platform directs spilt water to a drain.
- The drain directs water to a soakaway, situated at least 3 metres from each standpost.
- There are two taps per standpost.

2. Description of O & M Activities

Daily

- At each standpost:
  - Unlock taps and open the valve on the service line.
  - Check the tap operates correctly.
  - Check the flow of water is normal.
  - Attend to any dripping tap.
  - Attend to any leaking valve.
  - Clean the standpost platform, drain and surroundings.
  - Inspect standpost structure, platform and drain - repair any cracks with cement mortar.

Weekly

- Check at the reservoir:
  - for leaks;
  - the overflow is in good order;
  - valves are in the correct position;
  - clear water is flowing into the reservoir at the required rate.
- Walk the route of the distribution pipeline:
- Check for pipeline leaks.
- Look for any disturbed sections of pipe e.g. erosion around gulley crossings.
- Check valves are not leaking and are correctly set.

Monthly

- Collect water committee contributions

Yearly

- Inspect spring box and repair if necessary.
- Drain reservoir, clean and inspect.
- Repair any damage to the reservoir tank.
- Plaster and make good any cracks in the walls and floor of the reservoir.
- Check the operation of valves and inspect internal parts if a valve is stiff to operate. Repair or replace parts as necessary.
- Open 'wash-outs' to flush pipeline.
- Check air release valves operate correctly.
- In the dry season, remove soakaway stones and clean soakaway pit and stones before replacing.

Irregular

- Repair pipeline leaks, taps and valves as necessary.
- Inspect the pipeline after heavy rain and control erosion around pipes.

3. Description of O & M Requirements

Labour

Unskilled

Users carry out daily checks at the standposts.
Users assist in annual activities.
Users assist in the repair of pipeline leaks and erosion control.
Water (tap) committee collects, records and dispenses funds for tap and valve spares, etc. or replacement.
Water committee officials keep records of leaks and repairs.

Semi-skilled Caretaker carries out daily and weekly activities on the distribution system.

Skilled Water agency pipefitters to assist in major pipeline leaks.
Water agency or private mason to repair reservoir and spring box.
Private mason to repair standpost structures.

Materials & Equipment

Available within the community
Sand for cement mortar.
Brush for cleaning platform and drain.
Stone for erosion control.
Tools for digging up broken pipe.

Available within the country
Cement for reservoir and standpost repairs.
PVC and steel pipe for major pipeline repairs.
Spares for taps and valves.
Tools for maintenance and repair.

Only available from outside the country

Finance

Community funds
All labour and material costs of tap, valve and minor reservoir and pipeline repairs.

Government funds
Cost of the pipefitters and materials for major pipeline, reservoir and spring box repairs.

4. Identification of Tasks

O&M TASKS: COMPONENTS	Supervision & monitoring	Operation	Preventive maintenance	Minor repairs	Major repairs
Spring box	*	--	*	*	**
Reservoir	*	--	*	*	**
Pipelines	**	--	**	*	**
Valves	**	*	**	*	*
Standposts	**	**	**	**	*

** essential for sustainability
* preferable for sustainability
-- not relevant

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ROPE PUMP LAO-99

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4. Structure of Rope Pump Lao-99

- Rope Pump Lao-99A
- Rope Pump Lao-99B

1. Introduction

Water is an important factor. People cannot live without water. So far, Lao people have lived with natural riches of the country. They have settled along banks of rivers and streams, which is convenient for using water. On the other hand, the rivers and streams are clean enough for drinking as well as using for agricultural purposes. Now, those riches are slowly depleting, and river and stream waters are being contaminated everyday. The population is increasing so the living areas have to located far away from the rivers and streams in remote areas where natural water sources are lacking. In some regions, many people are using contaminated waters from lakes, ponds, canals, streams and rivers.

In the past, international organizations have funded many water supply projects to the Lao government, especially to villagers living in rural, remote areas. The main objective is to supply clean water of sufficient amount through borehole drilling, dug well digging, GFS construction, rain water collection, etc.

In the water supply projects, pumps are very important equipment which can contribute to getting clean water conveniently. So far, the pumps were imported from other countries in which, for the villagers they are very difficult to install and repair when they are damaged.

The Rope Pump Lao-99 is a new success as a result of research cooperation between the Lao National University and UNICEF. And, this pump is a Lao production. This pump is made from available local materials. The pump has a very simple structure. The villagers can understand easily and every people can repair it when it is damaged. On top of this, the Rope Pump Lao-99 also has a strong structure for long use and is highly effective.

This manual contains an introduction, background, characteristics, types of Rope Pump Lao-99, pump structure and parts of each pump type.

On this occasion, the author would like to thank UNICEF for supporting the production and research of the Rope Pump Lao-99, including the publication of this manual. Thank you very much Mr. Raphael and Mr. Mouti, water supply experts of UNICEF in Lao PDR, for your consultation and options in the pump production and also your facilities.

2. Special Characteristics of Rope Pump Lao-99

- This pump has the most suitable technology and high capacity, which can pump water from 50 m depths
- It is made from available materials which are sold in local markets.
- All spare parts are produced in Lao PDR.
- It is easy to maintain and repair without a technician and complex equipment
- It is easy to transport.
- It is easy to install.
- It is easy to pump water.
- Its cost is very cheap, which is suitable for villagers in rural and remote areas.
- It is durable to last a long time and sustainable
- It can supply clean water because the riser system is made from noncorrosive materials and the other parts, which are cement guide box, plastic pistons, nylon rope, ceramic pieces and PVC pipes will not pollute water

Capacity of Rope Pump Lao-99

The capacity depends on the installation depth and the type of person using the pump as shown in the table below. Even children can pump water to fill one full bucket by using this high capacity pump. This capacity is an important character of this pump and it is well accepted by the community.

Table 1. Capacity of Rope Pump Lao-99

Depth (m)	Adult (l/min)	Child (l/min)	Time for Adult to Pump Water by one Full Turn (200 lit) (min)
5	70	39	3
10	41	19	5
15	27	13	8
20	20	10	10
25	16	8	13
30	14	6.5	15
35	12	5.5	18
40	10	4.8	20

Technical Instructions

The technical instructions for the pump is very simple, which is only the size of the pipe. The riser pipe diameter is designed according to the installation depth as shown below.

Table 2. Technical Instructions

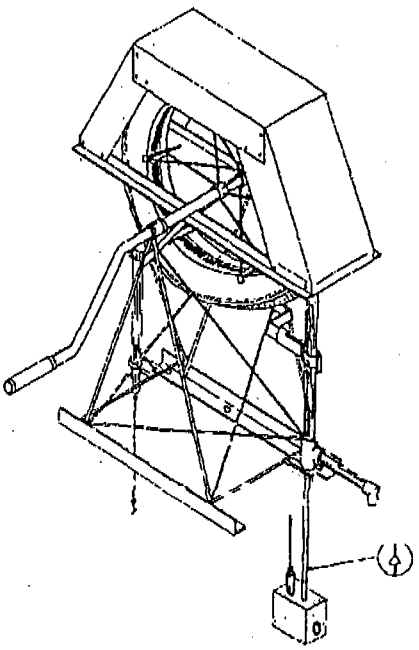
Depth (m)	Size of Riser Pipe (inch)
0 – 10	1"
10 – 20	3/4"
20 – 40	1/2"

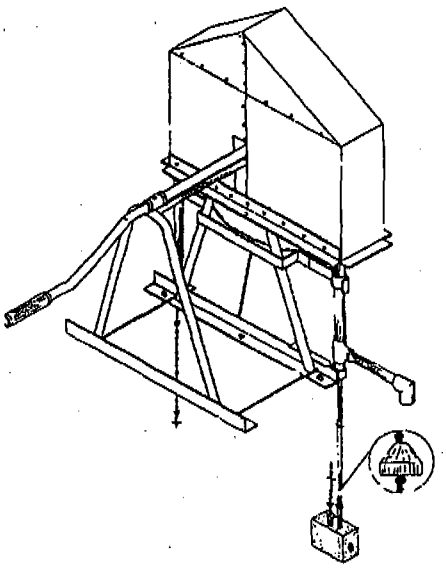
3. Specifications and Operation of Rope Pump Lao-99

Specifications

There are two main types of this pump according to their use.

1. Rope Pump Lao-99A for family use
2. Rope Pump Lao-99B for community use

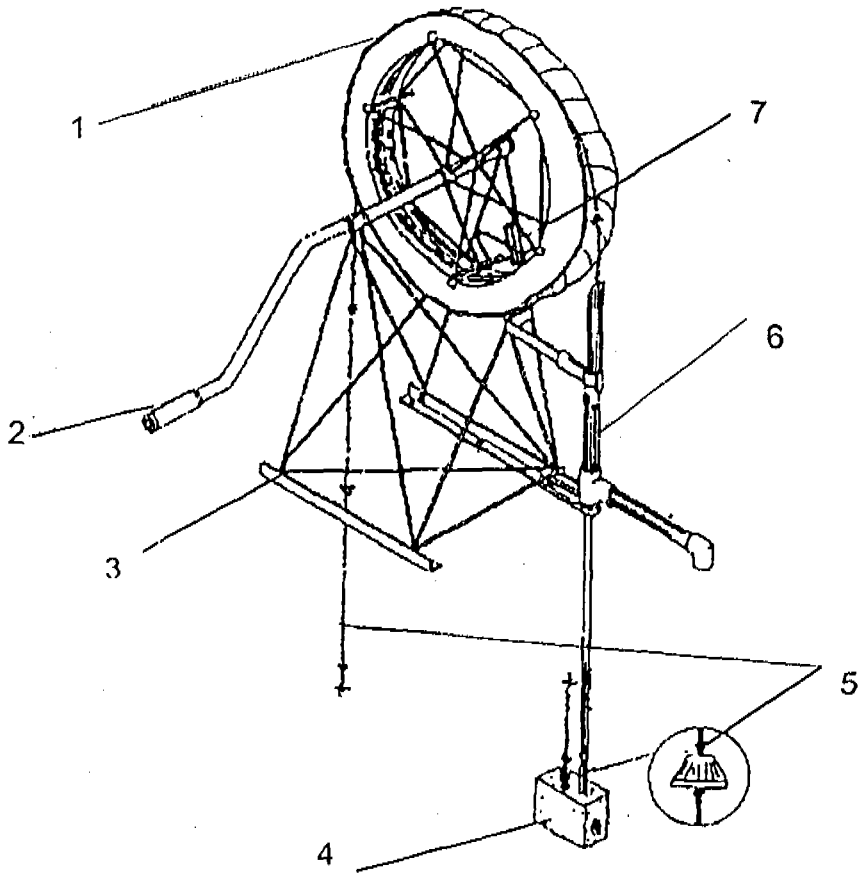




The difference between the two pump types is: The Rope Pump Lao-99A for family has a more simple structure, more cheaper and suitable for family use, and the Rope Pump Lao-99B for community has a stronger structure built for use in the community such as village group and school, but is more expensive.

However, the other factors including capacity and operation are the same. And, both types of pump have high capacity to pump water and can be install on dug wells and boreholes.

Operative System of Rope Pump Lao-99



Use the handle (2) to turn the wheel (1) and pull the rope together to move the pistons (5) in the riser pipe, which will pump water up from below to a higher level by the movement of the pistons. The brake system (7) is used to brake a return of the wheel to stop the pumping, and this prevents accidents such as hitting a child on the head hurting him when the wheel returns and the handle turns. The riser pipe (6) is rigidly fixed with concrete to the well head. Every piston is tied strongly to the rope in the front and back of the piston, and the distance between pistons is 1 m. The rope is made of nylon having a diameter of 6 mm. The guide box (4) is made of cement and ceramic which control the rope with pistons in the water at the bottom.

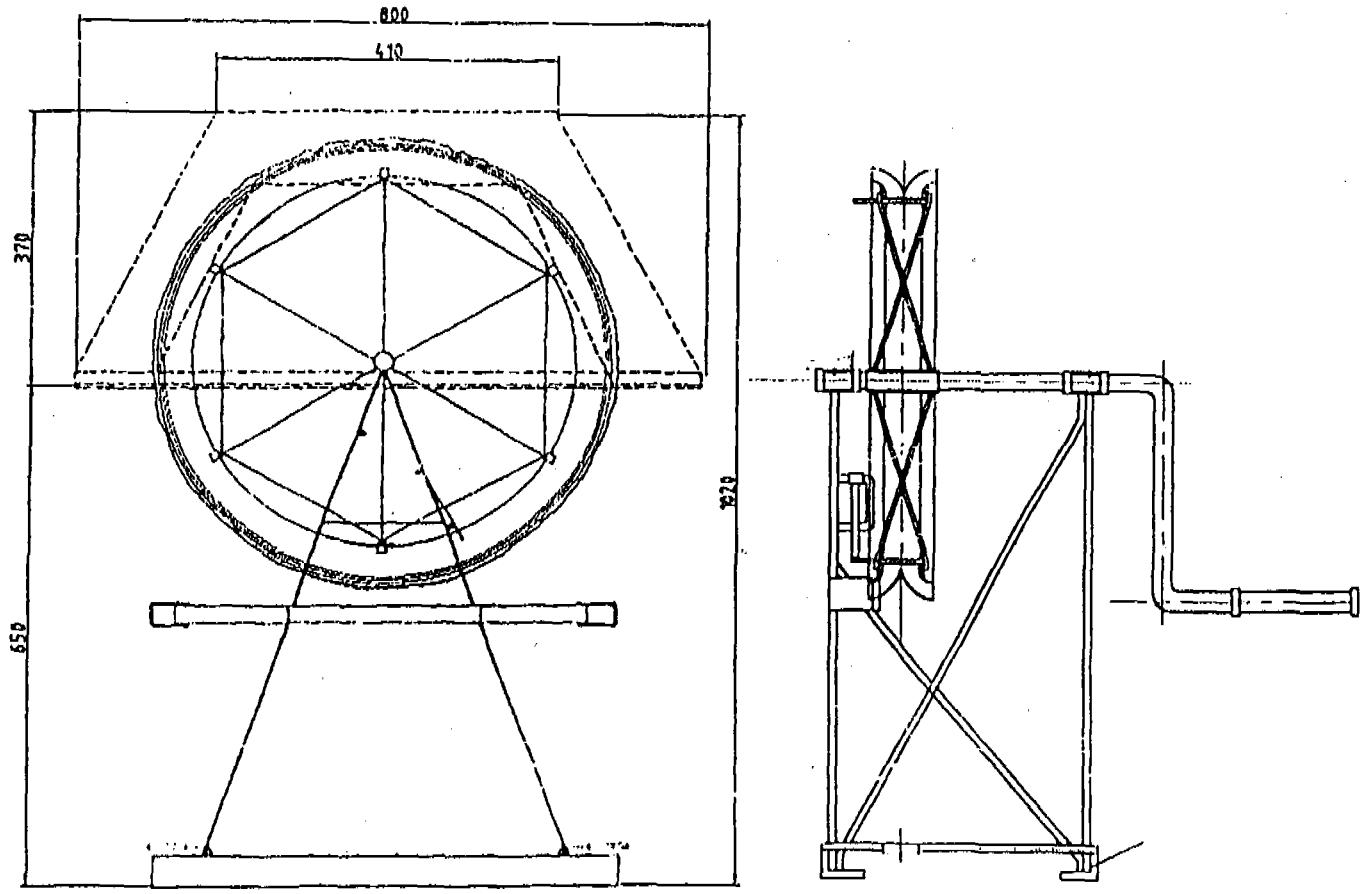
4. Structure of Rope Pump Lao-99

4.1 Rope Pump Lao-99A

As presented previously, the Rope Pump Lao-99A was designed specially to use by the family. So it has a simple structure to reduce its cost. Especially, the leg structure is made of steel reinforcement bar of ϕ12 mm which is strong enough for family use.

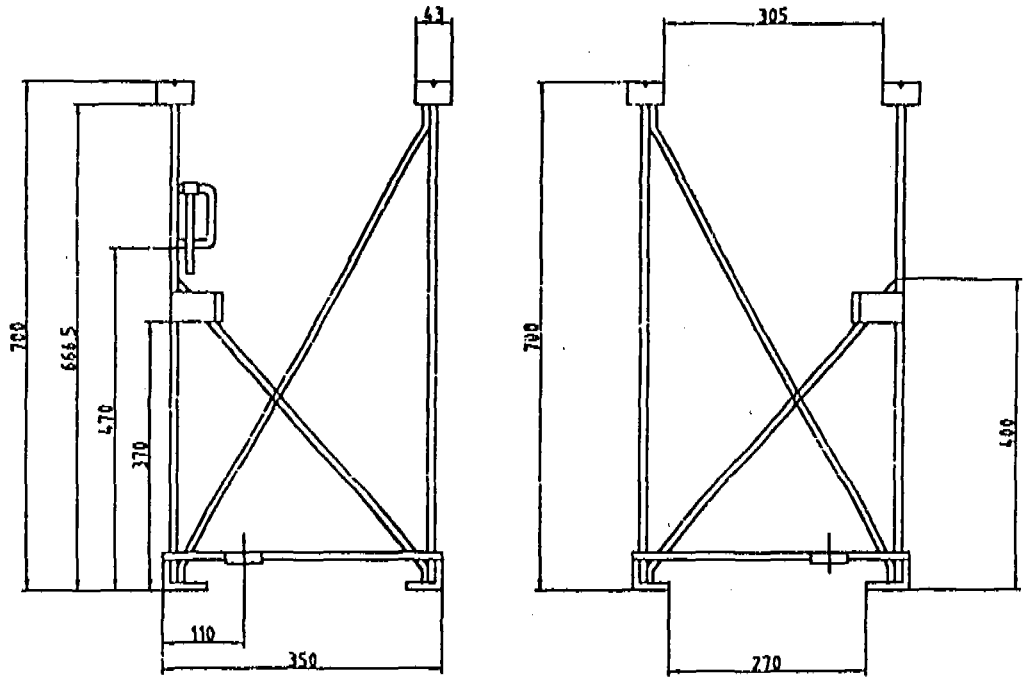
(1) Wheel Structure

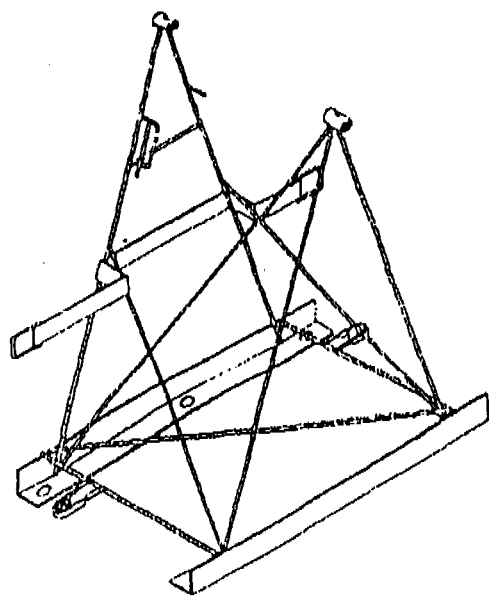
The wheel structure has the function to move the rope and pistons which can pump water continuously in the riser pipe. This structure is welded to strongly support the pumping operation.



(2) Leg Structure

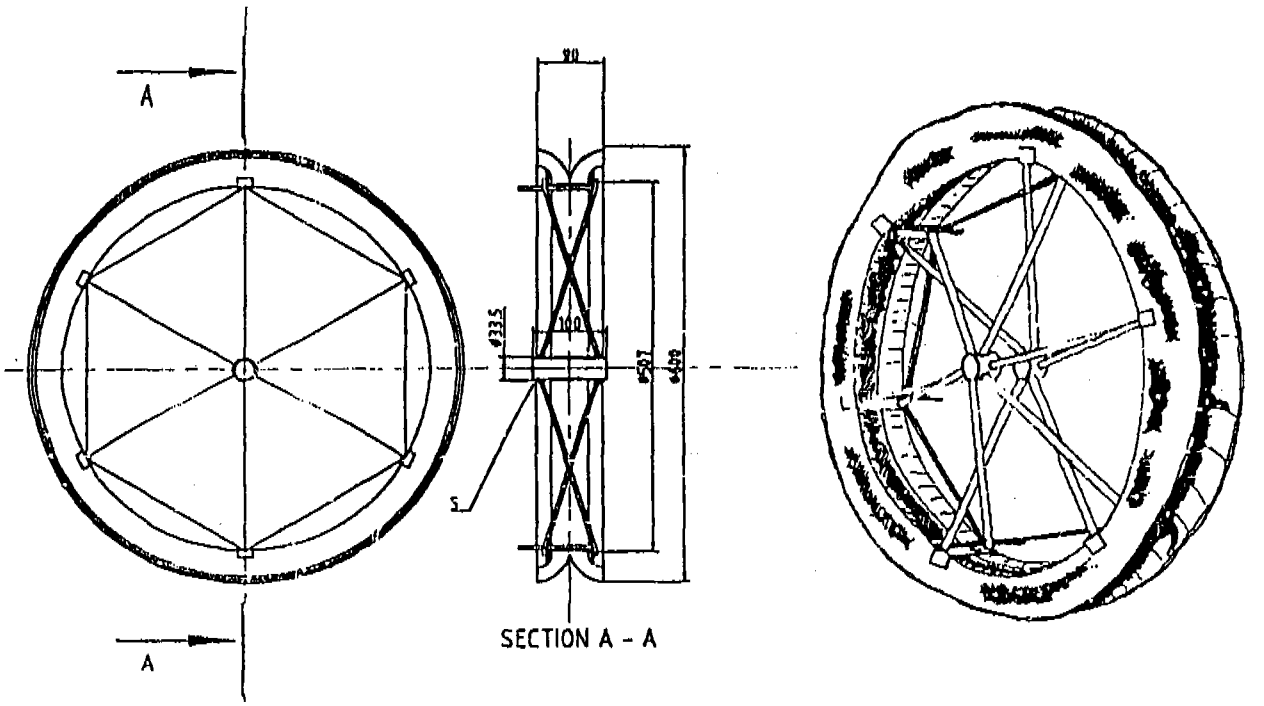
This structure mostly supports the weight of this pump and it is strong enough to support the operation when people are using the pump. This structure consists of steel reinforcement bar, L-shaped steel for footing, flat steel and ϕ 1" pipe all welded together.





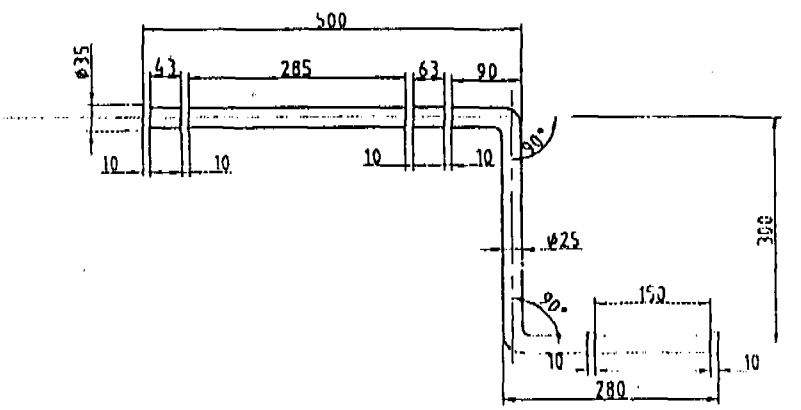
(3) Wheel

The wheel is made from an old car wheel of ϕ20", reinforcement bar for spokes, flat steel to hold the wheel, and ϕ1" pipe, all welded together. It is important to install the wheel correctly to prevent the rope and pistons from slipping off the wheel when the wheel is turning at high speed.



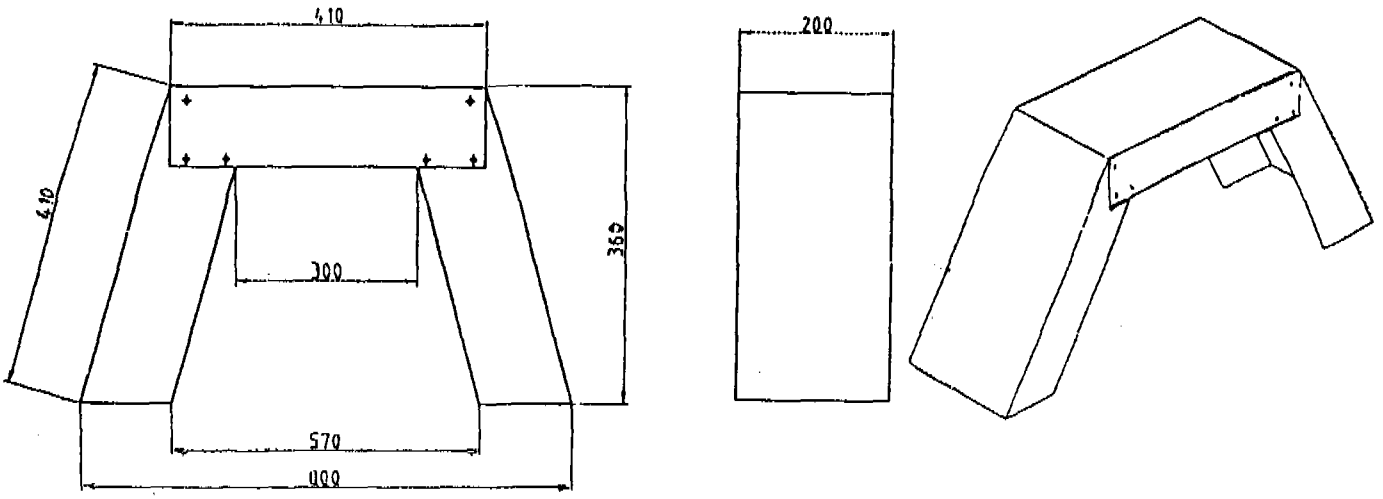
(4) Handle

The function of the handle is to transfer human power to the wheel. It is made from GI pipe ϕ 3/4" bent into the shape shown below.



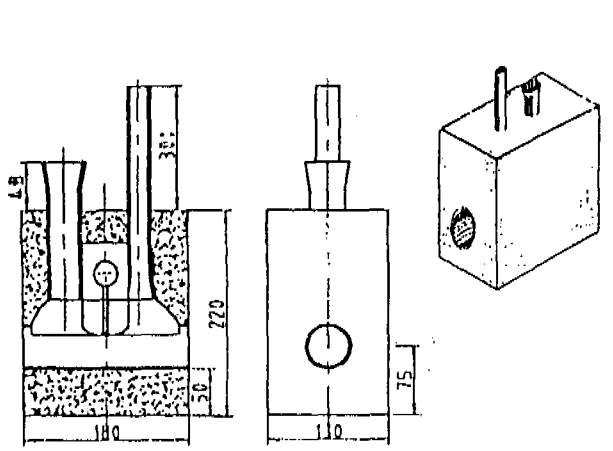
(5) Cover

It is necessary to use this cover because most pumps are installed outside of the house without shade. This cover can protect the pump from sunshine and rain. Also, this can prevent water from splashing out when the pump is pumped at high speeds. The cover is made from flat sheet of zinc and a steel structure for enough strength.



(6) Guide Box

The guide box functions in the water. It controls the rope and pistons to move in the correct direction. There are 2 types of guide box: one for dug well and another for borehole as shown in the drawing. The guide box is made of concrete. Inside of the concrete box, there are PVC pipes and a ceramic piece which assure that the water will not become dirty after long use.



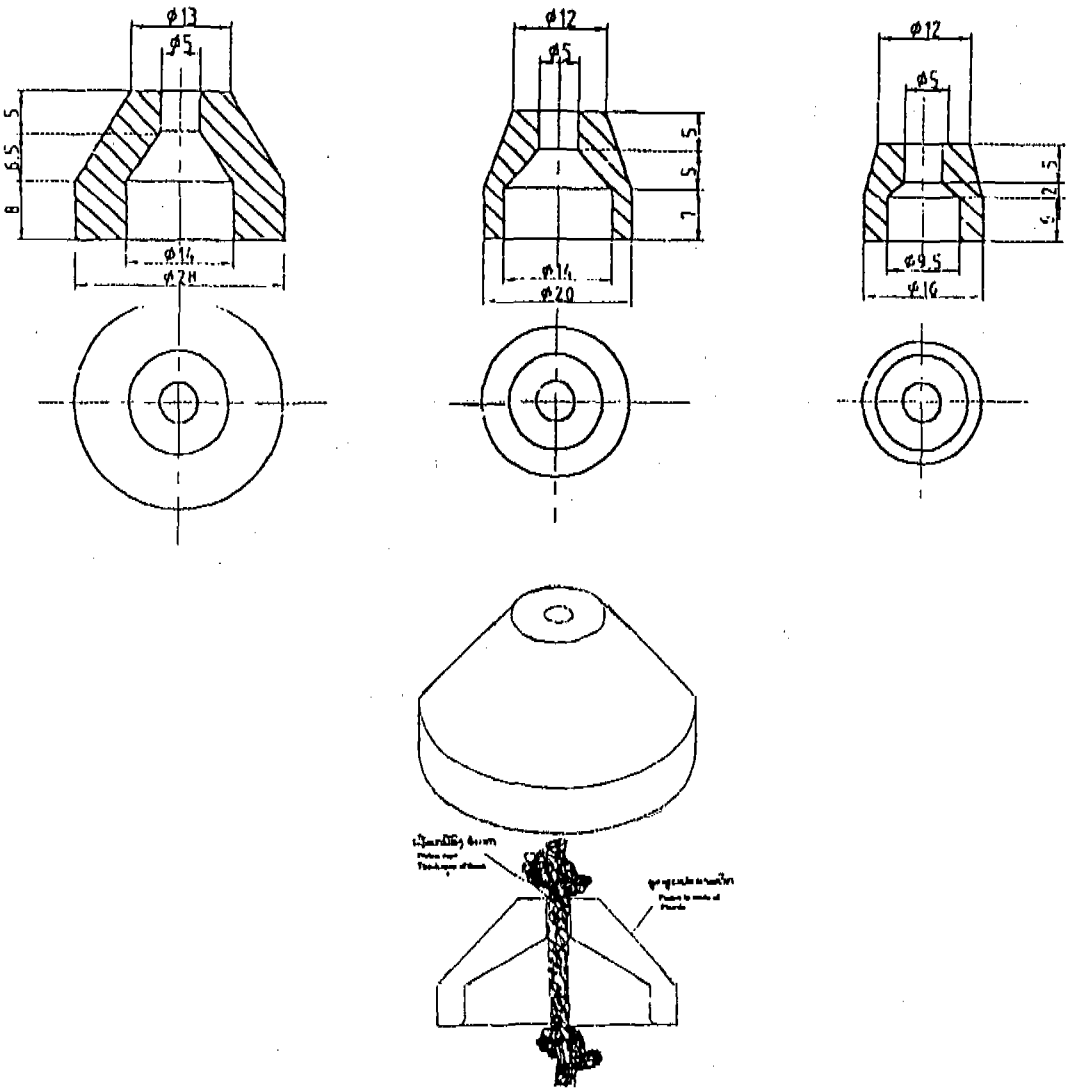
ຫົວດູດສຳລັບນ້ຳລຶກ



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(7) Pistons and Rope

The pistons and rope are important because their main function is pumping water from a lower point to a higher level through their movement in the riser pipe, so this pump is call a rope pump. According to standard PVC pipes available in the market, the pistons were produced in 3 sizes: (1) ϕ 16 mm for PVC pipe ϕ 1/2", (2) ϕ 20 mm for PVC pipe ϕ 3/4", (2) ϕ 28 mm for PVC pipe ϕ 1". The pistons are made from plastic which are suitable for use in drinking water. The rope is nylon of ϕ 6 mm which is available in the market.



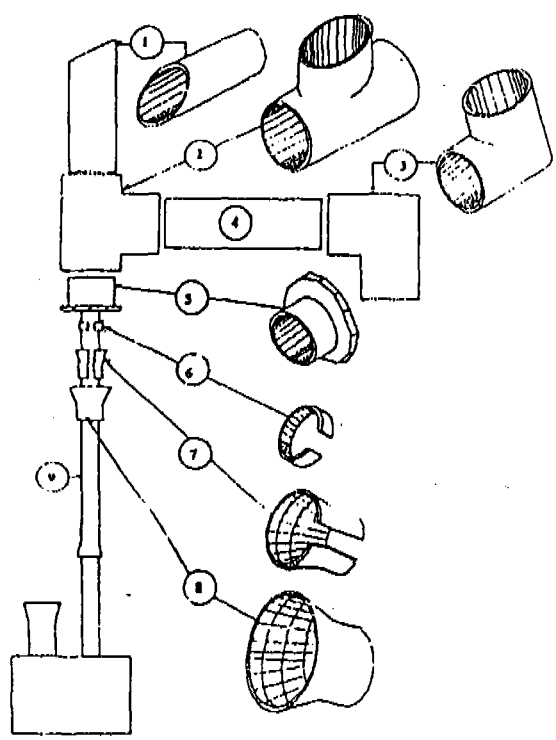
(8) Piping System

This part is responsible for discharging water. The piping system is made of many PVC pipe materials, including pipe (1)(4), Tee (2), elbow (3), reducer (5), ring (6)(7)(8), bonded together. The size of pipes (1) and (4) will change according to the pipe size shown in Table 3.

Table 3. Size of Pipe for Piping System

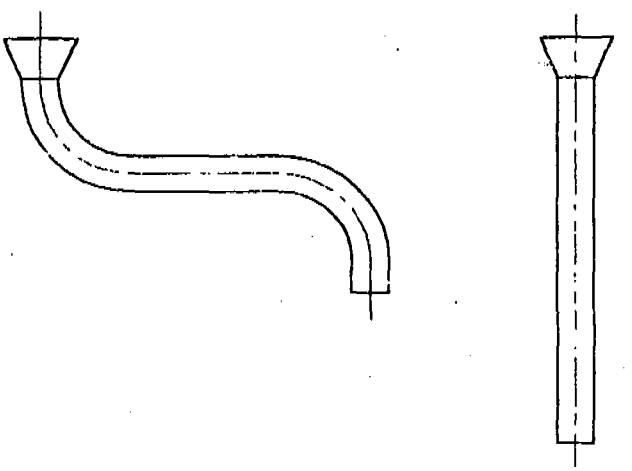
Size of Riser Pipe	Size of Pipe
1"	2"
3/4"	1-1/2"
1/2"	1-1/2"

The size of the other parts are chosen in accordance with the size of the pipe shown in Table 3.



(9) Return Pipe

After the pistons pass the wheel and go down to the guide box to pump up water, they will come up again through the return pipe, so the return pipe need to be big enough to correctly control the movement. The return pipe will prevent the rope and pistons from getting stuck and being damaged by abrasion. There are 2 types of return pipe, one for dug wells and another for boreholes. The size of this pipe depends on the piping system size as shown in Table 3.

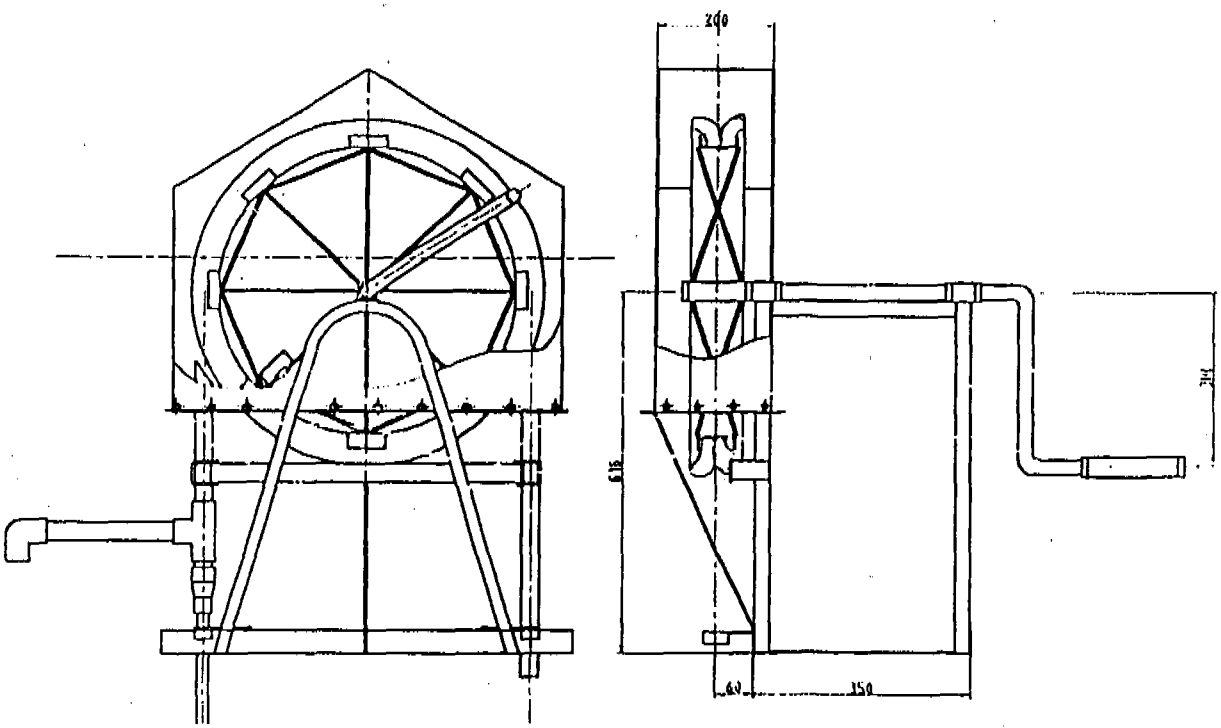


4.2 Rope Pump Lao-99B

As mentioned before, the Rope Pump Lao-99B has a strong structure with more durability. This pump suits uses for a community such as villages, schools and public offices. Its parts and structure are made from stronger steel such as thick GI pipe for the leg structure. The pipe is very strong and not corrosive.

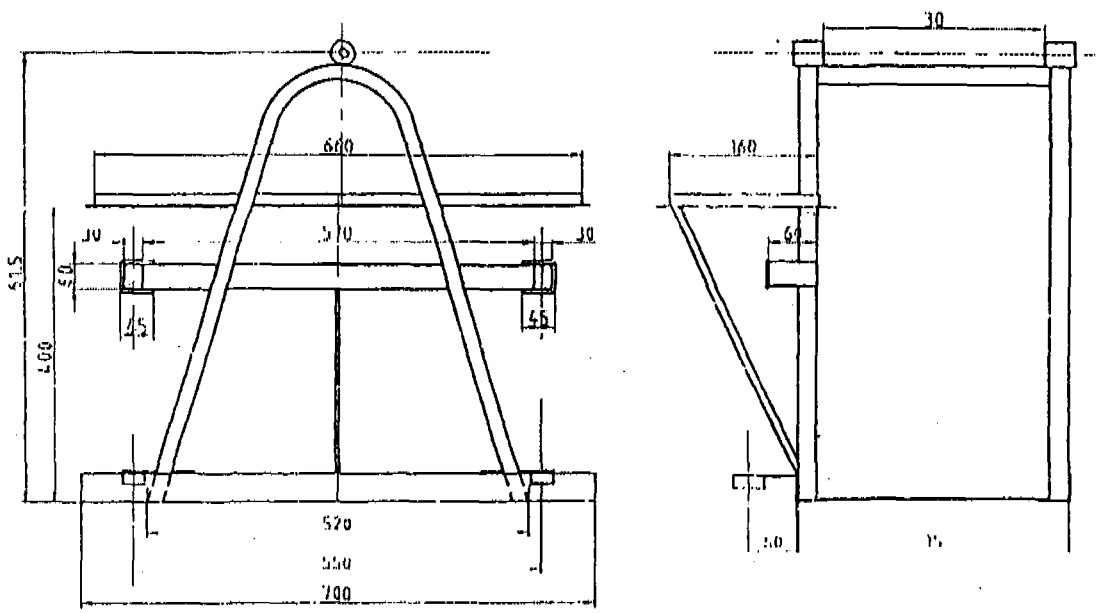
(1) Wheel Structure

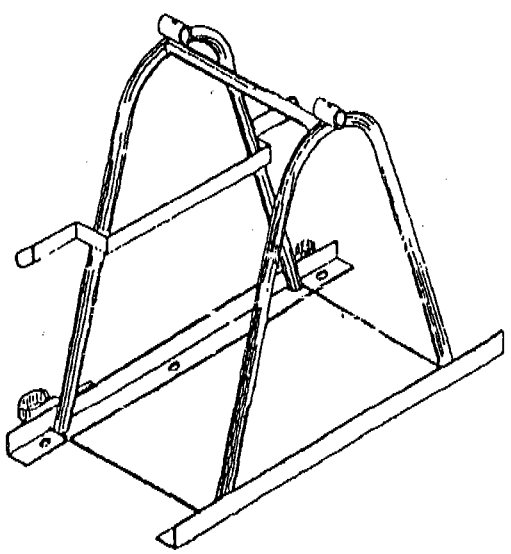
The wheel structure has the function to continuously turn the rope and pistons to pump up water. The parts of this structure are welded.



(2) Leg Structure

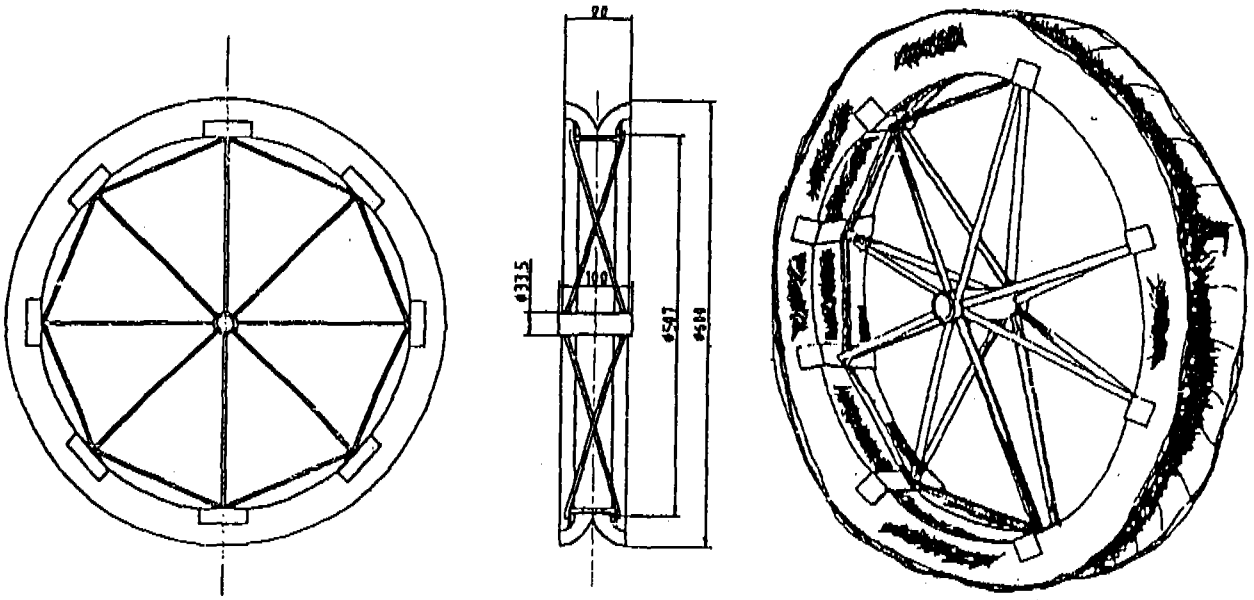
The leg structure is highly durable and it can support heavy weight. It is not corrosive because it is made of GI pipe. The shape is formed by bending and rounding which is suitable for students because there are no sharp parts to stick and wound them. This structure is welded together.





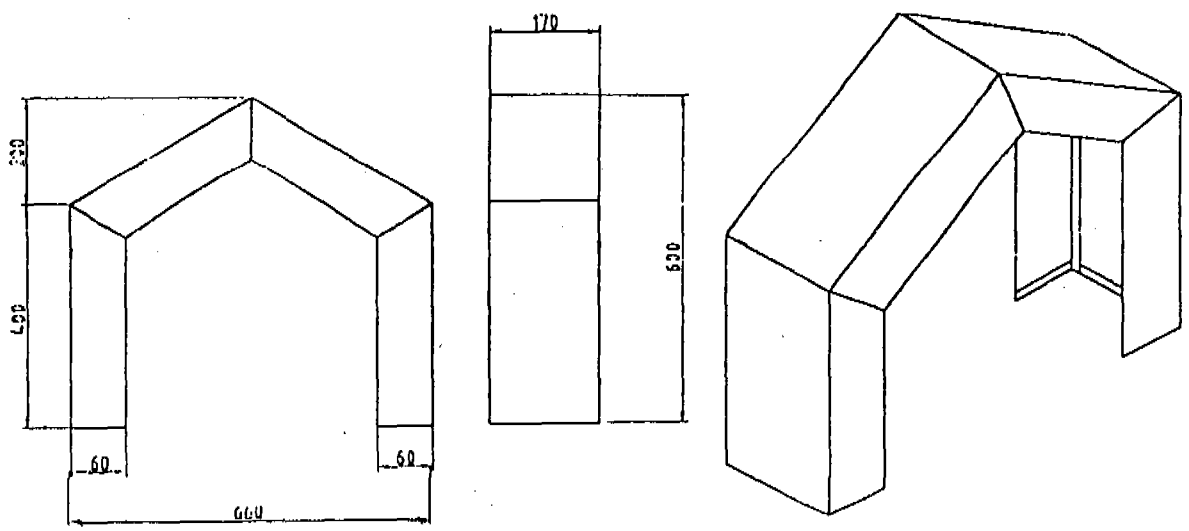
(3) Wheel

The wheel of Rope Pump Lao-99B is similar in shape and structure to Rope Pump Lao-99A. However, the diameter of the spoke of Rope Pump Lao-99B is larger than that of Rope Pump Lao-99A.



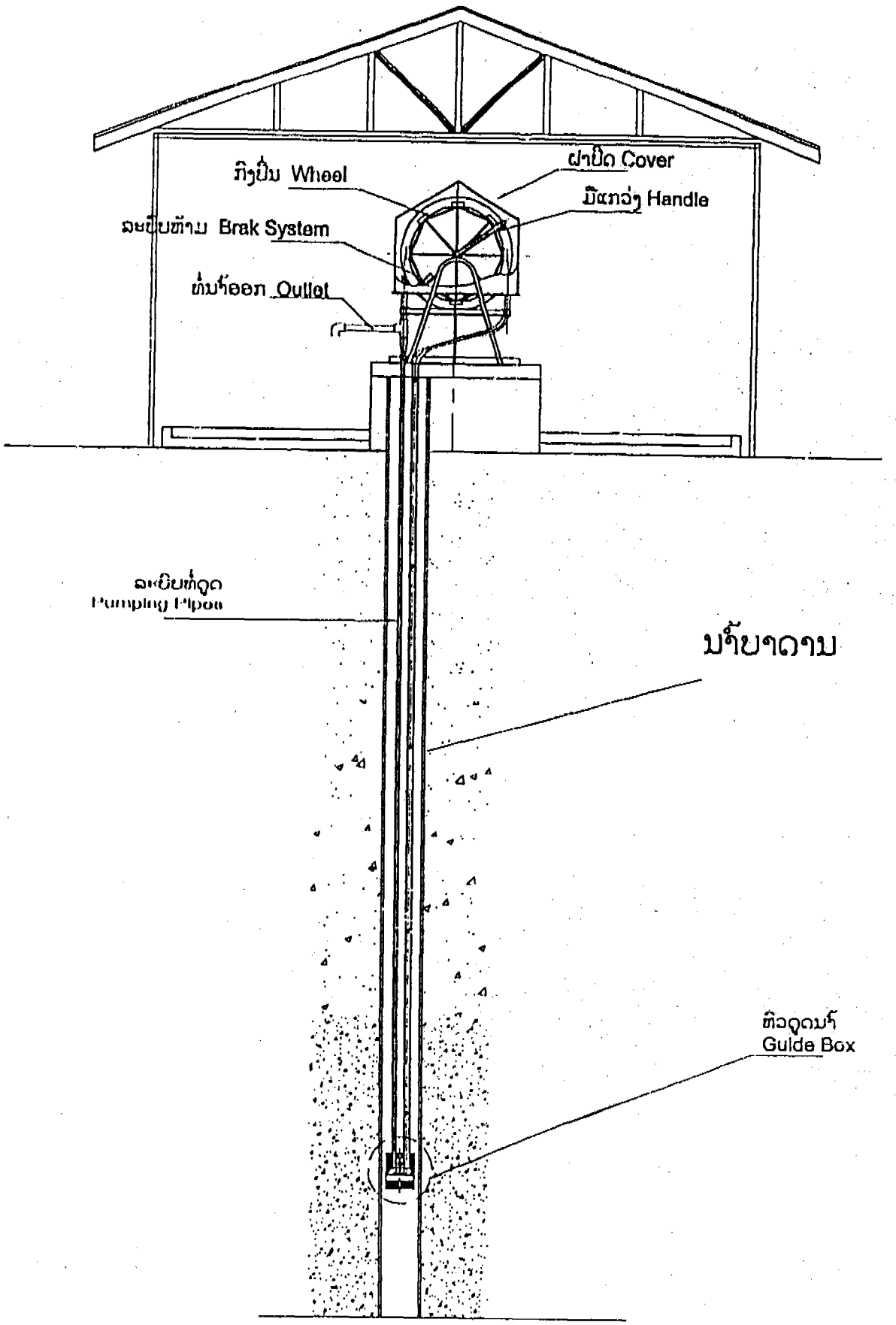
(4) Cover

The cover is made from flat sheet of zinc with steel bar structure having enough strength to support the cover.



The other parts such as guide box, handle, pistons , rope, piping system, return pipe and others are the same as those of Rope Pump Lao-99A as described before.

Final Installation of Rope Pump Lao-99B for Community in Borehole



SECTION II

OPERATION AND MAINTENANCE TRAINING TEXT

PART I

TRAINER'S GUIDE

PART 1 : Trainer's guide

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3. HOW TO BE AN EFFECTIVE FACILITATOR? 8

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5. EVALUATION 17

1. WELCOME!

How was this Training Package prepared?

The design of this training package has been originally made in 1991 by a group of sector experts from the Operation and Maintenance Working Group of the Water Supply and Sanitation Collaborative Council, in response to the short comings of the Water and Sanitation decade of the eighties. A first draft version was developed by the IRC, International Water and Sanitation Centre and tested in 1992 in Namibia. The recommendations of the evaluation have been incorporated into an English version that has then been subsequently translated into French and Portuguese. This version has been implemented since in various countries in Africa and Asia. In 1998, the Environmental Health Department of the World Health Organization (WHO) together with IRC decided to update this package.

The present version of this training package is the result of seven years of experience worldwide, and incorporates the most recent developments, the latest messages and methodologies in order to improve the performance of O&M of rural water supply and sanitation services.

Why "Management of Operation and maintenance"?

"Operation and Maintenance (O&M) !"...
These are key words which many sector professionals and community workers answer when asked about what can be done in order to *improve the performance, efficiency and sustainability* of rural water supply and sanitation services in developing countries.

O&M has indeed been neglected in the past, which has strongly affected the adequate functioning of services as well as on the credibility of investments done, the approach to the development of projects, and the well-being of rural populations.

O&M has nevertheless acquired considerable visibility over the past few years, and it appears that policy-makers and project designers are more conscious of the direct links between improved O&M practices and the sustainability of water supply and sanitation services. There is now greater recognition of the need to take a comprehensive approach to such projects, emphasizing not only the design and the construction of works, but also the post-construction activities.

Professionals in the sector are also realizing that *O&M is not just a technical issue*. It encompasses also social, community, gender, financial, institutional, political, managerial and environmental aspects.

This is why this training package is focusing on Management of O&M; O&M needs to be organized, and planned at national and local level; it needs to be managed at community level with appropriate support from local authorities and the private sector. This package looks into these different issues, with the aim to raise awareness and provide guidelines to programme and project planners and community specialists on how to improve the

performance, efficiency and sustainability of operation and maintenance of rural water supply and sanitation services.

The structure of the package

This training package is designed to be *a guide to trainers and facilitators* who are going to conduct courses or workshops on management of operation and maintenance of rural water supply and sanitation for working level managers, including engineers, social specialists and planners, and other specialists involved in the water and sanitation sector. *Its structure is flexible* enough to be adapted to local circumstances, by shortening certain sessions or extending others, as well as adding existing locally available information. It has been divided into two parts: **1) a trainer's guide; 2) course contents.**

The trainer's guide provides guidelines and hints on how to best facilitate course sessions. Indeed adult training is more than teaching; it requires to be able to use the experiences of participants in a constructive way as well transfer basic relevant knowledge and experience in an effective way. It was therefore thought pertinent to add some advice to trainers and facilitators on how to conduct adequate sessions in order to optimize the benefits for the participants. Facilitation is an art, and you can always contact the sponsors and authors of this package, for eventual training of trainers sessions which your project or organization might need.

The course content focuses on the main issues which are relevant today in order to improve O&M performance, such as: links between water, health, sanitation and environmental protection; operation and maintenance requirements; linking technology choice with operation and maintenance; institutional set-up; community management; gender awareness; cost recovery; monitoring for effectiveness; working and planning with communities.

The course contents demonstrates the use of various managerial techniques, such as: analysis of participation, analysis of constraints, identification of objectives, setting up a planning matrix and indicators, planning with communities, presenting a project. Experience has shown that working towards a concrete outcome, in addition with all the awareness raising done throughout the course, improves the quality of a course. Participants will be asked to prepare an individual assignment based on their own situation.

Welcome to this training package and do not hesitate to either contact WHO or IRC about any queries or need of further information you might have.

World Health Organization
Environmental Health Department
Operation and Maintenance Network
20 Avenue Appia
1211 GH Geneva 27 (Switzerland)
Fax: 41 22 791 41 59
e-mail: huebj@who.ch

IRC
International Water & Sanitation Centre
P.O. BOX 93190
2509 AD The Hague
The Netherlands
Fax: 31 70 358 99 64
e-mail: general@irc.nl

2. About the training package

What are the objectives?

The general objective of the course described in this training package is to contribute to the improvement of water supply and sanitation programmes and projects, by enhancing their ability to sustain adequate O&M activities.

The specific objectives are as follows:

- to upgrade knowledge on operation and maintenance aspects of rural water supply and sanitation programmes and projects;
- to reinforce management skills with regard to sustainable operation and maintenance;
- to specify approaches to better work and plan with communities;
- to develop the capacity to plan for operation and maintenance in one's own working environment, through an individual assignment.

What is the target group and size?

The target audience for this training is designed to be working level managers including engineers, planners, development and social specialists involved in the water and sanitation sector.

The ideal number of participants would be between 12 and 15, which allows for intensive exchange of experiences, although the group can go up to 20 for experienced trainers and facilitators. Larger groups will need to have a team of at least two facilitators, since work will have to be divided frequently into two groups, and using a blend of presentations and lectures in the large group and participatory exercises in smaller groups. The course includes the preparation of an individual or group assignment, which will require individual and team coaching; the greater the size of the group, the more assistance is required.

What is the course duration?

The course is designed to have a minimum duration of 80 hours of classes to which it is advised to add a field visit of one day. This version of the course is feasible within a period of two weeks, with possible adaptations according to local circumstances and demand.

The course duration may depend on the level of participants. High level managers and directors cannot afford to leave their responsibility for more then a week, while others can. Furthermore, the cost per participant is increased if the course lasts onger, but it can gain in quality, if the participants have more time to reflect on key issues and to prepare their individual assignments.

What are the expected outputs?

From experience, it has been shown that participants benefit most of a course if they work towards a product. Therefore, the participants are expected to work on an individual or group assignment at the end of the course, which is based on their own situation and integrates what has been learned in the course.

Course methodology

The training course contained in this package proposes to use as much as possible participatory learning methodologies, but also includes background information and overhead sheets, which could be used for lectures and presentations.

When learning, people remember 20% of what they hear, 40% of what they hear and see, and 80% of what they discover for them selves. This calls for a change in the way teaching is done, from a didactic education to a more participatory education.

The participatory approach to training is based on the concept that professionals learn more effectively when they are involved in activities that take their knowledge and experience into account and which meet their needs. By being involved in this process, both individuals and the group gain a new awareness of their potential, develop greater self-confidence, and see new possibilities. They become also more critically aware of the reasons that underlie their perceptions, attitudes and actions.

The training proposes also the use of one video "Prescription for Health", produced by IDRC[1] from Canada, which can be acquired by asking any Canadian Embassy or High Commission the world for its purchase or loan, or order to be forwarded at the national Film Board of Canada.

Training package outline

The training package is divided into 2 parts: 1) A trainer's guide; 2) Course contents.

The trainer's guide includes a welcome note and basic information about the training package. It provides a guideline on how to be an effective facilitator, as well as hints on how to prepare the course sessions, the field visit and the evaluation of the course.

The second part of the training package, "the course content", is divided into four modules which are sub-divided into units, each one linked a particular theme. The first module is an introduction to concepts and trends and integration between water, health, sanitation and environmental protection. The second module proposes to analyze the present situation of O&M. The third module is about the main factors which can lead to effective O&M. The fourth module gives a practical guideline on how to plan for effective O&M.

The course itself is following a logical sequence of progressive learning, through *awareness raising* in Module 1; *situation analysis* in Module 2; *learning* in Module 3; and *application of tools and knowledge* in Module 4.

[1] IDRC - P.O. Box 8500 - Ottawa, ONK1G 3H9 - Canada
Tel : +1.(613).236 6163 - e-mail : info@idrc.ca

Proposed time table

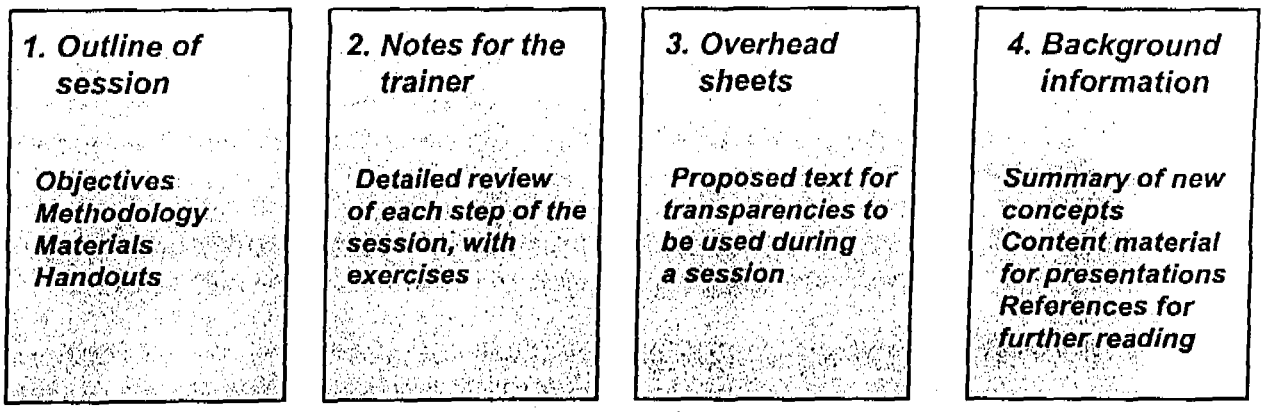
Week 1	Monday	Tuesday	Wednesday	Thursday	Friday
Session A	Introduction	O&M requirements	Analysis of constraints	Community management	Monitoring for effectiveness
Session B	Presentations	O&M requirements	Analysis of objectives	Community management	Monitoring for effectiveness
Session C	Concept and trends	Analysis of participation	Linking technology choice with O&M	Cost recovery	Gender awareness
Session D	Links WHSE	Analysis of constraints	Institutional set-up	Cost recovery	Preparation of field trip
	Daily evaluation	*Daily evaluation*	*Daily evaluation*	*Daily evaluation*	

Week 2	Monday	Tuesday	Wednesday	Thursday	Friday
Session A	Field trip	Working with communities	Individual assignments	Preparation of presentations	Presentations
Session B	Field trip	Working with communities	Individual assignments	Preparation of presentations	Presentations
Session C	Lessons learned for trip	Planning tools	Individual assignments	Presentations	Evaluation Closing
Session D	Lessons learnt from field trip	Planning tools	Individual assignments	Presentations	
	Daily evaluation	*Daily evaluation*	*Daily evaluation*		

Each session is planned to last about two hours, depending on local circumstances and demand. The structure of the course is flexible enough to allow modifications and adaptations. For example, in Vietnam, the course has been implemented for a duration of one week, but it became more of an awareness raising workshop than a course. In Burkina Faso, the course has been implemented for a period of three weeks, which allowed to have a longer field study and more time for individual assignments.

Outline of a Unit

Each unit is organized in the same way, according to the following format:



3. How to be an effective facilitator? [2]

Profile

The resource person / trainer / facilitator should be *acquainted with participatory training methodologies*, as this course is based on using facilitation techniques, rather than "conventional" teaching techniques, although not excluding them (such as lectures and presentations).

If the facilitator is going to be involved throughout the whole course, he should preferably be knowledgeable with the *new developments* in the water and sanitation sector.

It is advisable to include a *team of trainers* or facilitators rather than just one. Many of the activities require that the participants work in small groups, and therefore it is sometimes necessary and useful to have a trainer work with each small group. This will be specially needed during the individual assignments, where participants will need to be coached in their work.

Role of the trainer / facilitator

In the "conventional" teaching methodology, the teacher is presenting a set of concepts and provides his students with exercises for assimilation, in a "top-down" approach. In the participatory approach to training, the role of the trainer is to facilitate the process of learning, using experiences from the participants and of his own in order to raise awareness or knowledge on a particular subject, in a *"sharing" approach.*

Facilitation works best when certain values are accepted and practiced not only by the facilitator, but by the entire group, such as *democracy* (each person has the opportunity to participate without prejudice); *responsibility* (each person is responsible for his experiences and behaviour); *cooperation* (the facilitator and participants work together to achieve the same collective goal).

As a facilitator - resource person, you can affect the group dynamics and the discussion by how you present your information, what kind of atmosphere you set within the group, and by attitudes you show toward the people you are working with.

Many participants will be unfamiliar with facilitation as a leadership style. You should make sure everyone in the group understands what your role is. Your own attitude towards your skills and resources should be a humble one. Demonstrate to the participants that their opinions count, by treating their ideas with the same value you do with your own.

Communication

Communication is the essential ingredient of any group. Your effectiveness as a facilitator depends on your ability to communicate well with the group and to help the group members communicate effectively with each other. Some factors will enable you to better communicate such as :

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[2] This section contains extracts from "A manual for group facilitators", by Brian Auvine & al., published by the Center for Conflict Resolution, 731 State Streer, Madison, Wisconsin 53703, USA.

- *your language* (making sure that the terms you use are common language for the group);
- *your style* (the way you dress and interact with others);
- *the way you listen* (often when someone is talking to us, we aren't really listening; we are thinking about what we are going to say in answer; when you are listening to someone, try not to immediately evaluate what is being said in terms of what it means to you; instead, try to understand what it means from the other person's perspective);
- *being aware of what is happening in the group* (restlessness; silence; attention; postures);
- giving feedback (after an exercise, a discussion, a session; it helps the group to be aware of its own progress).

Facilitating discussions

Your role as a resource person / facilitator in a discussion is important too. Here are some hints which could enhance your work in facilitating discussions :

1. everyone should know exactly *what the discussion is about*, and what is the reason for having it;
2. *use questions* to stimulate discussion (the following provocative "open" questions enable the facilitator to encourage a group to find ideas in a creative way : " what is similar ? what can be changed ? why ? how ? who ? when ?, by which means ? ". Avoid "closed" questions requiring only a simple "yes" or "no" answer, which are unsuitable for group discussions;
3. *prepare questions in advance*;
4. relate the discussion to the *participant's experience* (it is difficult for people to feel very involved in a discussion that is highly abstract or far away from their own experience; give examples from field experience);
5. *list ideas on a board* as they are being generated, and regroup or summarize them;
6. *clarify and interpret* (at time you may rephrase something that has been said to make it clearer);
7. *keep the discussion focused on the subject* (your role may include reminding the group when the discussion is straying off the subject or when the meeting is violating an agenda that was agreed on at the beginning);
8. *keep pace and awareness of time* (it may your role to keep the group aware of how the discussion is proceeding and when it may be time to move on);
9. *use humor* to break tension and boredom.

The use of exercises

Exercises are group activities, usually designed to aid learning and awareness. Exercises can be used to illustrate a concept or demonstrate a specific point, to promote self-awareness, to stimulate thought and discussion, or to train participants in a certain skill.

Select exercises that fit the group and its goals, by being sure you know why you are using a particular exercise. *Be familiar with the exercise*, by previewing it before you use it; indeed, you should know what it accomplishes and how that happens. Don't present participants with a battery of exercises all designed to make pretty much the same point.

Giving instructions is a very important part of using exercises. The way you introduce an exercise can make a big difference in what the exercise means to people; it should include : an explanation of the objectives, a description of what exactly the participants are supposed to do, an estimation on how much time the exercise will take.

You should know also you own role during the exercise. Are you going to participate, observe, or remove yourself entirely from the scene. Once the exercise has been acted out, it is important to reflect on the results reached together with the participants, and how it relates to the participants own day -to-day realities.

Overview of tools which can be used by a facilitator[3]

The various tools described in the following the table are training techniques which are most commonly found in adult learning sessions. This course will be using most of the techniques described, and it is recommended to the facilitator to be familiar with a new technique before using it. Some reference documents are listed at the end of this section.

Tools	Description	Remarks
Group discussion / conversation	A discussion is a free exchange of knowledge, ideas and opinions on a particular subject. A conversation will be more structured and prepared in advance.	***Optimal use*** : for introducing subjects; a structured conversation helps to focus thinking. ***Advantages:*** group involvement; starting thinking process. ***Disadvantages***: risk for unfocussed discussions, time shortage and no change in ideas; needs preparation.
Brainstorming	The facilitator or an assistant writes down all the contributions on a board. Quality and substance is evaluated by the group afterwards..	***Optimal use :*** common method used in groups to help members think of possible changes or give new orientations. ***Advantages*** : Stimulates creativity, expands imagination ***Disadvantages*** : provides answers which are not always implementable; effort can be greater than expected.
Feedback	Informing people what they have done on a certain exercise, role-play or other action in order to let them know how things can be improved	***Optimal use*** : for creating awareness on participant's skills and performance. ***Advantages*** : participants become eager to learn. ***Disadvantages*** : possible distrust if no good feedback.
Lecture	An internally consistent, rationally clear presentation, adapted to a specific audience by using visual images, verbal illustrations and other tools.	***Optimal use*** : for transfer of model, concept or framework. ***Advantages*** : within short amount of time opportunity to transfer of knowledge. ***Disadvantages*** : monologue; requires good preparation in order to keep attention.
Demonstration	Letting participants go through an event that illustrates the theme of a session. Participants are asked to participate and at the same time observe what is happening.	***Optimal use*** : start of a session on a topic which needs sensibilization or awareness raising. ***Advantages*** : effective way to raise awareness in a short period of time. ***Disadvantages*** : easy failure, if not adapted to the group.

[3] Adapted from Training of Trainers, methods for experiential learning, by Little and van de Geer, P.O. Box 4040, 6803 EA Arnhem, The Netherlands

Field visit	Participants are taken out into a real life situation and get the opportunity to observe some elements linked to the course.	***Optimal use*** : to show real life situation. ***Advantages*** : helps to clarify concepts, and get a common understanding; excellent for group dynamics. ***Disadvantages*** : organization can be much work; takes time.
Reading assignments	During the course participants are asked to read relevant information	***Optimal use*** : Creating opportunity to digest written material; can be given for evening reading. ***Advantages*** : easy way to have some material covered ***Disadvantages*** : slows down dynamics if done in class; check on understanding is needed.
Case study	A history or example, with relevant details is examined by the participants. They come up with problems and alternative solutions.	***Optimal use*** : to practice analytical skills, and reflect on a situation as a group. ***Advantages*** : good learning experience when successful; group reaches a common understanding. ***Disadvantages*** : difficult choice or design of appropriate case study, needs preparation time and experience.
Games	Participants are presented with information and rules about a particular situation, and the group tries to go through a simulation of this situation.	***Optimal use*** : to practice and simulate a given situation. ***Advantages*** : Fun, dynamic. ***Disadvantages*** : careful preparation needed with good and clear instructions; unsure outcome; risk of having participants not taking it seriously.
Exercises	Participants are asked to undertake a particular task, following lines laid down by the trainer, in order to practice skills or test of knowledge.	***Optimal use*** : when complex skills or concepts are being taught. ***Advantages*** : creates confidence; very practical. ***Disadvantages*** : must be realistic, relevant and motivating.
Role play	Participants assume an identity other then their own, to cope with real or hypothetical problems and situations.	***Optimal use*** : to demonstrate a situation or practice participants are likely to face. ***Advantages*** : Strong participation and surprising outcomes. ***Disadvantages*** : hiding behind role description; needs "actors" focusing on subject required.
Small workshops	Participants come together in small groups and come to a conclusion by brainstorming, identifying problems and formulating recommendations.	***Optimal use*** : have the group take decisions or make plans and formulate recommendations, at the end of a major event. ***Advantages*** : shared vision. ***Disadvantages*** : experience needed in using tools and facilitating.
Individual assignment	Participants are asked to think through their own situation, and to apply what they learnt in an action plan.	***Optimal use*** : integrate learning into own situation. ***Advantages*** : participants think through, and prepare for going back. ***Disadvantages*** : takes time, and requires coaching.

Role playing[4]

Role playing is a training technique in which participants assume an identity other than their own, to cope with real or hypothetical situations and problems. It can be employed in almost any training context, even as an adjustment to a primarily didactic design.

In playing their roles, participants undertake *to act out behaviour patterns* they believe are characteristic of those roles in specific social situations. For example, in this course, a role-playing is proposed between two actors " an engineer" and "a community member", in order to reflect the process of resistance to change.

[4] Adapted from a draft manuscript "Experience with newer techniques for training managers" by Sidney Mailick and Nancy A. Bord, and published by the United Nations Institute for Training and Research (UNITAR)

Simulation of reality, in this way, eliminates many of the risks inherent in real life while retaining many other aspects of the interaction, which are relevant to the session. Role playing permits experimentation with different ways of behaving in a given situation.

The role playing session should start by the trainer *briefing all participants*, by outlining the situation which is the basis of the role playing, and by giving a concise description of the characters involved in the situation. At the end of the scene, the *actors and the audience discuss* what has taken place during the scene.

In planning for a role playing session, you should keep clearly in mind the basic principle, the problem to be covered or the message to get across to the participants. This idea should always be kept in mind while *preparing for the role playing with the actors prior to the session.*

Brainstorming[5]

Brainstorming produces ideas, explanations and interpretations. In an organized "storming of thoughts", a small group of participants puts forward as many suggestions as possible about a precisely formulated theme. The method stimulates intuitive seeking and spontaneous creative associations.

Hints on preparation: the topic must be formulated precisely; it must be clearly stated who is to participate and what is the time limit. For the actual brainstorming there are definite rules : no discussion, note every idea without criticizing it; combinations and associations of ideas are encouraged. There is no patent on good ideas. The contributed suggestions are usually written on cards and put up on a poster or board. They are the sorted, analyzed and evaluated by a small panel. Some sort of classification is useful such as "immediately feasible" and "needs to be more developed".

Visualization

The visualization method uses written cards which are pasted or pinned on posters, inboards or on other surfaces in a specific order. This facilitates a clear structuring of meeting discussions, workshops and the recording of statements in a concise and visible way. Concentration and attention are improved considerably and even shy participants are able to take part more actively. The discussion becomes more objective and is enhanced with regard to the preceding steps. Evaluations and prioritizing of options are much easier when using such a visible presentation.

Trouble shooting

When there is not enough time to do what you had planned. This is the most common problem you are likely to encounter. When you agenda will not fit into the time you have, get the group to assign probable time limits to each section remaining, while prioritizing items of the agenda. Ask someone in the group to be responsible for keeping track of time, and remind the group anyway when time limits are being approached or exceeded. If it becomes apparent that time will definitively be too short, discuss alternatives with the

[5] From "Cooperation Planning – A working aid for beginners and for more experienced planners", Swiss Development Cooperation , Evaluation Service, CH 3003 Berne, Switzerland. (1993)

group, such as extending the meeting, scheduling a later one, etc. But avoid to "push", "rush", "stuff" participants with all what still needs to be done, as the session could rapidly become useless.

When an exercise flops. The first thing to do is to admit it, and point out where your expectations were shot down, find out how others reacted and discuss why this occurred. You can discuss about what could have happened, and in this way, you provide valuable information. You can be prepared after this to switch to something completely different, which will draw the attention on another subject.

Your session and material are too simple or too complex for the group. If what you are saying is too simple for the group, boredom will result. If what you are saying is too complex, you can expect confusion and blank looks. Unfortunately, blank looks and boredom look remarkably alike, so it is not always easy to figure out which problem you are dealing with. Following are some elements which will help you be alert to the group's level of comprehension : a) ask before doing an exercise, if participants have ever done anything similar; b) begin a session by asking for some history of the group's pervious experience; c) stop regularly to ask questions to the group; d) avoid using "jargon", unless explained previously; e) the type of questions participants will be asking you, are usually the best indicator of what level of comprehension is.

Conflict resolution

Conflict can be part of the process of any group. It should first be treated as *something natural*, even sometimes useful, since it can force a group to become more aware of the ways it works and thus encourage change and growth. However, conflict can become destructive, hurt feelings and destroy efforts toward a common goal as well as inhibit participation by the participants.

There are many things to consider in seeking solutions to conflict. The main one is to try to *sort out the real disagreements from the perceptual disagreements*. Some disagreements might be generated from a wrong perception of a situation. In this case, clarification and information can help. Many conflicts are the result of poor communication or misunderstandings about goals and expectations.

Once you have diagnosed a conflict and understand its nature, you will be in a better position to decide what kind of conflict behaviour is most appropriate. If the conflict is serious, *stay calm* and trust your intuition. You may want to intervene as a facilitator, but before jumping in, *consider your options carefully*. Beware of your own biases and weaknesses, and be sure that you are not about to over-react. Can the problem be dealt with by taking a break (and discuss things over in another time and another environment privately), by being patient (wait till the thunder goes), or by someone else (someone with experience or someone not involved in the conflict)? Does the whole group appear to perceive the problem? During a crisis, people's feelings are especially important. Allow for expression of feelings, but don't get lost in them.

4. Getting prepared !

Organization

As a certain amount of preparatory work is required, the date of the course should be fixed well in advance. This will allow those involved to fit the course into their work schedule and plan. Course preparation should begin preferably *six months in advance*. In setting the dates of the course, account has to be taken of public and religious holidays and important meetings or events that participants are obliged to attend.

Secretarial support greatly facilitates the course organization. A well-ordered file containing all information and correspondence about the planning, implementation and evaluation of the course is needed. During the course it self, it will be necessary to have the support of a secretary for photocopying, administrative arrangements, contacts, as well as to word-process the work produced by the participants and the facilitator during the course. Very interesting work is being produced throughout the course, and memory of it should be kept.

The accommodation should include : 1) a meeting room large enough for plenary sessions. make sure that this room is not noisy, has adequate ventilation and light, and that there is sufficient power points to use a video and an overhead projector; there should be enough space on walls to stick up paper sheets. Preferably the room should totally available throughout the whole course; 2) separate rooms for the working groups should be arranged; 3) breaks should be organized with drinks and food, as well as lunches.

All *teaching aids, equipment and stationary* should be ordered well in advance of the course. This includes : a) a white or black board; b) markers for white boards only preferable, to be used by the facilitator but also enough for all participants; c) a flip-chart stand and paper; d) masking tape (easily removable) that you use to stick cards or paper on a wall; e) cards which can be made by buying a large piece of carton paper (with different colors) and cutting them to the size required; f) an overhead projector with transparencies; g) a screen or white wall; h) a video recorder and monitor; i) access to a photocopy machine; j) note pads, pencils, pens and pins.

A certificate of attendance should be prepared and signed by the relevant authorities who are sponsoring the course, to be given at the end of the course.

Participants should be invited through the appropriate channels your organization uses. *The invitation* should include clear statements on the course objectives, structure, duration, the importance of full time attendance, arrangements for personal and class accommodation and transport, insurance and medical coverage, costs and per diem if applicable. The invitation should include a form to fill in containing information on personal data, present function and job description, education and expectations regarding this course, as well as a curriculum vitae and financial sponsorship is applicable.

A field visit is planned in the course. The purpose of the visit is to give the participants an opportunity to look at the operation and maintenance arrangements in a particular community. A successful field visit is planned in advance, where local authorities, communities are warned about day and time of arrival as well as what will be the programme. You can ask also what they are expecting from this visit. Arrangements for transportation and food and drinks should be made as well.

The field visit programme will depend on the proximity, size and willingness of local communities to be involved in the course in this way. If the course group is large, it will have to divide into smaller groups in order to work efficiently and to reduce the disturbance of the community to a minimum.

It is suggested that visits can be made in the morning. The timing of the morning visit may be crucial to the usefulness of the field visit as a whole. Many of the activities associated with rural water supply take place very early in the morning. Women may traditionally collect water before, or at, sunrise. Operators will open valves, start pumps, dose tanks with chlorine, etc. at the start of the day to have sufficient water for early collection. The next peak of water collection may be in the late afternoon/early evening which will be too late for the field visit. Arrangements may have to be made to ensure an early arrival in the community, or communities, selected to visit and participants should appreciate the importance of an early start!

For further details about the field visit see Unit 8 of Module 3.

Course content

Besides the fact that all the material of this package should be known by the relevant facilitator, this package might have to be *adapted to the local circumstances*. It is proposed that the facilitator makes a research on relevant themes and tries to add all information (project reports, technical or policy documents) which will be needed.

Several *resource persons* with experience in the subject and new developments could be contacted and invited to participate at specific relevant times during the course, to give a lecture or a presentation. It is important that the resource persons are aware of the course objectives, concepts and main messages. They should be invited well in advance of the course in order to increase their acceptance. The course unit which corresponds to their participation should be sent to them as a reference or example.

In certain countries, *access to relevant additional information* is difficult, and so is the participation of appropriate resource persons. Consult specialized universities or agencies in your country. WHO or IRC, as well as other sector organizations and external support agencies (ESA) could be contacted in order to supply additional information or to organize a training of trainers event.

Getting started for your session

While *planning for your session*, make sure that you know exactly what you want to accomplish and that all the activities you are going to have relate to that goal. The material you use should be relevant to the objective of the session and meaningful to the members of the group. Present material in a logical order. Once you have reviewed all the objectives and content of the session, try to determine how long each segment will be and make your agenda flexible. Try to plan a variety in pace and methods used. Every session should have a beginning in which introductions are made, plans are discussed, and expectations are defined, as well as an ending which consists in a synthesis or summary of the session.

Before you begin, take time for yourself to be alone and make sure your agenda is clear in your mind. Seating arrangements are important. You can decide for participants to be all in a U shape or sitting without tables, depending on the exercise you are going to do.

As you enter the room, the first few moments will be important in influencing your perceptions and giving impressions to the group. It is important to be present on time, if not a little early. While setting an example for time behaviour throughout the course, it is also a matter of simple courtesy and respect to the group to be on time.

Your introduction should include your credentials (what justifies your being there !). This is also an opportunity to present yourself as a "person", a "facilitator" and not only an "expert". It might be difficult to know all the participants names immediately, but it is recommended to ask participants to write their names on boards which are placed in front of them.

Everyday should *begin with a review* of what was done the previous day. This can be done by asking some participants to recall what was done the day before, and ask what were the main messages conveyed at that time. The facilitator's role will then be to explain the link between what was done the day before and today.

Leisure and recreation

Some thought should be given to the organization of free time, since it is a way participants can interact and contribute to team building. Social evenings, excursions, are also particularly important for participants who are away from their normal context.

Some references on participatory training

- *Participatory Development Tool Kit.* Deepa Nayaran and Lyra Srinivasan, The World Bank , Washington DC, 1993.
- *Participatory Communication for social change.* Jan Servaes, Thomas Jacobson and Shirley White (Editors), Sage Publications Ltd, London.
- *A trainer's guide for participatory learning and action.* Julles N Pretty and al. IIED, London, 1995.
- *Training Trainers for Development : Conducting a Workshop on Participatory Training Techniques.* CEDPA-PACT Publications, Educational materials and training tools for the international community).

5. Evaluation

It is proposed to carry out a daily evaluation as well as a final evaluation at the end of the course.

The daily evaluations have the objectives *to let the participants express how they feel about what is going on*, in order to improve the group process. This is often the only time some people will be comfortable enough to express their ideas. It also gives a sense of closure to the day. Furthermore, this evaluation can help you to improve your sessions in the future (facilitation material distributed, exercises, content) as well as to identify possible points which will need to be reinforced during what is left of the course. The daily evaluation can be carried out through different ways : 1) an informal discussion; 2) a focused conversation; 3) a daily evaluation form.

The informal discussion will be based on questions that you pose, and it gives you the opportunity of asking for clarification and comments. This evaluation, however might not reflect the whole groups ideas as some participants will remain more silent then others. Some sample of questions are : what went well ? what could be improved ? what specific things do you think you have gained from the sessions today ? Were the expectations met ? Why ? why not ?

The focused conversation will start with an exercise asking all participants to write two "positive" comments and two "critical" about today's session in general. Each participant is given two cards for the "positive" comments, and two cards for the "critical" comments (cards should be of different colors, for example yellow for "negative" and green for "critical"; only one comment per card). All cards are then pinned or taped on a board, and grouped by categories as they appear. The result is discussed with the whole group, asking for clarifications and comments. This technique allows for everyone to express him or her self. This evaluation takes time however, and might recommended to use only once or twice in the course.

A daily evaluation form can be prepared, asking participants to appreciate the content, relevance and presentation of each session, using a scale of value, for example grading from 1 to 5 (**1** = Poor; **2** = Limited; **3** = Reasonable; **4** = Good; **5** = Excellent) or any other grading which you might find appropriate. If the facilitator is using this technique, he will have to share the results of this evaluation the next morning before starting the session.

A final anonymous evaluation form is proposed in the next pages, which is a detailed review of all the different aspects of the course. The results of this evaluation should be included in the final report of the course.

MANAGEMENT OF OPERATION AND MAINTENANCE IN RURAL DRINKING WATER SUPPLY AND SANITATION

EVALUATION FORM

Please tickmark where applicable

1. What do you think of the length of the course?

☐ *Far too long* ☐ *Too long* ☐ *Just right* ☐ *Too short* ☐ *Far too short*

2. In this training course you worked from Monday till Friday, from 09.00 am until 17.00 hrs. What is your opinion about this time schedule?

3. How do you think the time was distributed among the different ways of working in this course:

	Far too much	Too much	Just right	Too little	Far too little
Lectures					
Exercises					
Discussions					
Individual work					
Leisure					

Additional comments :

4. How do you consider the integration of the course within your country's setting?

- ☐ *Excellent*
- ☐ *Good*
- ☐ *Reasonable*
- ☐ *Poor*
- ☐ *No integration at all*

Comments:

5. What do you think of the balance between theory and practice ?

- ☐ *Far too much theory*
- ☐ *Too much theory*
- ☐ *Just right*
- ☐ *Too much practice*
- ☐ *Far too much practice*

6. In general I think this course was:

- ☐ *Too difficult*
- ☐ *Difficult*
- ☐ *Just right*
- ☐ *Easy*
- ☐ *Too easy*

7. Please try to remember what you expected of this course when you applied to join it. How were your expectations met?

- ☐ *Completely*
- ☐ *Largely*
- ☐ *Partly*
- ☐ *To some degree*
- ☐ *Not at all*

8. **To what degree, in your opinion, did this course achieve its objectives ?**

Objectives	Completely	Largely	Partly	Hardly	Not at all
1. Upgrade knowledge on O&M aspects of RWS&S					
2. Reinforce management skills with regard to O&M					
3. Specify approaches to work and plan with communities					
4. Develop capacity to plan for O&M in own project					

9. **Consider the specific requirements of your own job. How useful do you think the course has been:**

- ☐ *Very useful*
- ☐ *Useful*
- ☐ *Of some use*
- ☐ *Of limited use*
- ☐ *Not useful*

10. **Please name any technique or method that you learned, which you may consider to introduce or apply within your organization:**

11. **You probably have gone through most of the handouts and reading material provided. On average how relevant do you consider it to be?**

- ☐ *Highly relevant*
- ☐ *Quite relevant*
- ☐ *Of some relevance*
- ☐ *Of limited relevance*
- ☐ *Not relevant*

12. The list below gives the topics dealt with during the course. Please give a mark per topic or session with regard to its relevance and quality. Make additional remarks, if necessary.

(**1** = Poor; **2** = Limited; **3** = Reasonable; **4** = Good; **5** = Excellent)

Topic or session	Relevance (from 1 to 5)	Quality (from 1 to 5)	Remarks
Course introduction			
Presentations			
Concepts and trends			
Links between W, H, S, E*			
O&M technical requirements			
Analysis of participation			
Analysis of constraints			
Institutional set-up			
Community management			
Gender awareness			
Cost recovery			
Monitoring for effectiveness			
Working with communities			
Field visit			
Capacity-building			
Setting-up objectives			
Planning tools			
Individual assignments			
Final presentations			

13. What in your experience are the major professional problems in your work which HAVE NOT been discussed sufficiently in this training course?

* Water, Health, Sanitation and Environment

14. What was your experience of working relations with the :

Main facilitator(s)	Other training staff	Administration	Participants
☐ *Stimulating*	☐ *Stimulating*	☐ *Stimulating*	☐ *Stimulating*
☐ *Cooperative*	☐ *Cooperative*	☐ *Cooperative*	☐ *Cooperative*
☐ *Neutral*	☐ *Neutral*	☐ *Neutral*	☐ *Neutral*
☐ *Distant*	☐ *Distant*	☐ *Distant*	☐ *Distant*
☐ *Difficult*	☐ *Difficult*	☐ *Difficult*	☐ *Difficult*

Comments :

15. How do you rate the internal organization and logistical support during the course?

☐ *Excellent*
☐ *Good*
☐ *Reasonable*
☐ *Poor*
☐ *Not applicable*

Comments :

16. Were you satisfied with the accommodation (class room, etc...) ?

☐ *Very much*
☐ *Much*
☐ *Reasonable*
☐ *Not much*
☐ *Not at all*

Comments :

17. Please write any suggestions for improving this course.

PART II

COURSE CONTENT

Module 1

Introduction

UNIT 1 : COURSE INTRODUCTION 2

UNIT 2 : PRESENTATIONS 8

UNIT 3 : CONCEPTS AND TRENDS 11

UNIT 4: LINKING WATER, HEALTH, SANITATION AND ENVIRONMENTAL PROTECTION 24

Unit 1 : Course introduction

1. Outline of session

Objectives

- To introduce participants to one another
- To review fears and expectations of participants
- To reach a common understanding on course objectives and structure

Methodology

1. Welcome address
2. Exercise for group interaction
3. Group discussion on expectations and fears
4. Interactive presentation on course objectives, programme and course methodology

Materials

- ✓ Overhead transparencies on course objectives and programme
- ✓ A flip chart and masking tape
- ✓ An overhead projector with a screen or a white wall
- ✓ Stationary for each participant, including a note pad, a binder, a pencil, an eraser, a pen and a marker.
- ✓ Participant's binder should include the course objectives; the programme; a guideline on practical information (food / lodging / transport / recreation areas / access to telephone / access to medical help / contact person for information and emergencies; a list of participants)

Handouts

- ✓ Information about the centre in which the course is being held (optional)

2. Notes for the facilitator

Welcome address

The welcome address can be given by the Director of the Institute in which the course is being held, or by a sector specialist who would like to welcome the participants and speak about the relevance of the course.

This address can be followed by an introduction of your self and the team who will be working throughout the whole course. Your introduction should include a note about your credentials (not too long, but indicating the justification for you being there), what will be your role and some personal characteristics about yourself in order to "de-freeze" the situation. You should then explain how will the session then proceed, and give the session's objectives as well as the methodology which is going to be used.

Interactive exercise

One way to do introductions is to ask people to divide into groups of two and talk to each other for a few minutes. Then you go around the room, and each person introduces the person he or she talked with in the small group, giving the name, nationality, location of residence, education, professional function and one or two personal characteristics. In a course where participants do not know each other already, this method allows everyone to get acquainted with at least one person very quickly, and contributes to a more relaxed, informal session.

At the end of the exercise you can participants to write on a board to be paced in front of them (folded A4 paper) the name by which they would like to be called during the course.

Expectations and fears

You will engage the group into a discussion, asking first the question: "What are your expectations about this course ?", or "Try to remember when you registered for this course, what were your expectations about it ?". If no one speaks out in a voluntary way, you can choose someone to start the discussion. Ideas should be written on a flip chart as they come. Some expectations will not be clearly formulated; you can ask the participant to specify what she or he means. Once the group has expressed it self, you can summarize the expectations, and say that you will see how they match with objectives and programme in a few moments.

Same procedure concerning the fears. You can ask the question: "What are your fears about this course", which can regard all aspects content, logistics, follow-up after the course. This question is important as it will allow the facilitator to know more about the group, and highlight possible limitations or obstacles, which could arise.

Objectives, course structure, methodology and programme

Directly linked with the previous discussion is a presentation about the objectives, the course structure, the methodology and the programme of the course, using overhead transparencies (explanations are already given inside the trainer's guide, section "About the training Manual") As the facilitator will present the objectives and

the programme, he will try to show what is the link with the expectations which were formulated by the group earlier, gradually covering all expectations. Allow for questions of clarification, as all objectives should be clear. You can at the same time, try to see how fears can be overcome.

Some expectations will not be met, and some fears will remain. Expectations that are not met should be discussed with the group. The facilitator should try to find out if this "gap" is a general feeling or if is it only a misunderstanding, which can then be clarified by a more detailed explanation of the objectives of the course. It should be clear however that some expectations can just not be met in the course, such as making a technical maintenance plan for diesel engines for instance. It could be that you could add some information in a session during the course on an element that seems feasible to add. Fears that remain should be discussed with the group and see how relevant they are, and which ones need immediate action for the organization team and administration of the course.

End of this session

It is usual that the first break of the course is a bit longer which allows for further interaction between participants and staff. The first session is therefore ending earlier for drinks and snacks.

Overhead sheets

Course objectives

General objective

➔ to contribute to the sustainability of water supply and sanitation programmes and projects in rural areas

Specific objectives

- ⇨ to upgrade knowledge on O&M issues
- ⇨ to reinforce management skills on sustainable O&M
- ⇨ to specify approaches to better work and plan with communities
- ⇨ to develop an individual assignment based on lessons learnt and personal working context

Overhead sheets

Course outline

Module 1: Introduction

Unit 1 : Course introduction
Unit 2 : Presentations
Unit 3 : Concepts and trends
Unit 4 : Links between water, health, sanitation and environment

Module 2 : Situation analysis

Unit 1 : O&M requirements
Unit 2 : Analysis of participation
Unit 3 : Analysis of constraints
Unit 4 : Analysis of objectives

Module 3 : Towards effective O&M

Unit 1 : Linking technology choice with O&M
Unit 2 : Institutional set-up
Unit 3 : Community management
Unit 4 : Gender awareness
Unit 5 : Cost recovery
Unit 6 : Monitoring for effectiveness
Unit 7 : Working and planning with communities
Unit 8 : Field visit

Module 4 : Planning

Unit 1 : Planning tools
Unit 2 : Individual assignments
Unit 3 : Final presentations

Overhead sheets

Proposed time table

Week 1	Monday	Tuesday	Wednesday	Thursday	Friday
Session A	Introduction	O&M requirements	Analysis of constraints	Community management	Monitoring for effectiveness
Session B	Presentations	O&M requirements	Analysis of objectives	Community management	Monitoring for effectiveness
Session C	Concept and trends	Analysis of participation	Linking technology choice with O&M	Cost recovery	Gender awareness
Session D	Links WHSE	Analysis of constraints	Institutional set-up	Cost recovery	Preparation of field trip
	Daily evaluation	*Daily evaluation*	*Daily evaluation*	*Daily evaluation*	

Week 2	Monday	Tuesday	Wednesday	Thursday	Friday
Session A	Field trip	Working with communities	Individual assignments	Preparation of presentations	Presentations
Session B	Field trip	Working with communities	Individual assignments	Preparation of presentations	Presentations
Session C	Lessons learned for trip	Planning tools	Individual assignments	Presentations	Evaluation Closing
Session D	Lessons learnt from field trip	Planning tools	Individual assignments	Presentations	
	Daily evaluation	*Daily evaluation*	*Daily evaluation*		

Unit 2 : Presentations

1. Outline of session

Objectives

- To enable participants to present their professional experience linked with Operation and Maintenance

Methodology

1. Individual or group exercise
2. Presentations made by the participants

Materials

- ✓ Overhead transparencies on format for exercise
- ✓ A flip chart and masking tape
- ✓ Large sheets to be distributed to participants
- ✓ An overhead projector with a screen or a white wall

Handouts

- ✓ Information about Operation and Maintenance in the hosting country
- ✓ Format for exercise

2. Notes for the trainers

Presentations will allow participants to share their main professional experience and background with the group, as well as give an overview to the facilitator about the problems which participants might encounter in their professional life. In this manner, the facilitator will be able to plan better for future sessions and put more emphasis on a particular subject. Remember that each group is distinct.

The facilitator will explain to the participants the objective of this exercise and hand-over a prepared format to each one (see exercise sheet). It is possible to ask participants coming from the same department, region or project to group them selves and prepare only one presentation.

Participants have a maximum of 20 minutes to prepare their presentation. Each presentation should last a maximum of 3 minutes, and 2 minutes for questions of clarification. It is recommended not to allow debates at this stage, as there will be ample space for this during the course.

Presentations should be made on large sheets, which will be put on the wall during the presentation. It would be opportune to ask a secretary to type out the results, once the session is over, and distribute for information to all the participants.

One of the problems encountered in this exercise is the non-respect of time allocations. Time should be kept by the facilitator and asking the participants to conclude once time is over. This responsibility could be given to one of the participants as well.

Another common problem in this exercise is its repetitive nature. One way to overcome this, is to group participants who work in similar projects (for instance: gravity systems together, small piped systems with motorized water lifting together, etc.), and organize presentations by subject. Questions will be asked once all the participants in the subject area group have done their presentations.

Exercise sheet

Format for initial presentations

1. Personal data

- **Name :**
- **Nationality :**
- **Location of professional activity :**
- **Profession and education :**
- **Present function :**

2. Programme / project

- **Name of programme/project**
- **Main components of the project** (in brief, point by point)

3. Main O&M and management problems encountered :

-
-
-
-
-
-
-
-
-

Unit 3 : Concepts and trends

1. Outline of session

Objectives

- To specify the importance of O&M and management
- To analyze O&M in a wider perspective of sustainability
- To define the concepts of operation, maintenance and management
- To raise awareness on present trends

Methodology (2 hours)

1. Introductory note
2. Focused discussion on importance of O&M
3. Interactive presentation of factors and process of sustainability
4. Group exercise on definition of concepts
5. Quiz on present trends
6. Concluding remark

Materials

✓ Overhead transparencies on format for exercise
✓ A flip chart and masking tape
✓ An overhead projector with a screen or a white wall

Handouts

✓ Format for exercise
✓ Copies of selected parts of background information
✓ Copies of all transparencies

2. Note for the trainer

Introductory note

This session will try to clarify and define the key concepts around which this course is constructed. It is important for all participants to understand that the issues related to O&M are not only technical, but also social, managerial, institutional, financial and environmental. These concepts are reflecting the most recent advances in water supply and sanitation projects, based on trials and experiences from the past 20 years. This session will also be the opportunity for the participants to be introduced to a non-conventional teaching methodology, which is more of a participatory nature, although not excluding presentations and lectures. It is recommended to recall to the group from time to time, during the coming days, some of the concepts brought in this session, since they are the corner stone of the whole approach.

Focused discussion on the importance of O&M

The facilitator can begin by recalling to the group that they came to this course because they thought that O&M was an issue ion their professional life. The facilitator can then begin by asking " Why is O&M important?" The facilitator will write on a flip chart the various answers, which are arising. When the answer is not clear, clarification should be asked, and it is always useful anyway to ask the participants to give an example from their professional setting, while providing an answer. The facilitator should try to ensure that the following ideas come from the group: proper functioning, user's satisfaction, sustainability, quality of life, health standards, credibility of investments, among others. The results of the discussion should then be processed and distributed when ready. Do not forget to keep track of time.

Interactive presentation on factors and process of sustainability

An interactive presentation is a normal presentation which uses from time to time questions in order for the group to either explain the situation in their own words and experience or either propose new ideas.

It is proposed to start this presentation by recalling the close link, which we just saw between operation and maintenance and sustainability. The first message to give is that sustainability is a process which start right from the planning stage, so O&M is not only what happens once the system has been constructed, O&M starts from the planning stage. It is proposed to use the first overhead sheet, representing a graphic of sustainability. More content details are provided in the background information. The second message is about the factors that will influence sustainability. The facilitator can refer to the second overhead sheet and to the content details in the background information.

Another very effective way to present this, is to draw gradually the graphic or the sustainability circles so that the participants discover gradually what it is all about.

Group exercise on the definition of concepts

The facilitator will propose to the group to define the following:. 1) what is sustainability; 2) what is operation; 3) what is maintenance. The facilitator will ask the participants to come up some key words which he will write on a board, and

gradually build up a definition for each word, composed of a series of key words. At this stage we are not looking for full phrases.

A set of overhead sheets provides the definitions around which this course has been articulated, and can then be compared with what the participants have understood. Any misunderstanding should be discussed, until the whole group reached a common consensus.

Quiz on the attributes of good management

Management is one of the issues mentioned in the title of this course. It is therefore important to have a common understanding about what it entails. There is no right or wrong answers, but the objective if to highlight what is the conception of the participants on management and compare it to what the course will provide in terms of management tools.

The facilitator will divide the participants into three or four groups, and hand in an envelop containing labels, each representing a major attribute generally connected with management (see exercise sheet). Each group will try to choose 5 major attributes of appropriate management of projects. Allow 15 to 20 minutes.

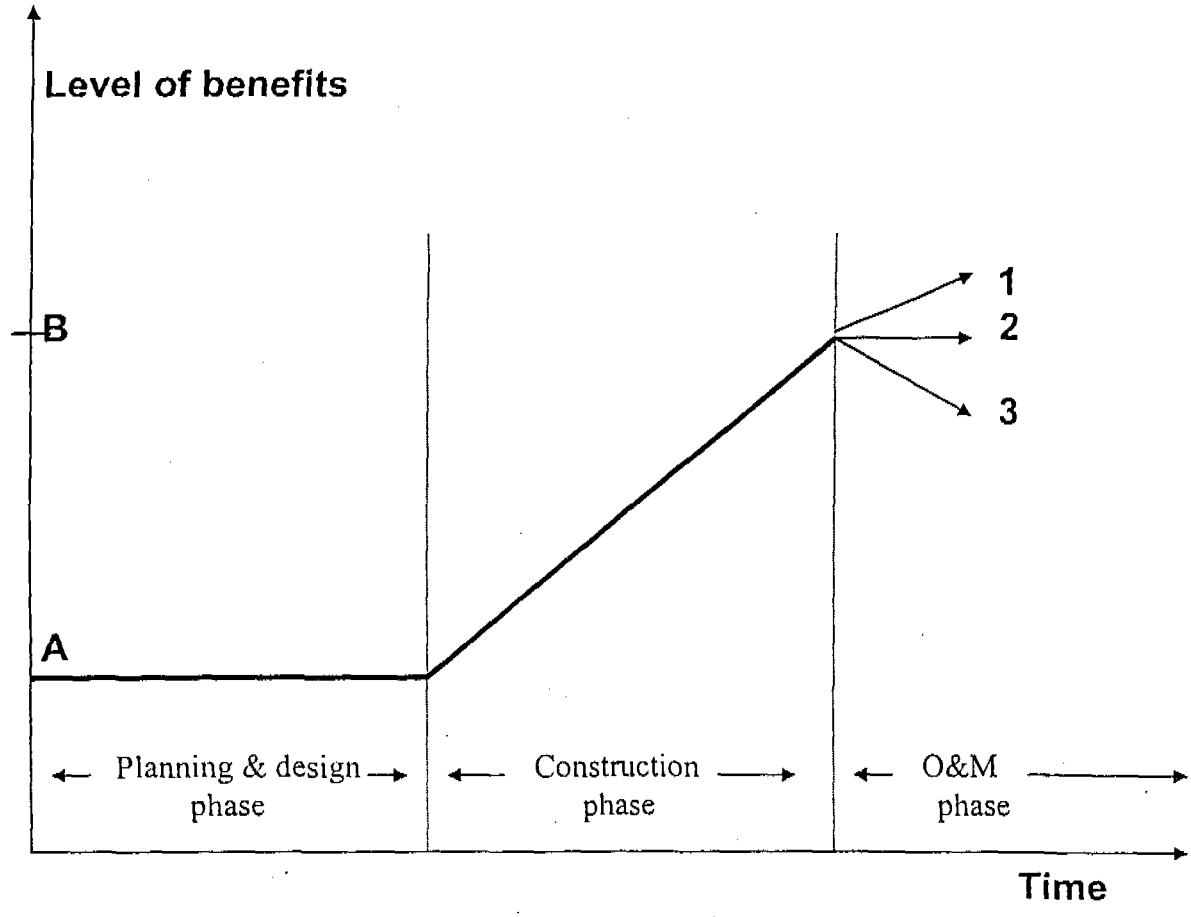
Each group will then expose the results by sticking their labels on a wall or a board and explain briefly the reason for this choice. Allow five minutes per presentation.
The facilitator will then expose the group with a definition of management, and also highlight the managerial issues, which will be worked upon in this course. If there are some concerns, allow for discussions and questions of clarification.

Focused discussion on what is rural?

The facilitator can then propose to the group to finish this session on the last word which is in the title of this course, by asking the participants, what is understood by rural? The definition of "rural" can cause sometimes some problems since each country has its own definitions and setting. In order to resolve this, it can be propose to agree that we are dealing about low-cost technologies, including small piped water supply systems. We do not aim here to give a precise definition of what is rural but rather give an overview of the framework in which we are working while considering rural water supply and sanitation. Water supply and sanitation technologies will be reviewed during the session on "O&M requirements".

3. Overhead sheets and exercises

Sustainability in the project cycle

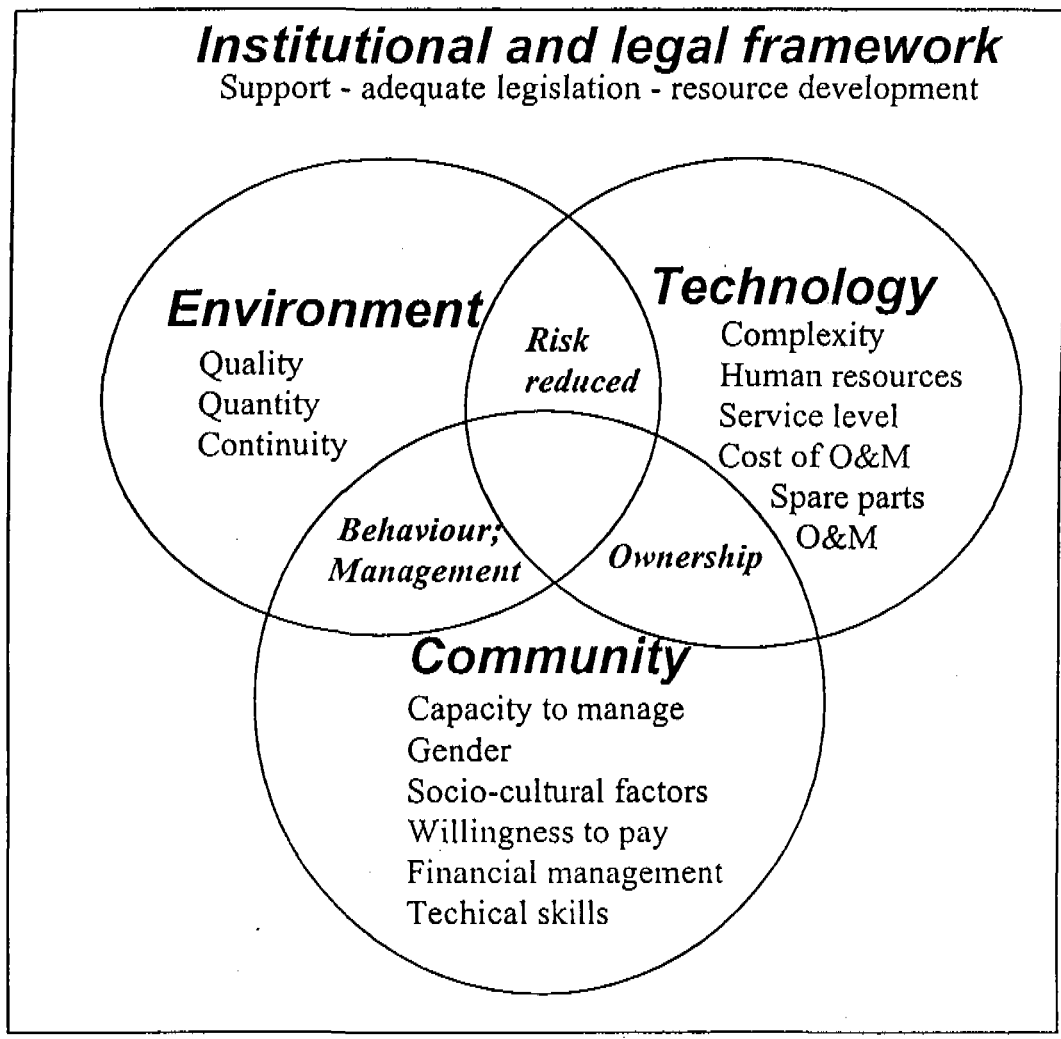


1 & 2 : Development reaches sustainability
3 : Unsustainable development

- **O&M has to be carefully planned for and designed already during the planning and design phase**
- **Sustainability starts at the planning stage**
- **What are the factors that influence sustainability ?**

Overhead sheets

Factors which influence sustainability[1]



[1] From CINARA - IRC course material "Gestion para la sostenibilidad en programas de agua potable y saneamiento", 1994-98

Overhead sheets

Processes which influence sustainability

- **Demand**
  from the communities

- ***Responsiveness***
  from the supporting institutions

- **Participation**
  of the committees throughout the project cycle

- **Linking technology choice**
  with operation and maintenance

- **Integrated planning**
  (sanitation, water, hygiene, environment)

- **Integration**
  of technical and social issues

- ***Decentralization***
  and transfer of responsibilities and resources

- **Capacity-building**
  at all levels

- **Communication**
  among stakeholders

- **Public-private partnership**

- **Co-responsibility between**
  communities and municipalities

Overhead sheets

Definitions

Sustainability

A service is sustainable when :

⇨ it functions and is being used,

⇨ it is able to deliver an appropriate level of benefits,
(quality, quantity, convenience, desired service level, continuity, affordability, efficiency, equity, reliability, health)

⇨ over a prolonged period of time,
(which goes beyond the life cycle of the equipment),

⇨ its management is institutionalized,
(community management; gender perspective; partnership with local authorities; involvement of formal (informal) private sector)

⇨ its operation, maintenance, administrative and replacement costs are being covered at local level,
(through user fees, or alternative financial mechanisms)

⇨ it can be operated and maintained at local level with limited but feasible external support,
(technical assistance; training; monitoring)

⇨ without negatively affecting the environment.

Overhead sheets

Definitions

Operation

Operation deals with the actual running of a service (eg : provision of fuel, starting or handling of pumps, control of water collection points, general mechanical or water treatment procedures, hygienic handling, etc...)

Maintenance

Maintenance deals with the activities which keep the system in proper working conditions, including management, cost recovery, repairs and preventive maintenance.

- ⇨ **Crisis maintenance :** maintenance only undertaken in response to breakdowns and / or public complaints, leading to poor service level, high O&M costs, faster detoriation of equipment and user's unsatisfaction

- ⇨ **Preventive maintenance :** maintenance activities undertaken in response to pre-scheduled systematic inspection, repair and replacement, leading to continuity in service level, O&M costs spread in time, extension of life span of equipment, user's satisfaction and willingness to pay

Overhead sheets

Definitions

Management

Management deals with the control and organization of a service and encompasses the following main functions:

- Development of a vision and strategy
- Planning
- Organization and mobilization of resources
- Administration
- Accounting
- Leadership, motivation of personnel
- Supervision and monitoring
- Promotion of external relationships

This course will focus on the following managerial issues :

- Strategy development
- Planning skills
- Skills in problem solving
- Integration technical and social issues
- Communication *(efficient presentation technique)*
- Monitoring
- Human resource development
- Planning with communities

QUIZ sheet

Management attributes [2]

It is proposed to prepare before hand an envelop which will contain all the following labels which describe a possible management attribute. Each group will have to choose five main attributes considered as the most important ones while managing for O&M. (see notes for the trainer).

Sense of responsibility	Skills in planning
Willingness to take risks	Staff supervision
Skill in problem solving	Sense of humor
Capability to generate new ideas	Communication
Planning with communities	Enthusiasm
Promotion of external relations	Monitoring
Strategy development	Initiative
Integration technical / social	Technical skills
Mobilizing resources	Ability to work in group
Human resource development	Stimulating leadership

[2] Adapted from Exercise in Tools for community participation - A manual for training trainers in participatory techniques, by Lyra Srinivasan. PROWESS/UNDP Technical Series

4. Background information

4.1 Operation and Maintenance in the context of sustainability

Effective and efficient operation and maintenance contribute greatly to sustainability. In this context, many factors and processes which contribute to sustainability have a direct influence on operation and maintenance.

Sustainability can be analyzed in time, looking at the project cycle as it is proposed in the previous overhead sheets. A service is sustainable when :
a) it functions and is being used; b) it is able to deliver an appropriate level of benefits, *(quality, quantity, convenience, desired service level, continuity, affordability, efficiency, equity, reliability, health); c)* over a prolonged period of time *(which goes beyond the life cycle of the equipment); d)* its management is institutionalized *(community management; gender perspective; partnership with local authorities; involvement of formal (informal) private sector); f)* its operation, maintenance, administrative and replacement costs are being covered at local level *(through user fees, or alternative financial mechanisms); g)* it can be operated and maintained at local level with limited but feasible external support, *(technical assistance; training; monitoring); h)* without negatively affecting the environment.

Proper Operation and Maintenance will contribute to the sustainability of a service after its construction, but it will depend on a series of factors and processes which will have to be planned for in the design and planning phase, as well as developed or consolidated during the construction phase. In other words, sustainable operation and maintenance starts right from the planning stage.

Factors which contribute to sustainability and to effective operation and maintenance

As described in the circles in the previous overhead sheets, sustainability relies on four interrelated factors (adapted from CINARA - IRC course material, 1994 to 1998) : a) technical factors; b) community factors; c) environmental factors; d) the legal and institutional framework.

The technical factors which are likely to influence operation and maintenance as well as sustainability as a whole are : technology selection; complexity of technology; its capacity to respond to a demand and a desired service level; its impact on the environment; the technical skills needed to operate and maintain a system; the availability, accessibility and costs of spare parts; cost of maintenance.

The community factors which are likely to influence operation and maintenance as well as sustainability as a whole are : availability of technical skills to operate and maintain a service, implement preventive maintenance activities, small and big repairs; capacity and willingness to pay; participation of all social groups of a community, men and women; financial and administrative management done through a legitimate and organized community structure; felt need for an improved service; socio-cultural aspects related to water; individual, domestic and collective behaviour regarding hygiene and sanitation.

The intersection between the technical circle and the community circle represents the level of ownership and responsibility of communities towards the service.

Ownership feeling and responsibility are key pre-requisites for sustainable operation and maintenance.

The environmental factors which are likely to influence operation and maintenance as well as sustainability as a whole are : the quality of the water source (which will in turn influence the technology choice, and its need for treatment); its quantity and continuity.

The intersection between the environmental circle and the community circle represents the way the community will manage water resources and especially the impact it will on environment have as a result of its behaviour in terms of sanitation and management of used waters. Water resources management, pollution control, hygienic behaviour and proper waste water management are all crucial components of the sustainability of a water supply service, with operation and maintenance should contribute to.

All these factors are evolving within a ***legal and institutional framework.*** At national level there must be clear and implementable policies and strategies towards operation and maintenance. Support activities, such as technical assistance, training, monitoring, water quality control, the setting up of alternative financing mechanisms are all likely to influence operation and maintenance activities.

Processes which influence a sustainable operation and maintenance

Processes differ from factors in the way that they consider more the approach and the methodology of working. In the past, it was thought that the development or consolidation of factors alone could contribute to greater efficiency, effectiveness and sustainability. However, today sector professionals realize that processes have also a important role to play. Among these processes can be listed the following : demand from the communities; responsiveness from supporting institutions and agencies; participation of communities (men and women) throughout the whole project cycle; linking technology choice with operation and maintenance; integration of water, sanitation, health and environment; integration of social and technical issues; effective decentralization; communication among all stakeholders; public / private partnership; co-responsibility between community and municipality; capacity - building at all levels.

Demand for an improved service by the communities is a pre-requisite for sustainability. It is the expression of a commitment, a way to responsibilize communities in their choice and future tasks. Demand should however be promoted, as communities need to be aware of what are the different technology options available, and what are their financial consequences. The concrete expression of demand varies from a country to another and from a development agency to another. Demand can be materialized in the form of an initial contribution in cash or in kind to the capital costs; it can be materialized in the form of a written solicitation from an structured and organized community group to the municipality.

Responsiveness from the support institutions and agencies is the capacity of municipalities, NGOs or other institutions and agencies to adequately respond to the needs and demand of communities. In many countries, municipalities need to be consolidated in their ability to deal with rural communities.

Participation of communities (men and women) throughout the whole project cycle is essential since it a way to motivate, responsibilize and build capacities of communities in their new tasks and functions.

Linking technology choice with operation and maintenance at the planning stage will be key in the technology selection process. Indeed, communities must be able and willing to operate, maintain, administrate and finance the new service.

The ***integration of social and technical issues*** is not sufficiently done in project planning. Technical issues are often the main concern of project planners. Social issues include community organization and management, communication relationship with other stakeholders, participation of all community social groups, training and capacity building.

The ***decentralization process*** which is underway in most developing countries has a definite impact on the way institutions deal about the provision of water supply services. The main trend being that municipalities are responsible and that the private sector (formal and informal) can contribute more actively in the maintenance of systems.

Communication from central to local level, and vice versa, between agencies and development agencies can enhance the coordination of activities and implementation of policies. Furthermore, a proper information and monitoring system relies on effective communication channels.

Public / private partnership can have an important role in the operation and maintenance of improved water supply and sanitation services, where the private sector can operate, maintain, manage the provision of service under contractual agreements.

Co-responsibility between communities and municipalities implies that tasks, responsibilities and functions of both parties are clearly defined. This is especially true now that municipalities are more and more given the legal and constitutional responsibility for the provision of public services. In the same time, community management is being promoted as a key element of sustainability. Efficient dialog and clear definition of roles need to be worked developed and consolidated.

Capacity-building at all levels is needed, especially in an environment of changing roles and responsibilities induced by a decentralization process.

Unit 4: Linking water, health, sanitation and environmental protection

1. Outline of session

Objectives

- To raise awareness on the necessity to link water, health, sanitation and environmental protection
- To show that adequate operation and maintenance of water supply and sanitation contributes to health and environmental protection

Methodology (2 hours)

1. Introductory note
2. Video presentation followed by a discussion
3. Interactive presentation on links between major health preventive measures and environmental protection
4. Focused conversation on behavioural change
5. Exercise in plenary using a behavioural change matrix

Materials

- ✓ Overhead transparencies
- ✓ A flip chart and masking tape
- ✓ An overhead projector with a screen or a white wall
- ✓ A video projector
- ✓ Video "Prescription for health"

Handouts

- ✓ Copies of all transparencies
- ✓ Selected extracts from background information

2. Notes for the facilitator

Introductory note

We have seen in the previous session that one of the trends in the sector is to link water supply, health, sanitation and environmental protection. The rationale for this is that adequate water supply alone does not solve all health problems. Its proper handling, its hygienic use, the hygienic maintenance of water points and water sources, the protection of the environment, safe sanitation disposal and cleaning of hands are all contributing to improvement of health.

The facilitator will introduce this topic and its relevance and explain that it is important to agree in the beginning that this integration makes sense.

Video presentation followed by a discussion

The video "Prescription for Health" is produced by the IDRC (International Development Research Centre), P.O. Box 8500 Ottawa , K1G 3H9, Canada. It lasts 23 minutes and was shot on action in Bangladesh, the Philippines, Sri Lanka, Thailand and Kenya. Extensive animation sequences have been used to illustrate clearly the contamination path. It is adequate for audiences of diverse cultural backgrounds.

The video promotes personal hygiene and community practices linked to water supply and sanitation that can help tom break the cycle of infection. Produced in collaboration with the World health organization and OXFAM, the video is primarily aimed at health care workers, and water and sanitation engineers. It is also a strong awareness raising tool and source of information for planners and policy makers.

Once the video has been watched, the facilitator can ask the participants: "What were the key messages brought up in this video?". The facilitator will write down the main ideas on a board, and complete them with what the video is actually saying, This requires that the facilitator has some knowledge about the film already. The facilitator can ask to the participants how far this type of approach is being implemented in their own working environment. Let the participants express freely their experience.

Identification in a plenary session of obstacles that inhibit the link between water supply / health / sanitation / and environmental protection. The aim of that plenary exercise is to show what kind of constraints needs to be overcome in order to reach integration. Such issues as: not a priority, not our mandate, no knowledge about it, poor financial resources, poor inter sector cooperation might come out.

In this course we will not try to solve these problems, but try to see how in O&M activities already contribute to the improvement of this integration.

Interactive presentation on major preventive measures and environmental protection

The facilitator will show what are the major preventive measures for the transmission of water and sanitation related diseases, using the overhead sheets provided. Some explanations are available in the background information and in the supporting material.

Same applies for the environmental protection. In both cases, it will be important to show how these issues are related to O&M and its management.

Once, an overhead sheet is presented, the question can be asked to the group. How can a better O&M contribute to this?

Focused discussion on behavioural change

A important part of hygiene practices and environmental protection activities are linked to specific individual, domestic or collective behaviours. It is therefore proposed to discuss with the group on this particular issue, by asking the following questions: Can you give examples in your professional environment, of activities aimed at changing behaviours, or specific outputs which depend on behaviour change ? Are they successful? What makes them successful or not successful.

The facilitator can afterwards share with the group some basic aspects which make behavioral change not always successful (see background information).

Exercise in plenary on behavioural change matrix

It is proposed to apply a concrete tool in a plenary session, using a matrix, which was developed by UNICEF, on criteria that are considered key in behavioural change activities. The matrix is to be found in the exercise sheets part.

The facilitator could ask the group for a particular behavioural change which all participants are familiar with, or propose for instance: "Disinfecting of water at household level, with chlorine tablets", among other examples.
The facilitator goes through the whole matrix with the participants, analyzing the chosen behaviour change, and scores the total amount of points. The final result is evaluated according to the ranges given in the exercise.

3. Overhead sheets

Prevention of water and sanitation related diseases

Major preventive measures

1. Safe human excreta disposal *
2. Personal hygiene
3. Domestic hygiene
4. Food hygiene
5. Water hygiene *
6. Safe wastewater disposal and drainage *

* : Link with Operation and Maintenance

Overhead sheet

Relationship between infection and preventive measures[3]

Infection	Safe human excreta disposal *	Personal hygiene	Domestic hygiene	Food hygiene	Water hygiene *	Drainage *
Diarrhoeas Dysentries Typhoid Paratyphoid	■	■	■	■	■	
Round worm (Ascariasis) Whipworm (Trichuriasis)	■	■	■	■		
Hookworm	■		■			
Beef and pork tapeworms	■			■		
Schistosomiasis (bilharzia)	■	■	■			
Guinea worm					■	
Scabies, ringworm, yaws		■	■			
Trachoma, conjunctivis		■	■			
Louse-borne typhus, Louse-borne relapsing fever		■	■			
Malaria, yellow fever, dengue			■			■
Bancroftian filariasis	■		■			■

** Can be influenced by adequate operation and maintenance*

[3] From "Action speaks : the study of hygiene behaviour in water and sanitation projects", by Marieke Boot and Sandy Cairncross. IRC and London School of Hygiene and tropical Medicine.

Overhead sheet

Drinking water source protection[4]

- **Appropriate source selection and intake**
- **Catchtment protection ***
- **Sanitary surveying of water point ***
- **Improvement of sanitation practices ***
- **Physical protection of wells and intakes ***
- **Soil and water conservation techniques ***
- **Waste water treatment ***
- **Waste water recycling ***
- **Artificial recharge**
- **Reforestation**
- **Community motivation and awareness ***
- **Partnership between communities and authorities**
- **Legislation and enforcement**

* can be influenced by adequate operation and maintenance practices.

[4] from "Drinking water source protection", by T.F. Bastemeyer and M.D. Lee, IRC.

Exercise sheet and overhead sheet

Behavioural change matrix

Criteria for evaluating likelihood of behavioural change

Health impact of behaviour change 0. No impact on health 1. Minor impact 2. Some impact 3. Significant impact 4. Very significant impact 5. Eliminates the problem	**Complexity of behaviour change** 0. Unrealistic 1. Involves too many actions 2. Involve many actions 3. Involves few actions 4. Involves two actions 5. Involves one action	**Consequences on health of behaviour change** 0. *No consequences* 1. Little consequences 2. Some consequences 3. Significant *consequences* 4. Major consequences 5. Consequences *guaranteed*
Frequency of behaviour 0. Too cumbersome 1. Must be done hourly 2. Must be done once a day 3. May be done every few days 4. May be done once a week 5. May be done occasionally	**Cost and effort of engaging behaviour change** 0. Unrealistic 1. Requires important resources and effort 2. Requires significant resources and effort 3. Requires some resources and effort 4. Few resources or effort 5. Requires only existing resources	**Persistence needed to induce behavioural change** 0. Unrealistic 1. Requires compliance for several weeks 2. Compliance for a week 3. Compliance for several days 4. Compliance for a day 5. Very brief compliance
Compatibility with existing activities 0. Totally incompatible 1. Significantly incompatible 2. Some incompatibility 3. Little incompatibility 4. Easy to incorporate in existing activities 5. Type of activity already widely practiced	**Observability** 0. Cannot be observed by an outsider 1. Very difficult to obverse 2. Difficult to observe 3. Is observable with attention 4. Observable 5. Cannot be missed	**Similar practices** 0. Nothing like this is done 1. Slightly similar 2. Existing practice similar 3. Several similar practices 4. Many similar practices 5. Similar practices widely existing

For each proposed behavioural change, score 0 to 5 for each of the nine boxes. Aggregate the total score for each behavioural change. If the score is less than 20, it is highly unlikely that the audience will make the change. Different goals must be set. If the score is over 36, it is highly likely that the goal will be achieved.

4. Background information

4.1 Why conventional hygiene education does not change behaviour ?[5]

Planners and practitioners of hygiene programmes often think that it is possible to give universal hygiene messages to the population. Such messages are often based on the assumption that knowledge of health educators is always superior to local insights and practices. It is forgotten that people adapt their lifestyle to local circumstances and develop their insights and knowledge over years of trial and error. General hygiene messages are often not relevant, complete and realistic.

The methods that are used to get the information across are also often unsuitable to create behavioural change. Many health messages are given in the forms of lectures at health clinics, talks in meetings and gatherings and through one way mass media like posters, radio talks, brochures and booklets. Even if the educators succeed in reaching the intended audiences by these media, the people are only "told what to do", and often do not get the chance to relate it to their own experiences. It is important to realize that people make sense of new information in the light of their own experiences, perceptions and cultural backgrounds".

Many health education programmes teach people about water and sanitation related diseases: what they are, how they are caused, and how they are prevented. But education does not, by itself, reduce the risks of transmitting these diseases, only action can. Knowledge is useful but nor sufficient. Review of hygiene programmes shows that setting for particular changes is rare.

4.2 What motivates people to improve hygiene ?

If general messages and information on disease transmission don't change practices, what is it that brings people to take action on the risky practices and conditions in their own environment.

An individual will take up a new practice when he or she believes that the practice has net benefits, for health or other reasons, and considers these benefits as important. He or she will the develop a positive attitude to the change. Positive or negative views from others on his or her environment will also influence the person's decision to try the new practice. Skills, time and means then determine if the practice is indeed taken up, and when found to be beneficial, is continued.

What hygiene education programmes can do is support participatory projects that install facilities which are used and maintained, by ;

a) assessing if water, sanitation and hygiene have a high priority among the various groups in the community and create understanding of the implications of existing conditions, technical options and maintenance for community and family health;

[5] From "Motivating Better Hygiene Behaviour" : Importance for public health - Mechanisms of change. UNICEF - IRC

b) before and after facilities are installed, follow-up use and hygiene to provide feed-back to planners and reduce other transmission risks preventing the realization of health improvements in the communities concerned.

Certain practices cannot be achieved by individual change alone, but require concerted action from larger groups and the whole communities. Making joint choices, assigning responsibilities and monitoring action also increases the commitment of the members to achieve the agreed changes. Communal change is only possible when the community members themselves feel there is a problem and jointly undertake action that will permanently improve the conditions and the behaviours.

When learning, people remember 20% of what they hear, 40% of what they hear and see, and 80% of what they discover for them selves. This calls for a change in the way teaching is done, from a didactic education to a more participatory education, and growth centered education.

Four major factors stimulate people to change behaviour : 1) Facilitation (or convenience, making life easier); 2) practical understanding; 3)influence from the others; 4) capacity to change.

4.3 Experience in better water resource management[6]

Source selection and sitting intakes

Field experience shows that good source selection and adequate sitting of intakes contribute to the reliability of the water supply system. For the selection of groundwater sources, in particular for small point source supplies, procedures could be more systematic, both in terms of locating high-yielding sites and in terms of avoiding sites with high potential for contamination by seepage from the surface.

For the sitting of shallow drilled and hand-dug wells, the risk associated with fecal contamination from on-site sanitation are poorly understood and quantified. Where water supply points are located within or adjacent to settlements, two elements have not been adequately addressed with respect to possible contamination by existing sanitation units and/or waste disposal practices. The first element concerns contamination risks to drinking water sources from waste. The lack of criteria for the establishment of safe distances between water source and possible contamination points is the second element.

With increasing population pressures and expansion of human activities into previously undisturbed catchment areas, risk assessment must be taken into account both current and projected activities within the catchment area.

Catchment protection

[6] Extracts from drinking water source protection", IRC

More active protection of catchment areas is needed, which involves a systematic appraisal of catchment areas for surface or ground water sources and the identification of environmental factors, related to land use. There is a need for practical experience to develop checklists for small sources to be effectively managed and maintained by local communities.

The groundwater pollution risk is the product of the contaminant load applied to the subsurface by human actions and the natural pollution vulnerability of the aquifer. To protect aquifers, it must be clear by which pollutants and pollution sources they are most affected. This knowledge forms the basis for the delimitation of protection zones in which human activities must be regulated.

Protection zones are important for the design, prioritization and distribution of water resources protection measures. The zones can be delimited with respect to the level and nature of risk, resulting in more coherent and incisive protection strategies. The effectiveness of protection zones relies on local people commitment to established protection measures. Protected areas are obviously increasingly vulnerable as population density increases.

Sanitary surveying

Sanitary surveys are a form of risk assessment which examine the bacteriological, physical and chemical quality of a water source, the technical quality of water supply point, the way it will be used by the communities, the surrounding environmental hygiene conditions and the potential causes for contamination.. Their purpose is to minimize the level of risks of on-site contamination by identifying remedial measures that can quickly and easily be taken.

Improvement in sanitation

The problem of users contaminating water supply through poor sanitation and hygiene is widespread. Use of latrines and other sanitary systems reduce fecal pollution risk by excluding contamination of top-soil or ground surface so that excreta is not washed into surface water or transported by animals. The design of latrine should in principle ensure that there is no direct sub-surface link between the excreta and the groundwater supply which involves consideration of sitting, soil type and depth, as well as seasonal or daily water levels.

Physical protection of wells and intakes

Users pollute their water sources due to the lack of awareness about ways and means to ensure adequate physical protection of the water supply point. Community water supply projects engaged in groundwater development through well construction, recognize the importance of simple site protection against pollution. The addition of well-aprons, soak-way drains, covers and hand pumps protect water quality by preventing the inflow of contaminated water back into the well.

Soil and water conservation techniques

Soil and water conservation activities can decrease turbidity by preventing sediment transport, increasing groundwater recharge and decreasing surface flow peaks by increasing infiltration. A full range of erosion control techniques and strategies have been pioneered for developing countries and applied with considerable success.

However, soil erosion has expanded at a faster pace than most national governments have been able to cope with. A large proportion of soil erosion problems have resulted from the expansion of shifting cultivation techniques into marginal areas. Additionally, they result from the settling of previously semi-nomadic people who have little history of terrace building or other forms of traditional forms of soil stabilization.

Waste water treatment

Both industrial effluent and domestic sewage should be treated to minimize pollution risk. For domestic sewage, different on-site and off-site technical options are available, but they are not always applied. For developing countries, sewage lagoons and oxidation ditches are among the most economical methods. Little experience exists in using simple and effective, low-cost treatment technologies for small-scale industrial polluters; especially for small rural agro-industries. Many toxic elements originating from industries and the misapplication of fertilizers have no feasible treatment possibilities. Therefore, preventive measures against contamination from industrial and agricultural activities are crucial.

Waste water recycling

Waste water treatment is complementary with waste water recycling. As such, sewage waste may only need partial treatment in order to be used on farmland for irrigation or in a range of industrial processes where water quality standards are not critical. Waste water recycling if carried out correctly, can be a form of water source protection as well as conservation. Contamination risk of water sources is decreased through proper recycling and increases the efficient use of the water source. Water is the way, is treated by less expensive methods, since treatment requires only mainly removal of coliforms and helminths (ex: waste water treatment ponding).

Artificial recharge

Ground water resources can be managed in order to decrease water table recession and saltwater intrusion, by artificial recharge. At the small and medium scale, recharge is predominantly done from infiltration ditches, ponds and basins, retention of river underflow (using sub-surface dams), and through the retention of river flood-water. Sand storage dams can also be used to increase the dimensions of the shallow ground water reservoir.

Reforestation

Reforestation programmes couples with anti-erosion, soil and water conservation techniques are considered essential for the improvement of many water source problems. However, for the moment many more trees are cut than planted.

Community motivation and awareness

Many water pollution problems are due to a lack of awareness of the causes of health problems among communities. The link between water, hygiene and illness is not strongly perceived since water is assumed be beneficial and cleansing rather than a potential risk for infection.

Partnership between communities and government agencies

A reliable and functioning water supply system may greatly contribute to the protection of water sources, and vice versa. Community-based maintenance and management of water supply systems is a good starting point for a more integrated approach to water source protection and environmental conservation. Although community water management strategies are possible, there must generally be direct links between the community and the water source. Communities must be the users of the water source or derive some other benefit from the protective action such as commercial benefits from tree-planting or increased crop production following soil conservation. Conflict of interest between upstream and downstream users is a serious problem worldwide.

Government institutions and local authorities should support community efforts to manage and protect their drinking water sources.

Legislation and enforcement

Currently, water resource and environmental legislation in most developing countries have evolved through time in response to particular water management problems that have been developed with associated economic and demographic growth. They are directed towards the control of water use from major rivers or lakes which are of economic significance and do not currently provide a good basis for protection of drinking water sources.

WHO has listed several legal issues that have recently come to the forefront :

- regulations are needed to ensure that the source exploited for community water supply is the most favorable in terms of quality, quantity , access;
- regulations are needed to ensure health and environmental protection for waste water use since there are obvious public health hazards;
- legal provisions are requires to ensure that potential water sources are adequately protected from deteriorating affects of waste water infiltration;
- fundamental legislation and regulations are needed to ensure that community water supply and sanitation costs are recovered from all water source users.

Module 2

Situation analysis

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Unit 1 : Operation and maintenance requirements

1. Outline of session

Objectives

- To identify rural water supply and sanitation technologies which are most frequently used in the participant's projects
- To identify the operation and maintenance requirements for both water supply and sanitation
- To review problematic of spare parts availability

Methodology

1. Introductory note
2. Focused discussion on water supply and sanitation technologies most frequently used in the participant's projects
3. Individual or group exercise on the assessment of operation and maintenance requirements and problems most frequently encountered
4. Presentation on main characteristics of spare parts availability.

Materials

- ✓ Overhead transparencies
- ✓ A flip chart and masking tape
- ✓ An overhead projector with a screen or a white wall

Handouts

- ✓ Copies of all transparencies
- ✓ Selected extracts from background information
- ✓ Format for exercise

2. Notes for the trainer :

Introductory note

This module on situation analysis starts by reviewing what are the main operation and maintenance technical activities we are talking about for rural water supply and sanitation. It will allow the participants to have a common understanding on the type of technologies we will be dealing with in this course.

Focused discussion on rural water supply and sanitation technologies

The facilitator will ask the participants what are the type of technologies they are promoting in their rural water supply and sanitation projects. He will make a list on the board, and compare it with what are in general the technologies we are dwelling with in this course, using the transparencies proposed in the "Overhead sheets " section.

As far as sanitation is concerned, it will be important for the facilitator to mention that this course will only deal about human excreta disposal systems, considered in many projects as the basic sanitation option. This does not mean that other aspects of sanitation such as waste water disposal, solid waste disposal and drainage of surface (rain) water are not important. In the contrary.

The integration of basic and simple waste water disposal into water supply should be an automatic reflex of all water supply and sanitation project planners, however, this course does not advocate for systems which rural communities will not be able to sustain".

Group assessment of Operation and Maintenance basic requirements

The aim of this exercise is to make an assessment of the basic activities, their frequency, tools / equipment / materials / spare parts requirements, as well as human resources and skills needed to operate and maintain a particular system. Participants are asked to divide into groups, corresponding to the main technologies exposed earlier, making sure that sanitation is also represented. All participants are given a format, as proposed in the exercise sheets "Assessment of O&M requirements". Once the format has been filled in, each group will present rapidly the results of their work, with an emphasis on the problems encountered. The facilitator will highlight the fact the problems encountered with be dealt with gradually throughout the course, and that this session will start with dealing about the problem of spare parts availability.

Interactive presentation of spare parts availability

One of the major problems encountered in sustainable operation and maintenance is the availability of spare parts. This session proposes to review the main characteristics, which need to be taken into account while planning for spare parts. The overhead sheets and background information can help to design this presentation, while asking participants about their experience also on this subject. One possibility is to invite a spare parts supplier to this session who can share also his vision and experience from his angle.

Overhead sheets

Water sources and water lifting technologies

(for low cost water supply)

Water sources	Water lifting technologies
Rainwater	• Rope and bucket, loose through a pulley or on a windlass
• Rooftop water harvesting	• Bucket pump
• Catchment and storage dams	• Rope pump
Groundwater	• Suction plunger handpump
• Spring water caption	• Direct action pump
• Dug well	• Deep well piston pump
• Drilled well	• Deep well diaphragm pump
Subsurface harvesting	• Centrifugal pump
Surface water	• Electrical submersible pump
• Protected side intake	• Axial flow pump
• Bottom Floating intake river intake	• Hydraulic ram
• Sump intake	

Power systems :

Diesel Photovoltaic Windmill Animal traction

Water treatment devises :

Household water treatment systems

- Heating
- Household slow sand filter
- Domestic chlorination

Central water treatment systems

- Pot chlorination in well
- Storage and sedimentation
- Upflow roughing filters
- Slow sand filtration
- Chlorination in piped water supply systems

Overhead sheets

Low cost sanitation technologies

Dry systems

- Basic improved traditional latrine
- Ventilated improved pit latrine
- Double-vault compost latrine

Wet systems

- Pour-flush latrine with leaching pits
- Septic tank and agua privy

Pit emptying techniques

- Vacuum tanker
- Manual latrine-pit emptying technology

Liquid effluent disposal systems

- Soakaway
- Drainage field
- Small bore sewerage

Exercise sheet

Assessment of basic Operation and Maintenance requirements

Technology choice (Fill in when applicable)			
Type :	Power system :	Distribution system :	Water treatment :
Major O&M activities	**Frequency**	**Tools, material, spare parts**	**Skills & human resources**

Conclusion
Tools, materials and spare parts needed:
Skills & human resources needed:
Main problems :

Overhead sheet

Sustainable spare parts provision depends on :

1. the demand of spare parts

- spare parts needs
- spare parts costs
- spare parts accessibility

2. the supply of spare parts

- use of local material and manufacture
- marketing and selling points
- perspective of profits

3. strategic issues

- efficient planning
- standardization or not ?
- approaches to reduction of spare parts needs
- appropriate pricing policy
- private sector, involvement
- capacity-building

4. Background information

4.1 What is sanitation ?

Sanitation encompasses the following areas : 1) human excreta disposal systems; 2) waste water disposal devices; 3) solid waste disposal; 4) drainage of surface (rain) water. However, this course will focus mainly on human excreta disposal, sometimes considered as the basic sanitation option, without denying the importance of the other three areas, of which basic comments are given below.

Waste water is either called sullage, "*gray water*", which is waste water coming from kitchen and bathrooms, or sewage, "black water", which includes sullage, and is settled waste water containing parts of human excreta, and water - borne waste. The main problems encountered are especially in areas of high density of houses and people, where waste water can be vulnerable to floods if there is no proper drainage, or can be a source of smells, rodents and contamination (see module 1, unit 4). Waste water can represent a threat to drinking water, by contamination through broken pipes, spreading of stagnant water and will depend on the absorption capacity of the soil. Furthermore, the problem with water borne disposal is its high water consumption, regular blockage in the drainage system, and high O&M costs.

Simple waste water disposal and drainage devices should be planned for during the initial technical design phase. Proper maintenance of small gutters, drainage devices, or areas surrounding water points are essential, and communities should actively participate in avoiding that they get blocked , as well as avoid that any stagnant water to form around the water points.

Solid waste generally includes : household refuse; institutional waste; industrial waste and hospital waste. Rural areas are mainly concerned with the two first ones, but can be contaminated indirectly by pollution caused by industrialized waste. Habitants from developing countries produce different waste than people in industrialized countries, and the same difference applies for urban and rural areas. Vegetable waste represents an average of 30% of total waste in industrialized countries and 75% in developing countries. The composition further defines the possibilities for compost and re-cycling. Improper solid waste disposal can represent a public health risk, and is often the cause of drainage blockage and aesthetic problems; unplanned and uncontrolled dumpsites can generate ground, and ground water pollution , as well as air pollution, and proliferation of rodents.

A large amount of maintenance activities of linked to waste water and solid waste disposal in rural areas is a matter of preventive small maintenance, in which users are actively involved. Effective awareness campaigns together with participatory sanitary problem assessment can contribute to induce behavioural changes in communities, and greatly improve the operation and maintenance of basic sanitation systems (see module 1, unit 4).

4.2 Water supply and sanitation O&M fact sheets

Extracts from "Linking technology choice with operation and maintenance , in the context of low-income water supply and sanitation", by F. Brikké, and co. , WHO, IRC (1997)

• Rooftop Water Harvesting (O&M fact sheet)

a. Brief description of technology

Rooftop catchment systems gather rainwater caught on the roof of a house, school etc. using gutters and downpipes (made of local wood, bamboo, galvanized iron or PVC) and lead it to one or more storage containers ranging from simple pots to large ferrocement tanks. If properly designed, a foul flush device or detachable downpipe is fitted for exclusion of the first 20 litres of runoff during a rainstorm, which is generally most contaminated with dust, leaves, insects and bird droppings. Sometimes runoff water is led through a small filter consisting of gravel, sand and charcoal before entering the storage tank. Water may be abstracted from the tank by a tap, handpump or bucket and rope system.

initial cost: In Southern Africa US$ 320 for a system with 11 m galvanized iron gutter, 1.3 m^3 galvanized iron tank, downpiping, tap and filters, not including transport (Erskine, 1991). Where roofs are not suitable for water harvesting, cost of roof improvement and gutters will have to be added to the cost of a tank. Such costs were found to vary between about US$4 (Kenya, subsidized) and US$12 (Togo) per m^2 (Lee and Visscher, 1992). Total capital costs for rooftop rainwater catchment systems are usually higher than for other water supply systems.

yield: Potentially almost 1 litre per horizontal square meter per mm rainfall. The quantities usually are only sufficient for drinking purposes.

area of use: Most developing countries with one or two rainy seasons (especially in arid and semi-arid zones with average annual rainfall figures ranging from 250-750 mm) and where other improved water supply systems are difficult to realize.

construction: Systems are usually produced locally.

b. Description of O&M activities

In case there is no foul flush device, the user or caretaker has to divert away the first 20 litres or so of every rainstorm. Fully automatic foul flush devices often are not very reliable. Water is taken from the storage tank by tapping, pumping or using a bucket and rope. For reasons of hygiene, the first two methods are preferred. Just before the start of the rainy season, the complete system has to be checked for holes and broken or affected parts and repaired if necessary. Taps or handpumps have to be serviced (see fact sheets on handpumps). During the rainy season the system is checked regularly, cleaned when dirty and after ever dry period of more than a month. Filters should be cleaned every few months, filter sand washed at least every six months and painting of the outside of metal tanks may be needed about once a year. Leaks have to be repaired throughout the year, especially leaking tanks and taps, as they present health risks. Chlorination of the water may be necessary (see fact sheet on chlorination). All operation and maintenance activities can normally be executed by the users of the system. Major repairs such as that of a broken roof or tank, can usually be executed by a local craftsman, using locally available tools and materials. Maintenance is simple but should be given ample attention.

Organizational aspects

The organization of O&M of communally shared roof or ground tank supplies is considerably more difficult than for privately owned systems. Rooftop harvesting systems at schools, for instance, may suffer water losses from a tap left dripping, and padlocks are often needed to ensure careful control over the supply. Ideally, one person should be responsible for overseeing the regular cleaning and occasional repair of the system, control of water use etc.. Selling the water is an option to ensure income for O&M and restrict water use. Where several households have installed a communal system, for instance several roofs connected to one tank, the users may want to establish a water committee to manage O&M activities, which may include collection of fees, control of the caretaker's work and of the water use by each family. External agents can play an important role in monitoring the condition of the systems and the water quality, providing access to credit facilities in order to buy or replace a system, training of users/caretakers for management and execution of O&M, and training of local craftsmen for larger repairs.

C. O&M REQUIREMENTS

activity	frequency	human resources	materials & spare parts	tools & equipment
clean system	1 - 3 times per year	local	chlorine	broom, brush, bucket
divert foul flush	every storm	local		
clean filters	twice a year	local	sand, charcoal, plastic mesh	
disinfect reservoir	occasionally	local	chlorine	bucket
repair roof, gutters and piping	occasionally	local	tiles, metal sheet, asbestos cement sheet etc., bamboo or PVC pipes, nails, wire	hammer, saw, pliers, tin cutter
repair tap or pump	occasionally	local or area	washers, cupseals etc.	spanner, screwdriver
paint outside of metal reservoir	annually	local	anticorrosive paint	steelbrush, paintbrush
repair ferrocement reservoir	occasionally	local	cement, sand, gravel, metal mesh, wire	trowel, bucket, pliers

d. Actors implied and skills required in O&M

actor	role	skills
user	close taps after taking water, keep system clean	no special skills
caretaker	check functioning, divert first flush, clean filters and rest of system, perform small repairs	basic skills
water committee	supervise caretaker, collect fees	organizational skills
local craftsman	repair roof, piping and tank	basic plumbing and masonry
external support	check water quality, stimulate and guide local organization, train users	microbial analysis, extension work

e. Recurrent costs

Recurrent costs for materials and spare parts are very low. In most literature these costs are even considered negligible. The recurrent personnel costs, in cash or kind (for caretakers, committee members and craftsmen), will need to be added.

f. Problems, limitations and remarks

Frequent problems

Corrosion of metal roofs, gutters etc.. Failure of functioning of the foul flush diverter due to neglect of maintenance. Leaking taps at the reservoir and problems with handpumps. Contamination of uncovered tanks especially where water is abstracted with a rope and bucket. Tanks may provide a breeding place for mosquitoes which may increase the danger of diseases such as malaria.

Limitations

The water may be insufficient to fulfill drinking water needs during certain periods in the year, making it necessary to also develop other sources or go back to traditional sources to overcome these periods. The investment needed for the construction of a tank and suitable roofing is often beyond the financial capacity of households or communities.

remarks

Thatched roofs produce less and more contaminated water. Tiled or metal roofs give the cleanest water. The acceptation of rooftop water harvesting as a suitable system may depend on the users' perception regarding the taste of the water

• Catchment and Storage Dams (O&M fact sheet)

a. Brief description of technology

With the help of a dam, the rainwater or snow catchment of a natural surface like a bedrock area or a valley can be made available for human use. Water is caught and stored behind the dam or diverted to a separate reservoir. Important parameters in the planning of dams are annual rainfall and evaporation pattern, present use and runoff coefficient of catchment area, water demand, geology and geography of catchment area and building site. Dams may consist of raised banks of compacted earth (usually with an impermeable clay core, stone aprons and a spillway to discharge excess runoff), masonry or concrete (reinforced or not). In this publication we only refer to dams of less than a few metres high. Users can take the water directly from the dam or it can be treated and distributed in a larger system.

Initial cost: Depending very much on local circumstances. To get an impression, the cost per m^3 storage volume for a 13,000 m^3 rock catchment in Kenya was US$1.60. For an earth dam of 30,000 m^3 in Tanzania this figure was US$1.90 but for an 80,000 m^3 earth dam in Mali only US$0.20 (1989 data, Lee and Visscher 1990).
Dimensions: From one metre high and a few metres wide to hundreds of metres wide and high.
area of use: Mostly in hilly or mountainous regions where other water sources are scarce.
design: For dams higher than a few metres, design by specialized engineers is recommended.

b. Description of O&M activities

operation

Operation by a caretaker may include activities such as opening or closing of valves or sluices in the dam or conduits to a reservoir. Abstraction of the water from the water points is usually done by the users, often women and children.

maintenance

All year round, cattle and people have to be kept away from the catchment area and reservoir. This can be enhanced by: regular patrolling by a watchman in the area, fencing the area and construction of tap points downstream of the reservoir. The dam, valves, sluices and conduits have to be checked for leaks and structural failures. If repairs cannot be carried out immediately, the spots of failure should be marked. The catchment area must be checked for contamination and erosion. To control erosion, just before the rainy season grass or trees may be planted. For this purpose, a nursery may have to be started. Once or a few times per year, the reservoir may be left to fall dry for a short period to reduce the danger of bilharzia. The reservoir, silt traps, gutters etc. must be desilted at least once per year. To avoid mosquito breeding and the possible spread of malaria, Tilapia fish can be introduced to the reservoir (each year if it runs dry). Fish excrement pollutes a reservoir less than if the reservoir has no fish and organisms are allowed to breed unchecked. All O&M activities on the reservoirs and catchment areas can normally be executed by the users of the system. Major repairs may be performed by local craftsmen, using locally available tools and materials.

Organizational aspects

For proper and sustainable functioning of a surface harvesting system, users will need to establish an organization that can effectively deal with issues such as the allowed water consumption by each user, prevention of use by unauthorized passers-by, of water contamination and of unequitable abstraction, solving upstream-downstream conflicts where the system has altered the natural hydrology, execution of O&M activities, and financing of O&M. Agreements will have to be made on contributions in cash, kind or labour by each household to O&M of the system. For O&M tasks at the reservoir and the catchment area a person who lives or farms near the site could be appointed. This person could also be made responsible for water allocation if water is obtained by the users near or at the reservoir, and be involved in monitoring activities. His authority should be clear and accepted by the people.

c. O&M requirements

activity	frequency	human resources	materials & spare parts	tools & equipment
check for leaks, damage, erosion etc.	daily	local		
repair leaks in dam	occasionally	local	clay, cement, sand, gravel	hoes, spades, buckets, trowels etc.
repair or replace valves	occasionally	local	washer, spare valve	
desilt dam, conduits, silt traps etc.	annually	local		hoes, spades, buckets, wheelbarrows etc.

d. Actors implied and skills required in O&M

actor	role	skills
user	use water, keep catchment area clean, assist in maintenance activities	no special skills
caretaker	perform small repairs	basic skills
water committee	organize repairs and cleaning, collect fees	organizing skills
local technician	repair concrete, masonry and piping	masonry, basic plumbing
external support	check water quality of system, stimulate and guide local organization	extension

e. Recurrent costs

Recurrent material costs may vary greatly although they are usually small. The recurrent personnel costs, in cash or kind (for caretakers, watchmen, labourers, committee members and craftsmen), will need to be added and may in certain cases far exceed the recurrent material costs, for instance where erosion control measures in the catchment need to be maintained, which may require high labour inputs on a regular basis.

f. Problems, limitations and remarks

frequent problems

Contamination of the water, siltation of the reservoirs, endangering activities in the catchment area like chemical spraying, overgrazing, agro-industry, industry, land clearing, settlements, etc.. Earth dams can be damaged by animals or people walking over them. Undermining of dams and reservoirs by seepage, rodents or other causes. Dam failure, collapse or injury due to wrong designs or unforeseen large runoffs. Waterborne and water-related diseases like bilharzia and malaria.

limitations

When demand is high and rainfall is low or very irregular, large catchment areas and dams are needed. Even if water law does provide some protection, catchment areas are vulnerable to damage by other people. If local soil and geographic conditions are unfavourable, transport of materials (clay, sand, gravel) and construction of the dam may become very expensive. Catchment areas are unsuitable if there is no suitable site for the dam or reservoir, for instance if the ground beneath does not provide a strong and sound enough foundation to support the structures and prevent seepage, if the dam or reservoir would have to be too large (or expensive) because the depth-to-surface ratio is too small, or if percolation or evaporation losses would be too large. The investment in labour, cash and/or kind needed for the implementation and/or maintenance of surface harvesting systems may be beyond the capacity of communities. If populated centres or important infrastructure are located downstream it may for security reasons be decided not to construct the system at that site.

remarks

Users normally highly value the taste and flavour of their drinking water. These can differ with different catchment areas. In certain cases this may affect the users' acceptability of the system.

• Spring Water Captation (O&M fact sheet)

a. Brief description of technology

Spring water captation systems abduct and protect ground water flows at the points where these arrive at the surface to facilitate their abstraction. Spring water is usually fed from a sand or gravel water-bearing ground formation (aquifer), or a water flow through fissured rock. Where solid or clay layers block the underground flow of water, it is forced upward and can come to the surface. The water may emerge either in the open as a spring, or invisibly as an outflow into a river, stream, lake or the sea. The main parts of a spring water captation are a drain under the lowest natural water level, a protective structure providing stability and a seal to prevent surface water from leaking in. The drain usually is placed in a gravel pack covered with sand and may lead to a conduit or a reservoir. The protective structure may be made of concrete or masonry and the seal is usually made of puddled clay and sometimes plastic. A screened overflow pipe guarantees that the water can flow freely out of the spring at all times. To prevent contamination from infiltrating from the surface, a ditch, known as the interceptor drain, diverts surface water away from the spring box and a fence keeps animals out of the spring area. There are many types of spring captations, ranging from a simple headwall with backfill to more complicated structures like tunnel systems for collecting water from a larger area.

initial cost: Capital costs vary considerably and depend on a large number of factors. In Nepal a relatively large spring box serving 150 households including facilities for clothes washing was constructed for about US$1,000 (1989 data, Rienstra 1990), including costs for unskilled labour. In Kenya minor structures for an average of 110 persons were constructed costing US$200, including a headwall, backfill, fencing and labour and transportation costs. Major spring structures for an average of 350 persons cost about US$400 also including a spring box (1986 data, Nyangeri 1986).
dimensions: From 0.5 m^2 to many square metres.
yield: From less than 0.1 l/s to many l/s.
area of use: In areas where groundwater arrives at the surface, usually at hill or mountain sides.
construction: Spring water captation systems are constructed on-site, often by local craftsmen.

b. Description of O&M activities

operation

Water should be permitted to flow out freely all the time to prevent it finding another way out of the aquifer. Operation may include activities such as opening or closing valves to divert the water to a reservoir, a conduit or a drain. Spring and surroundings must be kept clean.

maintenance

Prevent contamination (e.g. open defecation, latrines, cattle gathering places, use of pesticides/chemicals etc.) both in the area where the spring water infiltrates into theground (if possible) and in the immediate surroundings of the spring.Check the surface drains, animal-proof fence and gate and repair if necessary. Protect the vegetative cover both in the area where the spring water infiltrates into the ground (if possible) and in the immediate surroundings of the spring (prevent clogging of the aquifer by vegetative growth (roots) in the immediate surroundings of the spring). Check the water flow from the spring box. If there is an increase in turbidity or flow after a rainstorm, surface run-off has to be identified and the protection of the spring improved. If water flow decreases, it has to be suspected that the collection system is clogged. It may then be necessary to take out the gravel and replace with new gravel, or, in case a seep collection system is used, to clean the collection pipes. Regular water samples must be taken and analyzed to check for evidence of faecal contamination. Annually open the washout, remove all accumulated silt. Check all screens; replace (with non-rusting materials, e.g. copper or plastic screening) if damaged or blocked, clean if dirty. After cleaning, make sure to close the washout valve thoroughly and replace and seal the manhole cover. Disinfect the springbox every time a person has entered to clean or repair it or when bacteriological contamination is. Leaks in the protective seal or undermining of the headwall and damage caused by erosion or settlement of soil have to be repaired.

Organizational aspects

In many cases, springs are communally owned. Users may need to establish an organization that can effectively deal with issues such as the control or supervision of the water use, prevention of water contamination, execution of O&M activities, financing of O&M and monitoring of water quality, systems performance etc. Proper management may also contribute to preventing social conflict over these and other issues. For the execution of O&M tasks at the spring site, a person who lives or farms near this site could be appointed. This person could also be made responsible for water allocation if water is obtained by the users near or at the site, and be involved in monitoring activities. His or her authority should be clear and accepted by all users.

C. O&M REQUIREMENTS

activity	frequency	human resources	materials & spare parts	tools & equipment
clean well surroundings	weekly	local		broom, bucket, hoe, machete
check turbidity	after each flood	local		
check water quantity	occasionally	local		bucket, watch
repair fence and clean surface drains	occasionally	local	wood, rope, wire	machete, axe, knife, hoe, spade, pick axe
check water quality	regularly	area	laboratory reagents	laboratory equipment
wash and disinfect spring	annually	local	chlorine	bucket, wrench, brush
repair piping and valves	occasionally	local or area	spare pipes and valves, cement, sand, gravel	bucket, trowel, wrench, flat spanners
repair cracks	annually	local	cement, sand, gravel, clay	bucket, trowel, hoe, spade, wheel barrow

d. Actors implied and skills required in O&M

actor	role	skills
user	use water, report malfunctioning, keep site clean, assist in major repairs	no special skills
caretaker	keep site clean, check for damage, perform small repairs	basic skills
water committee	organize bigger repairs, control caretaker's work	organizational skills
mason	repair masonry or concrete	masonry
external support	check water quality, guide and stimulate local organization	microbial analysis, extension work

e. Recurrent costs

Recurrent material costs are usually very low. The recurrent personnel costs, in cash or kind (for caretakers, watchmen, labourers, committee members and craftsmen), will need to be added but will usually be low as well. Total recurrent costs are usually less than US$1 per year per capita, which often even includes O&M costs for the water transport system. Several sources report that "O&M costs are minimal and, for this reason, spring water technology is the technology of choice wherever sites permit." Problems may arise though when a sudden large investment is needed for a large repair or replacement of the system.

f.Problems, limitations and remarks

frequent problems

Erosion or collapse of the spring box due to wrong design, construction errors, large surface run-off flows or damage caused by people or animals. Leaks in the box or leaking taps and valves. Contamination of the spring water due to cracks in the seal or to behaviour of people. Damaged piping because of faulty construction, abuse or corrosion. Improper
drainage of surface runoff, outflow and wastewater. Clogged pipes because of siltation or plant roots. Poor accessibility for water users

limitations

Springs may not deliver enough water or fall dry during certain parts of the year. Not all springs produce clean water of acceptable taste. Springs may be sited too far from the households or on privately owned land. In some cases, cost of construction, large repairs or replacement may be beyond the capacity of communities. Some spring water is very corrosive.

• Drilled Well (O&M fact sheet)

a. Brief description of technology

Drilled wells, tubewells or boreholes give access to groundwater in an aquifer and facilitate its abstraction. They differ from dug wells in the small diameter, generally varying between 0.10 m and 0.25 m for the casing, which does not allow a person to enter for cleaning or deepening. The well is usually the most expensive part of a handpump drinking water supply project. Boreholes can be constructed by machine or by hand-operated equipment and usually consist of three main parts:

- At ground level, a concrete apron around the borehole with an outlet adapted to the water abstraction method prevents surface water from seeping down the sides of the well, provides a hard standing and directs wastewater away from the well to a drainage channel.
- Below ground but not in the desired aquifer(s), these parts are usually lined with pipe material (mostly PVC and sometimes galvanized iron) to prevent it from collapsing, especially in unconsolidated formations. In consolidated formations, lining may not be required.
- Below water level in the aquifer sections, the pipe material is slotted to allow groundwater to enter the well. A gravel filter layer surrounding this part facilitates groundwater movement towards the slotted pipes and at the same time prevents ground material from entering the well. In consolidated formations this gravel may not be required.

A proper combination of slot size, gravel filter and aquifer material and extensive sand pumping before the well is brought into production (well development) can considerably improve long-term performance.

initial cost: Capital costs vary considerably and depend on a large number of factors. According to Arlosoroff et al. 1987),the initial cost for a 50 m deep hand- drilled well in the alluvial plains in South Asia could be as low as US$200. More recent data state that typical costs for a 50 m drilled well in India were US$770 and in Mozambique US$10,000 (Wurzel and Rooy, 1993).

range of depth: From a few to over 200 metres.

yield: From less than 0.3 to over 10 litres per second.

expected life: Over 25 years.

area of use: In areas with suitable aquifers.

construction: In most countries, drilled wells are constructed by public or private sector drilling companies.

b.Description of O&M activities

operation

Operation of the well itself is usually not required. When production capacity of the well is lower than the demand, daily monitoring of the water level may be necessary. Abstraction of the water from the well is usually done by the users, often women and children, or by a caretaker.

maintenance

Apart from cleaning the apron daily and occasionally cleaning the drain and repairing the fence, if present, there are hardly any maintenance activities. Rarely, when a well has to be desilted or rehabilitated, all appliances have to be removed and a specialized company will have to come and do the job. There are various rehabilitation techniques such as forced air and water pumping, brushing and treatment with chemicals. It is very difficult to deepen an existing drilled well.

organizational aspects

Users may need to establish an organization that can effectively deal with issues such as the control or supervision of water use, prevention of water contamination, execution of O&M activities, financing of O&M and monitoring of water quality. Although the number of O&M activities required is limited and they usually cost very little, they should be given ample attention, as many wells have been abandoned because they were contaminated or had collapsed as a result of lack of maintenance.

c.O&M requirements

activity	frequency	human resources	materials & spare parts	tools & equipment
clean well site	daily	local		broom, bucket
clean drain	occasionally	local		hoe, spade, wheelbarrow
repair fence	occasionally	local	wood, nails, wire etc.	saw, machete, axe, hammer, pliers etc.
repair apron	annually	local	cement, sand, gravel	trowel, bucket
rehabilitate well	very rarely	national	gravel, pipe material etc.	various special equipment

d. Actors implied and skills required in O&M

actor	role	skills
water user	use water, keep site clean, assist with major maintenance tasks	no special skills
caretaker	monitor water use, keep site clean	basic skills for cleaning and disinfection
water committee	supervise caretaker, organize major maintenance, collect fees	organizational skills
specialized well company	rehabilitate well	very special skills
external support	check water quality, stimulate and guide users' organization	microbial analysis, extension work

e. Recurrent costs

Recurrent material costs are usually low. The recurrent personnel costs, in cash or kind (for caretakers, watchmen, labourers, committee members and craftsmen), will need to be added but will usually be low as well. Occasional large maintenance activities such as rehabilitation of the well may suddenly require a high investment, which may pose problems if this has to be financed by the community. The life expectancy of a good well is over twenty years but after a few years the yield may diminish drastically and rehabilitation may be necessary. In Ghana (Baumann, 1993), rehabilitation costs are estimated at US$750 once every ten years.

f.Problems, limitations and remarks

frequent problems

Bad water quality or collapse due to corrosion of galvanized iron lining, poor water inflow because of inadequately developed well, entrance of ground particles in the well because of wrong screens or wrong development, contamination due to wrong apron design or construction or neglect of maintenance, collapsing of borehole where no lining is applied or where lining is not strong enough.

limitations

Well construction depends on geohydrological conditions like presence, depth and yield of aquifers and presence of rock formations above them. Wells constructed at locations which are too far from the users' households or which are too difficult to reach, will not be sufficiently used or maintained. Wells should not be drilled near places with latrines or where cattle gather and vice versa. The usually recommended minimum distance is 30 m, although this is no guarantee that contamination will not occur. The investment, in labour, cash or kind, needed for the construction of an improved dug well may be beyond the capacity of communities.It may be impossible to transport the heavy equipment and materials needed to the drilling site.

remarks

In many cases wells are not only used for drinking water supply. Irrigation may be another use. When assessing the development potential of wells with the community it is important to place this in a wider context, including all water uses and their effect on water availability.

• Rope and Bucket, Loose, through a Pulley or on a Windlass (O&M fact sheet)

a. Brief description of technology

Mostly used with handdug wells. A bucket on a rope is lowered into the water. When hitting the water, the bucket dips and fills itself and is pulled up with the rope. The rope might be held only with the hands, run through a pulley or be wound on a windlass. Sometimes animal traction is used in combination with a pulley. Improved systems use a rope through a pulley and two buckets, one on each end of the rope. For water depths of less than 10 m, one can use a windlass with a hose running from the bottom of the bucket to a spout at the side of the well. Even with this system and a protected well, hygiene is poorer than with a bucket pump.

initial cost: US$6 for a plastic bucket and 5 m rope to US$150 with a windlass, hose and closed superstructure in Liberia. (Milkov 1987).
range of depth: 0-15 m (greater depths are possible).
yield: 0.25 l/s at 10 m.
area of use: All over the world, mainly in rural areas.
construction: Buckets, ropes, pulleys and windlasses are manufactured locally; buckets and ropes also by larger industries.b. Description of O&M activities

b. description of O&M activities

operation

Lower and raise the bucket by paying out and pulling in the rope or rotating the windlass. One must be careful not to dirty the rope or bucket.

maintenance

Preventive maintenance consists of greasing the bearings of the windlass or pulley.
Small repairs are limited to patching of holes in bucket and hose, reconnecting hinge of bucket and fixing windlass bearings or handle. All repairs can be done by local people and with tools and materials available in the community or area. More major repairs and replacement mainly consist of replacing a bucket, hose, rope or part or all of the windlass. Woven nylon ropes may last two years, twined nylon or sisal ropes only last a couple of months. A good quality hose may last over two years and buckets, depending on material and quality, may last a year. For well maintenance: see fact sheet on dug wells. For well disinfection: see fact sheet on chlorination

organizational aspects

When people use their own rope and bucket, no extra organization is required. For community wells, usually a community committee organizes the maintenance and cleaning of the well, maintenance of the windlass, etc. Most repairs can be paid with ad hoc fund raising.

c. O&M requirements

activity	frequency	human resources	materials & spare parts	tools & equipment
grease axles of windlass or pulley	every two weeks	local	grease or oil	lubricator
replace bucket	each year	local	bucket, wire	knife
replace rope	every two years	local	rope, wire	knife
replace hose	every two years	local	hose, wire, rubber straps from tyres	knife, tongs

d.Actors implied and skills required in O&M

actor	role	skills
user	lower and lift the bucket keep site clean warn in case of malfunctioning	no special skills
caretaker	keep site clean, do small repairs	basic maintenance
water committee	organize well cleaning, collect fees	organizing skills
local artisan	repair of bucket, windlass, well cover, etc.	tinnery, carpentry
shopkeeper/trader	sale of rope, bucket, etc.	no special skills
external support	check water quality, stimulate and guide local organization	microbial analysis, extension work

e. Recurrent costs

Consist of occasional purchase of rope, bucket, hose, wire, etc.; occasional repair costs of windlass are low. Annual per capita costs for rope and bucket in Upper Volta were reported to range from US$.56 to 1.36 (Hofkes, 1983). These costs varied with well depth and family size. For costs of well disinfection see fact sheet on pot chlorination.

f. Problems, limitations and remarks

frequent problems

Fast deterioration of bad quality rope. Sisal rope only lasts for a few months. Bucket falls into well. To prevent this, communities can keep a spare bucket available and fit the bucket in a protective cage, for instance like the design described in Carty, D. (1990). In windlass with hose systems the hose breaks frequently.

limitations

Very poor hygiene, especially when rope and bucket touch hands or ground. Communal wells often tend to get more contaminated than family-owned wells. Therefore the latter should be aimed for where possible.
Only suitable for limited depths, although examples are known of rope and bucket systems exceeding 50 m

• Deep well Piston Handpump (O&M fact sheet)

a.Brief description of technology

In a deep well piston handpump, the piston is placed in a cylinder below the water level which is usually in the range of 15 to 45 m below the ground. The pumping motion by the user at the pump stand is transferred to the piston by means of a series of connected pumping rods inside the rising main. On the up-stroke, the plunger lifts water into the rising main and replacement water is drawn into the cylinder through the footvalve. On the down-stroke, the footvalve closes, and water passes the plunger to be lifted on the next up-stroke. The pumping height is limited only by the effort needed to lift water to the surface. Nowadays most cylinders have an open top which allows the piston and footvalve to be removed through the rising main for servicing and repairs while the rising main and cylinder can stay in place. The pump rods have special connectors allowing for assembly and dismantling with no or only very simple tools. The joints incorporate pump rod centralizers that prevent wear of the rising main. To a large extent improved models can be maintained at village level.

initial cost: For well depths between 25 - 35 m, prices vary from about US$40 for a cylinder, plunger and footvalve set to be installed under a locally made pump head, to over US$2300 for a complete pump with many stainless steel parts. (1985 prices, Arlosoroff et al.) Most good pumps cost between US$300 and 500

range of depth: 15 - 45 m, depths up to about 100 m are possible

yield: 0.25 - 0.36 l/s at 25 m and 0.18 - 0.28 l/s at 45 m depth

useful life: 6 to 12 years

area of use: Rural and low-income peri-urban areas where groundwater tables are within 100 m but preferably within 45 m from the surface

construction: Afridev/Aquadev; Bestobell Micro; Bush pump; Blair pump; India Mark II and III; Kardia; Tropic (Duba); UPM; Volanta; etc.

b. Description of O&M activities

operation

Operation of the pump is done by moving a handle up and down or by rotating the handle of a flywheel. This can be done

by adults and even children. Handle forces are usually kept within acceptable limits (depending on brand and lifting heights). Pump and site must be kept clean.

maintenance

Preventive maintenance usually consists of checking pump functioning and cleaning pump and site daily, greasing weakly, checking all parts of the pump stand monthly and taking the whole pump apart for a check, cleaning the parts with clean water and painting the pump stand annually. Pump rods that show bad corrosion must be replaced. Under normal conditions, a galvanized steel pump rod needs replacement every five to six years. Rising mains consisting of galvanized iron have to be removed and checked and pipes with badly corroded threads must be replaced. Small repairs are the replacement of bearings, cupseals and washers, straightening bent pumping rods etc. Major repairs may involve the replacement of the plunger, footvalve, cylinder, pump rods, rising main, pump handle, fulcrum etc. With open top cylinder pumps, all preventive maintenance activities can normally be executed by a village pump caretaker. For major repairs and problems external support may be needed. Closed top cylinder pumps often need special lifting equipment to pull up the rising main and cylinder for maintenance of parts down in the hole.

Organizational aspects

Most deep well pumps are too expensive for family use and will have to be used at communal level. The price of these pumps also means extra importance of fundraising. Communities have to organize themselves in order to maintain the pump in good working condition. Often a caretaker is appointed and a pump committee coordinates activities. External support is often provided by state or non-governmental organizations but becomes costly. In some cases small private enterprises, paid directly by the communities, are now doing this job very satisfactorily.

c. O&M requirements

activity	frequency	human resources	materials & spare parts	tools & equipment
clean pump and site	daily	local		broom, brush
grease bearings	weekly	local	grease or oil	lubricator
check pump stand parts	monthly	local		spanner
replace pump stand parts	occasionally	local	nuts and bolts, bearings, pump handle	spanners, screwdriver
replace cupseals	annually or less	local or area	cupseals	spanners, wrench, knife, screwdriver etc.
redo threads in pump rod or main	*occasionally*	*local or area*	*oil*	*pipe threader, tackle*
replace footvalve, *plunger or cylinder*	occasionally	area	footvalve, plunger or *cylinder*	spanners, wrench
replace pump rod or main	occasionally	area	pump rods or main tubing	spanners, wrench, pipe threader
repair platform	annually	local	gravel sand, cement	bucket, trowel

d.Actors implied and skills required in O&M

actor	role	skills
user	pump water keep site clean warn in case of malfunctioning	no special skills
caretaker	keep site clean regularly check pump do small repairs	basic maintenance
water committee	supervise caretaker collect fees	organizing skills
area mechanic	perform more major repairs	some special skills, depending on brand
external support	check water quality, stimulate, guide local organization	microbial analysis, extension work

e.Recurrent costs

The costs for preventive maintenance may range between US$12 and 60 per pump per year for spare parts and materials (based on price indications from several brands). The recurrent personnel costs, in cash or kind (for caretakers, committee members, and, in case larger repairs are needed, mechanics or other skilled people) will need to be added.

f.Problems, limitations and remarks

frequent problems

Replacement of plunger seals is the most common repair needed. Problems with local manufacture, centering mostly around quality control, are often reported, especially in African countries.Hook and eye connections of pump rods tend to break more often than conventional connections. Rods also reportly get disconnected or bend spontaneously sometimes.Especially where groundwater is corrosive, corrosion has been reported to affect the pump rods (if not made of stainless steel), the rising main (if GI), the cylinder, and the pump head

bearing housing and other pump stand parts. Broken or shaky handles, mainly due to worn out or otherwise affected bearings. The number of problems usually increases with increasing groundwater depth.

limitations

The maximum lift differs per brand, varying between about 45 and 100 m. The forces required to turn the handle of the pump may be high in certain cases, depending on the brand and on the depth of the well.

remarks

The quality of the material used for the rising main should be as high as possible to reduce the number of repairs needed on this part. Many of these pumps can be produced in developing countries. Rigorous quality control is needed. Piston pumps may be driven by a windmill but often rotary pumps are preferred because of their lower starting torque.

• Diesel Engine (O&M fact sheet)

a. Brief description of technology

Diesel engines are very often used as a stationary power source. The main parts of the engine are the cylinders, pistons, valves, and crankshaft. The number of cylinders may vary from one to more than six. When air is heavily compressed by a piston inside a cylinder and diesel fuel is injected to it, this mixture comes to a controlled explosion that moves the piston. This movement is transferred to the crankshaft and from there it can be put to use, for example to drive a pump or an electricity generator. Valves in the cylinder regulate inflow of fuel and air and outflow of exhaust gasses. A high pressure pump forces the diesel fuel into the cylinder at the right moment. Diesel engines differ from petrol engines in that they use a different fuel, do not have spark ignition plugs and work at much higher pressures. Efficiency of diesel engines is higher and they need less maintenance than petrol engines. Engines can differ in size, speed (revolutions per minute), cycle (two-stroke and four-stroke cycles), cooling system (water or air), etc. Generally, low-speed four-stroke engines last longer and high speed two-stroke engines produce more power per kg of engine weight. Water-cooled engines generally need less maintenance than air cooled.

initial cost: US$200 per kW for engines round 25 kW to US$600 per kW for 2 kW engines (1990 data, McGowan and Hodgkin, 1992). Installation and other costs not included.
range of power: Commonly starting at 2 kW
life cycle: Average 20,000 hours of operation ranging from less than 5,000 to 50,000 hours, depending on quality of engine, installation and O&M.
area of use: All over the world, specially for high power need and where no grid electricity is available.
trademarks: Kubota; Lister-Petter; Lambardini; and many others.

b. Description of O&M activities

operation

The engine must be operated by a trained caretaker. Every engine has its own typical operating instructions. Before starting

it, the levels of fuel, oil and cooling water (if not air cooled) are checked. If these levels are low, extra fuel, oil or water has to be added. During operation, fuel level, oil pressure, and engine speed are checked and also the functioning of the pump or generator. Some moving parts may need manual lubrication. When the engine is operated at too low speeds, it has a low efficiency and carbon builds up rapidly in the engine, increasing the need for servicing. All data on liquid levels and running hours are written down in a log book

maintenance

Every day the outside of the engine must be cleaned, and in dusty conditions the air filter must be checked and cleaned. Some parts may need manual lubrication. In moderately dusty conditions, oil bath air filters are cleaned once a week, dry paper air filters a bit less frequently. The engine is serviced for preventive maintenance according to the number of hours it has run: Every 50 hours: clutch (if present) must be greased. Every 250 hours: clean all filters, replace if necessary, change oil. Check nuts and bolts and exhaust pipe. Every 1500 hours: major service overhaul: decarbonizing, adjusting valve clearance, etc. If the engine is connected to a pump or generator with a vee belt, this will regularly need replacement. Once a year the engine house must be painted and occasionally repaired. If a generator is present it will have its own maintenance needs. The following table shows only the most important O&M activities.

organizational aspects

Diesel engines require a lot of simple maintenance and if this is done well they can have a long service life. Therefore training and supervision of the caretaker are important. More complicated maintenance tasks and repairs have to be done by a well-trained mechanic with access to sufficient spare parts. Organization has to guarantee scheduled service at the right moments and quick response in case of breakdown.

C. .O&M REQUIREMENTS

activity	frequency	human resources	materials & spare parts	tools & equipment
check liquid levels and add if necessary	daily	local	fuel, engine oil, cooling liquid	funnels, containers for liquids
start and stop engine	daily	local		
keep logbook	daily	local	paper, pen	
check air filter, clean or replace if necessary	daily or weekly	local	new dry paper filter, or kerosene and engine oil	wrench
check for oil and fuel leaks	weekly	local		
tighten nuts and bolts	weekly	local		spanners
change engine oil	every 250 hours	local	engine oil	spanners
clean or replace filters	regularly	local	oil filter, fuel filter	spanners, special tools
decarbonize, clean injector nozzles, adjust valves, etc.	every 500 to 2000 hours	specialist		spanners, brass wire brush, special tools
replace drive belt	regularly	local	drive belt	spanners
replace engine parts	occasionally	specialist	nozzles, injectors, gaskets, bearings, fuel pump, etc.	depending on part to be replaced
repair engine mounting and housing	occasionally	local or area	cement, sand, gravel, nuts and bolts, nails, galvanized corrugated iron sheets, wood, etc.	trowel, bucket, hammer, chisel, saw, spanners, etc.

d. Actors implied and skills required in O&M

actor	role	skills
caretaker	operate engine, keep logbook, perform minor service, warn in case of irregularities	special training is needed for basic diesel O&M
water committee	supervise caretaker, collect fees, organize major service and repairs	organizational skills
area mechanic	perform major service and repairs	special training needed
external support	train caretaker and area mechanics	training and technical skills

e.Recurrent costs

Where fuel and spare parts are scarce, costs for these may amount to 50 percent of annual system capital cost (McGowan and Hodgkin, 1992).

f.Problems, limitations and remarks

frequent problems

Excessive wear due to wrong O&M, neglect or misunderstanding. Rapid carbon buildup and low efficiency due to running the engine well under full loading. Broken drive belts.

limitations

Frequent maintenance. Fuel costs a lot and may be difficult to get. From time to time a specialist mechanic is needed for service and repairs.

remarks

Diesel engines are especially suited for high stationary power output. With good maintenance they are dependable energy sources. It is very important to select a brand of good reputation ,locally available service and spare parts.

• Chlorination in Piped Water Supply Systems

a. Brief description of technology

Chlorination is a chemical method of disinfecting water that kills nearly all pathogens and provides a barrier against reinfection. It can be applied as the last stage in a drinking water treatment process or as the only measure when water quality is already reasonably good. The most used low technology methods are batch chlorination and flow chlorination.
For batch chlorination a concentrated chlorine solution is added to the water in a reservoir with in- and outlets closed. The water is stirred and the chlorine is left to react for at least 30 minutes. After that, the outlets can be opened. When the reservoir is empty the outlets are closed, the reservoir is refilled and a new batch is disinfected. This method will not be further discussed in this fact sheet.
Flow chlorinators continuously feed small quantities of weakly concentrated chlorine solution to a flow of fresh water, often at the instream of a clear water reservoir. Usually a small reservoir containing the chlorine solution is placed on top of the water reservoir and the solution is administered close to the point where fresh water comes in and turbulence guarantees good mixing. A special device like the floating bowl chlorinator enables precise dosage. Sometimes a special electric pump is used for this purpose. For on-site chlorine production, electrical devices can be bought that convert a solution of kitchen salt to a chlorine solution (Oliveira, Tavares and Meyers, 1995).
Chlorine doses must be monitored and adjusted to water quality and quantity. For this purpose, small test kits are available. Chlorine-producing chemicals must be stored and prepared with care. See also Fact Sheets 7.3 and 7.4 on domestic chlorination and pot chlorination.

initial cost: A chlorinator and hoses can cost as little as US$15. To this the cost of the tank for the concentrated solution, the construction costs of a protective shelter should be added.
yield: Generally 350 to 1400 m^3 of treated water per kg of 70% chlorine compound.
area of use: Where drinking water needs extra disinfection and chlorine is available.
trademarks: Chlorine compounds have many trademarks.

b. Description of O&M activities

operation

The chlorine tank has to be refilled with a freshly prepared solution once or twice a week. The flow rate has to be checked and adjusted if necessary. Operators must be very careful to avoid contact of chlorine compounds or solutions with eyes or clothes. In some cases, a logbook is kept with data on amounts of chlorine applied and residual chlorine levels measured. Chlorination can easily be learned.

maintenance

Chlorinators regularly have to be adjusted and cleaned of chlorine salts. When hoses get affected by chlorine they have to be replaced. If a steel chlorine tank is used, it must annually be painted and checked for corrosion. Protective gloves and utensils used for the preparation of the chlorine solution occasionally need replacement, and the shelter of the chlorine solution tank needs maintenance.

organizational aspects

Usually the water committee appoints a caretaker who is trained for the job. The chlorine compound has to be obtained through a merchant or the health department and an adequate supply of chlorine compound must be kept in stock. An external organization like a governmental health or water department will have to provide training for caretakers and monitoring.

c.O&M requirements

activity	frequency	human resources	materials & spare parts	tools & equipment
refill chlorine tank	once or twice a week	local	chlorine compound, water	spoon, scale, bucket, stirring rod
adjust and clean chlorinator	regularly	local	water	measuring cup, stopwatch
replace hose or chlorinator	occasionally	local	hose, small tubes of plastic, glass etc., plug, bowl	knife, nail
paint steel tank	annually	local	latex paint	steel brush, paint brush
check and adjust doses	regularly	area	test medium, water sample	test kit

d. Actors implied and skills required in O&M

actor	role	skills
caretaker	refill chlorine tank and prepare solution, clean and adjust chlorinator, perform small repairs	basic skills
water committee	supervise caretaker, collect fees	organizational skills
local health worker, shopkeeper or merchant	provide or sell chlorine compound	no special skills
external support	check residual chlorine in water and adjust doses, caretaker	basic testing and calculation, training skills

e. Recurrent costs

Recurrent costs for chlorine-producing chemicals in the USA are about US$7 per kg of available chlorine. In other countries this figure may differ substantially. One kg of available chlorine (1.4 to 4 kg of compound) is needed for disinfection of 500 to 2000 m^3 of water. Costs for rubber gloves, hoses and other spare parts are generally low. Apart from this, there will be recurrent costs for the fee of the caretaker, monitoring and training.

f. Problems, limitations and remarks

frequent problems

Bad quality hoses wear quickly. Some chlorine compounds are very sensitive to storage conditions and rapidly lose strength. If the chlorinator gets clogged or residual chlorine is not monitored, disinfection may not be sufficient.

limitations

Chlorination does not kill all pathogenic organisms but is generally very effective. In alkaline water, pH above 8, chlorination is less effective. When the water contains a lot of organic matter or suspended material, pretreatment will be needed. High cost and unavailability of the chlorine compound can be serious limitations.

remarks

Chlorination affects the taste of water and for that reason may be rejected by consumers. On the other hand, sometimes a chlorine taste is appreciated. The taste of chlorine in water is no proof of proper disinfection. Often a chlorine taste is caused by the application of too little chlorine.

• Slow Sand Filtration (O&M fact sheet)

a. Brief description of technology

Slow sand filter water purification is a combination of biological, chemical and physical processes occurring when water slowly passes downwards through a bed of sand. Fine particles are filtered out, and in the sand and on top of the filterbed, a population of micro-organisms develops that feed on bacteria, viruses and organic matter in the water. The filter reservoirs have drains on the bottom, covered with gravel and the filter sand. An inlet provides for smooth entrance of the raw water and an outlet structure leads the clean water from the drains to the clean water mains. During operation the filter sand is covered with a water layer of 0.3 to 1.0 m. For good functioning there must be a continuous flow in the range of 0.1 to 0.3 m/hour. For community use, filter reservoirs can be made of concrete, bricks, ferrocement etc. At least two filters are needed to provide continuous operation.
It is recommendable to combine slow sand filters with a dynamic roughing filter pretreatment unit. When raw water quality is low, adding upflow roughing filters is recommended. Sometimes the water is chlorinated afterwards to prevent recontamination. For small scale application, see also Fact Sheet Household slow sand filter. With good operation and maintenance a slow sand filter produces water virtually free from harmful organisms.

initial cost: Data from rural India, 1983, indicate US$60-130 per m^2 of filter area. In Colombia, this was US$105-215 per m^2 in 1987.
yield: 0.1 - 0.3 m/hour or 0.028 - 0.083 l/s/m^2.
area of use: All over the world.
manufacturers: Slow sand filters can be built by experienced building contractors or even by communities with external technical assistance.

b. Description of O&M activities

operation

Operation of a slow sand filter is crucial to its effectiveness. The flow of water must be maintained in the range of 0.1 and 0.3 m per hour to provide the organisms in the filter with a stable flow of nutrients and oxygen and give them time to purify the water. After several weeks to a few months the population of micro-organisms gets too dense and starts to clog the filter. Depending on filter design, flow rates may have to be adjusted accordingly or the layer of supernatant water on the filter will get too high. The caretaker of a slow sand filter keeps a logbook with flow rates and operation and maintenance activities. Slow sand filters can be operated and even monitored by communities, provided caretakers are trained well. It takes less than one hour a day for a caretaker to check functioning and adjust flow rates. Cleaning the site and other activities may take more time.

maintenance

When flow velocities get too low the filter is drained and the top layer of the sand is scraped off, washed, dried in the sun and stored. After several scrapings the sand is restored, together with new sand to make up for losses during washing. It takes one day for several people to clean a filter unit. Hygienic measures must be taken every time someone enters a filter unit for maintenance or inspection. Valves must be opened and closed every two months to keep them from getting stuck. Any leaks must be repaired immediately. If well-designed and constructed, hardly any repairs of the filter tanks and drainage system will be needed, although valves and metal tubing may need occasional attention. Test kits are available that only require some basic training to monitor water quality.

organizational aspects

organizational aspects

A slow sand filter for community use requires quite some organization in order to have enough labour for scraping and resanding of filter units. A local caretaker will have to be trained and some other people may need training for water quality testing and to be able to replace the caretaker. It may take some time for people to get to trust that a green and slimy filter is capable of producing safe water. Apart from extra sand, some chlorine and test materials very few external inputs are needed. With proper external assistance, water organizations can become very independent in managing their water treatment.

c.O&M requirements

activity	frequency	human resources	materials & spare parts	tools & equipment
check inflow	daily	local		
regulate flow	daily	local		
keep logbook	daily	local	logbook. pen	
clean site	daily	local		broom
scrape off sand, wash dry and store	about every six weeks	local	water, disinfectant for tools, boots or feet	wheelbarrow, hoe, rake, spade, rope, bucket, ladder, planks, broom, wash basin
resand filter	about every 18 months	local	recycled and new sand, water, disinfectant for tools, boots or feet	sieve, wheelbarrow, hoe, rake, spade, rope, bucket, ladder, planks
repair valve	occasionally	local	washers, spare valve	spanners, screwdriver, wrench
replace metal tubing	occasionally	local or area	nipples and accessories, plumbing sealant or teflon, cement, sand,	steel saw, wrench, pipe threader hammer, chisel, trowel, bucket
disinfect filter outlets	occasionally	local	chlorine	bucket, brush
analyze water quality	regularly	local or area	water sample, test media	test kit

d. Actors implied and skills required in O&M

actor	role	skills
local caretaker	regulate flow, keep site clean, lead scraping and resanding	fair understanding of filter process and hygiene, organizational skills
water user or paid worker	assist in scraping and resanding of filter units	no special skills
water committee	supervise caretaker, monitor water quality, collect fees, organize scraping and resanding	organizational skills, basic water quality testing
local plumber	repair valves and piping	basic plumbing
external support	train caretaker, monitor water quality	training and microbial testing skills

e. Recurrent costs

The caretaker's fee and the cost of additional sand are the main recurrent costs, assuming that water users provide occasional labour inputs free of charge.

f. Problems, limitations and remarks

frequent problems

If flow rates through the filter are too high, water quality drops. Excessive turbidity (>30 NTU) in the raw water can cause the filter to clog rapidly; in this case a prefilter may be needed. When water quality is very bad, harmful and badly tasting products like NH_3 and H_2NO_3 may be formed in the lower layers of the filter. If water flow is interrupted for more than a few hours, beneficial micro-organisms in the filter may die and filter action is disturbed. Smooth vertical surfaces can cause short circuits in the water flow, producing poor quality water.

limitations

In some regions, sand is expensive or difficult to get. Slow sand filters require a substantial initial investment and dedicated operation and maintenance.

remarks

After resanding a filter it takes a few days to ripen; in this period water quality is lower.

• Public Standpost
(O&M fact sheet)

a. Brief description of technology

At a public standpost or tapstand people from various households can get water from one or more taps. Because they are used by many people and often not so well taken care of, the design and construction have to be more sturdy than with domestic connections. The standpost includes a service connection to the supplying water conduit, a supporting column or wall and one or more 0.5 inch protruding far enough from this column or wall to enable easy filling of the water containers. The taps can be a globe or a self-closing type.

The column or wall may be of wood, brickwork, dry stone masonry, concrete, etc. Some standposts have a regulating valve in the connection to the mains that can be set and locked to limit maximum flow. Also a water meter may be included. A solid stone or concrete slab or apron under the tap and a drainage system must lead spilled water away and prevent the formation of muddy pools. A fence may be needed to keep cattle away. The residual pressure head of the water at the tapstand should preferably be between 10 and 30 metres and should never be under 7 or over 56 metres. Location and design for a public standpost have to be determined in close cooperation with future users.

initial cost: In 1995 a self-closing tap for 0.5 to 1-inch pipes costs US$12 (UNDP/APSO, 1995). Cheaper taps can be found. Other costs depend largely on standpost design.
number of taps: 1 to 3 and more.
users per tap: Maximum 200 people.
yield: 0.2 to 0.4 l/s per tap.
area of use: Piped public water systems.

b. Description of O&M activities

operation

Water users clean and fill their containers at the tap. Bathing and washing of clothes is usually not permitted at the standpost itself. The tap site has to be cleaned daily and the drain inspected.

maintenance

The drain must be cleaned at least once a month. Formation of pools must be prevented at all times. Once in a while a rubber washer or other part of a tap may have to be replaced. The fence may need repair too. If the structure gets serious cracks it must be repaired, and when wood rots it must be treated or replaced. Occasionally the tubing may leak or need replacement. For maintenance of a water meter, see Fact Sheet 8.7 on small flow water meters.

organizational aspects

A caretaker or tap committee may be appointed in order to keep the tap functioning and the surroundings clean and to regulate the amounts of water used. These people may also collect the fees for water use. Sometimes water vendors fill their tanks at public tap stands against special rates for resale to people living farther away.

c.O&M requirements

activity	frequency	human resources	materials & spare parts	tools & equipment
tap water	daily	local		jar, bucket, can etc.
clean site	daily	local		broom or brush
inspect and clean drain	daily	local		hoe, spade
repair or replace valve	occasionally	local	rubber or leather washer, gland seal, Teflon, flax, spare valve	spanners, screwdriver, pipe wrench
repair fence	occasionally	local	wood, steel wire, nails	machete, pliers, hammer
repair valve stand, apron or drain	occasionally	local	wood, nails, cement, sand, water, etc.	hammer, saw, trowel, bucket, etc.
repair piping	occasionally	local	pipe nipples, connectors, elbows etc., oil, Teflon, flax or plumbing putty	pipe wrench, pipe cutter, saw, file, pipe threader

d.Actors implied and skills required in O&M

actor	role	skills
user	tap water, keep site clean	no special skills
caretaker or tap committee	clean site, perform small repairs, collect fees	basic skills
communal water committee	organize more major repairs, collect fees	organizing and bookkeeping skills
mason	repair tapstand and apron	masonry
plumber	repair piping and taps	basic plumbing
external support	monitor hygiene, train committee members	training skills and microbial testing

e. Recurrent costs

Recurrent costs for a tapstand comprise a few minor repairs of taps per year and occasionally repair of the pipes, column, wall, apron or drain.

f. Problems, limitations and remarks

frequent problems

Tampering, insufficient maintenance and conflicts over use due to bad location of tapstand or unsolved social problems. Poor drainage. Often taps are not closed after use and even left open on purpose to irrigate a nearby plot. Tapstands at the tail end of a piped system often have insufficient water pressure.

limitations

If people are willing to organize communal use and maintenance the only limitation is the cost.

remarks

Special attention should be given to how the water is handled after recollection at the tapstand in order to prevent subsequent contamination.

• Ventilated Improved Pit Latrine (O&M fact sheet)

a. Brief description of technology

The Ventilated Improved Pit (VIP) latrines are designed to reduce two of the problems frequently encountered by traditional latrine systems, namely their smell and their insect production. A VIP latrine differs from a traditional latrine by a vent pipe covered with a fly screen. Wind blowing across the top of the vent pipe creates a flow of air which sucks out the foul smelling gases from the pit. As a result fresh air is drawn into the pit through the drop hole and the superstructure is kept free from smells. The vent pipe also has an important role to play in fly control. Flies are attracted to light and if the latrine is suitable dark inside they will fly up the vent pipe to the light. They cannot escape because of the fly screen, so they are trapped at the top of the pipe until they dehydrate and die. Female flies, searching for an egg-laying site, are attracted by the odours from the cent pipe but are prevented from flying down the pipe by the fly screen at its top.
VIP latrines can also be constructed with a double pit. The latrine has two shallow pits, each with their own vent pipe but only one superstructure. The cover slab has two drop holes, one over each pit. Only one pit is used at a time. When this one is full, its drop hole is covered and the second pit is used. After a period of at least one year, the contents of the first pit can be removed safely and used as soil conditioner. The pit can be used again when the second pit has filled up. This alternating cycle can be repeated indefinitely.
initial cost: *Single pit VIP family latrine:* about US$ 70 - 400. *Double pit VIP family latrine:* about 200 - 600 US$. Prices include: costs for materials (60-80%), transport (5-30%), and local labour (10-25%). Prices depend on: (1) pit volume, (2) quality of lining, slab and superstructure, (3) extent to which locally available materials are used, and (4) country or region.
area of use: Rural or peri-urban areas, household and public use.

b. Description of O&M activities

operation

Operation of pit latrines is quite simple and consists of regularly cleaning the slab with water (and a little disinfectant if available) to remove any excreta and urine. The door must always be closed so the superstructure remains dark inside. The drop hole should never be covered as this would impede airflow. Appropriate anal cleaning materials should be available in or near the latrine. Non-biodegradable material like stones, glass, plastic, rags etc. should not be thrown in the pit as they reduce the effective volume of the pit and hinder mechanical emptying.

maintenance

Every month the floor slab has to be checked for cracks and the vent pipe and fly screen must be inspected to ensure they are not corroded or damaged. Rainwater should drain away from the latrine. Any damage should be repaired. Repair of the superstructure (especially light leaks) may be necessary too. When the contents of the pit reach the level of 0.5 m below the slab, a new pit has to be dug and the old pit covered with soil. Another possibility is to empty the pit mechanically.

In case of a twin pit system, one should switch over to the other pit when a pit is full. The full pit can be emptied safely by hand after it has been standing for a year or more. Occurred

organizational aspects

Where latrines are used by a single household, O&M tasks are implemented by the household itself or by hired labour. If more households use the latrine arrangements on rotation of cleaning tasks have to be made and agreed upon to avoid social conflicts. Pits can only be emptied manually if their contents have been left to decompose for at least a year. In

all other cases either new pits have to be dug when a pit is full or the pit has to be emptied mechanically (see Fact Sheet 9.3 on .....).

If double pit latrines are used, the users need to understand the concept of the system fully in order to be able to operate it properly. User education has to cover aspects such as reasons for switching, using one pit at the time, use of excreta as manure and the need to leave the full pit at least a year before emptying. The users also need to know how to switch the pit and how to empty it, even when they do not do these tasks themselves. Where these tasks are carried out by the private (informal) sector, the labourers also have to be educated in the concept of the system and its operational requirements.

c. O&M requirements

activity	frequency	human resources	materials & spare parts	tools & equipment
clean drop hole, seat and superstructure	daily	household	water, soap	brush, bucket
inspect floor slab, vent pipe and fly screen	monthly	household		
clean fly screen and vent inside	every one to six months	household	water	twig or long bendable brush
repair slab, seat, vent pipe, fly screen or superstructure	occasionally	household or local	cement, sand, water, nails local building materials	bucket or bowl, trowel, saw, hammer, knife
dig new pit and transfer latrine slab and superstructure (if applicable)	depending on size and number of users	household or local labour	sand, possibly cement, bricks, nails and other local building materials	shovels, picks, buckets, hammer, saw, etc.
switch to other pit when pit is full	depending on size and number of users	household or local labour		shovels, buckets, wheelbarrow, etc.
empty pit (if applicable)	depending on size and number of users	by hand: household or local labour (not recommended), or by mechanical means: specialized service	by hand: water, by mechanical means: water, spare parts for machinery	by hand: shovel, bucket by mechanical means: pit emptying equipment

d.Actors implied and skills required in O&M

actor	role	skills
user	use latrine, keep clean, inspect and perform small repairs, empty full pit and switch over, dig new pit and replace latrine	understanding of hygiene
local unskilled labour (sweepers/scavengers)	dig pits, transfer structures, empty full pits of double pit systems, small repairs, solving small problems	knowledge about the concept of a double pit system (when working with such systems), knowing how to solve simple problems.
local mason	build and repair or transfer latrines	basic masonry, latrine building
health department	monitor latrines and hygienic behaviour of users, train users	training skills and knowledge on sanitation

e.Recurrent costs

These costs are usually very low, maximum about US$1 to 2 per capita per year, as normally maintenance activities are few (mainly cleaning) and can be done by the households themselves. Even if local labour has to be hired for digging a new pit, the recurrent costs per time unit and user are low although paying in full at once may pose a problem. The same applies for the cost of mechanically emptying of the pit. Emptying a double VIP pit can be done by hand, either by the household itself or by hired labour. Sometimes the humus can be send to farmers.

f. Problems, limitations and remarks

frequent problems

Bad quality of the floor slab due to inappropriate materials or improper curing of concrete. Inferior quality fly screens get damaged easily by the effects of solar radiation and foul gases. Improperly sited latrines can get flooded or undermined. Children may be afraid to use the latrine because of the dark or because of fear of falling into the pit. If the superstructure allows too much light to come in, flies will be attracted by the light coming through the squat hole and may fly out into the superstructure; this may jeopardize the whole VIP concept. Odour problems may occur during the night and early morning hours in latrines relying more on solar radiation for the air flow in the vent pipe than on wind speed. Leakages between pits can occur because the dividing wall is not impermeable or the soil is too permeable.

limitations

In hard soils it may be impossible to dig a proper pit. Pits should preferably not reach groundwater level and latrines must be 15 to 30 metres away from ground and surface water sources. VIP latrines cannot prevent mosquitoes breeding in the pits. People may not be able to bear the much higher costs for construction of a VIP latrine in comparison to a simple pit latrine.

remarks

Cultural resistance against handling human waste may prevent households from emptying their double-pit themselves. Usually local labour can be hired to do the job

• Double-Vault Compost Latrine (O&M fact sheet)

a. Brief description of technology

The double-vault compost latrine consists of two watertight chambers (vaults) to collect faeces. Urine is collected separately as the contents of the vault have to be kept relatively dry. Initially, a layer of absorbent organic material is put in the vault and after each use, the faeces is covered with ash (or sawdust, shredded leaves or vegetable matter) to deodorize the faeces, soak-up excessive moisture and improve C/N ratio, which ensures that sufficient nitrogen is retained to make a good fertilizer. When the first vault is three quarters full, it is completely filled with dry powered earth and sealed so the contents can decompose anaerobically.

The second vault is used until it is three quarters full and the first vault is emptied by hand, the contents are used as fertilizer. The vaults have to be large enough to keep faeces for at least a year in order to become pathogen free. The superstructure is built over both vaults with a squat hole over each vault which can be sealed off. The latrine can be built everywhere as there is no pollution coming from the watertight chambers to pollute the surroundings. Where there is rock or a high watertable, the vaults can be placed above ground.

initial cost: US$35 - 70 (Guatemala, in Winblad U. and Kilama W., 1985 (in 1978 US$))
Prices include costs for materials and local labour; construction with above ground vaults of 0.3 m^3 each and a movable raised seat.

area of use: *Areas where people are motivated to handle and use humus of human excreta as a fertilizer and where no water is used for anal cleansing.*

b.Description of O&M activities

operation

Initially some absorbent organic material is put in the empty vault. After each use and whenever available wood ash and organic material are to be added. When urine is collected separately it is often diluted with 3-6 parts of water and utilized as fertilizer. This may cause a health hazard and should be avoided. Adding lime or ash may help, but there is no guarantee that the urine will then be safe. Water used for cleaning should not be allowed to go into the latrine as it will make the contents too wet.

maintenance

When the vault is three-quarters full, the contents are leveled with a stick, after which dry powdered earth is added till the vault is full. The squat hole is then sealed and the other vault emptied with a spade and bucket, after which it can be taken into use. The removed contents can be used safely as a fertilizer. Households may grow insect repelling plants like citronella around the latrine

Organizational aspects

Extensive investigation among potential users is needed to find out if the system is culturally acceptable and if they are motivated and capable to operate and maintain the system properly. Prolonged support by the agency is needed to ensure that users understand the system and execute operation properly.

c.O&M requirements

activity	frequency	human resources	materials & spare parts	tools & equipment
clean toilet and superstructure, empty urine collection pot	daily	household	water, lime, ashes	brush, water container
add ashes or other organic material	after each defecation and whenever available	household	wood ashes and organic material	pot to contain the material, small shovel
inspect floor, superstructure and vaults	monthly	household		
repair floor, superstructure or vaults	when necessary	household or local	cement, sand, water, nails, local building materials	bucket or bowl, trowel, saw, hammer, knife
close full vault after leveling and adding soil, empty other vault, open its squat hole and add 100 mm of absorbent organic material before taking into use, store humus (or use directly)	depending on size and number of users	household or local pit emptier	water, absorbent organic material	shovel and bucket
use humus as fertilizer	when needed	household or other users	humus	shovel, bucket, wheelbarrow

d. Actors implied and skills required in O&M

actor	role	skills
user/household	use latrine, remove urine, keep clean, inspect and perform small repairs, empty pit and switch	understanding of hygiene, understanding of system and its O&M
local mason	build and repair latrines	basic masonry, latrine building skills
local pit emptier	empty pit and switch, check system and perform small repairs	understanding of hygiene, understanding of system and its O&M
external support organization	investigate applicability, monitor users' O&M and hygienic behaviour and provide feedback, train users and local artisans	research/surveying skills, training skills, knowledge of system, organizational skills, communicative skills

e. Recurrent costs

When the system is well designed and constructed and O&M is done properly the recurrent costs will remain limited to the costs made for small repairs and emptying of a vault when full. Sometimes the humus can be sold to farmers.

f. Problems, limitations and remarks

frequent problems

Proper operation needs full understanding of the concept. This is often lacking and as a result for instance contents are left too wet, making the vault difficult to empty and malodorous. Where people are eager to use the contents as fertilizer, they may not allow sufficient time to become pathogen free.

limitations

Only to be used where people are motivated to use human excreta as a fertilizer. The system is not appropriate where water is used for anal cleansing.

remarks

Double-vault latrines have been successfully used in Vietnam and Central America (Guatemala, Honduras, Nicaragua, El Salvador). When tried elsewhere they have usually been unsatisfactory.

• Septic Tank and Aqua Privy (O&M fact sheet)

a. Brief description of technology

Septic tanks and aqua privies have a water-tight settling tank of one or two compartments, to which waste is carried by water flushing down a pipe connected to the toilet. If there is a tank immediately under the latrine, excreta drop directly into the tank through a pipe submerged in the liquid layer (aqua privy). If the tank is located away from the latrine (septic tank) the toilet usually has a U-trap. The systems do not dispose off wastes: they only help to separate the solid matter from the liquid. Some of the solids float on the surface, where they are known as scum, while others sink to the bottom where they are broken down by bacteria to form a deposit called sludge. The liquid effluent flowing out of the tank is, from a health point of view, as dangerous as raw sewage and remains to be disposed of, normally by soaking into the ground through a soakaway or with a connection to small bore sewers. The sludge accumulating in the tank must be removed regularly, usually once every one to five years, depending on size, number of users and kind of use. When sullage is also disposed in the tank, a larger capacity is required for both the tank and the liquid effluent disposal system. Connection to small bore sewers may then be needed. Where high groundwater tables or rocky or impermeable undergrounds occur, this may also be the case. Every tank must have a ventilation system to allow escape of explosive methane and malodorous gases (generated when bacteria decompose some of the sewage constituents) from the tank. Septic tanks are more expensive than other onsite sanitation systems and require sufficient piped water. Aqua privies are slightly less expensive and need less water for flushing.

initial cost: I. US$90-375, including cost of labour and material
area of use: Rural or peri-urban areas where water is available.
amount of water needed per toilet flushing: about 2 to 5 litres if a pour-flush pan or agua privy system is used.

b. Description of O&M activities

operation

Regular cleaning of the toilet with soap in normal amounts is unlikely to be harmful, the use of large amounts of detergents or chemicals may disturb the bio-chemical process in a tank. In aqua privies the amount of liquid in the tank should be kept high enough to keep the bottom of the drop pipe at least 75 mm below the liquid level. A bucket of water should be poured down the drop pipe daily in order to clear scum (in which flies may breed) from the bottom of the drop pipe and to maintain the water seal. When starting with a new tank, adding some sludge from another tank will ensure the presence of micro-organisms so that the anaerobic digestion process can start directly and more completely.

maintenance

Routine inspection is necessary to check whether desludging is needed and to ensure that there are no blockages at the inlet or outlet. The tank should be emptied when solids occupy between one-half and two-thirds of the total depth between the water level and the bottom of the tank.

organizational aspects

Organizational aspects revolve around reliability of emptying services, availability of skilled contractors for construction and repair and control of disposal of the sludge.

c. O&M requirements

activity	frequency	human resources	materials & spare parts	tools & equipment
clean squatting pan or seat and shelter	daily	household	water	brush, water container
unblock U-trap when blocked	occasionally	household	water	flexible brush or other flexible material
inspect if entry pipe is still submerged (for aqua privies)	regularly	household	water	stick
inspect floor, squatting pan or seat and U-trap	monthly	household		
repair squatting pan or seat, U-trap or shelter	occasionally	household or local artisan	cement, sand, water, nails, local building materials	bucket or bowl, trowel, saw, hammer, knife
control vents	annually	household	rope or wire, screen material, pipe parts	scissors or wire cutting tool, pliers, saw
empty tank	every one to five years	service crew	water, fuel, lubricants, etc.	vacuum tanker (large or mini) or (possibly) MAPET equipment.

d. Actors implied and skills required in O&M

actor	role	skills
user	flush, keep clean, inspect vents, keep record of emptying dates, control contents in tank and contact municipality or other organization for emptying when necessary	understanding of hygiene, basic bookkeeping, measuring skills
sanitation service	empty tank, control tank and vents, repair if needed	skills to work with vacuum tanker or MAPET, basic masonry
agency	monitor tank performance, and tank emptying by emptying teams, train emptying teams	training skills, monitoring skills, organizational skills and technical knowledge

e. Recurrent costs

The main cost involved is the emptying of the tank. The frequency of emptying depends on the amount of solids and liquids entering into the tank. The average annual O&M cost per capita measured over 39 countries was US$3.09, while in Brazil this cost was only US$0.67 (World Bank studies, quoted in Wilson H., 1988 (in 1987 US$).

f. Problems, limitations and remarks

frequent problems

Many problems are due to inadequate consideration being given to liquid effluent disposal. Large surges of flow entering the tank may cause a temporarily high concentration of suspended solids in the effluent owing to disturbance of the solids which have already settled out. Leaking tanks may cause insect and odour problems in aqua privies because the water

seal is not maintained.

limitations

Unsuitable for areas where water is scarce, where financial resources are insufficient for construction of the system, or where safe tank emptying cannot be done or afforded. Where not enough space is vailable for soakaways or drainage fields small bore sewers will have to be installed. Aqua privies only function properly when they are very well designed and constructed and operated.

remarks

Septic tank additives - such as yeast, bacteria, and enzymes - which are often sold for "digesting scum and sludge" and "avoiding expensive pumping" have not been proven effective.

• Drainage Field (O&M fact sheet)

a. Brief description of technology

Drainage fields consist of gravel-filled underground trenches called leachlines or drainage trenches, into which the liquid effluents coming from septic tank are led through open-jointed (stoneware) or perforated (PVC) pipes, allowing the effluents to filtrate into the ground. Initially the infiltration into the ground may be high, but after several years the soil clogs and an equilibrium infiltration rate is reached. If the sewage flow exceeds the equilibrium rate of the soil, eventually the sewage will surface over the drainage field..

Trenches are usually 0.3-0.5 m wide with a depth of 0.6-1.0 m below the top of the pipes,. They are laid with a 0.2-0.3% gradient and containing 20-50 mm diameter gravel with 0.3 to 0.5 m of soil on top, with a barrier of straw or building paper to prevent soil from washing down. They should be laid in series so that as each trench fills its overflows to the next one. This ensures that each trench is used either fully or not at all. Trenches should be 2 m apart, or twice the trench depth if this is greater than 1 m. The bottom of a trench should be at least 0.5 to 1 m above groundwater, bedrock or impermeable soil and land slope should not exceed 10%. An equal area of land should be kept in reserve for possible extension or replacement of the drain field if it becomes clogged.

Compared to soakaways, drainage fields are often used where larger quantities of liquid effluents are produced.

initial cost: no data found.
area of use: rural or peri-urban areas where sufficient water and space are available and soil is permeable.

b. Description of O&M activities

operation

Hardly any activities for operation are required, except for observing if overflowing occurs and switching to a second drainage field every 6 to 12 months and administering the dates of switching (if applicable).

maintenance

Clean tank outflow and check if still in order (if not it should be cleaned or repaired). Deblocking of delivery pipe may be necessary sometimes. Diversion boxes have to be cleaned from time to time. Control plant growth to prevent roots from entering the pipes or trenches.

organizational aspects

Minor O&M and bookkeeping organized and executed by households, groups of households or community organization. The government department needs to monitor performance of drainage fields and train users (and their organizations), artisans and caretakers on technical aspects of O&M.

b. O&M requirements

activity	frequency	human resources	materials & spare parts	tools & equipment
control plant growth	regularly	household or caretaker		shovel, bucket, panga etc.
switch to other drainage field	once every six to twelve months	household or caretaker	bricks or other material to block pipes	tools to open diversion box
deblock delivery pipe	occasionally	household, caretaker or local artisan	water, piece of pipe, glue	brush, shovel, long stick or flexible brush, knife, saw
clean diversion boxes	every month	household or caretaker	water	shovel, brush
check outflow of tank and clean	once a month	household or caretaker	water	brush, tools to open access hole.

d. Actors implied and skills required in O&M

actor	role	skills
household/user or local caretaker	check outflow tank and performance of drainage field and control plant growth	understanding of hygiene, some technical knowledge of tank and field
local artisan	repair parts if broken, remove obstructions in delivery pipes	basic masonry, piping techniques, knowledge of system techniques and functioning
agency	monitor performance of systems, train users/caretakers and local artisans, provide assistance with big problems	training skills, technical skills for repair and maintenance of drainage fields, monitoring skills

e. Recurrent costs

If the system is well designed, repairs are needed only very occasionally and therefore recurrent costs are low.

f. Problems, limitations and remarks

frequent problems

Overflowing leachlines, unpleasant odour, groundwater contamination and social conflict (over siting of the drainage fields, odour etc.

limitations

Unsuitable where insufficient space, water or financial resources for construction are available, where the permeability of the soil is poor or where bedrock or groundwater are at shallow depth.

remarks

Pressure can be taken off drainage fields by reducing the amount of water and solids flowing into the solids interceptor tank, e.g. by improved design of toilets which use less water or by preventing sullage from entering the tank.

• Small Bore or Settled Sewerage (O&M fact sheet)

a. Brief description of technology

Small bore sewerage (or settled sewerage) is a sewerage system that is designed to receive only the liquid fraction of household wastewater. The setteable solid components of the waste are kept in an interceptor tank (basically a single-compartment septic tank) which needs periodic desludging. Because the sewers only receive the liquid sewage, they are designed differently from conventional sewers and have the following advantages:

- the system needs less water as solids do not need to be transported;
- excavation costs are reduced because pipes can be laid at shallow depths and do not need to maintain self-cleansing velocity;
- reduced material costs as the diameter of pipes can be small (peak flow is attenuated by the interceptor tanks) and there is no need for large manholes
- reduced treatment requirements because the solids are kept in the interceptor tanks.

The small bore sewer system consists of a house connection, an interceptor tank, sewers, cleanouts/ manholes, vents , sewage treatment plant and lift stations (if there is no gravity flow). The system is most appropriate in areas that already have septic tanks but where the soil cannot (no longer) absorb the effluent or where densities are such that there is no room for soakaways. It also provides an economical way to upgrade existing sanitation facilities to a level more comparable to conventional sewers.

initial cost: No recent data available, but the cost of the system in Brotas (Brazil) has been calculated as being 78% cheaper than conventional sewerage; in Australia and USA savings on construction cost are 25 to 35 percent but this excludes the costs of the interceptor yanks.

area of use: areas where individual soakaways are not appropriate (soil conditions or densities) areas where pour-flush latrines with soakpits can be upgraded to a small bore sewer system.

b. Description of O&M activities

operation

The main operational requirement for the household is to ensure that no solids can enter the system and that the interceptor tank functions properly.

maintenance

Regular removal of the sludge in the interceptor tank. This has to be checked by the local sewerage authority because the system will be at risk if solids can enter. Removal of blockages, regular control of sewage pipes and periodic flushing. The performance of appurtenances in the pipeline system such as cleanouts, manholes, (possible) lift stations, and ventilation points should be regularly checked and maintained.

organizational aspects

The main organizational aspects with the system are the organization of desludging services for the interceptor tanks. The principal problems related to this desludging revolve around responsibility. Normally this lies with the property owner since the interceptor tank is on their property. Residents who are not owners have no incentive to desludge regularly. Desludging cost money and is inconvenient and sludge overflowing in the sewerage system will not directly affect the resident but will affect the communal sewer system downstream. If the sewer system is to work effectively, therefore, responsibility for tank desludging must devolve to the organization responsible for communal sewer maintenance. This organization also has to bear the responsibility for treatment of the liquid from the sewers and the sludge from the interceptor tanks.

c. O&M requirements

activity	frequency	human resources	materials & spare parts	tools & equipment
clean grease trap	daily/weekly	household	water	
repairs and removal of blockages	when needed	local labour or mechanic	water, specialized materials and spare parts	rodding tool, mechanic's tool set
check inspection chambers, appurtenances such as pumps and controls, vacuum and surge chambers, check valves	at least annually	household or mechanic	water	basic mechanic tool set
inspect street sewers	regularly	staff sewerage department	specialized spare parts and materials	specialized tools and equipment

d. Actors implied and skills required in O&M

actor	role	skills
household	check appurtenances within pot, assist community organization in maintenance of inspection chambers and common block sewer line	understanding of system, some technical skills to check appurtenances
local labour/mechanic	check on-site appurtenances, perform small repairs, removal of blocks	mechanical skills
community organization	organize regular checking of block sewer, notify agency of problems cannot be solved, collect sewer charges	understanding of system and bookkeeping skills, organizational skills, monitoring skills, communicative skills
agency	monitor system's performance; keep regular contacts with community organizations and monitor their performance; train teams, mechanics, organization staff and community organization members, operate and maintain collector sewer, pumping station and treatment plant	technical skills, administrative skills, organizational skills, monitoring skills, communicative skills, training skills

e. Recurrent costs

The main expenditure of recurrent costs is the emptying of the interceptor tanks, which varies per country and city. Other recurrent costs are needed for treatment, occasional flushing of the system and repairs to the system maintained.

f. Problems, limitations and remarks

frequent problems : Overflowing interceptor tanks because they have not been desludged in time. Blockages due to illegal connections without interceptor tank.

Limitations : Basically only suitable where septic tanks or other on-site system are already in existence. If a new system needs to be installed, the shallow sewer system is more appropriate as it does not need an interceptor tank. The dependency on regular desludging of the interceptor tank means that a well organized sewerage department is necessary.

Remarks : The system needs a somewhat regular lay-out along back lanes or streets and a regular (be it limited) water supply system. In many low-income urban areas these conditions do not apply and therefore the system is not appropriate for application. So far, positive experiences with the system have all been in developed countries.

4.3 Spare parts provision in general

Too often consideration of spare parts is an afterthought to the technical and operational design of a water supply or sanitation project, instead of being one of the principal items on a check-list for sustainability. Spare parts provision should therefore be one of the deciding factors of selection, not merely a consequence.

Spare parts can be defined as all materials and goods that are necessary for the efficient and sustainable operation and maintenance of a water supply or sanitation system. These include therefore:

- Mechanical, hydraulic, electrical and electronic parts
- Tools
- Seal and washers
- Fuel, lubricants
- Paint
- Chemicals, consumables
- Parts for essential transport and communication equipment
- Stationary

4.4 Towards sustainable spare parts provision

Spare parts provision should be viewed as much from the demand side as from the supply side. Furthermore, sustainable spare parts provision depends also from strategic issues.

Such elements as spare part needs, spare part costs and accessibility are likely to influence the ***demand of spare parts***, and the following items should be considered while analyzing demand of spare parts :

Spare parts needs

- Assessment of the spare part needs of a particular technical option, based on technical notice and experience;
- Identification and inventory of parts required, owing to an accurate diagnosis of problems most likely to occur, with their periodicity;
- Allowance made for emergency repairs, accidents, or scheduled replacement;
- Spare parts needs vary in time, and communities should be made aware of this fact;
- Possible determination of a "cut-off" point when it becomes more efficient to rehabilitate or replace, rather than maintaining a system;
- Proper operation and maintenance, as well as an effective preventive maintenance will definitely decrease the need and frequency of spare parts;
- Some parts can be interchangeable with other brands or technologies.

Spare parts costs

- Can the costs of spare parts be covered by the tariff in place ?
- Are the costs of transport to go and get spare parts covered by the tariff in place? If not, how are the costs met ?
- What are the financial mechanisms put in place in case tariffs are not sufficient to cover the costs of spare parts ?
- Comparison of spare parts produced abroad with similar spare parts

produced locally or in neighboring countries;
- Assessment of the importance of exchange rate fluctuations on the cost of spare parts.

Spare parts accessibility
- Distance between village and selling point is likely to influence demand of spare parts, even though spare parts are available at the selling point;
- Spare parts can be divided into three different categories: 1) *frequently needed* spare parts, for which the accessibility should be as close as possible to the village (shop, mechanic); 2) *occasionally needed* spare parts every six months or year, from which accessibility can be at a major close-by centre; 3) spare parts needed for major *rehabilitation or replacement*, for which the accessibility can be at the local region or state capital.

Such elements at the use of local material and manufacture, marketing and selling points, and perspective of profit are likely to have an influence the ***supply side,*** and the following items should be reviewed while analyzing the supply of spare parts:

Use of local material and manufacture
- Better use of materials from sustainable local sources;
- Options for recycling and re-use / restoration of worn parts;
- Improving the reliability of fabrication (quality control) and improving guarantees;
- Improving compliance with delivery deadlines through penalties, bonuses or other mechanisms;
- Encouraging local entrepreneurs or cooperatives to provide spare parts manufacture;
- Making sure that there is a commitment on a period for which parts are guaranteed to remain available;
- Building on experience of local manufacture in other sectors;
- Balancing the proportion of spare parts being manufactured locally and others from abroad;
- What incentives can be offered for local entrepreneurs (tax windows, subsidies, preferential consideration against foreign suppliers,...).

Marketing and selling points
- Encouraging local entrepreneurs, mechanics, shops in the distribution and supply of spare parts, making sure that they are aware of the market, and that accessibility can be divided according to the different categories of spare parts as described above in "accessibility";
- In some cases, it could be possible to install a system of revolving fund for spare parts which is managed by a cooperative of users or mechanics;
- Making sure that the provision of spare parts through donor assistance or government channels is only temporary and designed in strengthening, promoting the private sector;
- Creating better links between the supplier and the user;
- Ensuring stock control, warehousing and sustainable outlet options.

Perspective of profits
- Involving local manufacturers, entrepreneurs, mechanics and shops can be done if there is some kind of profit or benefit for them (incentives; definition of profit margins; percentage of sales as own income; free stock for first sales;
- Making sure that donor assisted or heavily subsidized prices do not "kill" the market; it that sense realistic market prices should be established right from

the start, in order to keep a system sustainable.

Strategic issues for improving spare parts provision include efficient planning, standardization or not, approaches to reduction of spare parts needs, appropriate pricing policy, private sector involvement and capacity-building.

Efficient planning

- Planning for spare parts provision should start as early as possible in the project cycle;
- During feasibility study, the project should assess : the type of spare parts presently available on the market, locally or in neighboring countries; the distribution network; the type of equipment used in other regions and other projects; the possibility of interchangeability; the possibility of local manufacture (steel works and plastic works); the costs of spare parts once they arrive to the customer; the level of import taxes; the national policy regarding spare parts provision;
- During the implementation of the project, ensuring that the provision of spare parts by making sure that it is sustainable on a long term basis, and that there are several possibilities ranging from an extremely dependent live of spare parts provision to an independent type;
- After the construction phase, improving the monitoring and evaluation of spare parts usage to help determination of rehabilitation timing and economic life of a scheme; and improving feed-back to manufacturers on the use and weaknesses of spare parts and equipment for future improvements to design.

Standardization or not?

- Several countries have chosen to standardize the choice of technology; this choice has positive aspects as well as negative aspects which should be carefully considered before applying such a policy; if the policy is applied, it could be for a certain number of years only;

For standardization	Against standardization
Common use of the same item of equipment encourages agencies and shopkeepers to store and supply spare parts as there is a "guaranteed demand"; Avoids proliferation of brands and technologies for which it is difficult to organize spare parts availability; Prices and market can be easier determined. Users become familiar with one type of technology. Training of personnel can be standardized.	Chosen technology does not respond totally to the needs and preference of users; Market is closed for new, innovative and cheaper technologies; Poor incentive for private sector involvement and research; Possible conflict with donor policies on technology choice. Competition between different brands can result into a price reduction or optimization.

Approaches to reduction of spare parts needs

- Better design of technology with minimization of replacements;
- Better engineering to reduce operation and maintenance requirements;
- Better use and operation, in spending more time on user education in order to reduce wear and tear;
- Introduction of a maintenance "culture", in which it is better to prevent than to cure.

Appropriate pricing policy

- It is important to note that the pricing policy of the donor regarding spare parts might play as an incentive for local distributors, but it might also raise false expectations and send distorted signals to a market;
- Highly subsidized prices might not be sustainable over a long period;
- Pricing policy could include an agreed margin of benefit for the different intermediaries right to the final outlet point, at a price which beneficiaries can afford and are willing to pay.
- Free price policy could enhance the market of spare parts distribution, but at the same result into higher prices for the consumer to start with; however, if competition exists between various brands, this could result in a decease in prices.
- A reduction of imported taxes on foreign equipment for water supply could be granted.
- Price s of spare parts should be one of the key element in the technology selection process.

Private sector involvement

- Policy towards private sector incentives and promotion;
- Are there spare parts manufactures in other sectors from whom lessons can be learnt, and with whom resources and experiences can be shared?
- What are the opportunities for inter-regional cooperation in terms of shared markets, marketing, agreements on prices or division of specialization?
- What are the possibilities of joint ventures with western firms and manufactures, to include technical, entrepreneurial and managerial training?
- Could the links between manufacturers be strengthened?
- How can the informal private sector at local level contribute to spare parts manufacture and provision?

Capacity-building

- Assessment of training needs for stock management, manufacture, distribution supply and use of spare parts;
- Opportunities for learning from the experiences from neighboring countries and partners.

Unit 2 : Analysis of participation

1. Outline of session

Objectives

- To identify all the actors who are involved in the operation, maintenance and management of rural water supply and sanitation systems
- To identify their role, interest, problems and degree of participation

Methodology

1. Introductory note
2. Interactive group exercise
3. Concluding remark

Materials

- ✓ Overhead transparencies
- ✓ A flip chart and masking tape
- ✓ An overhead projector with a screen or a white wall

Handouts

- ✓ Background information

2. Notes for the trainer

Introductory note

Operation and maintenance deals about technical activities, but it is also about people and institutions. This session aims to identify all the actors who are directly and indirectly involved in the operation and maintenance of water systems, see what is their role, and what are their interest (interest can be contradictory or complementary between different actors), and what are the major problems they are facing.

The facilitator will also explain that all the work that will be done during this session and the next one will be done with the whole group.

Different sitting arrangements should be organized, as participants will not need to take notes or make any special exercise. Tables should be put aside, and chairs placed in a semi circle facing the wall on which the group is going to reflect. All the results of the two coming sessions should be distributed to the participants once completed.

The participation analysis is an integral part of the O.O.P.P. analytical method (Objective Oriented Project Planning). A full explanation on the methodology is given in the supporting material. Some elements have been adapted though especially for this course.

This session requires that the facilitator has prepared beforehand a wall covered with paper (Craft paper or flip chart sheets), on which is drawn the format for the participation analysis (see exercise sheet). Participants will only need their marker pen.

Group exercise on analysis of participation

Once the framework has been explained, the facilitator will proceed by steps :

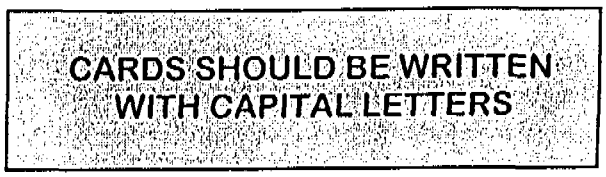
Step 1 : Ask the group what are the actors involved in the operation, maintenance and management of rural water supply and sanitation systems. The analysis can be done for both water supply and sanitation, or only for one of the two. This choice is left to the demand and need of the group , previously identified.
All contributions are materialized with cartons, on which the name of an actor is written down, and placing it the framework on the wall. The facilitator can ask for the assistance of the participants in writing down the names of the actors. Some of the cards can be grouped if necessary.

Step 2 : Ask the group what are the main roles of each major actor. Same methodology is applied. See background information for more details.

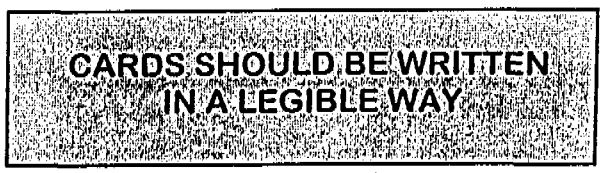
Step 3 : Participants can be divided into the five major groups which correspond to the five major group of actors (national level, provincial/ district/ level, local level, ...) and they will have to identify what are the interest of each group, and the problems they are facing. All the results are written down on cards and placed in the framework on the wall, which each group will present and stick, while explaining the meaning behind each card.

It is useful to recall to the participants some basic rules about card writing :

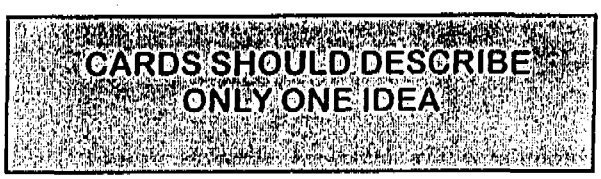
Rule 1 :



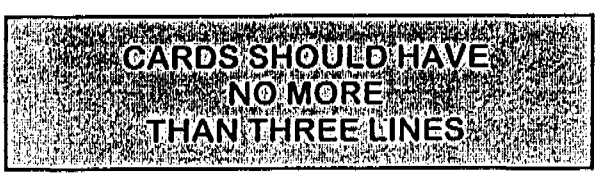
Rule 2 :



Rule 3 :



Rule 4 :



In the next session will be given more explanations about how to formulate problems in an appropriate way. The facilitator should accept formulations as they are now. However, if needed, explanations should be made about the cards with unclear formulation.

Concluding remark

The facilitator should go over the whole framework, highlight the main roles, interests and problems which have risen. One of the last column (***Present degree of involvement***), can be filled in at the same time, in accordance with the group.

The facilitator will also point out that this analysis has shown that O&M concerns quite a greet number of actors and that it is important to see how all of them can cooperate in an optimal and effective way, which will be dealt with in more details in the module 3, Unit 1). The initial identification of the problems will be a starting point for the next session dealing about the analysis of constraints.

3. Overhead sheets

No overhead sheet as the framework should be prepared on a large sheet of paper on a wall. For its format see Background information.

4. Background information

An analysis of participation can rapidly show that various actors are implied in the operation and maintenance of rural water supply and sanitation systems. An analysis of participation consists in listing all actors involved at various levels, highlighting their role in operation, maintenance and management, their interest, what are the main constraints each actor is facing, and what is the degree of implication of them, as indicated in the table below :

Actors / group of actors	Role in O&M	Interest	Problems encountered	Degree of implication *	
				Present	Future
National level					
Provincial/ district level					
Local and community level					

*** Degree of implication 1: little implication 2: medium implication 3: major implication**
Future implications should be filled once decentralization policies have been reviewed, as proposed in module 3, unit 1.

Roles usually include : policy making for maintenance; sector planning and programming for maintenance; coordination; budget allocations; follow-up and monitoring; normative control; regulation; training; technical assistance; tariff setting; payment of services; day to day operation of the system; preventive maintenance; small repairs; major repairs; rehabilitation; manufacture of spare parts; provision of spare parts.

This analysis can be summarized by the diagram below, trying to give an overview of the degree of implication of major actors in the operation and maintenance of water supply and sanitation systems :

	Degree of implication		
Major actors	**Little**	**Medium**	**Major**
National institutions			
Provincial institutions			
Local authorities			
Community organizations			
Users			
Private sector and NGOs			
International assistance			

The above analysis can be done also in a more detailed way analyzing the degree of implication of each actor for each role as identified in the first table.

Unit 3 : Analysis of constraints

1. Outline of session

Objectives

- To further identify problems linked to O&M
- To analyze these problems in a logical way
- To draw a problem tree

Methodology

1. Introductory note
2. Interactive group exercise
3. Concluding remark

Materials

- ✓ Overhead transparencies
- ✓ A flip chart and masking tape
- ✓ An overhead projector with a screen or a white wall
- ✓ A large paper (Craft paper) hung on the wall for the problem tree exercise
- ✓ Cartons of various colours (code is important : for example Yellow for problems)

Handouts

- ✓ Copies of transparencies, background information

2. Notes for the trainer

Introductory note

This session is directly linked to the previous one. It will be useful here to introduce the O.O.P.P (Objective Oriented Project Planning) methodology in a wider context, which will be used in this course. See background information and overhead sheets. This is an adaptation of the original methodology, and should be seen as a flexible management and analytical tool. This session will deal principally about problem analysis, ands some of the other activities will be developed latter on the course. It should be noted that a problem analysis can be used as a tool in itself; the full use of the methodology is not necessarily a must, especially in training sessions, where a situation analysis is sought. This session is introducing a planing tool, but mostly is using this tool in order to analyze the problems linked to the operation and maintenance of water supply and sanitation systems. OOPP is not an end it self, it is a just a tool.

Focused discussion

It is proposed before starting with the OOPP methodology to ask the participants what are the planning tools they are using in their professional setting. The facilitator will make a list of the tools which are described on a board, and will ask for comments from the participants.

Group exercise

The group should preferably have the same informal sitting arrangement as during the last session. The facilitator will proceed in the following way :

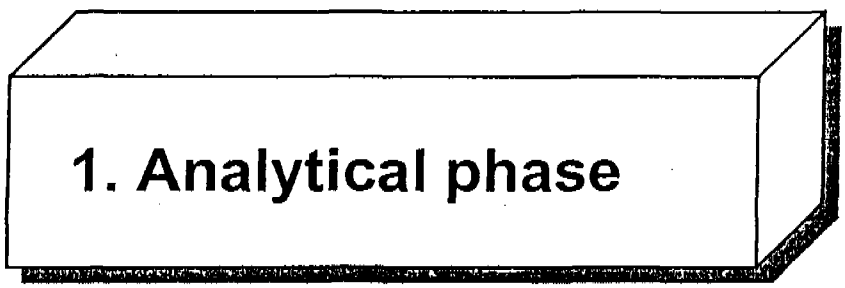
- Formulate problems which are linked to operation and maintenance of water supply and sanitation systems (if the group is large, problems can be formulated in smaller groups, while asking to prioritize the problems and come up with a maximum of five to seven cartons); these problems can already come from the previous analysis of participation, but more can be added.
- The understanding of each problem must clear for all the group; the facilitator might have to rewrite some cards.
- All the identified problems are put on the side of the wall in order to leave enough space for the actual analysis.
- The analysis starts by asking the participants which of the problems could be direct causes of the main problem we are analyzing "poor O&M", and son on for all the problems which bit by bit becomes tree;
- The analysis also looks at what are the effects of poor O&M; if the problems have not been highlighted, the group can do so now;
- The whole logic of the tree can be checked in terms of relation cause-effects;
- At the end of the analysis, lines should be drawn between the cards in order to materialize the relationship between each one, and therefore building an objective tree.

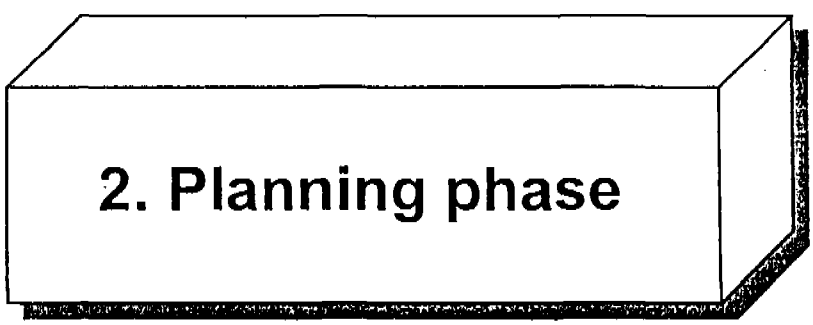
This session is very participatory and the facilitator should be careful to keep a good track of time. The idea is not to get a unanimous consensus but a reach an acceptable compromise for the group that is based on an hypothetical situation. At this stage, the objective is to deal about main problems in order to see that how they are interrelated. The participants will have the opportunity to develop this in more details during their individual assignment late in the course.

3. Overhead sheets

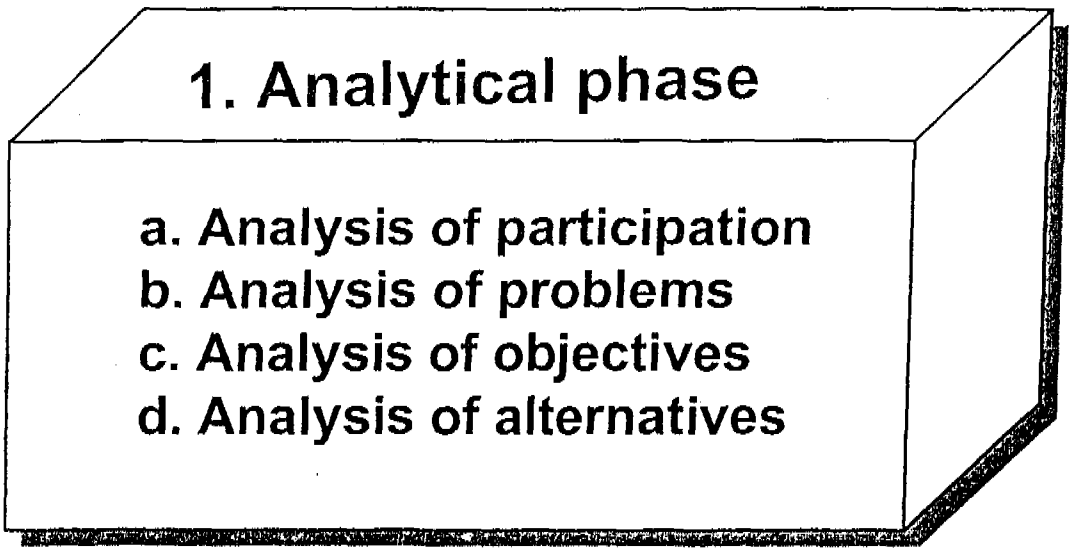
O.O.P.P.

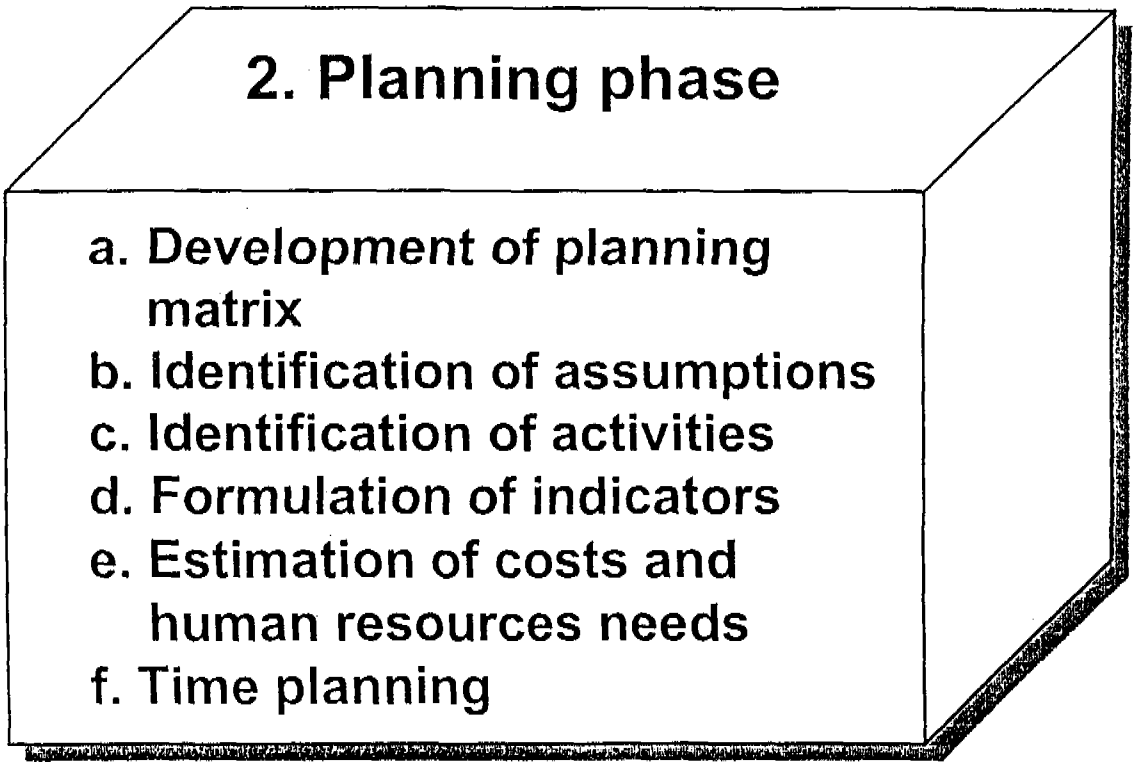
Objective Oriented Project Planing





Overhead sheets





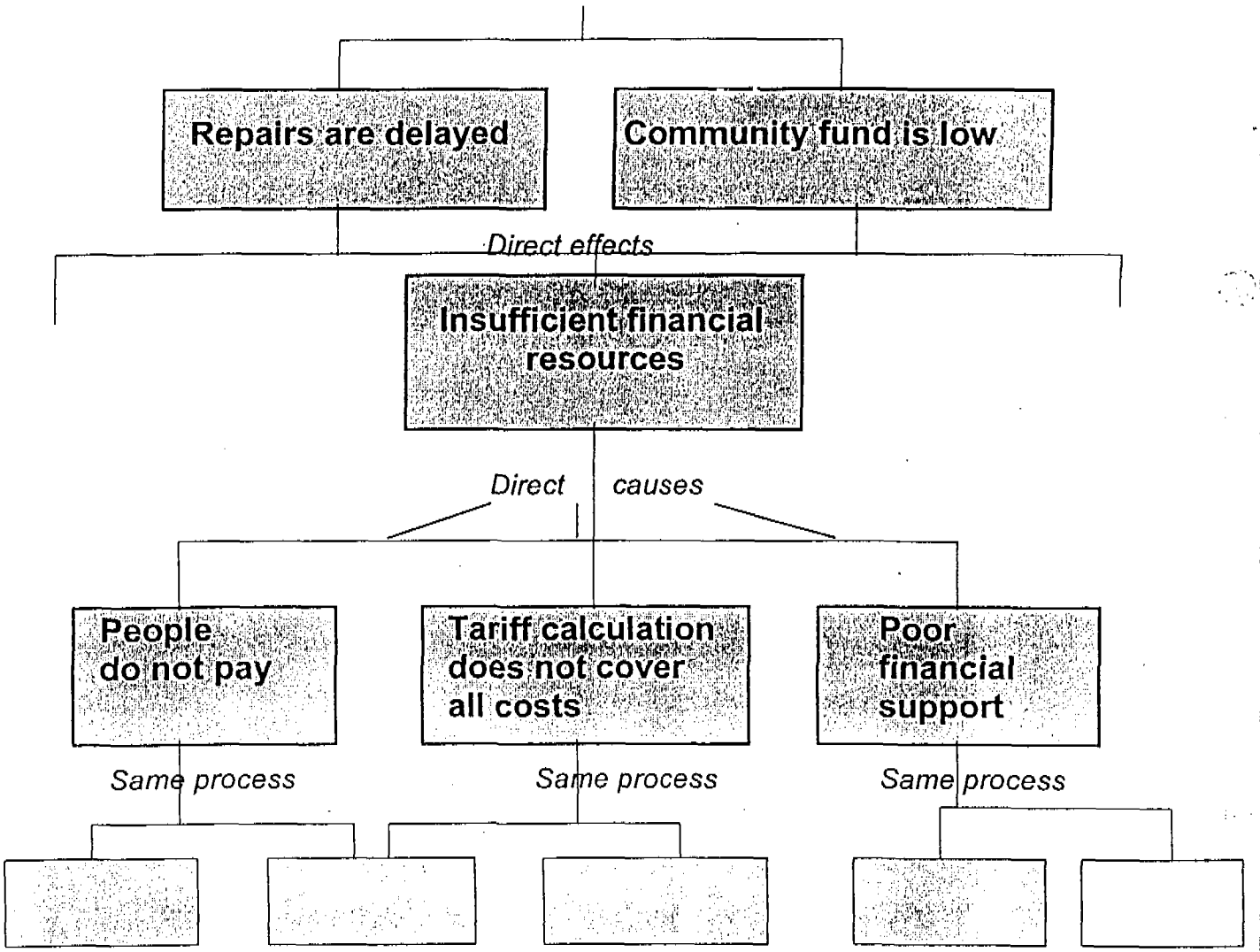
Overhead sheets

PROBLEM ANALYSIS

1. Identification and formulation of problems
2. Selection of an "essential" problem
3. Identification of direct causes of this problem
4. Identification of direct effects of this problem
5. Continuation of identification of cause - effect relationships
6. Control of the global coherence
7. Drawing of lines, into a problem tree

Overhead sheets

Cause - effect relationships



4. Background information

4.1 The importance of problem analysis

One of the first task that a manager or a group of persons could be facing, is to understand and assess what is the present situation. There are many different ways to go about this. One can read reports and studies which have been written on a particular project; one can hold a series of interviews and meetings, and ask staff about their perception of a situation; one can make field visits in order to have visualize a situation; one can decide to analyze successes, and focus on them only.

Experience has shown that good plans are based on an appropriate understanding of a situation, which is based not only on an analysis of successes, but also of constraints and problems. However, many managers will limit themselves to the only identification of problems, and omit its analysis. Further more, there are often as many interpretations of a same problem, as there are professionals.

Without denying the positive aspects of other working methodologies, this methodology proposes to assess a situation on the basis of common understanding of problems. It is simple, participative, democratic and motivating. It allows a group of professionals at different levels, from different departments, or sectors, in reaching a common consensus about the situation, which is vital for the effective implementation of a plan. Its logical sequential analysis allows to understand that problems are inter-related, and cannot be isolated.

4.2 What is a problem ?

According to the Collins Cobuild English Language Dictionary, a problem is "*a situation or a state of affairs that causes difficulties for people, so that they try to think of a way to deal with it*".

People do not always have the same perception and vision of a problem, since they belong to different cultures and have different priorities in their working or living environments. However, the above definition helps to focus our vision of what is a problem.

It causes difficulties to people, so that they try to think of a way to deal with it. A problem is based on a real, existing situation, which becomes trouble some in a way that one has to react towards it. Therefore, a problem is not an interpretation of a situation, it is a fact, a reality. Further more, it is significant enough that people do want to react towards it, thus avoiding minor troubles which a normal existence is filled with any way.

Many people will identify a problem in terms of a desired situation they do not have, visualizing a problem as an absent solution. For example, some will say that "no equipment", "no vehicle" or "no money" are problems while analyzing a situation of long delays for repairs. This could be hiding the fact that there is poor planning, that villages are far away, that tools and equipment are obsolete, that the project is understaffed, that spare parts are not available, etc... However, lack of equipment, or poor budget allocations can be a reality as well.

In this course, we will formulate problems with a negative formulation., since this

formulation allows to raise an issue, a challenge to be met. A formulation just stating "spare parts" does not raise an issue, and does not say what is wrong, although spare parts can be a problem. This could be formulated as "poor availability of spare parts", or "high cost of spare parts",etc.. depending the situation.

In summary, we will define a problem as :

1. A real, existing situation
2. Significant
3. Preferably, not an absent solution
4. A negative formulation

4.3 The O.O.P.P methodology

The methodology was first developed in 1983, by the German Organization for Development Cooperation (GTZ), combining the logical framework tool, with new communication techniques (Metaplan), into an analytical and planning tool called "Objective Oriented Project Planing", O.O.P.P., or ZOPP in German. It is now being used as a major planning tool by the great majority of development cooperation.
Other planning tools are also proposed in this course, and will be exposed in the Module 3, unit 6).

OOPP is based on a logical sequence of reflection and team work process is its essential approach. It is using a strong visualization tool, the use of cards, in order to materialize what could stay abstract other wise. The result of the thinking process is a result accepted by the group. The analytical method is based on the analysis of a logical sequence of cause-effect relationships between various problems as it will be exposed latter.

OOPP is composed of two phases : an analytical phase and a planning phase.
The analytical phase consists in a participation analysis; a problem analysis; an objective analysis; and a analysis of alternatives.
The Planning phase consists in the development of a planning matrix; determination of assumptions and conditions; determination of activities; formulation of indicators; estimation of financial and human resources needed; development of a chronogram (timing of activities).

What are the advantages of the methodology ?

- Reaches a common understanding of problems
- Clarifies cause-effect relationships
- Provides clear planing documents
- Allows the participation of various staff and professionals , as well as beneficiaries of the project.
- Establishes a consensus
- Easier to implement because accepted by many

What are the limitations of the methodology ?

- Truth is not only rational and logical; the methodology puts aside all intuition, contradictions and feelings
- Can lead to a simplified "linear" representation of reality
- The whole planning depends on an adequate and accurate problem analysis

- Creative thinking only done for the problem analysis, but lost into mechanical sequences afterwards.
- The emphasis on problems can put a shadow on the perception of existing potentials and successes.
- Certain groups are not familiar with an abstract and logical analytical sequence of thinking, which can create problems in its application.
- Needs a good and experienced facilitator.

4.4 How to analyze problems ?

Once problems have been identified and are understood by the whole group, it is asked to the group to select among the identified problems, a problem they consider as essential, which will help to start the analysis. Criteria of selection can be : most pressing problem, most frequently occurring problem. In the coming example, we have chosen for illustration purposes, the problem : " Insufficient financial resources".

Among all listed problems, then select the main causes for this essential problem, which are directly linked to it. It is possible to formulate additional problems if they are not all present yet. It is also possible to reformulate some cards, which appear to be too vague. It is also possible to throw away cards that appear to be totally out of context. The question to be asked in order to find the direct causes, is **WHY?**

In a second step, , it is now proposed to select among the list of identified problems, the problems which can be the effects of the essential problem, which are directly linked to it. Problems can be added, or *thrown* away as in above. The question to be asked in order to find the direct effects, is WHAT are the direct consequences of this essential problem ? What will lead it to ? This process is then repeated for each cause. What are the causes of this problem ? Same applies for the effects, until all the cards have been placed. Lines are then drawn showing the relationship between each card. The final result is a problem tree. There is not a perfect problem tree. All problem trees are different, since all groups are different. It just represents the consensus and understanding of a particular situation for a give group, at a given time, in a given context.

Unit 4 : Analysis of objectives

1. Outline of session

Objectives

- To identify objectives linked to O&M
- To analyze these objectives in a logical way
- To draw a problem tree

Methodology

1. Introductory note
2. Interactive group exercise
3. Concluding remark

Materials

- ✓ Overhead transparencies
- ✓ A flip chart and masking tape
- ✓ An overhead projector with a screen or a white wall
- ✓ A large paper (Craft paper) hung on the wall for the problem tree exercise
- ✓ Cartons of various colours (code is important : for example Green for problems)

Handouts

- ✓ Copies of transparencies and background information

2. Notes for the trainer

Introduction

This session is the immediate follow-up of the problem analysis, which looks into the future, on the basis of an analysis of a present situation, the problem analysis.

Group exercise

The group exercise is decided mainly into two parts : 1) construction of the objective tree; 2) selection of a strategy.

1) Using the problem tree, the facilitator will ask the participants to restate the problems, which are formulated in a negative condition, into objectives , which are formulated in a positive and achievable condition. Do not make objective statements which indicate an ultimate and long term improvement, but rather, on the basis of the problem situation, indicate an improved situation. For example, do not translate the problem as lack of funds, as plenty of funds ! But rather as improved financial situation, etc.

It can be that some problems cannot be changed into objectives, as the project will not be able to solve them, as for example, "corruption". These cards will remain problems, even in the objective tree.

It is important also to formulate objectives on cards of a different colour than the problems.

The facilitator with the help of the participants can rebuild an objective tree, similar to the structure of the problem tree. However, he will have to look at with the participants at the relationship means-end, (as opposed to cause-effect for problems). It can very well be that the logic is not always the same, and that some analysis needs to tuned. It can be also that other objectives need to be added in order to complete the analysis.

The end product is an objective tree. In this tree, the facilitator can circle the various entities which are appearing, such as "community", " technical aspects", "institutional support", etc...

2) The selection of a strategy consists in the selection of objectives.
It would be impossible for a project to tackle all the objectives which are formulated in the objective tree, mainly for the following reasons :

All the objectives are not within the mandate and responsibility of a project
There are not enough financial and human resources to work on all objectives
The project has to be responding to some priority or urgent issues first

The management will have to choose and prioritize. The selection process can be done in the following way :

Identify those objectives which are not within the mandate and the responsibility of the project (in this case, it might be difficult, because the project is hypothetical).
Identify those objectives (maximum seven) which are key and can greatly influence the main objective : "Improved O&M"; those objectives should generate a maximum impact for a minimum input of resources, since resources are limited; it could be that

the main objective is not completely resolved, but the chosen objectives will be greatly contributing to it.

Process: The facilitator asks the participants to form small groups of three persons. Each group will have the task to identify a maximum of seven objectives which will lead contribute to the main objective. They will also have to give a priority to them.

Once the objectives have been chosen, the facilitator draws the following table on the board :

Selected objectives	Number of groups who have selected this objective	Priority given

This table will allow to make a participatory decision on which objectives to chose. The final selection will correspond to the selected objectives which have obtained the best score. Priority can be given as well.

Conclusion

The project now has precise objectives to work on which are based on an analysis of a real situation. The results of the selection of strategy will be kept for later, module 4.

Overhead sheet

How to do an objective tree

Step 1 : Reformulate all negative conditions into positive reachable conditions

Step 2 : Check whether rewording has led to unrealistic or ethically questionable statements

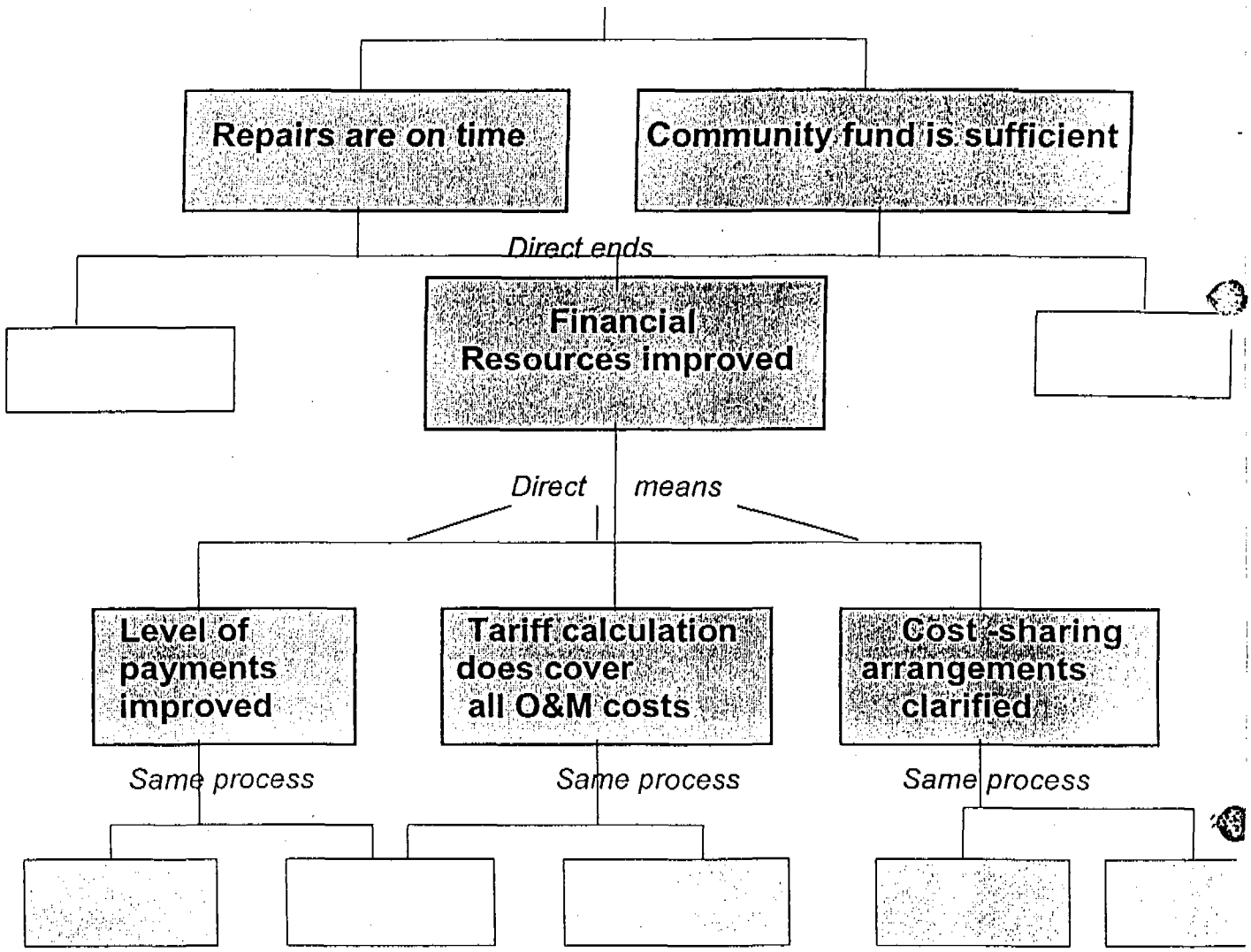
Step 3 : Examine the "means – ends" relationships, thus derived to assure the validity and completeness of the tree; add cards if necessary

Step 4 : Draw lines between all the objectives showing the relationships and finalize the objective tree

Step 5 : Circle different groups or entities which appear within the objective tree and give them a name

Overhead sheet

Example of objective tree



4. Background information

4.1 Discussion on alternatives – identifying potential alternative solutions

The chief criterion when evaluating and selecting alternatives is whether the project is expedient and realistic. The following aspects can be significant :

- Development – policy priorities
- Specific conditions in the project country
- Suitability of the chosen alternative to the donor agency or national department supporting the project
- Funding available
- Project's experience in the region or sector
- Available manpower
- Complementary or competitive activities of other projects

The choice among alternatives can be supported by : cost benefit analyses, additional analysis of various interest groups, management discussion and decisions.

Module 3

Towards sustainable O&M

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Unit 1 : Linking technology choice with O&M

1. Outline of session

Objectives

- To raise awareness on Operation and Maintenance criteria that influence technology choice
- To become familiar with processes that influence technology choice of community water supply and sanitation facilities

Methodology

1. Introductory note
2. Plenary discussion on criteria
3. Group exercise on processes (two groups)
4. Conclusion

Materials

✓ Overhead transparencies
✓ Overhead projector and screen or white wall
✓ Flip chart and markers

Handouts

✓ Copies of transparencies
✓ Exercise sheet
✓ Extracts from background information

2. Notes for the trainer

Introductory note

Module 3 will be dealing with the main issues that influence effective operation and maintenance, among which technology choice. Linking technology choice with operation and maintenance is the first factor contributing to effective operation and maintenance. Indeed, the type of technology and the way it has been selected are likely to have an impact on future operation and maintenance activities. This session will highlight criteria and as well as processes that link technology choice with Operation and Maintenance.

Plenary discussion on criteria

The facilitator will divide the board into 10 columns, five for water supply and five for sanitation. Both four columns correspond to the sustainability factors which were seen earlier and will include : 1) technical aspects; 2) community aspects; 3) environmental aspects; 4) institutional and support aspects. It has been found in past experiences that participants are willing to add more factors, such as financial factors. Although financial factors are inherent and present in all four other factors, a sub-division can be added if the group wants to do so. The facilitator will ask the group for each column : "what are the important O&M criteria to consider during the planning stage ?", and write down the answers provided by the participants. If needed, the facilitator can complete with the information provided in the background section.

Group exercise on technology selection process

The facilitator will divide the participants into two groups : 1) water supply technology choice; 2) sanitation technology choice. Each group will receive a set of prepared cartons (A4 divided by 3 size), describing typical activities which are undergone while in the process of technology selection. The cartons should be ordered in a logical. This exercise has the advantage to show how technical and social factors could and should be integrated. Each group discusses the best way to arrive at a choice, and will present its results in a plenary. The facilitator can use the model shown in the background information to guide and propose some feasible and realistic alternative. Cartons can be made using the text in the exercise sheets. Participants usually find useful to keep a record of exercises done. It is therefore advised to ask for secretarial support in order to keep record of these exercises and distribute a copy to all the participants.

Conclusion

Linking technology choice with Operation and Maintenance is a key factor of sustainability, and it relies not only on selection criteria but also on processes.

3. *Exercise sheets*

Process of water supply technology choice

The facilitator should prepare beforehand a set of cartons as described below, leaving some blank cartons for additional activities if needed, and distribute a complete set to the group. The group will have to organize the cards in a logical sequence,(some activities can be done in parallel to others). All these activities have a definite direct or indirect impact on future O&M activities.

Analysis of water quality	Analysis of data by the agency/dept.
Formal agreement	Formal request from community
Assessment on user's expectations (men and women)	Analysis of comparative advantages between various options
Initial service assumption	Participatory base line survey
Collection of information on hydrology	Discussion with communities on options and O&M and costs implications
Definition of management responsibilities	Community meeting to decide technology option
Deposit of financial community contribution	Initial contact with the community
Promotion campaign	Global hydrogeological survey
Willingness to pay assessment	Analysis of existing or potential spare parts distribution system
Assessment of financial mechanisms to cover major repairs and replacement	Assessment of available technical skills

Exercise sheet

Process of sanitation technology choice

The facilitator should prepare beforehand a set of cartons as described below, leaving some blank cartons for additional activities if needed, and distribute a complete set to the group. The group will have to organize the cards in a logical sequence,(some activities can be done in parallel to others). All these activities have a definite direct or indirect impact on future O&M activities

.Participatory assessment on socio-cultural aspects	Study of present situation and practices
Selection of technology by the community	Hygiene awareness campaign
Base line survey on physical conditions	Assessment of men's and women's preferences
Analysis of comparative advantages of various options	Participatory assessment of problems related to sanitation
Discussion with the community on O&M and cost implication of various options	Assessment of willingness to pay for capital and O&M costs
Formal request by users and / or the community	Identification of availability of technical skills
Identification on availability and cost of material	Demonstration project in selected families or areas
Start of sanitation campaign	Set-up of financial mechanisms for the purchase of latrines
Sanitary education activities	Monitoring of use and hygienic state of latrines

4. Background information

4.1 Direct or indirect operation and maintenance specific criteria affecting water supply technology choice

Technical criteria	• Technical standards; quality and longevity of equipment Spare parts needs, costs, availability and accessibility • *Dependence on fuel, power, chemicals* Cost of O&M activities; cost of fuel and chemicals • Complexity of operation and maintenance procedures Necessity of skilled personnel • Potential for local manufacture, and for standardization • Use of local material and equipment • Dependence on imported parts • Technical options available on the market • Water demand
Environmental criteria	• Quality of water source • Needs for water treatment • Necessity for water source protection and waste water management
Institutional and support criteria	• Legal framework and national strategy for O&M • Training capacity and follow-up support • Availability of technical assistance to the communities • Capacity of municipalities to dialog and assist communities • Involvement of the formal (informal) private sector & NGOs • Monitoring capacity • National or local budget allocations for O&M activities. • Availability of financial mechanisms to cover replacement and rehabilitation costs
Community criteria	• Responsibility and ownership feeling • Desired service level • Demand for improved service level • Perception of benefits; culture; habits; beliefs • Organized and elected community structure to be responsible for O&M • Managerial capacity • Gender perspective in O&M activities • Technical skills available in the community or within reach of the community • Maintenance culture within the community • Tariff structure • Cost recovery mechanisms to put in place • Financial management capacity • Ability and willingness to pay

4.2 Direct or indirect operation and maintenance specific criteria affecting sanitation technology selection

Experience has shown that many sanitation projects followed a technical approach where the intervention and the type of technology were determined by the implementing agency, demand for sanitation was not assessed. Hardly any communication between the future users and the project took place, and social, gender, cultural and religious aspects were not sufficiently taken into consideration in the project approach.

In other cases, environmental factors were not considered in the design, leading to the collapse of pit walls and unsafe situations. Hygiene education for changed sanitation behaviour was hardly included in the sanitation project approach, as this had another time-scale of implementation. Planning for sanitation interventions requires a comprehensive approach with many aspects to be included. The criteria which influence sanitation technology choice can be grouped into four different groups, and the specific O&M criteria are a part of general context.

Criteria	*General Criteria*	*Specific O&M criteria*
Technical	• Technical standards • Availability of construction material • Lifetime • Cost of construction • Design preference (sub-structure, floor slab, squatting or raised seat, superstructure)	• O&M requirements • Ease of access • Use of decomposed waste
Environmental	• Soil texture, stability, permeability • Ground water level • Control of environmental pollution • Availability of water	• O&M implications for environmental protection • Ground water contamination
Institutional	• Existing national/local strategies • Role and responsibilities of actors implied • Training capacity • Availability of subsidies and loans • Availability of masons, carpenters, plumbers, sanitary workers, pit emptier and diggers • Monitoring	• Pit emptying services (municipal/private) • Sewerage maintenance capacity • Potential involvement of private sector • National budget allocations for sanitation • Training and sensibilization
Community	• Socio-cultural aspects: • Taboos, traditional habits, religious rules and regulations, cleansing material, preferred posture, attitude to human feces, gender-specific requirements • Motivational aspects: • Convenience, comfort, accessibility, privacy, status and prestige, health, environmental cleanliness, ownership • Discouraging factors: • Darkness, fear to fall in hole, fear of collapsing pit, be seen from outside, smells, insect nuisance • Social organization factors: • Role of traditional leadership, religious leaders, school teachers, community-based health workers • Other factors: • Population densities, limited space for latrines, presence of communal latrines	• O&M costs • O&M training and sensibilization for sanitation • Health awareness and perception of benefits • Presence of environmental sanitation committee • Women groups • Social mobilization on hygiene and sanitation behaviour

The approach of considering upgrading the existing sanitation facility, as the first option for improvement of the sanitation conditions, is based on the understanding that existing sanitation facilities are a reflection of the local social and cultural preferences, as well as the local economic and technical capacities. If existing facilities are not meeting basic hygienic requirements, then upgrading hygienic shortcomings is to be considered first. If no sanitation facilities are present, the simplest technology option is to be considered, taking into account the factors mentioned before.

4.3 Technology selection process

The technology selection process will depend greatly on the basic strategy applied by planners as well as the general trends that are emerging in the water and sanitation sector. A basic principle outlined in this document is the need to involve communities right from the start in the selection of technologies. Hence, agencies, communities and users should work together as partners, and plan subsequent activities in mutual agreement. This prerequisite is particularly important in the context where users and communities, both men and women, are more and more endowed with the responsibilities of operating, maintaining and managing their water supply systems.

Various formulations of the word "technology" can be found in the literature, such as: appropriate technology, progressive technology, alternative technology, intermediate technology, village technology, low-cost technology, labour intensive technology, self-help technology or technology with a human face. In this course, we advocate for a ***sustainable*** technology, a technology that should, as much as possible, match people's needs, expectations, preferences and cultural habits. It should be convenient, manageable, maintainable and affordable.

Linking operation and maintenance and technology selection encompasses not only technical, environmental, financial, institutional and social aspects, but also the testing and feasibility of the O&M system required. An O&M system is the framework defining all actors and their involvement in O&M, the way they are organized and interrelated to one another.

Experience shows that non-technical issues play a considerable role in determining the effectiveness of O&M. Therefore, personnel involved in O&M assessment and development should cover a range of relevant disciplines: social development, economic, health, management, as well as engineering. It is important that the process is consultative and carried out in partnership with the operators and users of schemes.

Rehabilitation of defective schemes can provide an economic alternative to investments in new projects, but that decision should not be automatic. Just as with a new scheme, the rehabilitation option has to be evaluated by balancing community needs, preferences and capacity to sustain with the support potential of the water agency. In assessing the scope for rehabilitation, the community and the agency together need to review what made the system breakdown, with a problem analysis and recommendations of feasible technologies. Furthermore, rehabilitation should not simply be a matter of replacing broken equipment or infrastructure. The most common cause of failure is organizational.

If a risk analysis is carried out for each water supply option then an attempt can be made to anticipate factors which may change and affect O&M. This will not be easy, especially in unstable economies where inflation and the availability of imported equipment and spare parts are difficult to predict. However, a comparison of technologies can indicate the degree of risk attached to each option.

4.4 The process of community water supply technology choice

The following steps are proposed :

1. **Community requests** agency for support on water supply improvement (demand-driven approach); this could be preceded by promotion and mobilization campaigns. Motivation and users' (men's and women's) expectations and preferences should be assessed.

2. **Initial service level assumption** - what service level corresponds to the environment and users' preferences (men's and women's) ? What are the comparative advantages between various options? Collection of local information by agencies, including confirmation on validity of collected data by local resource persons (hydrological, technical and institutional data)

3. **Participatory baseline survey** - including needs and problem analysis with the community.

   - What reliable water source is available ?
   - Can this source provide the required quantity and quality of water ?
   - What is the treatment needed ?
   - What materials and spares and skills are needed to sustain the desired service level ?
   - What is the most appropriate structure to sustain the desired service level which corresponds to the management capacity of the communities ?
   - What is the capacity of present community organization to manage, operate and maintain an improved water supply system ?
   - What is the involvement of women and men in community activities ?
   - What are the costs (capital and recurrent) of options considered ?
   - What are the financial resources available and the willingness to pay ?
   - What is the present approach to O&M applied within the programme or country area ?
   - What are the causes and effects of poor O&M within the area ?
   - Should technology match the available O&M system and capacity (including spare parts distribution), or should the O&M system be adjusted to match the most suitable technology ?
   - What type of support can the communities receive, in terms of technical, financial and capacity building assistance ?
   - What is the overall impact of the option selected ?

4. **Analysis of data** by agency, leading to the possible selection of the most suitable technologies and service levels, including a review and appreciation of all specific O&M criteria .

5. **Presentation and discussions with the community** of the most sustainable technologies, considering all O&M implications and commitment to long-term

management of O&M. Clarification should be made at the same time on all necessary adjustments of the existing O&M system, with a definition of the responsibilities of the actors implied in the development of the project. Communities are given enough time to consider the options and to appreciate the future implications of each one.

6. **Formal agreement on technology selection** between community and all partners involved, once the community has made its informed choice. Is the technology and service level affordable, manageable and agreed between all partners ? This agreement can be formalized in the form of a contract, or in the form of a financial contribution (in cash or in kind) from the communities.

7. **Finalization of planning for implementation phase.**

4.5 The process of low-cost sanitation technology choice

It is assumed that the following technology selection process is preceded by, or based upon, a participatory needs assessment, carried out following an expressed demand for improved sanitation facilities. Hygiene awareness and promotion campaigns can result in an increase in the demand for improved sanitation facilities. The process of choosing sanitation technology should include at least the following steps:

1. **Participatory assessment of problems** related to the existing human excreta disposal system, hygiene behaviour, hygienic environment and human excreta-related diseases. Participatory assessment of cultural, social and religious factors influencing human excreta disposal and sanitation technology choice. Participatory assessment of local conditions, capacities and resources (material, human resource and finance).

2. **Hygiene and sanitary initial awareness raising** with the community, about the benefits of safe human excreta disposal and appropriate human behaviours linked to sanitation and personal hygiene.

3. **Identification of local preferences and matching capacity** for sanitation facility and possible variations. Matching preferences with local capacities and environmental conditions as well as contamination risks, and determination of O&M requirements and other implications of pre-selected technology.

4. **Discussion with the community** about the implementation of different sanitation technology options, their implications in terms of operation and maintenance.

5. **Selection of technology** done by the community.

Sanitation facility improvement should be accompanied by Information, Education, Communication (IEC) activities to promote safe sanitation behaviour and proper hygiene. These activities have a longer time horizon than the physical improvement of structures. An important role is to be taken by schools, institutions, churches and social community groups to promote proper hygiene and sanitation behaviour. Attention must be paid to the selection of the most appropriate technology, design

and site, in order to prevent possible pollution of the environment, in particular water resources and direct living environment. Control measures must be carried out to minimize these risks.

Unit 2 : Institutional set-up

1. Outline of session

Objectives

- To raise awareness about the importance of proper institutional set-up for operation and maintenance
- To review consequences of institutional changes, such as the ones induced by decentralization and privatization
- To review possible management options at local level
- To raise awareness on the importance of communication periods of institutional changes

Methodology

1. Introductory note
2. Review of analysis of participation
3. Presentation and discussion on decentralization using a graphic
4. Document analysis on management options
5. Conclusion on the importance of communication

Materials

✓ Overhead sheets
✓ Overhead projector and screen or white wall
✓ Flip chart

Handouts

✓ Exercise sheet
✓ Copies of transparencies
✓ Copies of selected parts of background information

2. Notes for the facilitator

Introductory note

As the analysis of participation has shown, many actors are involved in different ways and degrees of implication in the operation, maintenance, management of rural water supply and sanitation systems. This session proposes to review how these actors are organized together in order to provide an effective service, forming together a maintenance system. Furthermore, most of the developing countries today are undergoing some structural and institutional reforms which have a far reaching impact on the way maintenance will organized and on who will be responsible.
This session therefore gives an analytical look at the framework in which all actors evolve, and should be linked with the next session on community management.

Review of analysis of participation exercise

In module 2, a participation analysis exercise has been proposed. If this exercise has not yet been done, it is proposed to do it here, while referring to the directions given. The review of this exercise consists in analyzing who is more involved in terms of degree of implications, and what is likely to happen at this stage, given the problems which have been identified. This review can be done with the whole group p by summarizing the situation using the following table, which can be shaded accordingly. The shades proposed in the following table are purely fictive and should be adapted to the situation met by the participants.

	Degree of implication in O&M		
Major actors	**Little**	**Medium**	**Major**
National institutions			
Provincial institutions			
Local authorities			
Community organizations			
Users			
Private sector and NGOs			
International assistance			

Some conclusions can be drawn by the facilitator from this table. For example, this table indicates that communities are greatly involved, but is still very much "donor-driven". Private sector and NGOs have a small role which could be enhanced in the future. Users seem not sufficiently involved. Etc...

Presentation and discussion on decentralization

It is proposed to present the various trends which are affecting the sector especially on sustainability, decentralization, private sector involvement, and new approaches.

The facilitator can first recall the main points of sustainability, which have been stated in module 1.

Document analysis on management options

In the exercise sheets, can be found documents which describe various forms of management options for piped water supply projects. Management of handpumps systems will be reviewed in the next session on community management. It is proposed to divide the participants into 3 groups, corresponding to the three management options proposed : 1) Concession to a community association; 2) Direct municipal management; 3) Cooperative association of public administration.

Each group has to review its management option, and highlight its strengths and weaknesses. The groups will then report briefly in a plenary the result of their work.

Short presentation on various management models for pied rural water supply system

The facilitator will go over the table giving a summary of these management models (see background information)

Final conclusion on the importance of communication between all stakeholders

The facilitator can start this conclusion by a small and rapid game. He says to the group : " I will count to three and ask you to clap in your hands"...." One .. two... (at this type the facilitator imitates the clapping of the hands without really clapping). The result is that every one claps. The facilitator says : "I have asked you to clap at three, and everyone claps at two !... Where is the communication ? Is this situation frequent in our professional world?" Allow for some discussion.

The facilitator can then use some of the information contained in the background information in order to make a concluding presentation the importance of communication, and on how to set a communication strategy.

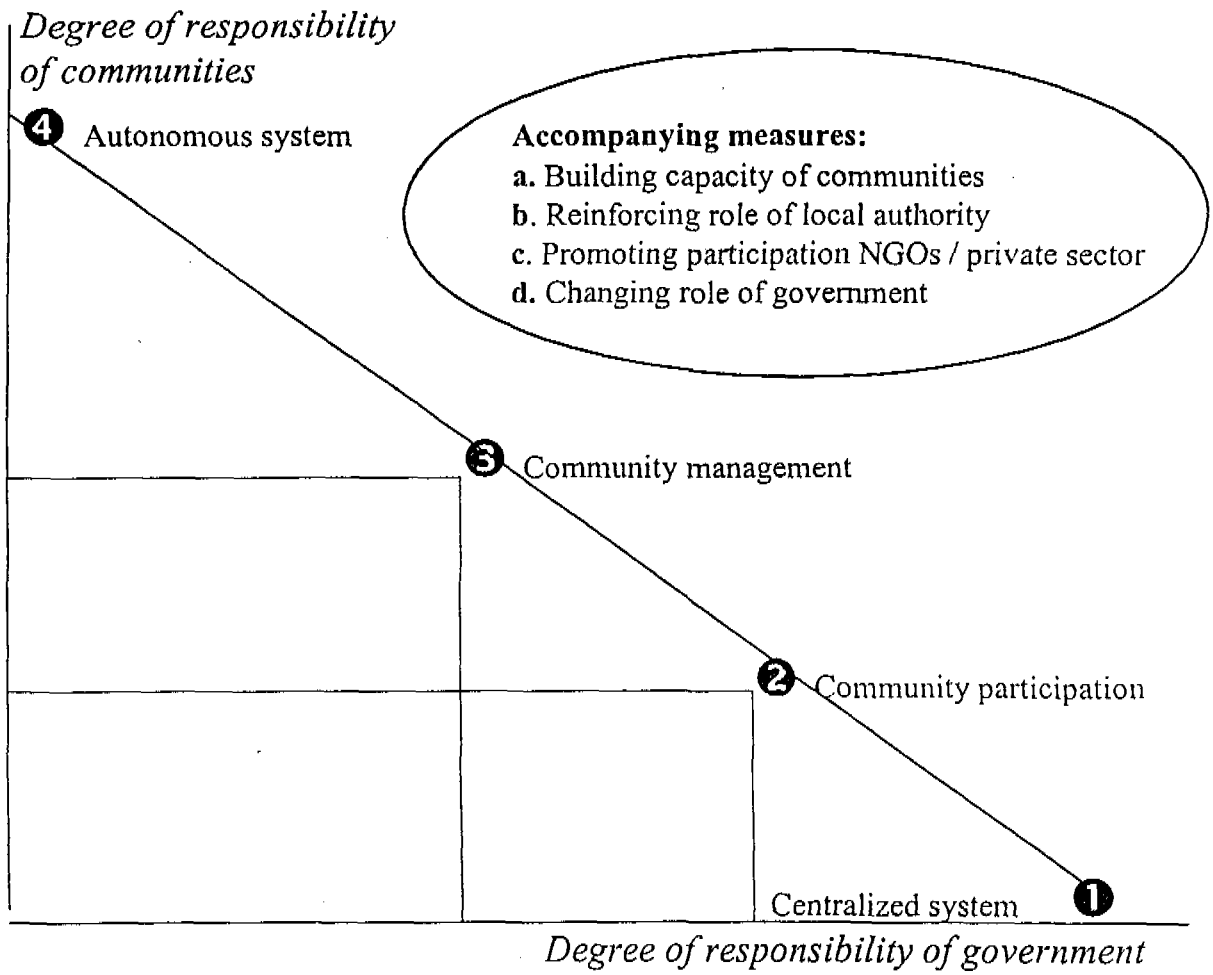
3. Overhead sheets and exercise sheets

After having reviewed the situation analysis done previously, shade the squares accordingly.

	Degree of implication in O&M		
Major actors	**Little**	**Medium**	**Major**
National institutions			
Provincial institutions			
Local authorities			
Community organizations			
Users			
Private sector and NGOs			
International assistance			

Overhead sheet 2

Substitution of responsibilities between government and community in a context of decentralization, with necessary accompanying measures



Overhead sheet 3

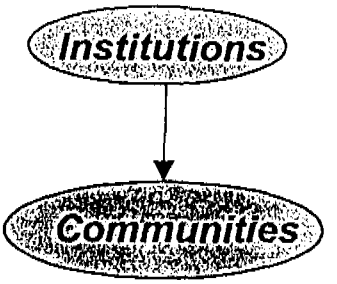
Who constitutes the private sector ?

Actors in the private sector	*O&M support role*
International and national manufacturers and suppliers	• design and manufacture pumps and other equipment for operation and maintenance at the village level • supply spare parts and consumable
International and national consultants	• design schemes for community management. • develop community/agency managed O&M systems • provide O&M training
International and national contractors	• rehabilitate and extend schemes for community O&M • on-the-job training of O&M staff during construction
Local contractors	• service and maintenance contracts • major repair work
Small-scale industries	• local manufacture of spare parts and tools
Non Governmental Organizations (NGOs)	• training, community sensibilization • technical assistance
Self-employed artisans in the formal and informal sectors	• local skills for preventive and corrective maintenance and repair work: mechanics plumbers, builders, masons, blacksmiths, electricians, etc. • operation of facilities
Local shops	• provision of spare parts
Administrators and accountants	• billing, rate collection, auditing of accounts
Banks	• provide banking facilities for O&M funds • provide credit facilities for irregular high cost items and for the expansion or modification of facilities

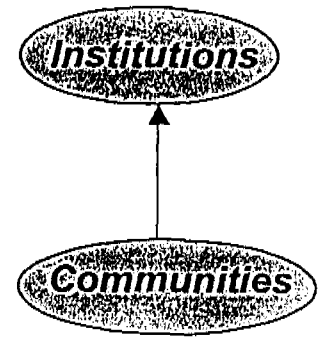
Overhead sheet 4

Approaches to development

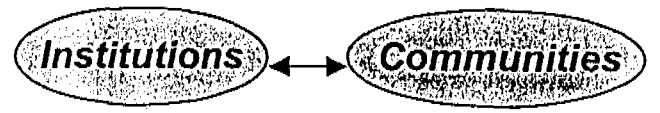
Supply - driven *(Top - down)*



Demand - driven *(Bottom - up)*



Demand - response
(sharing responsibility)



Overhead sheet 5

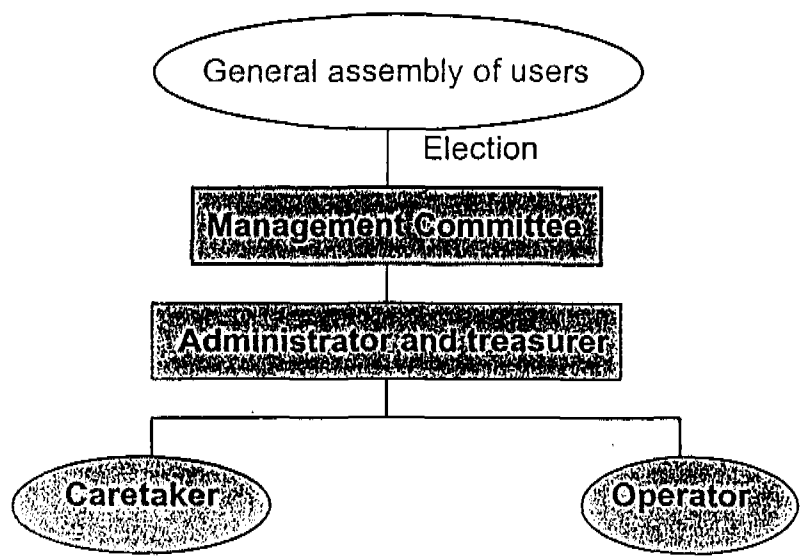
A communication planning sequence includes :

- Identification and formulation of key issues to be communicated
- Identification of target audiences
- Research on current knowledge, attitude and practice of each target group around the required future change in behaviour
- Development of messages based on current knowledge and behaviour
- Pre-test messages
- Identification of appropriate communication channels
- Preparation of communication materials
- Pre-test of materials
- Training of communicators
- Development of indicators to assess impact
- Implementation of communication programme
- Assessment of impact and adjustment of programme design

Document analysis 1 : Concession to community associations

Briefly highlight the strong and weak points of this management option for rural piped systems

Communities can already count on exiting forms of associations, which sometimes have been organized in an informal way. It is important in this case that associations are organized in a formal way, and obtain a legal status. They will be established as non-profit making associations with the aim to provide a public service, which could give access not only to community resources but as well as resources coming from the municipality, the province or the central government. According to the Colombian legal system, the mayor can be member of the association but has to promote community participation and facilitate access to municipal, provincial and national funding. The community association is organized in the following way:



The General Assembly of users adopts decisions and elects the members of the management of Committee of the association. The management Committee is composed of a President, a vice-president, a treasurer or administrator, a Secretary, representatives from the users, a representative from the local administration (if decided by the General Assembly, and if the local conditions allow it). It is responsible to supervise and control all managerial, technical and financial aspects of the service. The caretaker and operator are responsible for the whole operation, maintenance and conservation of the whole system; they participate in the tariff collection as well. The association has to be created from a decision taken in the General Assembly who writes an Act constituting the Committee. The General Assembly must study and approve the Charter and Regulations for the functioning of the organization. The Constituting Act, the Charter together with a written application are registered at the Chamber of Commerce. Furthermore, the creation of such an association will be authorized through an official document of the Municipal Council.

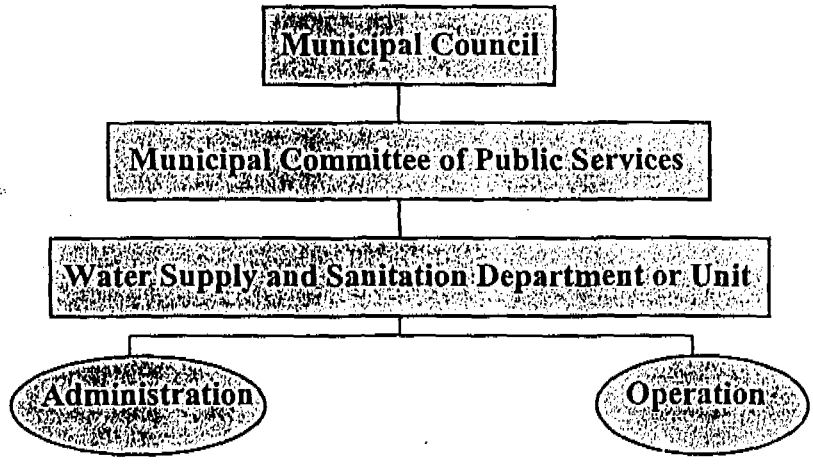
Document analysis 2 : Direct municipal management

Briefly highlight the strong and weak points of this management option for rural piped systems

In this management option, the municipality is directly responsible for the administration of the water supply service, through a department or unit which has been created for that purpose. However, several conditions are applied :

- the direct municipal management will be possible only the municipality has made a public call for firms to operate, manage and maintain the system, and that no one has proposed its services;
- the direct municipal management will be possible in the case of a private or public firm available, only after a study has shown that the operating cost of the direct municipal management will be lower than the ones of the private firm, and the quality of the service to the users will be higher.

It is stipulated that the accounts for the running of the service must be separated from the general accounts of the municipality., and distinguish incomes through tariffs and income through subventions. The direct municipal management is organized in the following way :

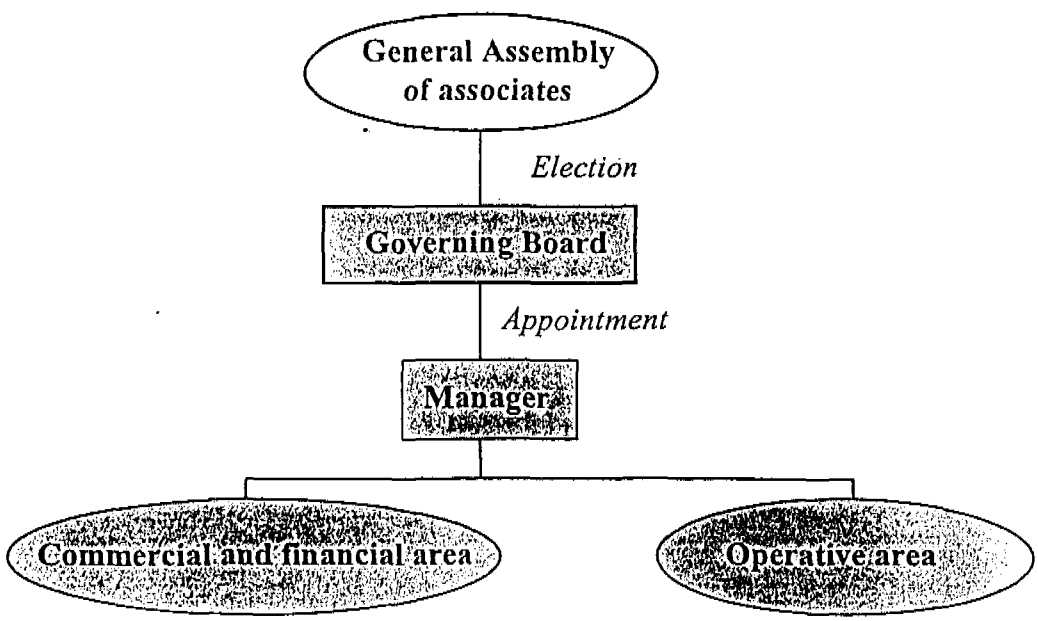


Document analysis 3 : Cooperative association of public administration

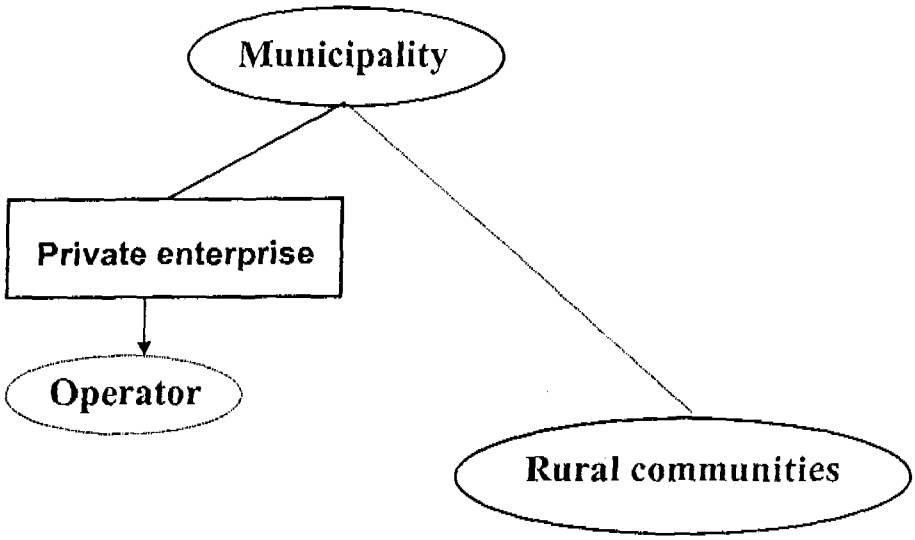
Briefly highlight the strong and weak points of this management option for rural piped systems

The cooperative association is an organization of private law, which aims at solving a social need through the production and the provision of a service. It is composed of associates including : users of the service, representatives of local authorities, representatives of other associations or public/private firms.

How is a cooperative association created ?After an authorization obtained from the Municipal Council, a General Assembly composed of all the associates, elects the members of the Governing Board, approves the charter and regulations, and establishes policies, programs and gives the general orientations. The Governing Board is the permanent body for the management and administration of the cooperative association.. It will nominate or remove the manager, determine the profile for the staff, approve the budget for control, and convene the general Assembly. It is composed of a president, vice-president, a Secretary, a controller, and are elected for a period of one year. The cooperative association is composed in the following way :



Document analysis 4 : Private management



The municipality while being in constant dialog with the rural communities has contracted the services of a private firm to manage, operate and maintain the water supply system, under the obligation that the communities are consulted over all matters that have a financial implication for them. The actual operation is done by an operator who is employed by the company. The community in return is ensuring basic preventive maintenance, and payment of a fee.

The contract with the private firm is renewable, and only concerns management, operation and maintenance. All other activities such as decisions for extension, rehabilitation and replacements are the responsibility of the municipality, in consultation with the community.

The firm will have to recover al, the costs through a tariff system, agreed with the community and the municipality.

Important notice !

- Other management options involving the community are analyzed in the next session : "Community management", but the facilitator might want to already introduce a few at this stage.

4. Background information

4.1 Institutions are evolving

The concept of sustainability induces some institutional changes as it highlights the importance of involving communities and users, in coordination with local authorities in the demand, design, management, operation and maintenance of the systems. It also encourages the use of available local resources, such as small private craftsman ship and shops, as well as NGOs, which will help to develop the local economy.

There are today a great number of countries which are implementing decentralization policies which have a direct or indirect impact on the water and sanitation sector. The institutional implications of a decentralization process are obvious, but vary from one country to another. The major rationale for implementing a decentralization process is aiming for a greater efficiency, effectiveness and sustainability of public services. It is based on the assumption that local level institutions can better respond to the needs of the population, and therefore adapt strategies and policies which are relevant to the local context. The central level institutions changing their role from provider of services to the one of coordinator, facilitator and support. This can be done by : 1) a transfer of responsibilities from national to provincial/communal level; 2) a deconcentration of activities from national to local levels; 3) a transfer of various activities to other actors such as NGOs and the private sector.

The graphic below describes this decentralization process and its consequences.

In ❶, the government is responsible for all activities and communities have no responsibilities and are completely assisted, this is a centralized system. This system has proven to be not efficient, especially concerning operation and maintenance of rural water and sanitation systems. Rural areas are very dispersed, and government budget allocations for operation and maintenance are insufficient.

In ❷, communities have a certain degree of responsibility which could range from participating in labor and payment of services. The government still keeps an important role however in the management of systems. This situation which now is commonly accepted and implemented in many projects around the world, corresponds to community participation, but not to community management.

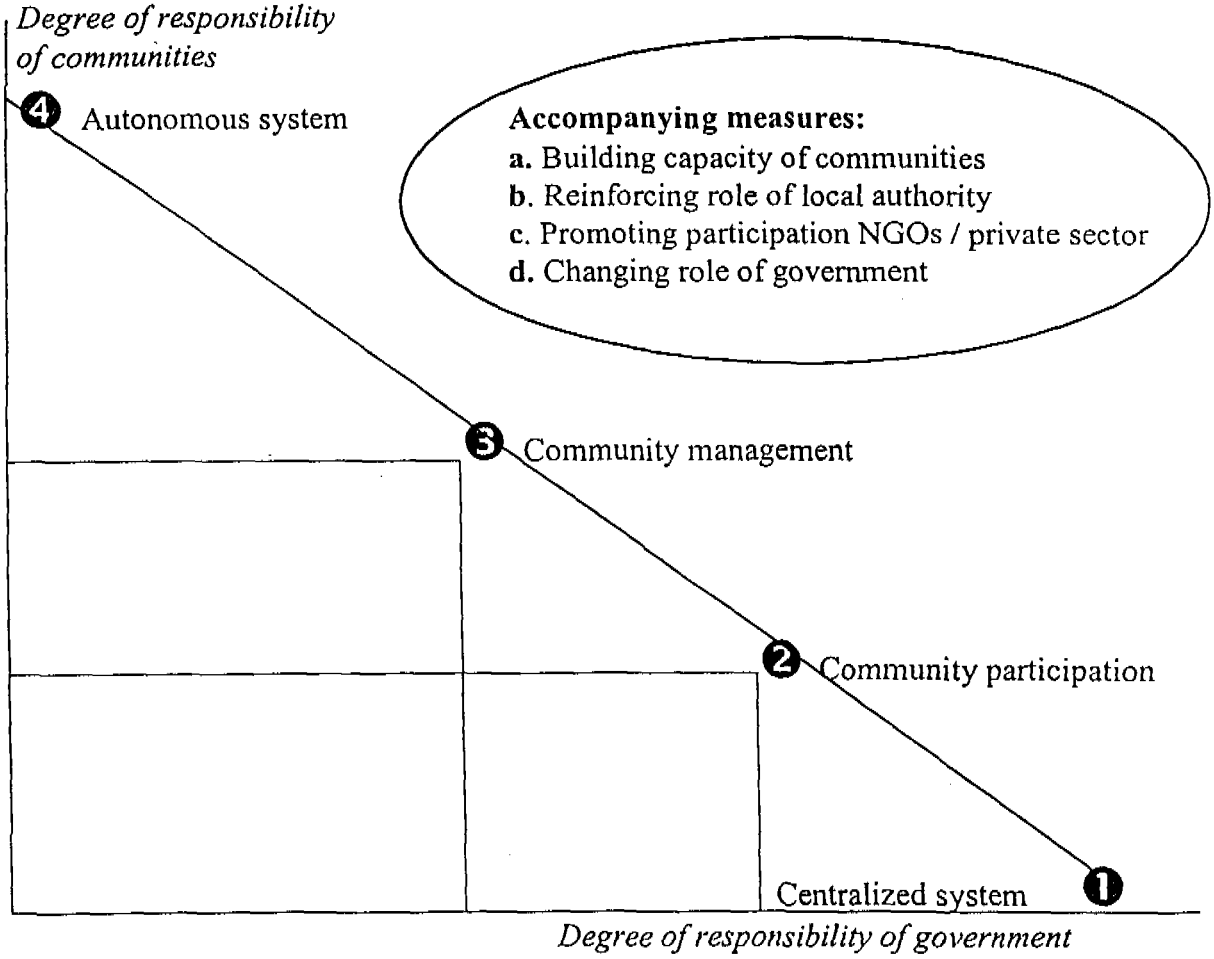
In ❸, communities are managing their system, while they still rely on technical assistance and support. This situation corresponds to community management.

In ❹, communities are autonomous, which is not sustainable since

communities will still need to rely on technical expertise and support.

The main consequence of this process from government to community level is that it increases the burden of financial, operational, technical, managerial responsibilities at local level which communities do not have the capacity to carry. This process will therefore rely on accompanying measures such as :

- Building the capacity of communities on technical, financial and managerial terms, with a gender perspective.
- Reinforcing the role of local authorities in coordination with communities, and giving the technical and financial means to do so.
- Promoting the participation of local Non Governmental Organizations and small private firms (formal and informal) in the provision of services (technical assistance, training, repairs, spare parts provision).
- Changing the role of government institutions from provider of services to coordinator and facilitator.



Who constitutes the private sector?

The private sector encompasses a range of individuals and companies from the village blacksmith to international companies manufacturing pumps and diesel generators. They all have a part to play in supporting O&M.

Actors in the private sector	***O&M support role***
International and national manufacturers and suppliers	• design and manufacture pumps and other equipment for operation and maintenance at the village level • supply spare parts and consumable (e.g. chlorine)
International and national consultants	• design schemes for community management. • develop community/agency managed O&M systems • provide O&M training
International and national contractors	• rehabilitate and extend schemes for community O&M • on-the-job training of O&M staff during construction
Local contractors	• service and maintenance contracts • major repair work
Small-scale industries	• local manufacture of spare parts and tools
Non Governmental Organizations (NGOs)	• training, community sensibilization • technical assistance
Self-employed artisans in the formal and informal sectors	• local skills for preventive and corrective maintenance and repair work: mechanics plumbers, builders, masons, blacksmiths, electricians, etc. • operation of facilities
Local shops	• provision of spare parts
Administrators and accountants	• billing, rate collection, auditing of accounts
Banks	• provide banking facilities for O&M funds • provide credit facilities for irregular high cost items and for the expansion or modification of facilities

Change in the approach

Water supply and sanitation improvements may also be characterized by being either a supply-driven or a demand-driven approach. In our case, we will however promote a demand - responsiveness approach.

The supply-driven approach (top-down) is based on a pre-selection of the intervention area, with village and technology selection criteria based on policies or replication of successful experiences in other countries or projects. This approach can have serious implications for the sustainability of projects, particularly in terms of community acceptance, functioning, use and O&M costs. The community not being involved in any phase of the project cycle.

In the case of a demand-driven project (bottom-up), the problems and needs are identified with and by the communities. This may be preceded by some awareness-raising by extension workers. The advantages are that the motivation of the community to participate in the planning, implementation and O&M phases will be high, and that community-based management will be better accepted and implemented.

A demand-responsiveness approach (sharing responsibilities), puts the accent on two sides, the need to elaborate projects around a demand emerging from the communities, but also on the capacity from the public and private, formal and informal, organizations to respond to this demand. As we have seen in the participation analysis, many actors are involved in the operation, maintenance and management of water supply and sanitation systems.

4.2 Summary of various management models for rural piped systems

Management options	Main characteristics
Direct municipal management	
Direct administration	Administration by the municipal service or department, with no autonomous budget. Controlled by the mayor.
Autonomous administration	Administration by the municipal service or department, with autonomous budget and separate services.
Semi-direct municipal management	
Inter-municipal administration	Administration agreements between several municipalities, with a coordination unit controlled by the municipalities, managing the system.
Direct or autonomous administration with some activities delegated to other firms	Administration by the municipal service, with activities delegated under a contractual service agreement to the other firms for a specific task, and a limited period of time.
Delegated management	
Management contract to a firm or individual	While the municipality remains responsible for the service for investment and tariff setting, it delegates the management of it to a firm or an individual, under a remuneration contract.
Special management contract to a firm or an individual	Same as management contract described above, but with a remuneration based on a fixed agreement with the municipality and a percentage of the collected tariffs.
Leasing / renting contractual arrangements with a firm	The municipality establishes a contract with a firm, who will not be responsible for the investments, but only for the operation and maintenance of the system, whose remuneration comes through collected tariffs.
Public administration (cooperative association)	Distinct legal status, and financial autonomy. Controlled by the Assembly of Associates (where the municipality is a member among others), with the authorization of the Municipal Council.
Concession to community associations	Associations created by a General Assembly of users, with the authorization of the Municipal Council. It manages and operates the system.
Concession to a private firm or society	Under a contractual agreement between the firm and the Municipal Council, the firm will fully manage, operate and maintain the system, with complete financial autonomy. The firm will invest with its own resources, at its own risks, but the municipality must approve them.
Private management	
BOOT contractual agreement (Build-Own-Operate-Transfer) . Also possible: BOT (Build-Operate-Transfer); BOO (Build-Own-Operate); Inverse BOOT.	Under a contractual agreement, a private firm is totally responsible for the construction, management, operation and management of a system, but will transfer it to the municipality at the end of the contract, which is usually long term. For the inverse BOOT, public authority builds, but system becomes private at end of the contract.
Management by a private with public/private capital	Private company whose shares are public and private, i some control is kept at the shareholders assembly.
Private management	Private company owns the system and is totally responsible.

As described above, management options consist in a blend of ownership and responsibilities between the public sector and the private or social sector (social sector = associations). This can be graphically represented in the following way :

Towards more ownership or responsibility of the public sector



❶ Direct / autonomous administration

❷ Inter-municipality administration

❸ Direct / autonomous administration with service contracts

❹ Administration with (special) management contracts

❺ Leasing / renting contract

❻ Cooperative associations

❼ Concession to a community association

❽ Concession to a private firm

❾ BOT (Build-Operate-Transfer) contracts

❶❶ BOOT (Build-Own-Operate-Transfer) contracts

❶❶ BOO (Build-Own-Operate) contracts

❶❷ Inverse BOOT contracts

❶❸ Private company with public / private capital

❶❹ Private company

Towards more ownership and responsibility of private or social sector

4. Issues affecting the choice of management models for the operation and maintenance of rural water supply and sanitation systems[1]

The choice of an O&M management model is influenced by several key issues that are listed below and are discussed in detail : Capacity of Traditional Community Organizations; ; Key Community skills; Health Education and Community Participation; Participation of Women; Complexity of Technology; Availability of Spare Parts; Standardization and Local Manufacture of Equipment; Requirements Shared with Other Sectors; Capacity of Private Sector; Cost Recovery Mechanisms; Ability and Willingness to Pay; National and Regional Economies; Logistics and Transportation; Government Leadership; Strength of Government Agencies and Staff; Regional Autonomy; Policies and Legislation; Communication and Information Sharing

- **Capacity of Traditional Community Organizations**

The community is a focal point in the management of rural WSS systems because it has a vested interest in efficient operation and maintenance. By their very nature, communities are structured to provide leadership, conduct social and religious activities, and attend to legal, property, and economic matters affecting their members. The control of traditional water supply sources and waste disposal sites is part of this structure, since all communities have some type of WSS facilities, however primitive these might be.

Some communities have a highly sophisticated set of rules and responsibilities for managing their WSS facilities. For instance, communities located near rivers may not have a rigorous management system, since water is readily available. But communities in and regions with precarious water supplies usually have strict rules governing individual rights and responsibilities and impose penalties for violations. Similarly, densely populated communities usually have a tighter management system for sanitation facilities than those more sparsely settled.

While the physical environment dictates the need for certain levels of management, so does the character of the society. There are significant differences between societies and their view of management needs for WSS. Some societies have a strong communal approach to meeting their needs; others prefer an individualistic approach. Some are hierarchical while others are more diffuse in structure. These differences must be considered, and, whenever possible, the traditional management system should be empowered. However, certain technologies may require skills that the traditional management system does not have, and new management models may need to be introduced.

- **Key Community Skills**

Among key community skills that must be considered in assessing local management capacities are leadership, accounting, and mechanical aptitude. Leadership is required to organize, motivate, and educate the community. Many decisions require a consensus after the issues and alternatives have been clearly explained. For example, the siting of a well or standpipe could be controversial,

[1] Extracts from "management models for the operation and maintenance of rural water supply and sanitation systems", by Phil Roark, WASH technical paper N. 71, Arlington (USA) (1993)

since one location will be more convenient for some users than for others. The level of service and fee structures are questions that deserve wide discussion. Many WSS projects rely upon community participation for the construction of facilities. To marshal this work force requires leadership skills. Often communities will have transferable experience in sectors unrelated to WSS, such as building a school.

Accounting and record keeping skills are necessary for the proper collection and disbursement of funds. Typically, families in a community pay a flat fee or one that is based on service received. In some cases fund-raisers, such as the sale of crops from a communal field, are organized for the WSS facility. Community confidence must be ensured by public disclosure of collections and spending and scrupulous accounting. Further, decisions reached at meetings should be placed on record. In some developing countries where literacy levels in rural areas are low, this is not always possible.

Some mechanical skills within the community are necessary. Depending upon the technology involved, these can range from simple caretaker skills to repair skills for sophisticated machinery. Deep wells, for example, may be the only option for supplying potable water to a community, but the pumping requirements may be beyond local repair capability. In such cases, the community will provide only caretaker and operational labor and call upon outside assistance for repairs.

Training is one way of upgrading community skills. Of course, there are limits to training adults with a low level of literacy, but for most areas of community need instruction can be held to these limits and still achieve adequacy. Many projects provide WSS management committee members with training in the maintenance and repair of pumping equipment.

- **Health Education and Community Participation**

In addition to technical and management training, community understanding of health, hygiene, and community participation is important. This understanding may vary considerably from region to region. For a WSS facility to be effective it must not only be functional but also be used. Many properly designed WSS facilities have not been utilized sufficiently or correctly through ignorance of their health benefits. When poor quality water is more easily available, good quality facilities often are allowed to fall into disrepair. Sometimes clean water at the distribution point 'LS polluted by the user through improper transportation and storage.

Other areas of health awareness, particularly child survival activities, also are important. Widely disseminated information on the benefits of immunization, oral rehydration therapy, breast feeding, and nutrition will reinforce understanding of the cause and effect of disease and lead to effective use of WSS facilities. Female literacy is a particularly important determinant of community health, since women are the key implementors of health practices. Since WSS projects usually are cited as a priority need among potential beneficiaries, they often serve as a catalyst for the introduction of other health interventions.

- **Participation of Women**

Women are primarily responsible for obtaining and using water, but generally have not been given much say in decision making. The result has been facility

designs and management structures that hamper effective use. Women deserve a significant voice in the design, construction, management, and utilization of WSS systems.

Increasingly, they are being given more responsibility. Some projects have stipulated the number of women to serve on WSS committees. Others have assigned them specific roles, including non-traditional ones such as that of pump operator.

The role of women as decision makers varies among societies. While there is general progress in increasing their participation, some societies maintain barriers that must be respected in designing management systems.

- **Complexity of Technology**

Technologies for rural or periurban water systems range from capped springs that feed gravity distribution systems, to deep wells equipped with electric powered pumps and a distribution system consisting of a storage tank and pipelines, to household connections. Sanitation system-Ls in rural or periurban areas range from simple latrines to flush toilets with cesspools. Many of these technologies have been in use for decades with only minor changes. However, research has produced many new improvements adapted to the needs of developing countries. For example, handpumps are now designed to be more robust and more easily repaired. Drilling rigs for shallow wells have been reduced in **size** and cost. Pumping systems relying on wind and solar energy have been developed. Low-cost latrines that are sanitary and well ventilated are now easily available.

Given this range of technological choice, the fundamental maxim is that the technology should be compatible with the beneficiaries' ability to handle it. If repairs are too complex for them, the next tier up must assume this responsibility. Some communities may be able to repair part of a system, such as a pipeline, but not an electrical generator. In this case the responsibility would have to be shared. Generally, it is preferable for the beneficiaries to be primarily responsible for managing the system even if they require outside mechanical assistance.

- **Availability of Spare Parts**

The availability of spare parts has been a recurring problem for many WSS projects. Some have installed hundreds of handpumps and presumed that market mechanisms would impel local hardware dealers to provide needed parts. In certain countries government agencies retain this responsibility, in others they import spare parts and rely upon a commercial system for distribution. In any case, the laws of supply and demand do not always work as expected. Too often systems fail because spare parts are simply inaccessible.

- **Standardization and Local Manufacture of Equipment**

The problem of the availability of equipment and spare parts can be overcome by standardization and/or domestic manufacture. The installation of pumps made by several foreign manufacturers has led to a chaotic situation in many countries. Spare parts often are not available and repairmen are not familiar with certain pump designs. This situation is largely the results of bilateral aid that restricts

procurement to pumps manufactured in the donor country. Some developing countries, in response, have insisted on specifying which pumps they will accept.

Many of these countries are now developing an indigenous capacity for the manufacture of plastics for pipe and well casing. Locally manufactured equipment and policies that standardize equipment are the best answers to technological choice. Local manufacture also eliminates the need for hard currency, which is always in short supply.

- **Requirements Shared with Other Sectors**

Procurement problems often can be eased by considering the requirements that the WSS sector shares with other sectors. The irrigation sector, for example, uses considerable quantities of pumping equipment, pipe, and related materials. The housing sector uses faucets, toilets, pipes, and building materials. The market for equipment in one sector can influence decisions in another sector. Thus, a new irrigation project could determine the type of pump the WSS sector would select for a project in the same region.

- **Capacity of Private Sector**

The private sector may have a role in the design, construction, maintenance, and repair of WSS facilities. In urban areas there is seldom a question of its capacity; in rural areas its presence may be limited or nonexistent. Some projects have trained repairmen to maintain several facilities in a region. Others have presumed that a sufficiently large market will in itself attract repairmen to the target area. This generally is true of WSS facilities near urban centers.

If the profits to be made are reasonable, private sector participation usually is assured. Some projects have established prices for services and parts to protect the communities from price gouging. But prices must be fixed with due regard for adequate financial returns in the context of the local economy. Tasks such as well drilling and the construction of storage reservoirs are best contracted to the private sector. Many projects arrange franchised regional repairmen for the equipment installed.

- **Cost Recovery Mechanisms**

Government policies requiring cost recovery in WSS projects have two objectives: to make the beneficiaries pay for the benefits they enjoy; and to ensure that the beneficiaries gain a sense of ownership and thereby a concern for preserving the facilities. The costs of many rural WSS projects are beyond the means of the communities they serve, and the government or a donor subsidizes all or part of these costs. The philosophy behind this is that state revenues are to be distributed for the national good, and that rural health and living standards are entitled to special attention if this goal is pursued. However, if a project is to be sustainable, the beneficiaries must be able to fully cover all operation and maintenance and replacement costs.

Among the cost recovery mechanisms employed in WSS projects, perhaps the most common is a flat monthly fee levied on each family or household. In and

zones, where water is at a premium and conservation is essential, water typically is sold by the unit volume. When water is Pumped by a fuel driven engine, volume sales are the norm. In areas where cash is not in general use, communal sales of agricultural products are earmarked for the WSS system. Some communities insist on payment from every consumer, while others may provide free water to the very poor. In notable instances, some communities receive funds from presumably richer members who have moved to the city or to foreign countries.

- **Ability and Willingness to Pay**

The ability to pay is a function of disposable income and depends on the absolute wealth of the wage earners in a household. WSS interventions must be scaled to a level compatible with the ability to pay.

Willingness to pay is a different matter, influencing all expenditures including that for WSS service. Where there is no alternative water choice, the willingness to pay may be quite high, resulting in vastly inflated prices. Thus, water vendors in periurban areas often charge several times the price that is paid in the adjacent urban zone. In contrast, improved water supplies may not be used if there are streams nearby and the cost of water from the improved source is considered high. Water quality often is ignored if water can be obtained free from an unimproved source. In societies where women control money, they often are more willing to pay for water than men are, realizing the benefit of a clean and convenient source. For sanitation facilities, convenience and privacy are paramount. Dwellers in dense housing neighborhoods appear more willing than there. rural counterparts to pay for latrines or toilets.

Because of difficulties with payment, many projects require funds to be collected in advance for O&M, and sometimes for construction, as evidence of the community's willingness to participate. In other cases, potential participants are surveyed to determine their willingness to pay. These surveys require the use of appropriate sampling techniques to ensure accurate answers to delicate questions related to personal financial preferences.

- **National and Regional Economies**

Many developing countries have high rates of inflation, costs of living, and unemployment, all of which have a significant effect on 0 & M management. High inflation requires careful attention to budget planning. Many meticulous plans have crumbled because of the loss of buying power by local currencies. Several countries, notably in the Middle East, depend a great deal on funds sent home by workers who have found higher paying jobs abroad.

Rapidly rising prices of basic commodities also plague certain countries. Fuel prices are often critical for WSS projects that use engines for well drilling or pumping.

Unemployment can create a large labor pool for labor intensive tasks such as the digging of a pipeline. This lessens the need for expensive machinery and places responsibility in the hands of the beneficiaries. Some communities carry out such tasks without remuneration as their contribution to the project. These tasks

should be arranged to coincide with seasonal levels of unemployment, so that they do not interfere with the regular agricultural cycles, for planting and harvesting, when everyone is busy.

Some countries have regional pockets with distinctive characteristics that set them apart from the national economy. These may be areas of high poverty that lack natural resources, or they may border a country that has a more developed economy and thus be in a more favorable position to support development projects.

- **Logistics and Transportation**

Isolated areas difficult to reach because of long distances or bad roads will add to project costs and increase uncertainties in planning. They will require special attention to the logistics of communication and transportation of supplies.

- **Government Leadership**

The strength of government leadership in the WSS sector is an important factor in selecting a management model. Governments that take the lead in formulating policies and plans are likely to maintain control over all aspects of WSS development. When the WSS sector is singled out for centralized control, the government may be emphasizing the importance of the sector. Indicators of leadership include public pronouncements of the value of WSS by prominent officials, social marketing campaigns to influence public behavior, significant investments in the sector, and the existence of agencies to respond to public requests for information and services.

Some prudence is necessary, however, in evaluating public pronouncements. It is not uncommon for politicians to develop platforms that call for improvements in the WSS sector. Some governments take a paternalistic attitude to providing for the people's welfare.

Campaign promises and professed support for the sector must be judged by actual accomplishments.

Visible and active leadership is needed to bring issues relating to WSS to the forefront. Where government leadership is lacking, more emphasis must necessarily be placed on management approaches molded to fit local conditions.

- **Strength of Government Agencies and Staff**

Institutional effectiveness is a critical factor in the sector and is influenced particularly by the organizational framework and the quality of the staff. The organizational framework should encompass all the components of the sector from planning and design to operation and maintenance, with support for programs of health education and community participation. There should be clear lines of authority and responsibility, and when several government ,agencies are involved, coordinating mechanisms are essential. Often the Ministry of Public Works and the Ministry of Health are each assigned specialized tasks. Public Works is responsible for constructing the systems, while Health is responsible for health education and

community surveys. Coordination is crucial but difficult unless there is a formal organizational agreement and framework.

Ultimately, the key to agency success is the quality of the staff, from the top to the lowest echelons. Successful agencies have leaders who are good managers, technically competent in the WSS sector, and able to articulate the objectives of the agency. Staff must clearly understand their role and have the technical expertise to carry it out.

Extension agents are the vital link between the agency and the community. There must be enough of them to cover vast rural areas, and they must have adequate transportation and be skilled in community outreach techniques.

Another important requirement for a successful agency is a budget large enough to carry out the mandate, including line items for staff salaries, administration, equipment, transportation, and training. Attractive salaries and benefits are necessary for retaining competent workers since the private sector often competes for their talents.

- **Regional Autonomy**

Many countries have wide regional differences in climate, topography, land use, social and religious customs, economy, and access to services and materials. Climates may range from tropical to arid, requiring significant differences in the approach to WSS projects. Mountainous regions may offer abundant spring development, while flat lands may require deep drilling. Local cultures can differ considerably and can be separated by philosophies and geographic distance. Some regions may have a relative abundance of natural resources. In large countries travel to outlying areas may be arduous. All these differences are conducive to the creation or strengthening of regional administrations. Decentralization brings power nearer to the beneficiaries. Central control of the WSS sector in countries with significant regional autonomy can be detrimental to development.

- **Policies and Legislation**

Without sound policies and legislation, there is little chance of significant WSS development. Policies must express government goals and objectives, and issues must be clearly defined. Policies governing the following issues are particularly important:

- the responsibilities of the communities and their ownership of the WSS systems;
- technology choices affecting equipment standardization and the procurement of spare parts;
- the role of the private sector;
- cost recovery mechanisms and fee structures; and

- the role of government agencies and the scope of their support.

The application and enforcement of government policies and legislation must be judged by results. Comparisons between stated goals and actual outputs offer useful insights.

- **Communication and Information Sharing**

Communication and information sharing spring from a commitment to the process. Objectives can be met only if adequate information is available at all levels from the communities to the central government. All players within the sector should be abreast of policies, legislation, decrees, administrative decisions, and any other pertinent matters. While the lack of technological hardware sometimes impedes communication with distant points, more often it is a lack of will that is the cause.

Mass communication techniques such as radio messages in local languages have been successfully used to inform dispersed populations in rural areas. Frequent visits by extension agents to the communities are also an important means of communication, as are audiovisual aids such as posters, bulletins, and videos.

4.4 The importance of communication[2]

One area often overlooked in planning a water and sanitation programme, is the need for a clearly articulated and systematic communication strategy. The inclusion of a planned communication strategy not only recognizes the necessity of communicating with people, it articulates the needs of each stakeholder and helps find a way to bridge the gap between planners, government agencies, private sector and communities.

Communication can also both compliment and, in some cases, substitute for the regulatory work. It can compliment because the design and successful implementation of a rural water policy requires a level of dialogue between those who design or implement the policy and those who are addressed by it. It substitutes for other instruments when it motivates people to change their behaviour voluntarily.

Communication is not the same as "telling"; the words "to communicate" imply a two-way process. A communication strategy must include the opportunity for feedback from the audience to the sender and back again. When people are allowed to participate in the process of defining and implementing the rules for their own water strategy, the potential for sustainability is accelerated. A corollary to this is the need "to listen", and therefore communication requires "listening". If the messages coming back across the feedback loop are not listened to (and acted upon where appropriate), communication is not taking place.

In order to be effective, a communication strategy must be deliberately and systematically planned. While most programme planners assume that some level of communication will take place, whenever it does, it does so on an ad-hoc basis without necessarily reflecting the communication needs of different groups of people

[2] Extracts from "Study of the Institutional arrangements for the provision of rural water supply and sanitation services in Mozambique", March 1997, Cowater International Inc.

nor does it facilitate a two way dialogue between planners and people.

A communication planning sequence can include the following activities :

- Identification and formulation of key issues to be communicated
- Identification of target audiences
- Research on current knowledge, attitude and practice of each target group around the required future change in behaviour
- Development of messages based on current knowledge and behaviour
- Pre-test messages
- Identification of appropriate communication channels
- Preparation of communication materials
- Pre-test of materials
- Training of communicators
- Development of indicators to assess impact
- Implementation of communication programme
- Assessment of impact and adjustment of programme design.

Unit 3: Community management

1. Outline of session

Objectives

- Participants understand concepts of community participation and community management;
- Participants are familiar with pro's and con's of degrees of community involvement in management;
- Participants are aware of resistance to change and how to deal with this when working with communities;
- Participants have identified ways to approach the community and facilitate community management

Methodology

1. Introduction
2. Discussion on: "What is a community?" and "What is management?"
3. Role play on resistance to change and means to react to various situations
4. Participatory lecture on concepts and characteristics of community management, including role of management committees
5. Concluding session on pre-requisites for community management.

Materials

✓ Overhead transparencies
✓ Overhead projector and screen or white wall
✓ Flip chart and markers

Handouts

✓ Copies of transparencies
✓ Exercise sheet
✓ Extracts from background information

2. Notes for the trainer

Introduction

One major element of the concept of sustainability is community management. This session will highlight this element, which will be followed by ways to a session on gender issues and another one on how to approach and work with communities.

Discussion on "what is a community"? and "what is community management?"

It is important to first assess the level of familiarity with community management approaches among the participants with a discussion. The concept of community management contains also the word ***'community'.*** Too often the community is taken for granted. Support and development agencies just assume that people they support form some kind of a 'common - unity', that is a group of people sharing common values and interests. Too often it is assumed that people living in a specific geographic unit or administrative service area (e.g. a district, a sub-district or ward, a village, a village quarter, a group of households sharing a water point) form a homogeneous group. Is this true?

Participants should reflect on this by asking them questions like: "Are you member of a community? Which one? Are you member of other communities? Which ones?"

Similarly a rural community not necessarily consists of a homogeneous group of people. Participants can identify typical sub-groups within a community (e.g. rich - poor, peasants - cattle owners, women - men, groups using water for different purposes, polluters - non-polluters, people living in the centre - in the periphery, high - low educated people).

Support agents should be aware of this and take into account these differences within a 'community' when promoting community based management .

In the term "Community-management", is also the word ***management***. It is important to make some clear distinction on what is meant by management in "community management". The facilitator can therefore ask the participants the following question: "what does management mean in community management?". He should highlight as well the difference between community participation and community management. The overhead sheets and the background information provides with ample information on this issue.

Role play on resistance to change and ways to deal about it

This exercise has several objectives : a) to show that the receptivity of a community to a water project can be very different; b) communities are not all the same, and that it would be wrong to apply only one type of approach to all communities; c) there are appropriate responses to each type of community.

The role play should be prepared beforehand. It is in fact a role play and a presentation at the same time. It basically involves only two persons : 1) an "engineer", who represents the project assistance; 2) a "peasant" (preferably a woman), who represents the community. The "peasant" can wear some traditional close or a traditional hat coming from the country which shows that she is a peasant.

The facilitator will have to prepare before hand some cards, which correspond to the various steps of the role/play - presentation, similar to what is presented in the overhead sheet (Resistance to change continuum). On aboard should be drawn beforehand as well only the "climbing" steps. The steps will filled in gradually.

Step 1 : The community does not see the need for any improvement; there are no problems !

- Cards needed : **No problem!** and **Sensibilization**

- Role play : The engineer simulates his arrival in a community all happy to have something to propose to them. He exposes rapidly to the "peasant" (who looks quite surprised!) all his water supply improvement project. But rapidly, the peasant manifests her opposition, and says that there is no problem with the water they drink and that they have been drinking this water for generations and that they don't need this project. She throws the engineer out the community !

- Question to the participants : "Is this a common situation ?" ; "Can you give an example ?"

- Presentation : The "no problem!" card is put on the board at the level of the corresponding step of the drawing. The facilitator will explain that the best way to approach the community in that setting is to organize sensibilization activities, by placing the card " Sensibilization" and by presenting briefly what this means.

Step 2 : The community sees the problem but it feels that it not their responsibility.

- Cards needed : **Not our responsibility !** and **Mobilization**

- Role play : The engineer simulates again his arrival to the community and explains briefly again what the project is about, but the peasant explains that the project looks interesting but that it is not their responsibility, that they pay enough taxes to the government and that sit is up to the government and the project staff to take their responsibility. Again the peasant throws the engineer out of the community.

- Question to the participants : "Is this a common situation ?" ; "Can you give an example ?"

- Presentation : The "not our responsibility !" card is put on the board at the level of the corresponding step of the drawing. The facilitator will explain that the best way to approach the community in that case is to organize mobilization activities, by placing the "mobilization" card and by presenting briefly what this means.

Step 3 : The community sees that there is a problem but has doubts the proposed project

- Cards needed : **We have doubts** and **Information**

- Role play: The engineer simulates again his coming to the community. The peasant recognizes him and says that they now recognize that there is a problem in their community concerning safe water supply, and that they now that they will have to take some part of the responsibility. But now they have strong doubts about the proposed solution, and they don't understand why this is proposed.

- Question to the participants : "Is this a common situation ?" ; "Can you give an example ?"

- Presentation : The "We have doubts" card is put on the board at the level of the corresponding step of the drawing. The facilitator will explain that the best way to approach the community in that case is to organize participatory information activities, by placing the "information" card and by presenting briefly what this means.

Step 4 : The community sees that there is a problem but is afraid of the changes that it might bring.

- Cards needed :  and 

- Role play : The engineer simulates again his arrival in the community, and the peasant seems somewhat reluctant to accept the project, because he is afraid of all the implications that it will have, and especially of the changes in habits the community has already. The peasant thanks the engineer, and says that they be sometimes in the future they will go for it.

- Question to the participants : "Is this a common situation ?" ; "Can you give an example ?"

- Presentation : The "afraid of change" card is put on the board at the level of the corresponding step of the drawing. The facilitator will explain that the best way to approach the community in that case is to organize demonstration activities, by placing the "demonstration" card and by presenting briefly what this means.

Step 5 : The community sees the problems and is willing to take responsibility, and feels somehow that the option is appropriate to their situation, but they don't know enough about it yet.

- Cards needed :  and 

- Role play : This time when the engineer enters the community the peasant is much more welcoming and tells him that he likes the project but he feels like he needs to know more. The engineer then sits down with the peasant in order to organize the timing of the training events.

- Question to the participants : "Is this a comrnon situation ?" ; "Can you give an example ?"

- Presentation : The "need to know more" card is put on the board at the level of the corresponding step of the drawing. The facilitator will explain that the best way to approach the community in that case is to organize training activities, by placing the "training" card and by presenting briefly what this means.

Step 6 : The community is ready for a change, accepts the responsibility and requests to implement the project

- Cards needed : **We are ready** and **Implementation**
- Role play : The community warmly welcomes the engineer with simulation of a party, and is ready to move ahead with the project. Some mention could be made about the contribution which the community has accepted to take, in terms of cash or labour, as well as in terms of responsibilities.
- Question to the participants : "Is this a common situation ?" ; "Can you give an example ?"

- Presentation : The "We are ready" card is put on the board at the level of the corresponding step of the drawing. The facilitator will explain that the best way to approach the community in that case is to organize the implementation of the project, by placing the "implementation" card and by presenting briefly what this means.

Step 7 : The community has been involved in the implementation of the project and is willing to demonstrate to other communities the benefits of such a project

- Cards needed : **Will to show others** and **Duplication**

- Role play : The engineer and the peasant are seen discussing over how successful the project is, and the peasant mentions clearly that it the communities around them have the same problem and that they will be willing to collaborate with the engineer to demonstrate the positive benefits of introducing the project.

- Question to the participants : "Is this a common situation ?" ; "Can you give an example ?"

- Presentation : The "Will to show others" card is put on the board at the level of the corresponding step of the drawing. The facilitator will explain that the best way to approach the community in that case is to organize the duplication of the project, by placing the "duplication" card and by presenting briefly what this means.

Participatory lecture on community management

The facilitator can then proceed with an interactive presentation, using the overhead sheets which are proposed , on :

- Why involve communities in the management, operation and maintenance of rural water supply and sanitation ?

- Goals of community management
- Characteristics of community management
- Forms of community management
- Typical tasks of a water committee
- Composition and legal status of a water committee

Concluding exercise on pre-requisites for community management

The facilitator will ask the group : "What are the main elements which should be looked at in order to reach sustainable community management ?"
The facilitator will write down the answers on a board. He can use for himself or share with the group as a reference the list provided in the overhead sheets.

3. Overhead sheets

What is a community?

- Is a community a group of people sharing common values and interests?
- A community can be heterogeneous in various aspects
- A community does not necessarily live in one contiguous geographic area
- People can be member of a number of communities
- A 'community' can also consist of groups of people with divergent values and interests:

  rich - poor

  peasants versus cattle raisers

  women - men

  people using water for different purposes

  polluters - non-polluters

  people living in the centre - in periphery

  highly educated - low educated

Overhead sheet 2

What is management ?

- **Planning**

  Development of a strategy, objectives, results to be reached, with what resources and in what time

- **Organization**

  Distribution of responsibilities and tasks

- **Decision-making**

  Taking decisions on regular activities, as mandated

- **Coordination**

  Harmonization of contacts between various actors, and communication

- **Control**

  Supervision and enforcement

- **Monitoring**

  Regular check and problem solving

What is community management ?

Social management

(all aspects linked to the organization of the community)

Technical management

(all aspects linked to O&M technical activities)

Financial management

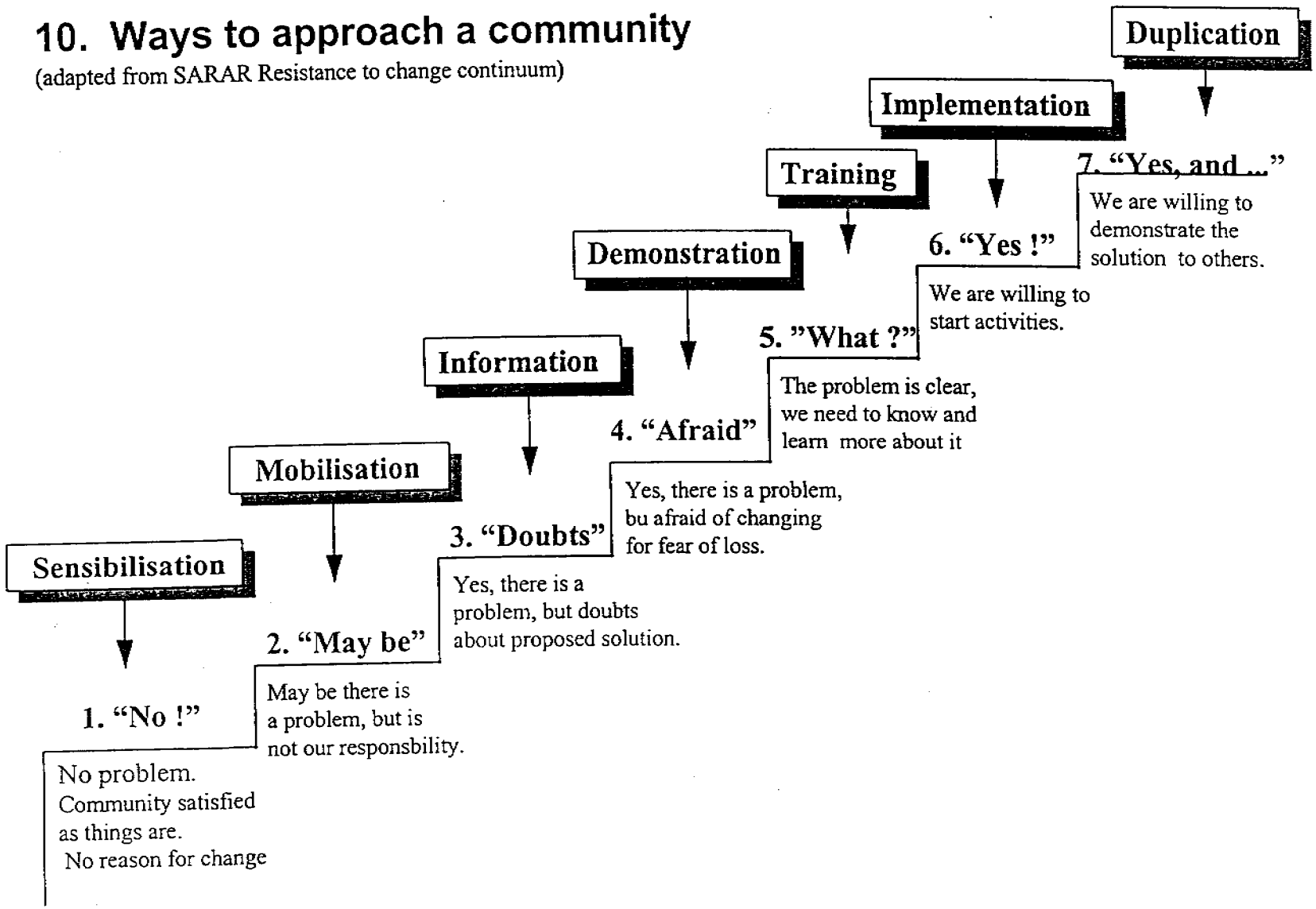
(accounting, tariff setting and all O&M costs recovery)

What is the difference between community participation and community management ?

Participation as a form of 'cheap labour'	Participation as 'cost sharing'	Participation done as a 'contractual arrangement'	Responsibility in 'decision making'
Community's contribution • Free construction labour • Free local raw materials	**Community's contribution** • Token contribution in cash or in kind towards maintenance	**Community's contribution** • Volunteers in committee • Volunteer as caretaker • Commitment by leaders • Contributions	**Community's contribution** • Community fully in charge with possible subsidies for capital investments; part of running costs / support
Community's involvement Only carrying out work	**Community's involvement** Only some community members	**Community's involvement** Not all community members; contract can be commented	**Community's involvement** of all community members, including women
Role of "outsiders" Idea, planning and design	**Role of "outsiders"** Decide on contribution level	**Role of "outsiders"** Develop ideas and contract	**Role of "outsiders"** Facilitation; advice
Aim/Benefit Lower cost	**Aim/Benefit** Lower cost Cost recovery	**Aim/Benefit** Minimal local management infrastructure (local leadership, local committee, local maintenance volunteer)	**Aim/Benefit** Genuine commitment and support from whole community through participatory community education and involvement in decision making from the start
Assumption Pride will lead to maintenance	**Assumption** Contribution indicates service is valued and shows commitment	**Assumption** Legitimizes the project; local management; technology transfer through contract	**Assumption** Long term benefits and increased use and sustainability justify high investment (staff, time, costs)
Limitation Not community priority Contribution not voluntary Use and maintenance may vanish	**Limitation** Commitment only from some Not all involved: e.g. women: the users; System rejected if major break downs	**Limitation** Not all villagers may be involved in decision. Contract not fully understood. Selection of committee and care taker too hastily; willingness to pay can be poor after some time	**Limitation** Requires highly trained and motivated staff; Difficult, time consuming, expensive

10. Ways to approach a community

(adapted from SARAR Resistance to change continuum)



Why involve communities in the management, operation and maintenance of RWSS ?

- Building on existing local knowledge and management capacities
- All social groups feel concerned and can participate
- Addressing true needs of community members
- Solutions acceptable to community members
- Solutions adapted to community capacities
- Increased community commitment to improve situation
- Better understanding of causes and effects of problems
- Empowerment of community and reducing dependency
- Increased sense of ownership and responsibility
- Increased self-consciousness and confidence in own capacities
- Direct interest to have a system well maintained
- Possible improvement of willingness to pay
- Reduced overall and government costs
- Improved reliability and sustainability of systems

Goals of community management

- Improved system reliability and sustainability
- More appropriate choice of technology and service levels
- Reducing investment and operation costs both for support agencies (government) and communities
- Increased confidence and problem solving capacities for further development activities
- Promoting gender sensitive solutions
- Contributing to democratization and equity in development process
- Increased health and socio-economic well being

Characteristics of community management

Community is responsible for:

- Maintenance and repair
- Local management and organization
- Financing

Community decides on:

- Technology choice
- Service level
- Form of local organisation
- Local rules and regulation of use
- Financing mechanisms
- Sanctions

Community controls:

- Ownership of system
- Outcome of decisions
- Quality of work done and functioning of system

Forms of community management

Forms of community management vary according to the size of the community, the technology used, the local context and national legislation. Basically, community management operates through a Committee whose members are elected by a General Assembly of users. The following forms can be found :

- **A Tap or Neighbourhood Committee**

Responsible operating and maintaining a specific water point.

- **A Water Committee**

Responsible of all activities (managerial, operational, technical and financial) of a particular scheme, covering a larger area than a neighborhood, possibly the whole community.

- **A Village Association**

(the village association is responsible for all development activities, and is also overlooking water and sanitation)

- **A "coordinating" Water Committee**

(coordinating several other smaller tap / standpost or neighborhood committees (the water committee is responsible for managerial and financial matters, while the other committees are responsible for operation, maintenance and collecting fees)

- **A Water Committee contracting a private body**

(A water committee contracts a private body, an individual, a mechanic, a group of artisans, or a firm) to operate and maintain the system, while it keeps general management and control role)

- **Delegated responsibility by local authority**

(While ownership and decision-making is done by local authority, a water committee operates and manages the system)

- **Inter-community Federation of Committees**

(Several communities share the same pipe or water source; each community has a water committee, which operates, and maintains its own water point, and collects money, and part of the collected fees goes to an Association of committee for maintenance of the whole system (pipes, source)

Typical tasks of a Water Committee

- Represent community in contacts with support agencies
- Coordinate with and respect roles of other community institutions and decision making bodies
- Ensure efficient and effective overall management of systems
  - Take up assigned roles and tasks
  - Ensure equity
  - Organize contributions
  - Organize effective O&M
  - Accurate financial management
  - Promote hygienic and effective use of facilities
  - Hold regular committee meetings
  - Ensure good communication at all levels
  - Provide information and feedback
  - Collect information

Composition and status of a Water Committee

The composition of a water committee will vary according to its management and operational mandate

It generally is composed of a President, Vice-president, Treasurer and several representatives of the users, with a balance between posts occupied by men and others by women. If the community is directly responsible for the technical operation and maintenance of the system, the Committee also includes the operator and caretaker.

In many countries, the Water committee does not have a proper legal status. This puts the Committee in a position of vulnerability in front of any material, financial, contractual and legal problems. The general legal status found are the following :

- ***The Municipality officially registers a Committee*** which has been elected by a General Assembly of users; a "constituting" Act must be produced by the Assembly.
- ***The Water Committee is registered at the Chamber of Commerce as a non-profit making association.***
- ***The Water Committee is registered at the Chamber of Commerce as an association with an economic interest,*** which then can operate as a concession or under contractual arrangements with local authorities.
- ***The Water Committee operates under the legal mandate of a Development Association.***

Pre-requisites for community management

- Demand for improved systems
- Policy and legal framework promoting community management
- Effective external support
- Information about system options must be available to the community
- Technology options selected with the communities, and adapted to community's capacities and needs
- Community understands implications of choice in terms of responsibilities and tasks
- Community willing to pay
- Community has decision-making power
- Community has access to required capacity building support
- There should be a policy framework to permit and support community management

4. Background information[3]

4.1 The concept of community management

Community management has different connotations in the literature. It has similar unclarities as community participation, which already in 1982 was defined as the provision of free community labour inputs in government projects on the one extreme, to autonomous self-reliant development on the other (White, 1982). Despite or perhaps because of the unclear definition, community management of water supply and sanitation systems is increasingly seen as a fundamental option for sustainable development. Community management of services, backed by measures to strengthen local institutions in implementing and sustaining water and sanitation programmes, was one of the guiding principles adopted in the New Delhi Consultation in 1990 and reconfirmed in Agenda 21 (Evans and Appleton, 1993).

Why is it believed that community management of water supply and sanitation systems, will be any more successful in achieving sustainable coverage than the top-down approaches from the past? Experience in many developing countries shows that even very good water agencies cannot successfully operate and maintain a network of widely dispersed water systems without the full involvement and commitment of the users. Despite the best endeavours of central agencies, staff, transport and budgets become overstretched, leading to broken down systems, dissatisfied consumers and demoralised agency personnel (Lammerink, 1998). Many governments are becoming convinced that centralised systems cannot deliver the required services for the Sector. This resulted in a strong push towards decentralization that started in the late eighties.

Hopes are high with respect to community management. It is suggested that community management is an approach that seeks to make the best use of resources available within the community with support from government agencies. It puts people in charge of their own water systems in flexible partnership with supporting agencies. In this, communities take on more tasks and responsibilities, relieving agencies of routine management and maintenance duties. This releases agency resources which then can be used to reach more people. Successful community management is claimed to build community confidence and to stimulate wider development efforts. It is also stressed that there is still a lot to learn (Evans and Appleton, 1993).

Much of this learning is at agency and institutional level as they often still hold the strings of the purse and so can dictate the developments. Increasingly governments and institutions are trying to adopt a more integrated and demand responsive approach. This is stimulated by the growing pressure to focus on sustainable functioning and effective use of water supply and sanitation systems. Another reason why government agencies are searching for alternatives and are amenable to participatory approaches is that over the past two decades "blue print" development strategies have been shown to be ineffective in meeting the basic needs of large numbers of marginalized, vulnerable people (Thompson, 1995). Thus public sector agencies show growing interest in participatory approaches, involving the community in their attempt to do more with less financial resources. They

[3] Most of the following background information are extracts coming from "Putting Community Management in Place" – Four years of experience with improving water management in rural communities- Community Managers for Tomorrow, Document N.1, IRC, 1998.

develop, for example, links with NGOs who have been using similar types of approaches.

In this, it is surprising to see that agencies do not really have internal mechanisms to learn from their experience with communities, to learn how to work with them and to share this among their staff. What is needed is an approach to learning that allows to develop new methodologies and promotes changes of prevailing attitudes, behaviour, norms, skills and procedures within the agencies.

Not only does the agency staff need to learn to work with communities and to overcome the top-down approach from the past, but the communities also need to come to grips with working with the agency staff in a horizontal relationship. In the future the push for change however will be more radical with increasing decentralization and with communities who are to pay a larger share of the cost. Then the paradigm shift of communities participating in agency projects to one of the agencies participating in community projects will become even more important.

Community management does not imply that the communities must take care of everything or pay the full costs. They operate in partnership with the agencies and possibly the private sector thus enabling different distributions of responsibilities. The function and task to be performed by the organization acting on behalf of the community can thus vary considerably (Lammerink et al., 1995).

4.2 Some findings from the field

In 1995 a participatory action research (PAR) project on community management for rural water supply has been initiated by IRC together with partner organizations in six countries, Cameroon, Kenya, Nepal, Pakistan, Colombia and Guatemala. Local research teams worked closely with community members of a total of 24 communities to better understand community management and to explore possible improvements. The essence of this project is to help communities to gain a better understanding of the problems they face and to let them become a key factor in problems solving. "The knowledge we gain from this 'research' is much more valuable then gifts. It is something we keep for life" (villager from Nkoundja, Cameroon). Community members thus become catalyst and in beginning to understand and discuss their problems they create the space to allow a range of actors to participate and express their views (Bolt et al., 1996).

A first assessment of the situation in the six countries (IRC, 1997) indicates that:

- in each of the countries, community management of completed rural water supply systems is the accepted national policy, but implementation is not universal and each agency has its own procedures;
- no governments so far treat communities as future managers in the sense that they can make their own choices from a range of options, each with their own pro's and con's. None train communities for all community management aspects. Training is focused on technical tasks and bookkeeping, and is mostly given to men;.
- experience with existing community managed-water supply systems varies. In Cameroon, 438 schemes were built to be community managed showing a present breakdown of 9 percent, whereas many other schemes built without community involvement are no longer operational. Others report that a lot of community managed systems do not function well, partly for technical and ecological reasons partly because of poor administration and lack of

management training and back-up support.

- quite some community members are not served because of poor water distribution and poor network management. Several of these persons have contributed to the construction of the system in cash or kind, but do not obtain the benefits;
- problems in existing systems are of technical, managerial and socio-economical nature, but communities just mention technical problems. Other problems surface only after further probing and discussion.
- record keeping both financially and concerning agreements in meetings is very limited and erodes the confidence of the community members. The same goes for communication and information sharing that is sparsely done and is mainly in the hands of the local leadership;
- many ESA's stipulate preconditions for future management, usually the formation of a water committee with some women representation. However little is done in developing management tools or management training;

Another participatory evaluation of 40 community managed water systems in Ecuador revealed that the systems do provide water but are in need of both technical improvements and better management (Visscher et al., 1996).

On the positive side the PAR project already shows that working in a horizontal way with the community and helping them to clarify their problems is a very powerful tool for change. Communities in Kenya for example were initially timid but are now enthusiastic about the management of the water system, and are taking tasks at hand in a transparent way. An overall picture is emerging that communities are capable to manage water supply systems, but do need back-up support. On the side of agencies clear support approaches are needed. Strategies and tools for enhancing management capacity in communities are developed and tested in the project, which offers now a flexible support approach, called Participatory Action Development for community management. This approach aims at responding to concrete needs of a community related to their management tasks and skills around public services, it aims at finding solutions to concrete problems and conflicts in the management of rural water supply by communities (Lammerink et al., 1998).

However, also better strategies need to be found that harness the partnership between communities, governments, NGOs and private sector. In different parts of the world such strategies are being developed for example in the Transcol project in Colombia (Visscher et al., 1997) and in the WAMMA project in Tanzania. These strategies all have in common that they work towards institutional change and changing attitudes of both agency staff and community members.

4.3 "Revisiting" community management

Instead of trying to complete the definition of community management or add another version, there seems to be an easier way to increase our understanding of what it encompasses. Community management deals with two dimensions, communities and management and the relation between both.

Communities, groups of people with common but also conflicting interests and ideas and different socio-economic and cultural backgrounds. The identity of the people in the communities is shaped by their history and their socio-economic and environmental conditions. Some of them, often the economically better off, may be better informed, may know more of the world, but may on the other hand, have certain interests in keeping the

status quo and therefore may not be willing to solve certain problems. Women may have interests different from those of men and may not have been heard in the past, or their position may make it difficult to achieve changes on their own (Galvis et al., 1997; Lammerink and Wolffers, 1994; Wijk van, 1997). Men, women and children have different needs, different access to resources and different areas in which they can take decisions. Yet all have the right to equally contribute to and benefit from development activities, thus making it necessary to strike a gender balance in programme activities, problem identification, conflict resolution and joint management of common interests.

The water supply system may be one such common interest, but at the same time can be a major source of conflict. This brings us to the dimension of ***management***. In his discussion about resource negotiation, Röling (1994) introduces the concept of a platform of decision making, which he defines as a nodal point of social interaction between stakeholders to allow for integral decision making about a resource they perceive to be in need of management. He argues that stakeholders coming together in a platform to manage an ecosystem must learn from scratch about the system, agree on its boundaries, share concepts about its sustainable management, develop indicators for success and methods for making things visible (Röling, 1994). This has very interesting parallels with the water sector, where communities establish water committees that serve as platforms to manage and take decisions concerning their water supply systems, including the sensitive water catchment areas. This platform may also serve sector agencies that increasingly must enter into negotiations with communities about the service that they want (Visscher et al., 1997). These agencies must accept however that as Röling states the stakeholders need to learn about the system in all its aspects. This implies no quick fits, but a process of dialogue, creating adequate learning opportunities for all involved on both the community and agency side.

Management is a concept that is very much in development and is changing to sharing responsibilities in new ways. It is becoming much more focused on learning, creating an enabling environment, building trust. It places much more emphasis on communication and holistic approaches. A collective learning process, starts with dialogue, or an open exchange of ideas in the group. This permits the participants to discover their potential and perspectives. This dialogue differs from the more common discussion, which has its roots with 'percussion' and 'concussion', literally a heaving of ideas back and forth in a winner-takes all competition (Senge, 1990). Team learning develops the skills of groups of people to look beyond individual perspectives. It requires a positive learning environment. This is not easy, particularly in a politicized environment such as the water and sanitation sector. Not only are good facilitation and a variety of techniques required, but also leadership training for group members and a review of the historical developments with the community. Equally important is the need to review with the sector staff the social missions of their institutions and their own aspirations. This requires building confidence and trust, helping them to become self-confident and gain self-esteem. A guide to this process was already provided by Tao to Loa (700 BC):

> 'Go to the people, live among them, learn from them, love them, start with what they know, build on what they have. But of the best leaders when their task is accomplished, their work is done, the people all remark: We have done it ourselves'

The community is not the only actor, but can benefit from partnerships with the water sector institutions and the private sector. There is no blue-print what the inputs of different actors can be in the different project stages , but what may be expected is that the role of the government or NGOs who initially are the project leaders will reduce over time and the

role of the (community) water enterprise (water committee, users association, private enterprise etc.). increases. The different actors or their representatives thus have to come to an agreement on what the specific contributions and responsibilities will be over time. This they can only do on the basis of informed decision making which particularly addresses the expected service level and the long term management of the system, being still the weakest issue today. The discussion may include possible future extensions of the system, not in great detail but the basic concept should be clear.

4.4 Some concluding remarks about community management

Although a paradigm shift seems to be emerging the principal challenges to put community management into mainstream practice are still huge. Currently in most countries, community management of rural water supply systems is the accepted national policy. However, their is still a considerable gap between policy and practice. In fact, communities are not treated as future managers in the sense that they can make their own choices from a range of options. Nor do they get the opportunity to learn the required management skills.

This and the lack of back-up support for problems going beyond the community level are important reasons for the sub-standard performance of many systems. This will continue to be the case unless the managerial aspects are better taken in hand and practical management tools are developed together with communities.
Management skills also include handling of conflicts because communities consist of people which not necessarily share the same interests and values. Often conflicting interests exist both within the community and between the community and outsiders.

Gradually we see agencies start to participate in the development endeavour of the communities instead of the community participating in the agency projects. This paradigm shift however will only materialises if new learning approaches and participatory methods are adopted in challenging institutional settings where community knowledge and institutional knowledge are equally valued and people start to respect each others views.

The partnership approach means for agencies that new coherent strategies and methods are needed to further build management capacity in, and in dialogue, with communities. This also implies that agencies need to make the necessary adjustments and strengthen their own capacity to provide such effective support to communities.

Also institutional change is needed which allows for harnessing the partnership between communities, governments, NGOs and private sector. The relationship should be transparent, based on mutual understanding and appreciation of the different 'social' missions of the institutions.

In order to be able for a community to share management responsibilities at a higher degree, stakeholders should be allowed to learn about the system in all its aspects. Support strategies should enable for sufficient learning opportunities and a process of dialogue for all involved. The challenge is how to enable such a continuous process, knowing that 'each place, each culture, each experience requires its own approach'.

Unit 4 : Gender awareness

1. Outline of session

Objectives

- to clarify the concept of gender and its importance in water supply and sanitation projects
- to raise awareness on how to develop and apply a gender approach for operation and maintenance

Methodology

1. Introduction
2. Quiz on the concept of gender
3. Focused discussion on relevance of a gender approach
4. Interactive presentation on key elements for developing and applying a gender approach for operation and maintenance
5. Group exercise on development of gender approach

Materials

- ✓ Overhead transparencies
- ✓ Overhead projector, screen or white wall
- ✓ Cartons
- ✓ Flip chart

Handouts

- ✓ Quiz and exercise sheets
- ✓ Copies of transparencies and selection of background information

2. Notes for the facilitator

Introduction

The purpose of this unit is not to look at women in isolation but to enable differences between women and men to become visible. It implies not only identifying gender differences, but analysing how these differences lead to the inequalities of power between women and men which may hamper their full participation and management of water supply and sanitation programs.

Some participants may be a little resistant in accepting gender because it does question their own behaviours towards men or women. One suggestion in dealing with this resistance is to highlight examples of our daily lives where gender has evolved within generations, simply because circumstances have made us do so.

Quiz on the concept of gender

The facilitator distributes one red card (representing men) and one blue card (representing women) to each participant. He will the ask a series of questions, all related to O&M activities (see overhead) to then group. For each activity, the group should indicate with the cards, if men or women are more concerned by this activity.

At the end of the quiz, the facilitator can ask the group to reflect on issues and differences between men and women which they observed in the questions (e.g. difference in access and control to resources, decision making, work..etc).

The facilitator will then try with the group to make a definition of what is gender (see overhead).

Focused discussion on the relevance of gender

The facilitator will ask to the group "why a gender approach is relevant ?". Ideas must be then written on the board. Discussions or disagreements may arise, and the facilitator should try to let the participants express their experience , and control time at the same time. An overhead sheet is provided giving some suggestions on this issue.

Interactive presentation on how to develop an O&M project with a gender approach

The facilitator can use the information contained in the overhead sheets or in the background information for a small presentation. However, he might find opportune to invite a gender specialist to the course who can explain his or her experience in setting a project with a gender perspective.

Group exercise on development of gender approach

Participants should be divided into smaller groups which correspond to : a) sanitation project; hand-pump project; small piped system (or other). They are asked to develop the main points, which are critical to include in a project which aims to develop sustainable operation and maintenance in a gender perspective. Results are then shared and discussed in plenary. Experience has shown that participants like to keep track of the work they have been doing, so it is important to organise secretarial support.

3. Overhead sheets

QUIZ on Gender specificity

For each question, participants respond by raising a red card (men) or a blue card (women). If important differences arise from the group, the facilitator should ask for comments.

- Who specifies rules and regulations about the use of the water point ?
- Who ensures that these are kept by all users ?
- Who keeps the water point and the surrounding area, including the drain, in a good and clean condition ?
- Who repairs any small damage or leak immediately to prevent major failures and more costly repairs ?
- Who takes care about the regular maintenance (lubrication, cleaning of mechanical parts) ?
- Who reports any major failures immediately to those who are responsible for big repairs ?
- Who collects and keeps the money safely, while recording all income and expenditures ?
- Who makes the necessary payments for maintenance and upkeep of the water point?
- Who reports to the community on how the money has been spent ?
- Who takes decisions within the Committee ?
- Who contributes to the construction of the water supply system ?
- Who contributes to the construction of a latrine ?
- Who maintains latrines ?
- Who transports and stores water ?
- Who educates children on proper hygiene behaviour?

Overhead sheet

What is gender ?



- Sex relates to the biological difference between a man and a woman
- Gender relates to the social difference between a man and a woman
- Gender is not relating to only women, but to both women and men

- A gender approach is about optimising the roles and responsibilities of both men and women

Overhead sheet

Why a gender approach is relevant ?

- Because users form an heterogeneous group
- Because women have a keen and direct interest in water supply, sanitation and hygiene
- Because women stay in the community
- Because men can contribute to a higher efficiency of the system, by sharing responsibilities, decision-making and problem soling with women
- Because women transfer behaviour patterns to their children
- Because it generates a wider and more specific participation of the community in the project cycle
- Because it contributes to the development of women
- Because it contributes to sustainability

Overhead sheet

Planning with a gender perspective

1. Participatory diagnosis on :

- existing water supply and sanitation service within the community
- health status by gender
- work division in households
- accessibility, use and control of water
- problems and constraints
- technical know-how of men and women
- Cultural elements and beliefs linked to water and sanitation
- Social participation in decision-making

2. Consolidation of community organizations

- constitution of mixed committees
- promotion of the active promotion of women in the committee
- discussion with the committee on problems related to participation, and decision-making in a gender perspective
- revision of the election process of community members in the Committee

3. Appropriate selection of technology

- technology adapted to needs of both men and women (washing, etc.)
- technology using knowledge and skills of both men and women
- technology can be maintained by men and women

4. Operation and Maintenance

- training for both men and women
- active and organised role in preventive maintenance

4. Background information [4]

4.1 Definitions

What is gender and what is a gender balance? Contrary to what is still being found in the literature, gender is not only relating to women, but to both women and men. As the Institute of Development Studies of the University of Sussex puts it, 'The gender-based approach is distinct in that it focuses on women and men, rather than considering women in isolation' (IDS, 1995: 1). A group of women and men working in water resources projects in Asia defined gender as follows: 'Gender ...is the result of a socialization process which assigns certain attitudes, roles and responsibilities [to women and men], leading to certain forms of behaviour' (Bolt, 1994: 3). The group stressed that, as gender is a social construction, it is changing with time. They also stressed that, in traditional roles and responsibilities, women tend to be a disadvantaged group in most Asian countries. A gender approach highlights such differences and changes. In particular a gender approach pays attention to:

- differences between women's and men's interests, even within the same household, and how these are played out;
- the conventions and hierarchies which determine men's and women's position in the family, community and society at large, whereby women are usually dominated by men;
- differences among women and among men, based on age, wealth, ethnic background and other factors;
- the way gender roles and relations change, often quite rapidly, as a result of economic forces, migration for work and other social trends (IDS, 1995: 1).

4.2 Historical background

The phenomenon that a gender approach is still often taken to mean only changes for women, and not for men, has a historical background (Hannan, 1995: 1). The first expression of concern for women and their involvement in development emerged in the 1960s. Women were recognized as a disadvantaged group, for whom special women's components had to be developed. In general projects, such as in water supply, women were seen mainly as the beneficiaries of the improvements.

In the late 1970s and early 1980s, women began to be recognized as actors and managers of water in their own right, and it was demonstrated that involving women in planning, construction and management, brought benefits for general development, for the projects, for the households and for women themselves (Compare for instance the first edition of this book and publications by Elmendorf (1982), Narayan (1988), PRG (1980), Schmink (1984), Schoeffel (1982) and du Toit (1980).

In the second half of the 1980s and beginning of the 1990s it became clear that the effective involvement of women requires them to unite and develop strength and self-reliance. This enables them to give direction to their lives and circumstances and encourages men to look upon women's participation, not as competition, but as a natural right for women to deal with and decide on material and non-material resources which are crucial to them. Without such changes it still occurs that women do the physical work of transport, digging, cleaning and caretaking, but have no say in and do not share control of

[4] Most of this background information are extracts coming from "Gender in Water Resources Management, Water Supply and Sanitation" – Roles and realities revisited- technical paper Series N. 33-E, by Chrisitine van Wijk, IRC.

the resources on which their livelihood depends (Groote, 1990; Hannan, 1984, 1995; Mlama, 1994; Wijk, 1985).

Carolyn Moser (1989) has called these stages in development programmes the welfare approach, the equity or anti-poverty approach, the efficiency approach and the empowerment approach. The *welfare approach* focuses exclusively on women's reproductive roles. The approach sees women exclusively as mothers, wives and housewives. It identifies the women themselves as the problem and places the solution to family welfare in their hands: if the women change their domestic behaviour, better hygiene, health, nutrition, etc. will follow.

In contrast, the *anti-poverty* and *efficiency approaches* point out that besides being mothers, wives and housewives, women are also economic producers and actors in the public realm. During colonial and neo-colonial times these roles were not recognized and women's position was lowered. This resulted, not only in a loss of status, but also in a loss of sources of income and lower efficiency for projects which bypassed such productive roles.

The *empowerment approach* seeks to identify power, less in terms of domination, which carries the implicit assumption that a gain for women implies a loss for men, but rather in terms of the right for women, as for men, to determine choices in life and to influence the direction of change. The approach challenges women to seek a new self-consciousness and new positions in their countries' legal and civil codes, economies, institutions and management systems.

While a gender approach is becoming accepted in theory, the concept of parallel women's involvement as an 'add-on' still persists in the field, as evidenced by the following quote on a USD 80.2 million salt rehabilitation project in Uttar Pradesh, India:

> 'Under instruction from the World Bank, the project was redesigned to target women. In the name of gender in development, village women were bunched together to form thrift groups, so that one day they, too, might buy land. For the project managers, the women's element -and it is little more than an element- seemed like a side-show. When I told one government official I was more interested in seeing the reclaimed fields than a staged women's group meeting, he said: "I am so happy to hear that. You know, we really are technical people. These social activities, these are an add-on". He stressed that word, "add-on"' (Stackhouse, 1996: 15).

4.3 Elements for a gender analysis

In its broadest sense the water sector includes domestic water supply and sanitation, irrigation, wetlands management, drainage and flood control, hydro-electric power generation, navigation and pollution prevention (Sida, 1994). When dealing with gender the main issues are how work, control and benefits are divided between women and men of different classes and age groups.

For the formulation, assessment and review of policies, projects and programmes and documents, such as the present literature review, the following six questions may form the basis for the analysis of gender in water resources development and management:

1. *How are men and women using the resource and for what purpose(s)?*
2. *How are contributions (labour, time, payments, and contributions in kind) to the development and management of water resources divided between men and women?*
3. *Who makes the decisions and controls their implementation, at the various levels?*
4. *Who gets the project or programme resources, such as jobs and training?*
5. *To whom go the benefits and the control over these benefits, such as status, water, products produced with this water, income resulting from products and functions and decisions on how this income is used?*
6. *How is the division of these attributes among women and among men of different wealth, age, and religious and ethic divisions? In other words: do some women and men benefit more than others?*

Indicators for developing and assessing such a gender approach are the division, between men and women, rich and poor, of the access to information; the contributions to implementation and management; the decision-making power; the share in project resources and benefits; and the control over these benefits.

A gender approach analyses current gender divisions and strives for a more balanced division between men and women of different ages, marital and socio-economic status in terms of:

- *the access to information*
- *the amount of physical work*
- *the division of contributions in time and cash*
- *the degree of decision making*
- *the access to resources and benefits: water, training, jobs, income*
- *the control over these resources and benefits.*

4.4 Ways to overcome constraints to women's participation

Activity	***Mechanism***
Project initiation	Programmes establish contacts with male leadership to understand and support also participation of women
Information and dialogue	Programmes use information channels and materials that reach also women
Meetings	Programmes facilitate women to participate and speak out in project meetings: • suitable time and place • awareness of meeting and invitation to attend • appropriate seating arrangements (not at the back) • facilitation of speaking out (vernacular language, discussion breaks, choosing spokeswoman, etc.) • separate meeting with women where necessary
Planning	Water and sanitation projects are linked to economic and educational development programmes, so that women can make developmental use of water and timegains and get new meeting and learning opportunities when traditional meeting and learning opportunities are reduced

Decision making	Programmes enable also women to participate in informed choices on: • caretakers and mechanics • committee members • design and location of facilities • local management arrangements • local financing system
Representation	Women choose their own representatives for trust, ease of contact, leadership capacity, feasibility (time and family support)
Management	Programmes build on traditional tasks, skills and knowledge of women for new roles in water supply, sanitation and water management (without excluding men): • management of water, waste and soil use • maintenance and repair of water points • hygiene education with fellow women • construction of latrines and monitoring their maintenance and use • management of funds
Training	Also women are trained for technical and managerial tasks Programme staff and management are aware of reasons and trained on practicalities of equivalent participation of women and men

4.5 Gender and operation and maintenance

With decentralization to the lowest appropriate levels, many of the operation, maintenance and repair tasks are delegated to the communities. In the sharing of this work gender perceptions and relations have a strong influence. Initially the tasks have been seen as purely technical and a male prerogative (Poluha, 1993).

A wide variety of reasons have been put forward by men why women cannot take part in operation and maintenance (Harkness, 1983; Kelles, 1983). 'Women do not want to do unpaid work' [But do men?]. 'They are often away at the market' [But what about mobility of men?] 'They are tied to the house and cannot report or go about the village' [But they visit the water sources]. They are afraid to go out at night to repair a pump' [But is that necessary?].

A review of the daily and monthly tasks of handpump caretakers and scheme attendants did not reveal any tasks that could not be done or organized by women(Wijk, 1985). The main problems reported in Bangladesh and Guinea Bissau were that bolts were not fastened and bearings not oiled (Germany and UNICEF, 1983; Ploeg, 1980). Nor should the physical strength of rural women accustomed to heavy work in agriculture and food processing be underestimated. Take the above-mentioned food-for-work programme in Tanzania, where project managers hired fewer women than men, at a lower rate and for female tasks, because they are considered as the weaker sex. In practice the women did all work at the work site, irrespective of its arduousness, and were keen to be trained for maintenance (Tomoda et al., 1987). With the correct tools and training, they should be able to do all regular maintenance tasks, and can obtain assistance from others for the occasional heavier task. New light-weight handpumps that allow internal parts to be replaced through the top of the pump head also facilitate maintenance by women (Iddamalgoda and Dharmasili, 1987; Mauluka, 1981; Srivastava, 1990, 1991).

Neither do all men have more technical experience than women. Many men trained in handpump maintenance in Upper Region, Ghana had no previous technical know-how

and experience (Harkness, 1983). A study in four villages in Sri Lanka revealed that a considerable proportion of women has used screwdrivers and spanners (Gunaratne, 1976). Female familiarity with tools and construction is also reported from Tanzania (Drangert, 1993).

Opinions that women cannot perform maintenance and repair tasks thus seem to be based more on stereotyped gender concepts than on any real inabilities. Confronting such gender stereotypes, Wijk (1985: 33) quotes nine publications which demonstrate that women may well make better maintenance and repair workers than men. The reasons advanced are the direct concern and personal interest of women in their water supply; their regular visits to distribution points; the compatibility of preventive maintenance and user education with women's gender-specific tasks; the easier communication between female maintenance staff and female users; women's greater sensitivity to social pressure from other women to do a good job; the importance of health aspects; the lower career orientation and labour mobility of women; and training of women in modern technology in recognition of their age-old management of the domestic water systems.

Recognizing the value of a gender approach, most programmes now also involve women in local maintenance. Here a distinction must be made between voluntary maintenance jobs ('caretaking') and paid jobs (mechanics or similar functions). Patterns that occur are that both women and men are caretakers and both do the same work; that a man and woman work as a caretaking team; that only women are caretakers, while the men have the paid jobs of mechanic, etc. and that mechanics' jobs are taken up by women as well as men.

The more common situation is that women become voluntary caretakers of the waterpoints in their neighbourhoods. As such they have mainly environmental and preventive tasks: keeping the sites clean and dry, avoiding water pollution and wastage, reducing misuse and vandalism, especially from children, diagnosing and reporting problems. The work is mainly physical. Training, if given, tends to focus on health and hygiene, rather than on technical know-how for early diagnosis and preventive maintenance.

In the last decade, women have had better opportunities to be trained for maintenance jobs that go beyond cleaning and reporting and are paid. In particular, women handpump mechanics have become more prevalent. What the effects are of maintenance by women on the one hand, or men on the other, have on the condition and performance of the water system, and on the workers themselves, has not yet been researched extensively. Available research tends to indicate that women perform technically as well or better, and that the costs of maintenance to the agency are lowered. This is reported, for example, by projects in Tanzania, Bangladesh, Zimbabwe and Uttar Pradesh in India (Binamungu, 1994; Hoque et al., 1994; INSTRAW and UNICEF, 1988; Madsen, 1990; Sharma, 1989). In the case of Rajasthan reported above, both frequency and duration of handpump breakdown were lower for female than for male mechanics. However, the opportunity costs are high (Jonsson and Rudengren, 1991; Madsen, 1988). In Rajasthan the amount of time the women spent on preventive maintenance was almost seven times higher than men. Having still to carry out their domestic work, they also face a double workload.

In Bangladesh two separate handpump programmes were evaluated gender-specifically. The study team visited a sample of 324 handpumps maintained by men and 148 maintained by women. They found that 12 out of 256, or 4.7 percent, of the pumps

maintained by men, and 4 out of 121, or 3.3 percent out of those maintained by women, were not functioning. Over the previous two years, 68, or 21 percent of the male-maintained pumps, and 27, or 18 percent, of the female-maintained pumps, had had a breakdown time of more than six months.

The reported frequency of breakdowns was significantly lower for the pumps maintained by the women . The reported duration of breakdown was also lower, but not significantly. Eleven percent more women than men cleaned the platform regularly. Of those who did this every day, twice as many were women. The views of the male caretakers coincided with the findings of the study. Almost three-quarters thought that women would be as effective as men at pump maintenance (Micro, 1984).

These findings, while interesting, should be viewed with caution because they are based on recall of experience over a period of two years and not on monitoring. Also, more than 80 percent of handpumps were located either on the land or in the house of the caretakers. A possible distorting factor is also the age of the pumps, which was not taken into account in the analysis.

4.5 Gender and management

The new policy framework for water resources development and management advocates that all management takes place at the lowest possible level. It also stresses that development and management must be holistic, because the various subsectors often share and have an impact on the same water resources and water demand in communities is holistic rather than sectoral. River basins are stressed as the most appropriate level for integrated water management. How is gender operationalized in the management of drinking water supply and in the more holistic management of water resources. And what is known of the effects on the water resource and on local men and women?

Men and women in community-managed services

In the past it has been quite uncommon to see both women and men on organizations that manage improved domestic water supply services. This is now rapidly changing. Female members of local management organizations are the result of appointments by local leaders or interventions by the programme agencies. Alternatively they are chosen by the men and women in the communities themselves. Reported experience suggest that the latter is more effective than the former. When the Gujarat Water Supply and Sewerage Board sent a government order to the formal village leaders that they should select women on the water committees, many of the women were only members on paper. The leader had passed their house and taken their name and thumbprint on an official paper, but they did not know what exactly they were supposed to do and had never taken part in any management activities (R. Nanavatti, personal communication). The same is reported earlier in Maharashtra (Stanbury, 1984).

Where water committee members are chosen by their fellow men and women, formal barriers may impede the election of women. Because board members are usually chosen from association members, excellent women candidates who are not heads of household have been excluded. Both water supply and irrigation user associations in the Philippines had almost no women in decision making and managing functions, because only heads of household were permitted to be members of user associations (Cloud, 1994; Philippines, undated). Individual membership of user associations for male and female heads of households gives women a better guarantee of a voice in collective

decisions and ensures that both men and women contribute to the service (Zwarteveen and Neupane, 1996). As one woman in a Mexican user association stated: 'Sometimes I think one way and my husband thinks differently. But both votes count' (Schmink, 1984: 6).

The effects of female participation in management on the women and men in communities are manifold. Recognition of women's management tasks and training for new tasks and skills have increased their status and self-confidence (Libatique, 1994). Women in Visayayas in the Philippines reported that their views are increasingly met with respect and their needs met with regard to time of meetings, design of water supply and design of latrines. They now believe that they can really contribute something for the good of the community and be 'partners in progress' and not be 'for decorative purposes only'. Some believe they are no longer subordinate to the men. Male and female leaders welcome their participation because women have a role in development and they need the women's capacities, though sometimes limited to traditional female roles (Ybañez, ca. 1995: 17-18).

In a project in Indonesia women grew in knowledge, self-confidence and leadership and autonomous management of water systems increased (Narayan, 1989). Special training gave female committee members in Malawi the confidence to take management decisions themselves. The committees with more women also managed a higher latrine coverage (896 latrines or 95 percent coverage), of which 68 percent were 'in satisfactory condition'. Under male leadership the result was 632 latrines or 67 percent coverage and 43 percent 'in satisfactory condition'. Other effects of the gender strategy were: more connections, better payment and management of payments and less water wastage and poor drainage at the communal waterpoints. There were, however, also negative effects: more tension between men and women and withdrawal of the men from their shared responsibility for a community water supply (Kwaule, 1994). In New Delhi, 'many of the men eventually became reconciled to the participation of women inside or outside the project areas, and the women developed feelings of self-reliance.... Attitudes of older women changed to some extent, particularly in allowing their daughters and daughters-in-law to leave their houses to participate...' (Clinard, 1966: 272).

On the other hand, women still tend to take part in management only at the very lowest level, for example in tap and village committees. At the higher level, representatives are generally men. It is at this level that the more important management decisions are made, for example in a Sri Lanka programme (Kelles, 1983). Similarly, in Bhutan and Zimbabwe the district and ward committees in which the main decisions are made are exclusively male (Buringa and Lham, 1992; Olsson et al., 1990). Relegation of women to the lowest levels was not the case in an urban project in New Delhi which used layered representation. Women chose their own representative at the quarter and neighbourhood level. The levels consisted of 15 to 100 families and 250-400 families. Representatives from these levels were for the first time invited to civic functions and became members of neighbourhood councils which managed projects for 1,500 to 4,000 families. Two-third of these women attended higher level meetings occasionally and one-fifth regularly (Clinard, 1966).

Sometimes, agencies promote the management of water supplies exclusively by women and do not address male responsibilities and tasks (Gopalakrishnan, 1984; Janssen, 1988). It also occurs that project agencies pay so much attention to women's, as compared to men's involvement, that the service comes to be seen as a women's project, for which only the women are responsible (Oenga and Ikumi, 1991; Kinley, 1991a; Liao et

al., 1994; Valera, 1987). Women's groups that build rainwater collection reservoirs at their members' houses also tend to finance these facilities single-handedly, for example in Kenya, Tonga and the Philippines (Cumberlege et al., 1994; Fleming, 1986; Libatique, 1994; Mbugua, 1994; Wacker, 1990 and Figure 12). In such cases projects cause women to carry the burden of a community water supply from which also male household members profit, irrespective of women's higher workload and lower resources. The decision to do it alone may, however, also stem from necessity or choice. In her analysis of 24 women's groups that build rainwater tanks in Kenya, Wacher found that half of the members were single parents and that the women feared to lose control when they were no longer solely in charge of all tasks. Reporting on her experiences, Kavita, in Boesveld, 1994, reports how women were only prepared to bring in the men when they felt they had enough skills and confidence. 'After about ten years of separate training and activities, the women felt that men should be equally involved. "What about our husbands?" they asked. "If we had been getting the training together with our men, we could have been sharing ideas, plans and development activities in our villages" (Boesveld, 1994: 20)'.

There are other cases where only women manage a water supply service. Women's organizations in low-income neighbourhoods in the capitals of Honduras and Kenya buy water in bulk from the town water supply and sell it through vending points to the households. Although here, too, the women do not get support from the men, the difference is that the services bring them financial profit which they control themselves. In Nairobi, Kenya, the women use the water for beer brewing and tea stalls and depend no longer on private kioskholders who charge high prices. Women at the Kenyan coast use water and time gains for economic projects and use an unknown share of the profit to maintain the pumps (Narayan, 1988). In Honduras, the costs of ten litres of water became fixed at 10 cents while in the past private vendors had charged as much as 35 to 50 cents during the dry season (Elmendorf and Kruiderink, 1983).

4.7 Management, monitoring, maintenance and use of sanitation

So far, sanitation programmes have focused more on creating facilities than on creating capacities in communities to run their own programmes and services. Where communities themselves run programmes, a community organization formed for this purpose is usually in charge. Sometimes the local council is also involved (Kurup et al., 1996; Bakhteari and Wegelin, 1992; Khan, 1992; Soepardjo, 1987). They investigate demand, allocate support, organize and supervise construction and manage and monitor physical and financial progress and programme results. They may also manage the service (Schmink, 1984; Soepardjo, 1987). The gender aspects of taking part in management organizations, training and decisions are similar to those of management of local water supplies.

Monitoring the operation and maintenance of newly-installed sanitation facilities is very relevant. Poorly operated and maintained facilities are a health and environmental hazard rather than a benefit. Extent of use is also important. When only a small minority has and uses good sanitation, no impact on public health is possible. There is some proof that the critical frontier is 75 percent (Esrey, 1994). A threshold theory, tested in Bangladesh and Lesotho, states that there is a certain minimum level of investment in water supply and sanitation below which very little detectable health improvement will follow. In the same way, there is also a cut-off point above which additional investments will make little more difference (Shuval et al., 1981 in Nordberg and Winblad, 1990). Hence the motto at the closure of the IDWSSD: 'Some for All rather than All for Some'. Unfortunately, sanitation programmes still follow a scattered coverage approach and do not concentrate on threshold coverage in high risk, high demand areas (Murphy and

Perez, 1994).

Who monitors coverage, operation, maintenance and use? In the move towards community-managed sanitation, monitoring is increasingly part of local environmental management. In the Dosso sanitation programme in Niger, the village map serves as a monitoring and management tool. Follow-up visits on maintenance and use are being planned. (Nibakure and Wijk, 1995). The sanitation and hygiene programme in Uttar Pradesh, India, uses pictorial monitoring forms to monitor latrine installation and use, among other things. Female motivators engaged temporarily by the programme to mobilize latrine demand also pay the monitoring visits after installation and fill in the pictorial monitoring forms (Netherlands Ministry of Foreign Affairs, 1995).

Monitoring in Kerala, India, is part of the work of the voluntary ward water committees. Each committee consists of several women and men. The members visit the new latrine owners at home and jointly score the latrine on observable indicators of cleanliness and use (Figure 19). Care is taken that indicators are objective, such as 'no excreta or excreta smears in pans' rather than 'clean pan' which different people may interpret differently, for example, considering discoloured water due to a high iron content as dirty. In areas where use and cleaning are inadequate, the committee may organize a session to discuss health (Kurup et al., 1996). The work of visiting is voluntary and adds especially to the load of the women, as they have less free time then the men. The programme is aware of this and has looked into measures to reduce the strain. Basically, and similar to experiences in Honduras (Whitaker, undated), the women who do the monitoring see this as an important community service and find time for it by organising their housework in a different way (Abdulla, personal communication).

Proper operation and maintenance of latrines and other sanitation facilities is not only related to a sense of ownership and hygiene values, but also to ease of use and cleaning and to understanding the technical characteristics of the facility. Latrines have become sources of infection and have not been used regularly because the rough surface of the slab made it hard to keep clean (Blackmore et al., 1978; Feliciano and Flavier, 1967), the design made cleaning difficult (Jaeger and Mattson, 1989; Mbere, 1981) or the number of users was too large (Foster and Crossley, 1981). Since much of the regular maintenance work is done by mothers and their children (Gosling, 1975; Green, 1982; Langedijk, 1984), it is essential that they can review designs on ease of cleaning and that they understand the technology. This avoids that, for example, water seals are broken and junction boxes are not changed as required, because their function is not understood or, in the case of the seals, because there is no water for flushing within easy walking distance (Arrais, 1994; Kurup et al., 1996; Kanungo, 1957; Shafiuddin and Bachman, 1983; Wilson, 1981) .

Unit 5 : Cost recovery

1. Outline of session

Objectives

- To review the key principles which influence sustainable cost recovery
- To familiarize participants with financial arrangements, willingness to pay and financial management issues.

Methodology

1. Introduction and discussion
2. Lecture on the seven key principles for cost recovery
3. Quiz on financial arrangements
4. Work by pairs and discussion on willingness to pay
5. Group exercise on financial management issues

Materials

- ✓ Overhead transparencies
- ✓ Overhead projector, screen or white wall
- ✓ Flip chart and markers

Handouts

- ✓ Quiz and exercise sheets
- ✓ Copies of transparencies and selected material from background information

2. Notes for the trainer

Introduction

Cost recovery issues are another essential element of sustainable operation and maintenance. This session aims at highlighting the main principles which lead to sustainable cost recovery. The facilitator can ask to the participants if cost recovery is a problem in their projects, and asking them to giver examples.

Lecture on the seven key principles which influence sustainable cost recovery

It is proposed that the facilitator uses the information contained in the background information and the overhead sheets to prepare a small lecture, presenting the seven key principles of sustainable cost recovery.

Quiz on financial arrangements

Please refer to the overhead sheet.
Each participant is given three cartons of different colours : Yellow will represent the Central Government ; Green will represent the municipality ; and blue will represent the community. (Other colours can be added, if necessary). The facilitator uses the overheads sheet of his choice, representing Operation and maintenance tasks with operational and financial responsibilities, asking participants to vote on the operational and financial responsibility for each task. If there are important differences, the facilitator should engage the discussion to clarify the positions. The facilitator should highlight at the end that this division of responsibilities should be materialised afterwards into a contract.

Working in pairs on willingness to pay

The facilitator is asking the participants to group them selves in pairs (two by two), and each pair discusses in order to come out with factors which influence willingness to pay. (10 minutes). The facilitator then asks for people to express themselves in a free way and he writes down the points which are given. He can ask for clarifications if the factors appear not well understood by the group. He can also complete the list with the information provided in the overhead sheet and in the background information.

Group exercise on sound financial management

The facilitator then divides the group into two : 1) water supply (hand pumps) ; 2) water supply (piped system). Each group is given the exercise sheet on sound financial management, and is asked to fill in the table. The results are then presented in plenary and discussed. The facilitator can use the information contained in the background information.

3. Overhead sheets

Seven key principles to sustainable cost recovery

1. Clear financial arrangements
2. Willingness to pay
3. Minimizing costs
4. Appropriate tariff structure
5. Access to alternative financing
6. Sound financial management
7. Enabling environment

Quiz (page 1)

Each Participant is given three cartons of different colours : Yellow will represent the Central Government ; Green will represent the municipality ; and blue will represent the community. (Others colours can be added, if necessary). The facilitator projects this overhead (or a copy of another, see background document), asking participants to vote on the operational and financial responsibility for each task. If there are important differences, the facilitator should engage the discussion to clarify the positions.

O&M of borehole, diesel pump, storage and standpost system : who is responsible ? (adapted from Wash report n:93)		
O&M tasks	**Operational Responsibility**	**Financial responsibility**
Operate engine daily safely and efficiently		
Perform regular checks and adjustments (fuel, oil, filters, belts,..)		
Regularly replace engine oil, filters and pump oil if applicable		
Perform regular checks and adjustments on alternator, starter, radiator, valves and injectors		
Periodically conduct complete overhauls on engine, pumps and associated equipment		
Check all pipelines, tanks, valves for leaks breaks, and repair		
Monitor standpost use to encourage proper use		
Check all standposts for leaks, wear, tear, and repair if needed		
Flush all pipes periodically		
Clean standpost concrete aprons and drainage area, and repair		
Conduct water test for micro-biological contamination; locate and correct source of contamination; disinfect		
Measure water output periodically, at well head and standpost. Assess leakage and initiate leak detection needed and repairs		
Conduct well engine/pump rehabilitation		
Record all operation and maintenance activities in log book		
Manage a stock of fuel and oil, ensuring proper storage and security. Maintain special fuel log.		
Manage stock of parts, tools, and supplies		
Establish historical records of all engines, pumps and other .		
Develop schedules for preventive maintenance and monitoring		
Conduct effective vehicle maintenance		

Quiz (page 2)

O&M administrative & support activities for most water supply systems : who is responsible ? (adapted from Wash Technical report N.93)		
Administrative and support tasks	**Operational responsibility**	**Financial responsibility**
Conduct technical and socio-economic participatory studies		
Analyze O&M tasks for use in planning and budgeting		
Prepare annual budgets and long term financial estimates		
Select and appoint operators/ contractors for O&M		
Develop and evaluate technical & management training for water system operators		
Provide on-going technical training for operators		
Delegate task responsibilities, supervise and pay salaries		
Keep archives, inventories and log books		
Develop and evaluate financial & management training for community managers		
Provide on-going financial and management training for community managers		
Collect water fees and manage revenues		
Make payments for purchases, loans and other obligations		
Respond to users complaints		
Organize and conduct general meetings for discussions, elections,....		
Develop information and materials on hygiene education		
Organize community contributions for upgrading or extending the system		
Report urgent problems to government agency		
Provide technical and management support to community managers		
Collect, analyze, monitoring results, and conduct follow-up support or training of necessary		

Overhead sheet

Factors influencing willingness to pay

- Demand and participation from communities
- Service level
- Service standard
- Perceived benefits
- Relationship to production
- Level of income
- Price of water
- Relative costs
- Opportunity cost of time
- Characteristics of existing sources
- Reputation of service agency
- Community cohesion
- Policy environment
- Socio-cultural factors
- Perception of ownership and responsibility
- Transparency of financial management
- Institutional support

Exercise sheet

Sound financial management

Financial management issues	Possible options
What cost to budget for ?	
What sources of income to use ?	
How to collect money ?	
When to collect money ?	
Who collects the money ?	
Where to keep the money ?	
How to register movements of expenditures and incomes ?	
How to pay the mechanic or caretaker?	
Who administers the funds ?	
What are funds used for ?	
Who orders payments ?	
What type of financial control ?	
How to monitor ?	
What to do with bad payers ? *This problem is particularly crucial for "influential" members of the society and public institutions.*	

4. Background information

4.1 Introduction

"Lack of money" is often claimed to be a principal constraint to providing water and satiation services. But in many cases, it's not the lack of money that is the constraint, it is the mismanagement of resources or the poor willingness to pay for a service.

Efficiency, effectiveness, equity and sustainability are the four major aims in developing a financial system. Financial management has to be efficient in the way that the ratio between inputs and outputs is satisfactory. Effectiveness measures the contribution of a project towards its objectives, and the financial system put in place should lead to this. Equity measures how the costs and benefits are distributed among beneficiaries, furthermore these benefits should be sustained over a prolonged period of time.

The present trend to decentralize operational, managerial and financial responsibilities at local level, has dramatically increased the need to design and plan for water supply services which the communities can sustain financially. The effectiveness and credibility of both government sector strategies and development cooperation policies can be at stakes if this issue is not addressed urgently.

"Water is an economic and social good, and its service has to be paid for, since it has costs". Although this statement is now admitted in many countries, there is still a great number of rural areas where water is considered as a gift of Nature or a free service provided by the government, as it has been proclaimed in the past. Besides the need to sensiblize rural populations on the fact that the service of water has costs, certain financial arrangement issues have to be addressed early in a project design such as : Should all costs be covered ? who is financially responsible ? and how to organize financial arrangements ?

In the light of the major present sector trends and past trials efficient, effective, equitable and sustainable cost recovery of community water supply is based on seven key factors mutually dependent from one another. It is linked with :

1. **Clear financial arrangements**
2. **Willingness to pay**
3. **Minimizing costs**
4. **Adequate tariff structure**
5. **Access to other sources of financing**
6. **Sound financial management practices**
7. **Enabling and supporting environment**

4.2 Financial arrangements

Who is responsible ?

There is a tendency today to ask communities to contribute to the initial investment costs, as a way to materialize their financial responsibility, and future willingness to pay. This contribution, can represent 5 to 20% of total investments costs, which is composed not

only of financial contributions, but in labour and availability of local material.

Cost-sharing arrangements can be organized between the community and local/ national government agency in order to reach a full cost coverage. This will have to be materialized in a formal agreement or contract in which all parties have obligations. Financial responsibilities are very often linked with operational responsibilities, and can be organized as follows [5]:

O&M of handpumps : who is responsible ? (adapted from Wash Report N.93)

O&M tasks	Operational responsibility	Financial responsibility
Monitoring hand pump use and encourage proper use	Community	Community
Check all nuts and bolts, and tighten if necessary	Community	Community
Check and adjust pump handle and stuffing box	Community	Community
Grease or oil all hinge pins, bearings, or sliding parts	Community	Community
Clean the pump, well head, concrete apron, and drainage area	Community	Community
Check well head, concrete apron, drainage area, repair cracks	Community	Community
Measure output per stroke and compare with expected output	Community	Community
Disassemble pump, check drop pipe, cylinder, leathers, and foot valve. Check corrosion and wear. Repair or replace if necessary.	Community & local mechanic	Community
Conduct other well, handpump or apron repairs if necessary	Community & local mechanic	Community
Repaint handpump periodically, as necessary	Community	Community
Conduct water test for micro-biological contamination	Government	Government
In case of contamination, locate and correct source of contamination, and disinfect	Mechanic or government agency	Community & government
Conduct water level check and well yield test. Adjust cylinder setting if necessary	Government agency	Government
Record all operations and maintenance activities in notebook	Community	Community
Manage a stock of spare parts, tools and supplies on site	Community, local mechanic, private sector and government	
Replace entire handpump when fully worn	Local mechanic, private sector or government agency	Community & government

O&M of gravity distribution system : who is responsible ? (adapted from Wash Report N.93)

O&M tasks	Operational responsibility	Financial responsibility
Ensure protection of spring	Community	Community
Check spring box for leaks and cracks, and repair if necessary	Community	Community
Check all pipelines and valves for leaks or breaks, and repair	Community & private contractor	Community
Monitor standpost use to encourage proper use	Community	Community
Check all standposts for leaks, wear and tear, and make repairs	Community & private contractor	Community
Flush all pipelines periodically	Community	Community
Clean standpost concrete apron(s) and drainage area(s)	Community	Community
Check standpost concrete and drainage area, and repair if needed	Community	Community
Conduct repairs on spring box, lines, and standpost of necessary	Community & private contractor	Community or government
Conduct water test for micro-biological contamination	Government	Government
In case of contamination, locate and correct the problem and disinfect lines	Private contractor or government	Community & government
Measure water output periodically, both at spring, standpost and assess leakage	Community & Private contractor or government	Community and government

[5] Adapted from "Helping communities manage their finance", (1993),WASH Technical Report N.93.

In case of high leakage, initiate leak detection and repair	Community & *Private contractor* or government	Community & *government*
Record all operations and maintenance activities in log book	Community	Community
Manage a stock of parts, tools, and supplies	Community, local mechanic, private sector and government	
Rehabilitate spring box/ pipelines/ standposts	Local mechanic, private sector, *government*	Community & government

O&M of borehole, diesel pump, storage and standpost system , who is responsible ?
(adapted from Wash report n.93)

O&M tasks	**Operational Responsibility**	**Financial responsibility**
Operate engine daily safely and efficiently	Community	Community
Perform regular checks and adjustments (fuel, oil, filters, belts,..)	Community	Community
Regularly replace engine oil, filters and pump oil if applicable	Community	Community
Perform regular checks and adjustments on alternator, starter, radiator, valves and injectors	*Community, private* contractor, government agency	*Community or* government
Periodically conduct complete overhauls on engine, pumps and associated equipment	Community, private contractor, government agency	Community or government
Check all pipelines, tanks, valves for leaks breaks, and repair	Community	Community
Monitor standpost use to encourage proper use	Comity	Comity
Check all standposts for leaks, wear, tear, and repair if needed	Community	Community
Flush all pipes periodically	Community	community
Clean standpost concrete aprons and drainage area, and repair	Community	Community
Conduct water test for micro-biological contamination; locate and correct source of contamination; disinfect	Government	Government
Measure water output periodically, at well head and standpost. Assess leakage and initiate leak detection needed and repairs	Community, contractor	Community and government
Conduct well engine/pump rehabilitation	Contractor and government	Comity and government
Record all operation and maintenance activities in log book	Comity	Community
Manage a stock of fuel and oil, ensuring proper storage and security. Maintain special fuel log.	Community	Community
Manage stock of parts, tools, and supplies	Community, local mechanic, private sector and government	
Establish historical records of all engines, pumps and other .	Government	Government
Develop schedules for preventive maintenance and monitoring	Community & government	Community & government
Conduct effective vehicle maintenance	Government	Government

O&M administrative & support activities for most water supply systems : who is responsible ? (adapted from Wash Technical report N.93)		
Administrative and support tasks	**Operational responsibility**	**Financial responsibility**
Conduct technical and socio-economic participatory studies	Government with the community	Government
Analyze O&M tasks for use in planning and budgeting	Government with the community	Government
Prepare annual budgets and long term financial estimates	Community with the government	Community and the government
Select and appoint operators/ contractors for O&M	Community with technical advise	Community
Develop and evaluate technical & management training for water system operators	Government with community	Government
Provide on-going technical training for operators	Government with community	Government and the community
Delegate task responsibilities, supervise and pay salaries	Comity	Community
Keep archives, inventories and log books	Community	Community
Develop and evaluate financial & management training for community managers	Government with community	Government and community
Provide on-going financial and management training for community managers	Government with community	Government and community
Collect water fees and manage revenues	Community	Community
Make payments for purchases, loans and other obligations	Community	Community
Respond to users complaints	Community	Community
Organize and conduct general meetings for discussions, elections,....	Community	Community
Develop information and materials on hygiene education	Government with the community	Government
Organize community contributions for upgrading or extending the system	Comity	Community
Report urgent problems to government agency	Community	Community
Provide technical and management support to community managers	Private sector or government	Private sector or government
Collect, analyze, monitoring results, and conduct follow-up support or training of necessary	Community and government	Community and government

How to organize financial arrangements ?

Management options can influence directly the way cost recovery will be organized. For instance, water supply systems can be managed by a village water committee, by an inter-village association, by a private person or firm operating under contractual arrangements, by the municipality directly or indirectly operating through its own staff or through community committees or a private body. Each will have its own interest and capacity in fixing rules and managing finances, and therefore proposing each different ways to organize cost recovery.

4.3 Willingness to pay

Willingness to pay (WTP) being an explicit dimension of the demand of communities, is also a strong pre-requisite for the financial sustainability of a water supply system. It depends on a series of factors which are exposed below. Furthermore, WTP is a useful yardstick for assessing project feasibility.

Factors influencing willingness to pay (WTP)
Demand and participation of communities A project which is initiated upon a community's request and demand, and in which the community has been involved right from the start, can contribute to a greater WTP.
Service level Evidence suggests that there is a higher WTP for house or yard water supplies; however, this is a broad trend, and there is also evidence to suggest that low income groups are prepared to pay significant amounts for basic service levels
Service standard If a system does not perform consistently and provide an acceptable level of service, WTP is likely to diminish
Perceived benefits WTP is dependent on the benefits to be gained; the extent to which these are perceived by consumers is important. Agencies and communities may not share the same perception of benefits; within communities variations also exist, often linked to who stands to gain more than others. An awareness of these subtle differences in consumer preferences is central to developing a sustainable programme.
Relationship to production Where water use can be linked to productive activities or income-generating activities in particular e.g., garden irrigation, livestock watering, WTP will likely be elevated. Again, the improved supply must be able to deliver this advantage to a greater extent than an existing source.
Level of income Income directly relates to WTP. Where the cost of a water supply exceeds the means of consumers, WTP is a mute issue.
Price The chosen price level is likely to affect consumers' WTP for an improved service or continue with existing supplies. A balance is required between establishing a price that both covers costs and relates to what people are prepared to pay.
Relative costs Consumers may compare the cost of a service to other services, e.g., schooling or power supplies as benchmarks for measuring the relative costs of water supply. If the relative costs are too high for water supply, WTP may be affected.
Opportunity cost of time Is the value attached to time, comparing out to its next best use, e.g., productive activities. The value attached to this time may influence WTP and the extent the improved source of supply may save time. The value attached to time may be perceived differently within communities, and within households (i.e., between men and women). Daily time and physical effort in collecting water can influence WTP.
Characteristics of existing sources Where users consider their existing sources as acceptable, they are unlikely to be willing to pay for an improved service. Variables including perceived quality, reliability of supply, and distance from home will influence the WTP for an improved supply
Reputation of service agency The credibility of a service agency will affect WTP. The service agency (public, private, or community institution) must be able to deliver the expected service
Community cohesion

In rural areas in particular, cost recovery may be managed through voluntary contributions to a common fund. Cohesion within the community is essential, but cannot be assumed. Lack of trust or conflict between members may reduce cooperation, irrespective of felt need. Associated factors may extend to collection systems, and tariffs.
Policy environment Policies of providing water in rural areas free of charge or well below cost, may influence WTP since consumers may equate water services with public assistance. Although these policies are being revised, new policies may not be clearly communicated and applied consistently.
Socio-cultural factors Socio-cultural practices and traditions may vary WTP and will often have location-specific outcomes. Where water is considered a sacred 'gift from God' for instance, there may resistance to payment.
Perception of ownership and responsibility The degree of community autonomy over water supply services may affect WTP, as a sense of ownership often encourages responsibility and pride in the supply system and may result in increased WTP for the service where it is guided by the community. System handover to the community does not necessarily imply the above, and may be affected by, among other things, a history of government support in water service provision, or ineffective consultation or implementation regarding the service; WTP is likely to be adversely affected in these situations.
Transparency of financial management Transparency may be closely linked to the reputation of the service agency or local management organization and is often a matter of trust. Where user contributions are clearly accounted for, consumers will be motivated to continue these payments and WTP will be retained accordingly
Institutional framework The organization of a water supply system, for instance, the way water committees operate and interface with other institutions and consumers themselves, determines the effectiveness of the system and subsequent user support. A democratic, transparent management framework is likely to maximize user WTP in the long term.

Adapted from Evans, 1992

As it can be seen in the above table, WTP may have a strong affinity with a range of cultural, social and institutional factors that complicate efforts to measure it. Decision-making by consumers may not follow rational economic norms and consumers may instead reveal their own, location-specific criteria in source selection.

Measuring Willingness to pay

1. Indirect measures

The above mentioned factors can be assessed through socio-economic surveys or monitored throughout a project. They will provide some trend in willingness to pay, but are not always totally correlated.

2. Direct measures

On way to measure willingness to pay at the beginning of a project, is to assess the direct financial contribution of communities for the construction and investment of a water supply service or a sanitation facility. This might however diminish over time. Another direct way of measuring WTP, is to calculate the percentage of payments received, over total payments due. The lower the percentage, the lower WTP.

3. Hypothetical behaviour studies

An alternative approach to estimation of benefits is to ask users what would be their

choice of service available at a specified price, termed the *contingent valuation (CV)* method, since user responses are contingent, or depend, on the pre-determined conditions. Traditional water-demand models are used to estimate benefits via a demand function for the supply from market data, used to derive an individual's maximum willingness to pay by varying the price and assessing the demand response. Price and demand elasticity ratios can be determined. Data availability and non-rational behaviours severely constrain this approach in rural areas.

The bidding game method is a negotiation between the interviewer and respondent, moving within a range of potential prices for a water supply improvement until bidding settles at a final value. The summation of WTP bids for all the households served by a project is an estimate of the total benefits of a project and can be compared with the costs of the project to decide whether the investment is justified. This method is widely recognized as not always gaining optimal consideration from interviewees, or providing inaccurate results. Probability models derived from the bidding game describe the probability that a particular family will use a new water source.

4. Actual behaviour study
Actual behaviour studies assess the present payment behaviour of consumers, such as cash payment to vendors (which could indicate a good level of WTP), direct cost savings, indirect cost savings (calories, time, money). Time spent for collecting water and hardship of effort to collect water is often used as a measure of WTP.

4.4 Minimizing costs

Costs need to be identified, estimated and analyzed, and communities need to be informed about them in order to be fully aware the implications of choosing a particular technology.

What are the costs ?

Investment costs
• Pre-feasibility study, project design, social work • Equipment, materials, parts and tools • Construction costs • Human Resource Development, training • Institutional capacity building
Recurrent costs *
• Material (consumable, chemicals, energy, tools spare parts and equipment) • Works personnel (operation, maintenance, routine preventive maintenance, routine repairs, unanticipated repairs; construction for minor rehabilitation) • Management personnel (planning, supervision, financial management, administration, monitoring) • Follow-up (training support, technical assistance, institutional strengthening, monitoring and evaluation) • Financial costs (interest, amortization, depreciation, exchange rate variations; inflation) • Environmental costs (water source protection and conservation; waste water treatment) • Other costs (Transport; services paid to a private contractor) (Unaccounted for water, both due to leakage in system and bad administration, and vandalism; they become a cost the community if not prevented)
Future investment costs
• Construction for major rehabilitation, replacement, extension

* Recurrent expenditures comprise *fixed* costs such as annualized financing costs or water source protection fees, and *variable* recurrent costs according to output and other factors such as physical conditions.

How to estimate O&M costs ?

There are usually no difficulties in estimating investment costs. However, the case is different for recurrent costs. Using experiences in other similar projects although useful can be misleading, as recurrent costs vary widely from one project to another, in terms of what has been included in their calculation. Basic recurrent costs can be measured in the following way:

Basic recurrent costs estimation

1. List all O&M activities needed, and their frequency.
2. According to each activity, list all human resources, material, spare parts, energy, tools and equipment required.
3. Estimate quantity and volume needed for each requirement.
4. Define activity cost
5. Sum up all costs of all activities

This basic recurrent costs estimation does not include such elements as depreciation, replacement costs, initial capital reimbursement, training costs, environmental protection costs, etc. Depending on the strategy and policy of projects, these additional costs might have to be added.

Minimizing costs

An important aspect of costs analysis is how to optimize or reduce O&M costs. Costs can be significantly reduced in the following way :

- choosing a technology with non expensive spare parts or expensive operation costs
- reducing the transport costs to go and buy spare parts and chemicals (making spare parts more accessible and available)
- reducing dependence on chemical use (alternative water treatment technology for instance, such as multi-stage filtration system)
- reducing dependence on fuel or electric consumption (Solar; gravity)
- by installing firmly a maintenance culture within the community and professional staff
- by organizing preventive maintenance activities where users are also involved
- by a systematic leakage control
- by applying economies of scale for larger systems (reduces costs for the consumer)
- by applying a control for unaccounted for water (both because of leakage and of bad management)
- by installing proper administrative and financial control mechanisms

4.5 Appropriate tariff design

Designing a tariff requires that one keeps in mind equity, affordability and willingness to pay. Equity, in the sense that all members of the community, rich / poor, men / women, have an equal access to the benefits of improved water supply and sanitation services. O&M costs can only be recovered from users if they are both able and willing to pay for a water supply. It is generally admitted that people should not have to pay more than 3 to 5 percent of their income for water and sanitation services. A higher percentage of income expended on water will mean other important needs may not be fully met. Great care is therefore required when setting user's tariffs and contributions.

While starting with setting up a tariff structure, one should specify what costs need to be covered, since some costs might be covered by other financial mechanisms, see next section, or determine which other organizations and institutions are responsible. Should waste water treatment and sanitation be included in the tariff ? Should the tariff only cover short term O&M costs ? Should the tariff cover the estimated unaccounted for water?

It is also important to specify to whom the tariff will paid to, as it can be paid to a water committee, an operator, or to the local authority. Or is water vending the most appropriate option to be considered. Water re-vending might double or triple the original price, (as it is done in some low-income urban areas, where there are no other alternatives to safe drinking water supply than water sold by re-vendors).

Setting up a tariff should be done with and by the community, as it will allow the community to bear the full responsibility of applying decisions made and as it will be better accepted since the community knows why this tariff is determined as it is. However, project and support staff should assist the community in the calculations and financial feasibility of a tariff design and user charges.

There are different options for regular charges : non metered flat rates; non metered graded rates, block rates, metered rates and mixed system rates.[6]

Non-metered flat rates

In a flat rate system, each user household pays a fixed a mount of money, regardless of the volume of water used. In its simplest form, the total amount of money needed for the upkeep of the improved water supply system, is divided equally over the number of households using the system. Payment may be per month, per season, or per year, depending on what is most convenient for the users of the service.

Flat rates are easy to organize with private taps or group connections. IN these cases it is clear who is the user and who is not, and should be limited to the situations where social and economic start are almost equal. Families, who live at a further distance or who have their own water source may particularly object to pay the same amount of money as those who live close to the tap. Adjustments should be made accordingly.

A major disadvantage of non metered flat rates is that they are not equitable in the sense that low-income households pay then same amount as the better-off, what ever the consumption. They are however easy to administer.

[6] Adapted from "What price water ?", Occasional paper N.10, IRC

Non metered graded rates

Users and households are classified into several categories, based on estimated differences of water use and income. The advantage of non metered graded rates is that they take into account the consumption level and payment capacity of users, and therefore could reach a more equitable tariff structure. It is also a way to account for rough estimations of consumption volume, without investing in a metering system. The introduction of graded rates is easiest when clear and valid indicators of water use and income level can be found (land, herd, size of house).

An alternative system to graded rates is to raise a levy on cash crops on top of already existing rates, which will be used for the maintenance of the water supply system. However disputes may arise over the basis for grading, as some people may feel they have been favoured and others not..

Blocked rates

Apart from a basis rate which is fixed with references to affordability by the poor, the rest of the consumers may be charged a price equal to the volume consumed by the consumers, with ranges or blocks (from 0 to 10 m^3; from 10 to 20 m^3, etc.).

It is sometimes argued that the block rates should be declining because of possible economies of scale. It is doubtful, however, that there are such significant economies of scale per consumer basis. Considering the growth in services needed in developing countries, the most appropriate policy is an increasing block structure, with progressively increasing tariffs.

Metered rates

While graded rates based on social judgments or indicators have the advantage that they avoid the introduction of more complex metered connections, water meters enables to charge according to the actual volume consumed. If properly reinforced, metering induced users to avoid water wastage, which will reduce long-term costs or unaccounted for water losses.

Individual household meters are not only expensive to install, they also need to be read regularly and make the administration more complex. Special staff has to read meters, write bills and accept payments. Metering therefore requires administrative and management capacities.

The added cost of installing and operating meters, as well as billing and collection may outweigh the benefits of the system, notably in rural areas. In practice often a proxy is used, such as pipe diameter, number of connections or indeed container size where purchased from vendors

A major constraint to user participation in piped systems with metered connections, is the high connection fee which water agencies charge to individual households wishing to install a private tap. One way to alleviate this problem is to spread the connection fee in time, and include in the monthly water rate.

For or against water metering ?

For water metering	Against water metering
Regular income	High installation costs
Equity	Meters need maintenance and repairs
Reduction of water waste	Vandalism
Only one parameter : cost per m^3	Long delays in payment
Technical control of the system	Heavy administrative procedures for billing
Accounting made easier	Needs personnel for meter reading

Mixed system

Another option to cover the recurrent costs of a community water scheme is to combine paid private connections with free public standposts. When there are enough private connections it becomes possible to finance the cost of public taps for the lowest income groups from a surplus of the rates paid by the private users. However, households which can afford to take a house connection do not always do so, when there are enough free standposts. This system should be accompanied by sensibilisation and information activities promoting private tap connections, as well.

Establishing a tariff

1. Through budgeting mechanisms
The formula is basic = total annual costs / 12 / number of households.
See page 16, an example for pumped piped scheme in a rural area.

2. Through budgeting and varying the definition of tariffs

Fictive example with various definitions of tariffs :

Definitions for this case[7]
Operation, maintenance and administration costs = Functioning costs (f. c.)
Approximation of replacement and extension costs = 25% of functioning costs
Costs for the protection and conservation of the environment = CPCE
Estimation of unaccounted for water losses = 25% of functioning costs
Funds for the recovery of investment costs = RIC = 5% of investment costs
Depreciation costs = DC

Minimum Tariff = $\frac{\text{Functioning costs per month}}{\text{Number of households}}$ **(MT)**

Real cost Tariff = $\frac{\text{Functioning costs + replat \& ext. costs}}{\text{Number of households}} = \frac{\text{1.25 x functioning costs / month}}{\text{Number of households}}$ **(RT)**

Environmental real cost Tariff = $\frac{\text{(1.25 x funct. costs) + CPCE}}{\text{Number of households}}$ **(ERT)**

Global real cost Tariff = $\frac{\text{(1.25 f.c.) + CPCE + Unaccounted for water}}{\text{Number of households}} = \frac{\text{(1.5 x f. c) + CPCE}}{\text{N. of households}}$ **(GT)**

Total costs tariff= $\frac{\text{(1.5 x f.c.) + CPCE + recovery of invest. costs}}{\text{Number of households}} = \frac{\text{(1.5 f.c.) + CPCE + RIC}}{\text{N. of households}}$ **(TT)**

Efficient tariff = $\frac{\text{(1.5 f.c.) + CPCE + RIC + depreciation}}{\text{Number of households}} = \frac{\text{(1.5 f.c.) + CPCE + RIC + DC}}{\text{N. of households}}$ (ET)

[7] Course material "gestion para la sostenbilidad en programas de agua potable y saneamiento", CINARA, IRC

Example of tariff setting for a piped scheme in a rural area

Rural community of Teremendo, in Mexico; the system serves 600 families with an average of 5 persons per family.
Pumped piped system with simple chlorinator. Treatment costs could be reduced by using a multi-stage filtration technique. It is proposed to recover all costs, and to constitute a fund that will help to cover major repairs or replacements. The system includes :

Equipment	Life cycle	O&M costs, as a % of the initial investment cost	Initial investment cost in Mexican Pesos $ 1997
Drilled well	20	1%	
Distribution pipes (PVC)	15	2%	48,414
Reservoir	25	1%	110,768
Supply pipes (PVC)	15	1%	57,367
Distribution network	15	1%	51,361
Cholirinator	10	1%	12,990
Electro-mechanic equipment	15	5%	161,540
Special parts	15	1%	10,944
		Total	**453,384**

Facts :
Engine 41 HP, functioning 12 hours per day, debit 10 l.p.s
Lubricants: 2 liters / month, price $ 14.00 per liter
Sodium Hipochlorite: 0.5 mg / liter, price $ 9.00 per liter
Price of energy

From 1	to 5,000 KW	$ 0.14601 / KW
From 5,001	to 15,000 KW	$ 0.17455
From 15,001	to 35,000 KW	$ 0.19267
Additional KW		$ 0.21394

Daily salary of operator: $ 31.40
Daily salary of assistant: $ 22.50
Daily salary of accountant: $ 35.00
1 HP = 0.746 KW

Tariff setting (IV = Initial value; FV = Final value, estimated at 15% of initial value); LC = Life Cycle)

Cost item	Formula	Calculation	Result in Mex$
Amortization per month	Σ (IV - FV/EL) / 12	[48,414/15 + 110,768/25 + 57,367/15 + 51,361/15 + 12,990/10 + (172,484-25873)/15] / 12	2,165.00
Energy costs per month	[Hp x 0.746 x hours per day x 30 days] x price KW	41 x 0.746 x 12 x 0.17455	1,921.96
Lubricants costs / month	2 liters / month x price/ liter	2 x 14	28.00
Treatment costs / month	0.5 mg / lit. x costs x hours per day x 30 days	0.5 x 10 lps x 24 h x 3600 sec. x 30 days x 9$	116.64
Personnel Costs / month	Salary / day x 30 days	(31.40 + 22.50 + 35.00) x 30	2,667.00
Maintenance costs	Σ (IV x maintenance %) / 12	[48,414x2% + 110,768 x 1% + 57,367 x 2% + 51,361 x 2% + 12,990 x 1% + 172,484 x 5%] / 12	1,083.72
O&M costs / month	Sum of all above costs	(2,165 + 1,921.96 + 28 + 116.64 + 2,667 + 1,083.72	7,982.32
Contingent Fund	10% of the monthly O&M costs	7,982.32 x 10 %	798.23
Total costs per month	Sum O&M costs + Contingent costs	7,982.23 + 798.23	8,780.55
Tariff / family / month	Total costs per month / n. families	8,780.55 / 600	14.63

3.Through volumetric and efficiency pricing

A more precise way of signaling the true cost of supply to consumers is by pricing based on volumetric use. *Marginal cost (MC)* or *efficiency* pricing measures the cost of each additional (marginal) unit of water to a household. It is most clearly seen in volumetric prices measured by household meters. A rational consumer response would be to demand additional water only as long as their demand or *willingness to pay* exceeded the marginal cost of supply. When the average cost schedule begins to rise over time, each incremental or marginal unit of water supply becomes increasingly more costly to produce. Over the longer term, the marginal cost price will yield more revenue than the average cost price, and indeed is at a maximum where it intersects the demand curve.

Price as a tool to regulate demand of water

Water tariffs can be designed to regulate the demand for water. It is based on the assumption that consumers have rationale behaviours, and that the higher the price, the lower the consumption (called price elasticity). However, this "rational" behaviour is possible when there are substitutes, or alternative goods for water. What is the alternative to water ? Certainly not Coca-Cola or beer. Price elasticity is very low in low-income areas, meaning that people will need to acquire water what ever the price is. However in higher income areas, price elasticity can be higher, and consumption patterns can be influenced by price differentiation.

Adjusting tariffs

It is inevitable that over time tariff levels and structure have to be revised as a result of demand patterns, changing costs structure, inflation, needs for increased funds for major expansion. Delays in adjustments can have serious financial consequences for financial sustainability. It is therefore appropriate to review tariff levels and stricture at least once a year for piped schemes and once every two years for others.

However, water rates are often a local political issue, and political considerations might overrule financial balances.

4.6 Access to other financing options and mechanisms

It is indeed important to plan and determine financial mechanisms which will allow to cover for all costs, if those are not covered by user's fees, and even if those are, especially for big repairs, rehabilitation, extension and replacement. In this context, the access of alternative sources of financing makes sense, which could range from access to credit facilities, installation of a Fund, subsidies, cost-sharing arrangements with authorities.

The following table provides with an overview of different financing mechanisms which could be available other than tariffs and rates.

Summary of financing options and mechanisms other than tariffs and rates
Voluntary funds Done in communities with a tradition of fund raising and seasonal income, at the occasion of financial contribution for construction and big repairs. People can contribute according to their ability to pay, however contributions may not be linked to water use and is difficult to control.
General community revenue *Done in communities* which have their own sources of income, for construction, extension. Disputes may arise on the priorities to give to the use of these resources
Cooperative funds Water supply initiated and financed through production cooperative or village revolving fund, for construction and expansion works.
Revolving funds Starting capital may come from a Government donation or the issue of shares to individual households. On the basis of this capital, loans are given to individual households or groups. Upon repayment, new loans are given to other members or groups
Water vending Through water kiosks, concession sales, coin-operated taps, water carrying systems or community-based distribution systems. Users buy water from these distribution points. The distributors pay a fee to the main water supplier.
Taxation (municipal resources) *Municipalities can collect the necessary* funds through local taxes; Payment can be linked to income level, but charges may not reflect the level of water consumption. This option represents a limited scope for community involvement in decision-making and financial system management.
Cross - subsidy One way to make the service equitable and affordable for all is to subsidize the poor and surcharge the high income consumers. Another cross-subsidization could be done between sectors, within the same community or municipality.
Government subsidies Central government and local authorities allocate part of their budget to operation and maintenance activities. Subsidization can also come through the reduction of spare part and chemical prices, free technical personnel available to communities if requested.
Loan through a bank A bank allocates a loan to a water committee. However most banks have a poor small credit policy for *rural communities*. Communities cannot always produce the necessary guarantee. The Grameen Bank, in Bangladesh, is proposing a new bank approach to respond to the needs of the rural areas.
Micro-credit schemes Communities organize through local associations, micro-credit schemes, where individuals and groups can borrow money with a pre-determined and agreed with interest. These schemes are adapted to Community needs and realities, but have a limit to their lending capacity in volume.
Social and Development Funds Many developing countries have put in place, special funds which give access to money for social and development purposes, with an interest rate which can be much lower than on the financial market. However, access to these funds are often for local authorities and municipalities, and not necessarily for communities. It is therefore important that communities and municipalities work in partnership. Access to these Funds can be eased through the payment of a regular fee which will give the possibility to have loan ii case of necessity.
Donations (twining, other members) Donations can come through individuals (former inhabitants of a village who live in a city or abroad). In some cases, villages are twinned with other villages and cities in other countries, and grants have been allocated through this mechanisms in the past
Private sector involvement The private sector can invest some of its own capital in a water scheme. However, it will look for something in return which can justify its investment, such as future contracts or ownership.

4.7 Sound financial management

Many communities and, in certain remote areas, municipalities as well, lack skills in financial management which will allow to organize, implement and control a cost recovery system in an efficient way.

The table below is summarizing the basic aspects of financial management which need to be implemented by a Water Committee, and what are possible options :

Financial management issues	Possible options
What cost to budget for ?	Remuneration Tools and spare parts Small repairs only All repairs Extension, rehabilitation
What sources of income to use ?	Regular user payments (monthly, sale per unit) Village funds Voluntary contributions Credit schemes Government subsidy
How to collect money ?	Billing Collection at water point Fund raising when breakdown Taking money from a fund
When to collect money ?	Per service provided Monthly After harvest Beginning of financial year
Who collects the money ?	Care taker Operator User group Village Water Committee Community leaders
Where to keep the money ?	In a safe In the village account In a bank account In a development fund
How to register movements of expenditures and incomes ?	Log book Daily journal Bookkeeping Bank statements
How to pay the mechanic or caretaker ?	Per job Per month (fix + % of sales) Per year after harvest In cash / kind
Who administers the funds ?	The Committee Treasurer (man or woman) A village accountant Bank accountant
What are funds used for ?	Payment of expenditures related to O&M of water point Generating bank interest Use for other development projects

Who orders payments ?	Operator Treasurer Water Committee Village leaders *Assembly of users*
What type of financial control ?	Receipts from book-keeping Regular meetings of water committee Feed back to users Checking with meter reading Checking with bank statements
How to monitor ?	Use of log book Make a quarterly review and overview of the situation on expenditures, and incomes, % of people who do not pay.
What to do with bad payers ? *This problem is particularly crucial for "influential" members of the society and public institutions.*	Analysis of reasons fro bad payment Improvement of service Improvement of relationship with the users Campaign on benefits of good payments Rescheduling of debt Sanctions

4.8 An enabling and supporting environment

An enabling and supporting environment encompasses the legal, economical and institutional framework, as well as national or local policies which are clearly spelt out regarding sector cost recovery. It encompasses also the availability of support services and equipment (including availability and accessibility of spare parts) within an acceptable geographical area and affordable financial range. Finally, the enabling environment includes the capacity to train and assist communities on financial issues.

Policies will have to be clearly spelt out on the financial responsibility and mechanisms for cost recovery. Staff will have to be trained on how to approach communities on financial aspects and how to train communities on better financial management and administration practices.

Unit 6 : Monitoring for effectiveness

1. Outline of session

Objectives

- To distinguish the difference between :
  a) monitoring and evaluation;
  b) monitoring for efficiency and monitoring for effectiveness
- To raise awareness on the principles of participatory monitoring
- To review data collection methods
- To review indicators and practice methodology for defining indicators

Methodology

1. Introduction
2. Game on definitions
3. Interactive presentation on monitoring principles and monitoring system
4. Review of data collection methods by pairs
5. Demonstration in plenary of methodology for defining indicators and a monitoring system
6. Group exercises for defining indicators
7. Conclusion

Materials

✓ Overhead transparencies
✓ Overhead projector, screen or white wall
✓ Flip chart and markers
✓ Cartons
✓ Graphic

Handouts

✓ Exercise sheets
✓ Copies of transparencies and background information

2. Notes for the trainer

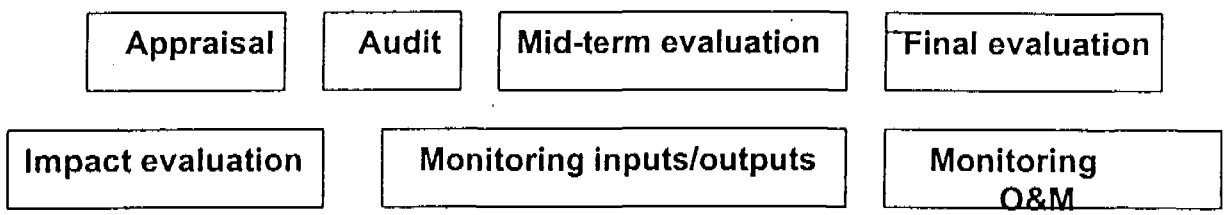
Introduction

Monitoring is a key factor of sustainable operation and maintenance. However, it is seldomly practiced in an efficient way, if at all. Monitoring is mostly practiced during the construction phase in order to control progress and expenditures, and rarely after the construction phase. This session will deal mainly about monitoring operation and maintenance, thus after the construction phase.

It could be useful at this stage to ask participants for their experience in monitoring, and also ask them what type of constraints they are facing with monitoring.

Game on definitions

The facilitator should recall the importance of having a clear understanding on the differences between monitoring, evaluation, audit, and appraisal. It is proposed to use the graphic of the project cycle, (see overhead sheets). The facilitator will prepare beforehand a graphic of the project cycle on the board without writing down all the various elements linked to monitoring, audit, evaluation and appraisal. He will also prepare the following cartons :



He will explain that the objectives of the game is to place the cartons in the appropriate place in the project cycle, and to try to define for each card : 1) What is it ?; 2) What is it for ?; 3) How is it done ?; 4) When it is done ?

For that purpose the facilitator will prepare a table with 8 columns and 5 rows, on a large sheet, in the following way :

	Appraisal	Audit	Mid-term evaluation	Final evaluation	Impact evaluation	Monitoring inp./outp.	Monitoring O&M
What is it?							
What is it for ?							
How is it done ?							
When is it done ?							

Finally, the facilitator will have to distribute an A4 paper with the main key words which will help to fill in the table (see in exercise sheets).

The game :

The facilitator will start with the first card "appraisal", and ask someone in the audience to come and place it on the graphic, drawing an arrow if necessary. (see overhead sheet). The group will then help the participant in responding to each question, using the key words provided in the A4 paper. The participants might want to add words, they should feel free to do so, as long as they explain to the group why. And so - on for each card to be placed and defined.

Hints:
The facilitator will end the game by clarifying that in this course, we will be dealing about monitoring for O&M, and this is what we are calling monitoring for effectiveness as opposed to monitoring for efficiency which is about monitoring inputs/outputs. Definitions included in the background information could be useful for the facilitator to look at before the session starts.

Interactive presentation on principles of monitoring and monitoring system

It is proposed to start with the key principles of monitoring, as described in the overhead sheet, and for each point clarify with an example either from the group, or either from the facilitator.

It is then proposed to have an explanation of information flows as shown in the overhead sheets, showing well to whom does the monitoring system profit, who will take action, and what are the laps of time between an incident and the actual solving of the problem. The facilitator should end the discussion on information flows by asking the participants which information allows for greater effectiveness.

The next overhead sheet on "seven steps for planning a monitoring system" provides with an overview on how to develop a plan for a monitoring system. It is then proposed to the group that of the session will focus on two main aspects : a) sources of information, for collecting data, and especially b) determination of indicators.

Review of collecting data methodology by pairs

The facilitator distributes to all the participants copies of "Sources of information" , and is asking to all participants to constitute pairs, and review the document two by two. The aim of the exercise is to highlight the tools and methodology which the participants are familiar with or which need some further clarification. An initial clarification can start through the discussion by pairs. 15 minutes are sufficient for discussion by pairs. It is the asked what are the tools which are most commonly known and what are the tools which need some clarification. The clarification can be done by any of the participants as well as by the facilitator. It is essential for the facilitator to have an understanding of what are the tools which are presented, even though he or she might not have practiced them all.

Demonstration of the determination of indicators

The facilitator will start with the definition of what is an indicator (see overhead sheets).
He will then proceed with the methodology, explaining the format :

Theme	Characteristics	Variables	Selection

See background information for explanations

It is then proposed to demonstrate the use of this methodology either using the given example in this manual, or any other which might have resulted from previous courses.

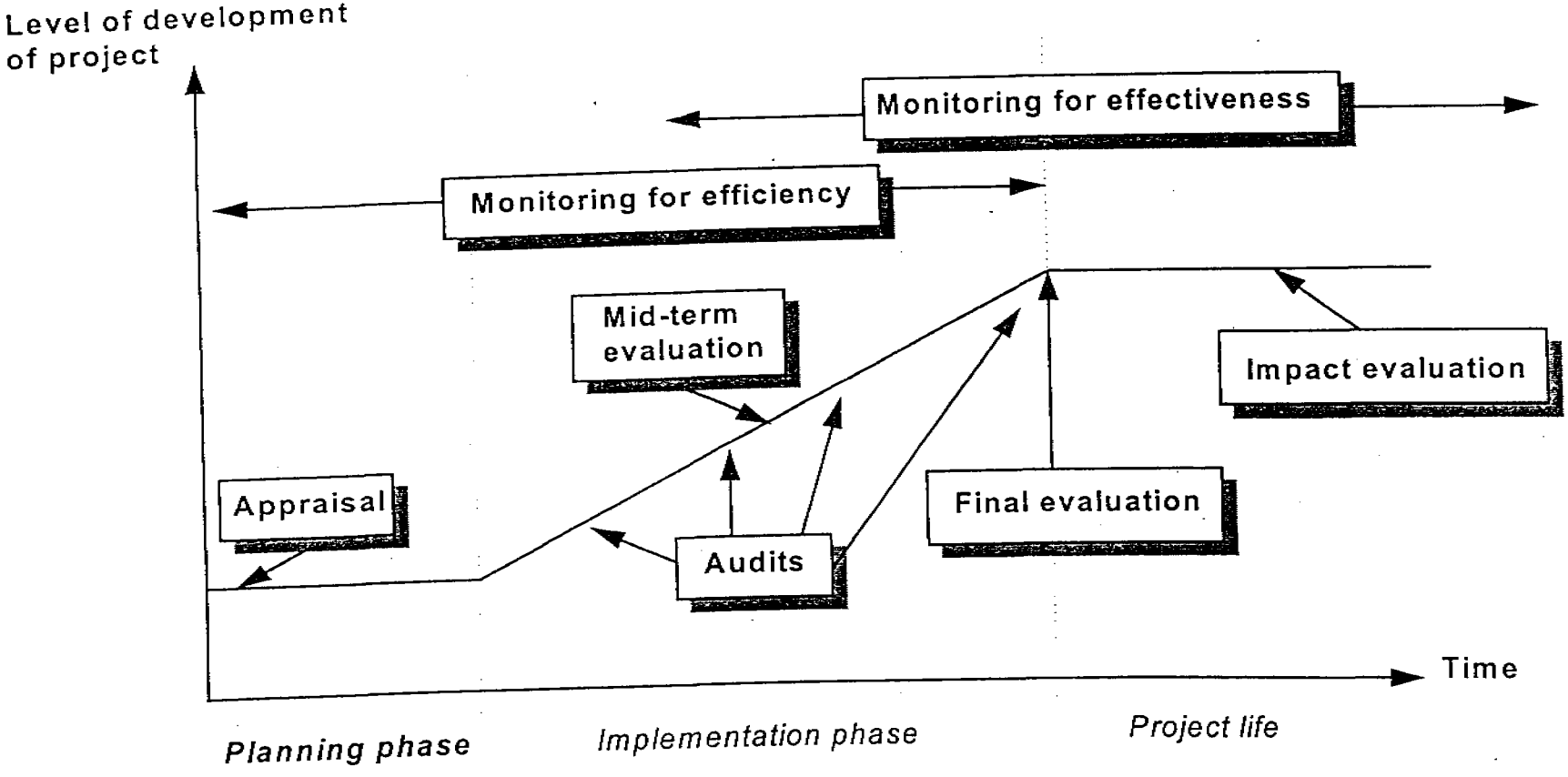
Group exercises on indicators and monitoring system

The participants are divided into small groups of four to five and are asked to select one of the key objectives coming from the objective tree. They will then determine a series of indicators using the format for selecting indicators and fill in the second format considering the monitoring system. Each group can the present the result of its work.

Conclusion

The facilitator will hand over at the end of this session a series of indicators which have been developed in several projects, as references.

2. Project cycle



Exercise sheet for game on definitions

Select the most appropriate definition for each term to be defined (some definitions can be sued twice or redefined if needed), in order to fill in the table which is proposed in the notes for the trainer.

Issue	Possible definition
What is it ?	• Assessment of a situation • Occasional assessment of the development of a project • Continuous review of activities • Occasional analysis and use of resources • Continuous and systematic review of functioning of system • Occasional assessment and analysis of effects of project • Occasional assessment of achievement of objectives
What is it for ?	• To take decisions on improvement of project performance • To revise objectives of project • To control achievement of targets and results • To control performance and efficiency of project • To control achievement of objectives • To control use of resources • To design future activities • To prepare a second phase of a project
How is it done ?	• Auto-evaluations, internal process • External process • Field studies sand participatory investigation • Analysis of project reports • Inherent management tool • Participatory process involving communities and other actors • Check of bookkeeping and accounts
When is it done ?	• After project implementation (one year or more) • During the whole implementation of the project , starting at the planning phase • During the life of the project (after implementation, but which could start already before) • Occasionally sometimes during the project implementation • Before the project starts (planning stage) • Half-way during implementation • Sometime before finalizing implementation of project

Overhead sheet

KEY PRINCIPLES OF MONITORING [8]

- Monitoring should be based and planned on a solid knowledge of objectives and activities

- Information should be used (solve as problem, answer a question, improve project, adapt activities)

- Monitoring information should be collected and acted upon at the lowest level possible

- Monitoring should be focused and simple (limit number of indicators, length and cost of data collection)

- Monitoring should be based on a careful definition of indicators (they should really be adapted to the project)

- Monitoring should combine qualitative and quantitative information

- Monitoring should ensure checks and balances, (validity and reliability of information)

- Monitoring should be come an in-built integrated activity and not a separate activity

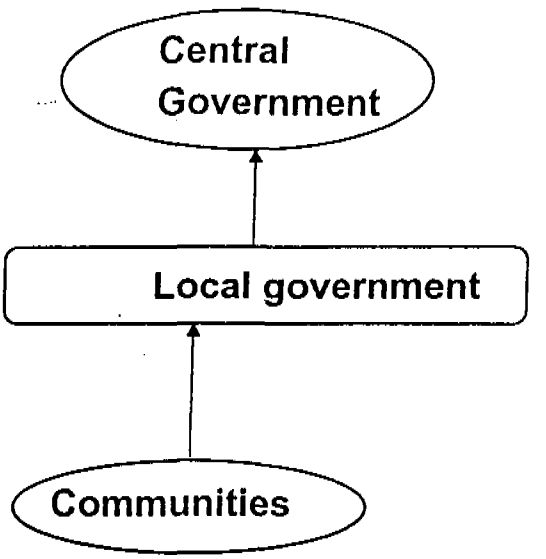
[8] Adapted from course material on "Monitoring for effectiveness", IRC

Overhead sheets

Information flow

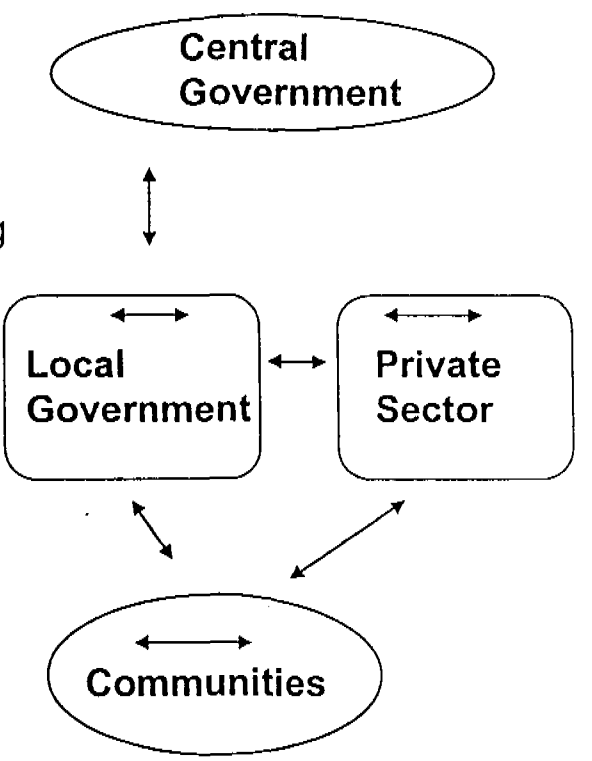
Centralized

Information is collected, and poor feedback is given. There can be very long delays in taking appropriate actions. Collection is often done by a special team, which can be costly.



Participatory and integrated

Information flows to the actors who have a direct interest in it, and who can take action. Monitoring is part of regular activities of each group. Costs are reduced, and efficiency increased.



Exercise sheet

Sources of information (page 1)

Sources	Advantages / disadvantages
Bookkeeping records, accounts, audit Used to monitror purchase, payments, contracts. Data in books needs to be compared with vouchers, purchase orders and receipts	Advantages: fast and already in use **Disadvantages**: limited information; information needs to processed and aggregated; not always easily available
Log-books Used to keep record of travels Data is more about total distance than number and type of villages visited	**Advantages:** already in common use in project activities **Disadvantages:** limited information
Check-lists Used to measure conformance to standard. Needs to be formulated in concrete, unambiguous words ; needs pre-testing	**Advantages:** Quick and easy to use **Disadvantages:** rough, inflexible; list of items not always appropriate
Community minutes Used to keep records of community meetings Needs to be done thoroughly	**Advantages:** provided information on assistance and periodicity of meetings **Disadvantages:** Information limited to issues dealt within the meeting
Monitoring sheets Used to check issues which change overtime Needs to made user-friendly	Advantages: shows progress overtime; can be used for many purposes **Disadvantages:** can be misused or under-analyzed
Periodic reports Used by project staff to report on progress of activities Data collected according to project format	**Advantages:** good source of information while the project is on **Disadvantages:** information analyzed and processed according to project objectives
Direct observation Used to appreciate general conditions of setting or to appreciate behavioural change Needs to be structured and organized	*Advantages: **direct information and good training tool*** **Disadvantages**: results often disregarded; not enough statistical weight
Semi-structured interviews **Used for short interviews** **Need to prepare informal questions beforehand**	**Advantages:** when done in depth, good information **Disadvantages**: needs trained interviewer; qualitative information often not used
Focused group discussions Used for discussions in segment groups, or discussions on a specific theme Needs to be prepared beforehand	**Advantages:** possibility to analyze problems and solutions in depth **Disadvantages:** needs skills and training to succeed; not always conclusive
Questionnaires, survey Used to collect specific information Needs to be kept short; needs pre-testing	*Advantages: specific; precise; cheap and fast way to collect data* **Disadvantages: Often poor quality; to be used with caution**

Workshops Used to gather community member or other stakeholders Needs to be well structured and organized; needs facilitation	Advantages: useful to specify or modify information Disadvantages: information might need to be validated
Stratified sampling Using above methods, by level of service, type of facility, socio-economic level, user / non-user.	Advantages: improves quality of data Disadvantages: sometimes inconclusive; results not always used.
Ranking; pocket chart voting Used for quantifying preferences Can easily be adapted to local circumstances	Advantages: gives valid data; good educational tool Disadvantages: needs experience on how to use it; needs time.
Venn diagram Used to learn about relationships among various groups, institutions	Advantages: Good probe of performance of various partners Disadvantages: subjective
Mapping ▪ Useful to correlate variables, and to analyze problems within the community	Advantages: excellent for planning, education and advocacy Disadvantages: complex to analyze if done on large scale

Overhead sheets

Seven steps for planning a monitoring system[9]

1. Identify key issues, concerns, questions or demands which will become the focus of monitoring
2. Determine indicators
3. Determine strategies for collecting, analyzing and reporting data
4. Determine the use of the information and how action will be taken
5. Determine information flow, checks and verification of information
6. Test monitoring system
7. Provide training or orientation to groups involved

[9] Adapted from course material "Monitoring for effectiveness", IRC

Overhead sheet

Matrix for setting up a monitoring system

Issue to be monitored	Indicator	Collection of data				Use of data			
		Source of information	Who collects ?	Periodicity	Means of verification	What is it for?	How does information flows ?	Who analyzes ?	Who takes action ?

Overhead sheet

Characteristics of an indicator

- Definition of a quality (what ?)
- Definition of a measure (how much ?)
- Definition of a target group (who?)
- Definition of a time horizon (when?)
- Definition of a place (where ?)

Example : All water points will be located within a radius of 200 meters of at least 8 settlements, by December 2000, in the region of Kebri.

In addition, an indicator must be :

- ***relevant***
  (the indicator measures what is needed, and it is related to the objectives)
- ***sensitive***
  (the indicator responds to variations and changes)
- ***simple***
  (the community and other actors are able to understand it; and the data will be easy to act upon; limitation of number of indicators)
- ***feasible***
  (possible and easy to collect information; possible to act upon; not costly)

Exercise sheet

Determination of indicators (1)

Issue	Characteristics	Variables	Selection
Issue to be monitored. What do I want to know? What is the result I am expecting ?	List of the major relevant characteristics of the issue to be monitored. This corresponds to a description of a description of the issue.	For each characteristic, determination of quantifiable variables. In some cases it can be qualitative variables.	Selection of variables, according to the following set of criteria : • relevance • sensitivity • simplicity • feasibility

Once the indicators are selected, understood and accepted by the various stakeholders, they need to be quantified and tested.

Overhead sheets

Determination of indicators (2), an example from a small piped system

Issue	Characteristics	Variables	Selection
Community management improved	Efficient service	N. of hours of functioning/day % of public taps functioning Delay between damage and repair Billed water / Produced water	• N. of hours of functioning per day • Billed water/produced water (if there are meters) • Frequency of meetings and attendance (men/ women) • Composition of Committee (men/ women) • % of users not paying • Balance in bank account • N. of training workshops • N. and type of people trained
	Community organization active	Frequency of meetings N. of participants/ total population	
	Costs recovered	Expenditures / Income % of users not paying Costs per month / monthly tariff Periodicity of payments Balance in bank account	
	Participation of community	N. of decisions taken in General Assembly N. of women with responsibilities/ N. of posts with responsibilities Rotation of leadership Presence of community in meetings	
	Technical and managerial capacity	N. of training workshops / year N. and type of participants in the Workshops Level of knowledge	

4. Background information

4.1 Monitoring in perspective[10]

Until recently, monitoring and evaluation have focused on finance, implementation and construction targets and it has been viewed as the routine collection of data in project operations. Evaluation has generally been used to assess the development of a project for the purpose of making funding decision and drawing useful lessons. The World Health Organization has developed in 1983 the Minimum Evaluation Procedures (MEP) which focused on functioning and utilization of water and sanitation facilities and on hygiene education. The MEP emphasizes cheap, simple and quick methods. It developed 17 measurable indicators and has added a new dimension to monitoring and evaluation by focusing on functionality and the utilization of outputs in projects. Gradually, issues such as relevance, efficiency, effectiveness and sustainability have been added.

There has been several significant developments since in thinking about monitoring and evaluation : more groups and actors are concerned by monitoring activities; there is an interest in monitoring behaviour change; there has been changes in the process of monitoring, going from a central "monolithic" type of monitoring to a participatory monitoring; monitoring should become integrated in regular activities; there is an emphasis on timely use of the results of monitoring.

4.2 Definitions

Appraisal

What is it ?	Assessment of a situation
What is it for ?	Design or implementation of future activities
How is it done ?	Field studies; participatory appraisals
When is it done ?	Planning phase of a project

Audit

What is it ?	Occasional analysis of use of resources (inputs)
What is it for ?	Control of use of resources and achievement of results
How is it done ?	Check of expenditures, income, using accounts/books
When is it done ?	End of fiscal year or end of phase of project

Monitoring

What is it ?	Continuous and systematic review of activities, processes, use of inputs and realization of outputs
What is it for ?	Control of achievement of targets and results fixed by a plan (performance, efficiency) and decisions about activities Control of achievement of objectives (effectiveness)
How is it done ?	Integrated and inherent management tool, through determination of indicators, collection / analysis of data Monitoring efficiency : through project activity reports Monitoring effectiveness : participatory process
When is it done ?	Monitoring efficiency : during project planning and project

[10] Adapted from IRC course on « monitoring for effectiveness »

	implementation Monitoring effectiveness : during end of project implementation and during project life

Evaluation

What is it ?	Occasional assessment of the development of a project
What is it for ?	To take decisions on : improvement of project performance, or modifications of project activities and objectives, continuation or end of project
How is it done ?	Auto-evaluations, external evaluations, participatory evaluations
When is it done ?	Mid-term evaluations, final evaluations, impact evaluations (after project implementation)

4.3 Indicators

An indicator is a variable which can me measured (quantity), or appreciated (quality or trend), and which can show changes in a given phenomenon, and appreciate the achievement of a result or an objective.

An indicator has several characteristics among which :

- Definition of a quality (what ?)
- Definition of a measure (how much ?)
- Definition of a target group (who?)
- Definition of a time horizon (when?)
- Definition of a place (where ?)

Example : All water points will be located within a radius of 200 meters of at least 8 settlements, by December 2000, in the region of Kebri.

In addition, an indicator must be :

- ***relevant***
  (the indicator measures what is needed, and it is related to the objectives)
- ***sensitive***
  (the indicator responds to variations and changes)
- ***simple***
  (the community and other actors are able to understand it; and the data will be easy to act upon; limitation of number of indicators)
- ***feasible***
  (possible and easy to collect information; not costly)

These last four specific characteristics can serve as selection criteria for the determination of indicators.

There are several ways to determine indicators. In many cases, indicators are selected from a document and applied to a project, without knowing if it corresponds exactly to what is needed and if the indicator is appropriate.
It is possible to determine indicators which correspond exactly to what the project or

the community wants to measure. The following steps are recommended :

Step 1 : Clarification of the issue to be monitored
The issue to be monitored normally corresponds to one of the results or objectives that the project is trying to reach. It has to respond to a question : What do I want to know ?

Step 2 : Description of characteristics
An inventory is made of the major relevant characteristics which correspond to the issue to be monitored. In some way, it is the same as describing the issue.

Step 3 : Identification of variables
For each characteristic, one will intent to identify quantifiable variables (time, %, ratio, price). It can be that the variable is more of qualitative nature.

Step 4 : Selection of indicators
Variables are then analyzed through an selection process, with the following criteria (as seen in the characteristics of indicators) : relevance; sensitivity; simplicity; feasibility.

The determination of indicators can be done with the community; or with other stakeholders who have direct interest in monitoring.
Indicators are then formulated in their complete way, and tested. It could be that the test reveals that the indicator is too difficult to measure, or that it does not have so much relevance.

At community level, very simple and basic indicators can be formulated, which concern the functioning and use of systems, as well as its management. The community has a direct interest in monitoring, since it is the one that will be able to act and the one who will benefit the most from an efficient system.

4.4 Examples of indicators

- ***Examples from the MEP (Minimum Evaluation Procedure) of WHO***

1. measuring functioning of systems

Indicators for water supply
- Water quantity (liters/person/day)
- Water quality (E.Coli ; fluorides concentration and other chemicals)
- Reliability (frequency and duration of breakdowns)
- Commodity (distance)

Indicators for sanitation
- Proportion of households having an improved latrine
- Hygienic state of latrines (% of clean latrines/ number visited)
- Reliability of installations (qualitative... % in good state/ number visited)

Indicators for Hygiene

- Understanding of the language of the messages (% of people speaking the language)
- Understanding of the content of the messages (sampling; with good; medium, low understanding, and proportion)
- Access to the messages (N. of people reached by TV or radio, etc..)

2. Measuring use of systems

Indicators for water supply
Proportion of households using the system
Volume of water used by destination

Indicators for sanitation
Proportion of users using the improved latrines

Indicators for hygiene
Behaviour in terms of water storage
Cleaning of hands after defecation
Knowledge of Oral rehydration

- ***Examples from the document : Participatory evaluation "tools form managing change", World Bank Technical paper N.207***

1. Sustainability

Reliability of systems
- Quality of water at source
- Number of facilities in working order
- Adequate maintenance (low frequency of breakdowns, quick repairs, low downtime of facilities)

Human capacity development
- Management abilities (who decides, men/women)
- Knowledge and skills (understanding of men/women on improvement of system; proportion of technical skills availability)
- Confidence/self-concept (rating scales on self perception; leadership; initiative and sense of efficacy

Local institutional capacity
- Autonomy (who defines rules? who controls finances?)
- Supportive leadership (style of management; working methodology)
- Systems for learning and problem-solving (systems in place to resolve conflict, and corrective actions)

Cost sharing and unit costs
- Community contribution
- Agency contribution
- Unit costs

Collaboration among organizations

- Planning (collaboration; participatory planning)
- Activities (collaboration)

2. Effective use

Optimal use
- Number and characteristics of users
- Quantity of water used (all purposes)
- Time taken to use facilities
- Management of water resources (protection)

Hygienic use
- Water quality at home
- Water transport and storage practices
- Home practices to improve water quality
- Site and home cleanliness
- Personal hygiene practices

Consistent use
- Pattern of daily use
- Pattern of seasonal use

3. Replicability

Community ability to expand services
Additional water/ latrine facilities built
Number of upgraded facilities
New development activities initiated

Transferability of agency strategies
Proportion and role specialized personnel
Established institutional framework
Budget size and sheltering
Documented administrative / implementation procedures
Other special / unique conditions

- ***Examples from "Tools for the assessment of operation and maintenance status of water supplies", WHO and O&M Working Group of the Water Supply and Sanitation Collaborative Council***

- Management system: System in existence and being followed

- Functioning supply points: $\frac{\text{Number in working order}}{\text{Total number}} \times 100$

- Reliability: $\frac{\text{Functioning time}}{\text{Total elapsed time}} \times 100$

- Spare parts accessibility: Mean time for arrival of identified spares/materials
- Cost: Average O&M cost per user
- *Operating revenue* $\frac{\text{Operating revenue}}{\text{Population served}} \times 100$
- Cost recovery $\frac{\text{receipts + subsidies}}{\text{Average O\&M costs}} \times 100$
- VLOM Personnel $\frac{\text{N. of systems with functioning committees}}{\text{Total number of systems}}$
- Supply continuity $\frac{\text{Average number of hours of daily supply}}{24}$
- Flow rating $\frac{\text{Present discharge}}{\text{Discharge at handing over of scheme}}$
- Pressure rating $\frac{\text{Present pressure}}{\text{Discharge at handing over of scheme}}$
- Water quality % samples > target number E. Coli per 100ml
- Training (VLOM) N. of VLOM personnel trained per community (men and women)
- Materials and spare parts N. of outstanding repairs due to lack of spare parts

  N . of outstanding materials orders

  N. of items out of stock

  N. of spare part requisitions per water supply/year

- *Examples from "Technology transfer in water supply and sanitation" – A learning experience from Colombia – Technical paper 32-E, IRC, CINARA*
-

Indicators for the evaluation of water supply systems

	Theme	Indicator	Desired level
1.	Coverage	No. of connected households / Total no. of households	100%
2.	Available quantity	Max. flow in the system / Min. flow in the source	Less than 50%
2.1	Production	Actual flow in the system / Design flow	Less than 100%
2.2	Quantity of use	Supply quantity per user / Design capacity per user	Less than 100%
3.	Continuity	Number of supply hours per day	24 hours
3.1	Continuity in the source	Reduction over time	No reduction
4.	Quality	Turbidity Residual Chlorine in distribution net	Less than 5 NTU 0.3 - 0.6 mg/l
5.	Use of other water sources	No. of persons using other sources / No. of persons interviewed	0%
5.1	Efficient water use	No. of houses with leaking taps / No. of houses visited	0%
6.	Management capacity	No. of indebted users / Total no. of users	Less than 5%
		Supervision of the operator	Yes
6.1	O&M capacity	Trained operator with work tools	Yes
6.2	Representation of women	No. of trained women in the committee / No. of trained committee members	50%
7.	Cost	Monthly revenue / Monthly expenditures	More than one
7.1	Tariffs	Monthly tariff / Monthly family income	Less than 3%

Unit 7 : Working and planning with communities

1. Outline of session

Objectives

- To review tools and processes of working with communities
- To identify best tools appropriate for different phases of the project cycle

Methodology

1. Introductory note
2. Plenary discussion on criteria
3. Group exercise on processes (two groups)
4. Conclusion

Materials

✓ Overhead transparencies
✓ Overhead projector, screen and white board
✓ Flip chart and markers

Handouts

✓ Copies of transparencies and background information
✓ Exercise sheet

2. Notes for the trainer

Introduction

Community participation and community management are now concepts which are more and more accepted in the developing world. However, very often they remain at the conceptual level, and there is a lack of know-how on how to apply and implement community management. This session will try to review the basic aspects linked to the approach and attitudes linked to promoting and developing community management. In this context, it will also draw on the lessons that IRC has summarized after a four year investigation on the role of communities in the management of their water supply system, in six different countries. The session will also highlight the various tools which are used to work and plan with the communities; however, the objective is just to give an over view, as the full detail and experimentation of these tools need a least a week or two of learning and practice. Finally, the participants will try to choose what tool and process is most appropriate to different phase of the project cycle.

Focused discussion and interactive presentation on approaches

The facilitator can start with asking the group what type of experiences they have in working and planning with communities, by giving some good and less successful examples. Some overhead sheets are provided together with information contained inn the background information on processes and approaches.

Review of tools

It is proposed to distribute to the group the overview of tools which is provided in the exercise sheets. The participants will review all the tools in pairs for about 15 minutes, trying to review the tools which are known and the tools which are not well known. Each pair will then express rapidly its experience and lack of knowledge on certain tools. It is most likely that some of the tools will not be known to the participants.

It is proposed that the facilitator becomes acquainted with the tools described (see supporting documents), or that a social worker comes in the classroom to explain his or her work in applying these tools. It is also possible to ask for participants to describe their experience on tools which they are familiar with. The facilitator could choose to have several tools experimented with in the class room. Common tools which are being experimented with are : Social mapping, Venn diagram, Pocket chart (see supporting document)

Exercise linking tools with project cycle

Participants are asked to go back to their work in pairs, and to try to come with what type of tools would be used for what type of situation, using the project cycle for that purpose. In the meantime, the facilitator has prepared on the board a graphic describing the project cycle. Once the groups have finished discussing (15 minutes), they can express where each tools could be placed in the project cycle and for what purpose they can best be used. (see background information).

3. Overhead sheets

Limiting factors for the participation of the community

- Poor credibility in front of institutions
- Lack of self confidence
- Resistance to change
- Fear of the financial consequences which a new project will bring
- Feeling of pessimism and got used to the bad situation
- Lack of experience in dialoguing with institutions
- Poor knowledge of planning and problem solving methodologies
- Timidity to speak in public
- Timidity to intervene in presence of a foreigner

Overhead sheets

Limiting factors for the participation of local authorities

- Poor knowledge of the integration of social aspects with technical aspects
- Lack of communication channels between the municipality and the community
- Poor perception of communities problems
- Rural communities are not a priority, poor political weight
- Lack of knowledge on participatory planning
- Insufficient staff trained for rural water supply and sanitation
- Low number of visits to the community
- Attitude of domination

Overhead sheet

How to stimulate community management ?

- Involvement of communities in project cycle

  Involve users right from the start of a project cycle: users in the driving seat - Awareness - Diagnosis - Planning - Prioritizing - Experimentation - Monitoring in an iterative way providing training where needed - Follow-up

- Approach

  Demand - driven
  Partnership between authorities and community
  Change from implementor to facilitator
  Coordinated, multi-sectoral, integrated approach
  Decentralization: come closer to the customer
  Making use of local knowledge and management skills
  Speaking the language and knowing the culture
  Working with a participatory approach

- Attitudes

  Build trust
  Take time
  Listen and observe
  Promote dialogue among all actors
  Aware of gender issues
  Provide feedback
  Ability to work with participatory techniques

Seven steps to community planning[11]

1. Problem identification
2. Problem analysis
3. Planning for solutions
4. Selected options
5. Planning for activities
6. Planning for monitoring and evaluation
7. Participatory evaluation

[11] From "PHAST Step by Step Guide : A participatory approach for the control of dirarhoeal disease", PHAST, SIDA, UNDP-World Bank, WHO, Geneva (Switzerland) 1998.

Overview of tools for planning and working with the community

Working and planning tools	Brief description	Advantages / disadvantages
PRA *Participatory Rural Appraisal*	Process used in development programs to help rural communities organize their knowledge, identify and prioritize local development needs an develop long-term action plans; consists in preliminary visits, participatory data collection exercises, participatory analysis and planning. (see further below information collection tools)	**Advantages :** full participation of communities right from the start; plans reflect a field reality; establishment of good working relationships and communication lines between authorities and the community. **Disadvantages :** needs to be familiar with participatory techniques; takes time.
Mind mapping	Thought processes are brought together in a spontaneous - associative way. A "map" of landmarks appears, which are classified and organized into a branching arrangement	**Advantages :** Open, expandable; good for vision development, very versatile. **Disadvantages :** global overview, emphasizes linear relationships.
SWOP *(Successes Weaknesses Obstacles Potentials)*	Simple, flexible, versatile working tool for situation analysis in groups. It records positive and negative experiences of participants, as well their assessment of obstacles and potentials in a given situation.	**Advantages :** Easy, can be understood in an intercultural setting. No special material needed. **Disadvantages :** Does not offer concrete solutions, just possibilities.
Brainstorming	Group puts forward as many suggestions as possible about a set theme. The ideas are sorted out, analyzed, evaluated. Classification can be done with "Immediately feasible", or "needs further development"	**Advantages :** Easy, quick; stimulates intuitive and spontaneous thinking. **Disadvantages :** Few suggestions are actually used; effort is often under estimated.

Scenario-writing	Design of alternative views for the future, with labels of "probable", "optimistic" and "pessimistic" options. Can start with a situation analysis, then prognosis analysis and programme phase.	**Advantages :** Suitable for complex, long term problems. Widens the planning horizons; **Disadvantages :** Time intensive; needs good information base.
OOPP *Objective Oriented Project Planning*	Systematic planning method based on teamwork and visualization, and logical analysis. Includes an analysis of participation, problems analysis, objective analysis, choice of alternatives; and project planning matrix.	**Advantages :** promotes mutual understanding of problems; clarifies cause and effect relationships; enables participation of professionals together with beneficiaries; only parts of it can be used, such as the problem analysis **Disadvantages :** Reality only accessible through rational thinking; requires a good facilitator.
Morphological box	Systematic search for alternative solutions. Possible solutions are broken up into elements and the most important characteristic of each element is identified. All these are arranged into a "morphological" box. Combination are drawn between various elements with lines.	**Advantages :** Suitable for clearly defined problems where combinations and variations are important. **Disadvantages :** Less suitable for problems which require high degree of analysis.
Utility value analysis	The situation is presented with various alternatives. Criteria are developed for the acceptation of the project. Each criteria is weighted (W), and each alternative is assessed for each criteria (A) (Ex: 1 to 10). Utility value will be W x A. A final comparative evaluation is done for decision-making.	**Advantages :** qualitative and quantitative assessment of a situation; versatile in its application. **Disadvantages :** Assessment and weighing figures should be documented. Can be difficult to understand for communities

Task chart	Used to organize work procedures, with functions of staff.	**Advantages :** organizational chart, good basis for job description **Disadvantages :** only operational plan, depends on previous analysis.
Bar chart *(Gantt-chart)*	Used for the chronological planning of tasks, with the individual working steps listed on an activity axis	**Advantages :** graphic and simple. **Disadvantages :** relies on previous analysis. Interconnections difficult.
Flow chart	Describing the sequence of activities and a structured process in the form of an algorithm	**Advantages :** Simple and easy, suitable for routine planning. **Disadvantages :** relies on previous analysis; suitable for s single-process.
Action research	Above tools can be used, but is included a review of experiences in the field, in a participatory way and over time.	**Advantages :** close to reality, integrates social change dimension, learning on experience; **Disadvantages** : time consuming; need acceptance of participatory results.
Mapping of community	Drawing of a simple map of the community, developed by both women's and men's groups, showing boundaries, water sources, housing infrastructure, roads, etc..	**Advantages :** provides a vision of the community by the community, and updates information; **Disadvantages** : more an information collection tool than planning tool
Village History	Shows on a time line local, national and international events which were important for the community, resulting from discussions with the communities.	**Advantages :** provides information about the community's past experience and problems. **Disadvantages :** needs several sources of information for validity
Transect walk	Description of the natural environment, areas of use and with particular problems or possible opportunities, resulting from a walk with community members	**Advantages :** direct information on surroundings observed and shared with community members. **Disadvantages** : requires afterwards a further analysis.

Trendlines	Provides a brief summary on trends on specific issues (health, water availability, etc...), as a result of small group discussions.	**Advantages :** graphic, visual **Disadvantages :** provides only very general, global information
Problem ranking	Shows key problem identified by the community, and the priority which they attach to having these problems solved	**Advantages :** participatory analysis on values and priorities **Disadvantages :** does not analyze the causes
Venn diagram	Represents groups or institutions in the form of circles (the bigger the circle, the bigger the role). The position of circles to one anoter shows the type of relationship that co-exist between the groups and institutions	**Advantages :** good visualisation and understading of how groups relate to one another **Disadvantages :** subjective and provided only limted information.
Pocket chart voting	Voting on drawings representing specific situations or alternatives	**Advantages :** democratic; expresses desires. **Disadvantages :** requires material & experience

4. Background information

4.1 In general

Working and planning with communities

One of the first tasks that a manager or a group of persons is facing while working with communities, is to understand and assess what is the present situation. There are many different ways to go about this. One can read reports and studies which have been written on a particular project; one can hold a series of professional staff meetings, and ask staff about their perception of a situation; one can make field visits in order to visualize a situation.

Experience has shown that good plans are based on a participatory assessment or evaluation of a situation; they reflect better field realities and are a way to involve communities right from the start in future responsibilities.

People do not always have the same perception and vision of a problem, since they belong to different cultures and have different priorities in their working or living environments. Participatory planning is based on a common understanding of problems. It is simple, democratic and motivating. It allows a group of professionals at different levels, from different departments, or sectors, together with community members and users in reaching a common consensus about a situation.

Several working tools can be used for this. The overhead sheets provide an overview of some of these tools, and additional information can be found in the supporting documents. However, a methodology is proposed based on an experience of four years in the role of communities in the management of their water supply service, resulting from an investigation in six different countries.

4.2 The PAD approach[12]

Participatory Action Development (PAD) is a methodology for improving community management of rural water supplies, in which all the actors involved contribute both to the creative thinking that goes into the undertaking, and to the action that is the subject of the development work (Lammerink, 1993). PAD aims to learn from the past and to find solutions to concrete problems and conflicts in the management of rural water supplies by communities. At the same time, PAD can help organizations to discover how they can best support communities in their efforts to improve the management of rural water supplies.

The methodology also aims to respond to the concrete needs of communities to improve their skills for managing public services, and thus operationalizing what is known as the 'demand responsive approach'. The key characteristics of this approach were developed during the Community Water Supply and Sanitation Conference in May 1998 (organized by the World Bank/UNDP World Bank Water and Sanitation Group (see box).

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[12] Extracts from "Facilitating Community Discovery : getting to know about community management", Document N.4 of the series Community Managers for Tomorrow, 1998, IRC, The Hague, The Netherlands

Key characteristics of the demand responsive approach

(a) community members can make informed choices about: whether to participate in the project; technological and service level options based on their willingness to pay and on the principle that more expensive systems cost more; when and how their services are delivered; how funds are managed and accounted for; and how their services are operated and maintained;

(b) the government plays a facilitating role, sets clear national policies and strategies, encourages broad stakeholder consultations, and facilitates capacity building and learning; and

(c) an enabling environment is created for the participation of a wide range of providers of goods, services and technical assistance to communities, including the private sector and NGOs;

(d) an adequate flow of information is provided to the community, and procedures are adopted that will facilitate collective decisions within the community and between the community and other actors (social intermediation).

Source: Community Water Supply and Sanitation Conference, World Bank/UNDP/World Bank Water and Sanitation Group, May 1998

PAD enables communities, together with the staff of the support organization, to participate throughout the development process, starting from the initial design of an intervention, through data gathering and analysis, to the presentation of the final results and discussion of the implications of their actions. Communities are actively engaged in the quest for information and ideas to guide their future actions.

It is not always possible or necessary to work closely with an entire community. Often a small group of people is selected to become the direct partners of staff of the support organization, and mechanisms are developed to provide feedback to the wider community when required. Members of the selected group are involved both as subjects and as local development workers, so that dialogue between development professionals from the support organization and the people at the grassroots level is a key feature of the process. PAD is a learning process for members of the community as well as for the staff of the support organization, in that it enables them to learn from experiences of social action.

PAD offers an effective and powerful strategy for carrying out the type of interdisciplinary work that is needed to assist communities to take the lead in their own development. It is a real demand responsive approach, resulting in improved community management of rural water supplies. It also allows for a better understanding of the strengths and weaknesses of community management, because through the methods and tools used, it takes a holistic view of management practices and problems. PAD can be rapidly adjusted to local conditions in different countries. In particular, by applying a short feedback mechanism it can stay close to reality. For more detailed background information on the origins of PAD, see the first document in this series, 'Participatory Acton Development: An approach to supporting community management in water'.

The PAD methodology places strong emphasis on participatory and gender-sensitive appraisal and needs assessment methods. It uses both qualitative and quantitative methods of collecting data on system performance and service, such as distribution, breakdown rates, costings, demographics, local organization, and the socio-economic characteristics of served and unserved households. In doing so, PAD

builds on earlier appraisal methodologies such as Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA).

PAD involves three major phases:

- *Diagnosing*: the staff prepare for the job, communities are selected, and problems and problem-solving strategies are identified;
- *Experimenting*: problem-solving strategies, methods and tools are tested and evaluated;
- *Sustaining the process*: the findings are shared and disseminated, and the work that needs to be done to sustain the development process is planned and coordinated.

These three phases are described in general terms in the first document in this series, and are elaborated in the second and third documents. This second document focuses on the diagnosing phase of PAD, and explains how the process can be sustained.

4.3 Diagnosis[13]

Getting prepared for PAD

The support organization first needs to prepare itself for the application of PAD. To identify what needs to be done to get prepared, the support organization needs to ask a number of questions, such as: Does PAD fit within the mandate of our organization? Is our organization sufficiently flexible to cope with support requirements that may vary in terms of the time required, the necessary resources and the intensity of support. Can we put together a multidisciplinary and gender-balanced support team that will allow us to address social as well as technical issues, and men as well as women? Do the staff have previous experience with PAD? Are they capable of facilitating development processes rather than merely implementing water and sanitation projects? Do the team members trust each other sufficiently to be able to collaborate and learn from each other? What do we know about community management experiences elsewhere in the country? The composition and the experiences of staff within the organization will determine the extent to which efforts are to be undertaken in order to 'get prepared' for PAD. In choosing to apply a PAD approach, the organization will move away from merely implementing water supply and sanitation projects, to *facilitating* development processes.

Training the support team

Planning and training workshops should be part of the preparatory phase (for details, see the *Training of Trainers* manual (IRC, 1999). During such workshops the project team of the support organization can exchange the preliminary findings from the country assessment, agree on an analytical framework, develop a common support approach, develop a methodology and criteria for the selection of project communities, and identify appropriate participatory and gender-specific methods and tools for carrying out the performance and situation assessments with community members. Learning to work with such participatory methods and tools for community diagnosis, and to use creatively a basket of tools should also be part of these workshops. Implementation plans, including indications of how gender aspects will be addressed, can be prepared and the team can draft material to brief the support

[13] Extracts from "Facilitating Community Discovery", opus citae.

organization on the approach and its implications.

The planning and training workshops can be facilitated by the staff of organizations who have experience with the PAD approach and who can offer training activities and facilities. Such organizations already exist in at least six countries in Asia, Latin America and Africa, and they are growing in number.

Selecting the communities
Part of the task of the planning and training workshop is to develop a methodology and a set of criteria for the selection of communities to work with. First, a choice needs to be made as to whether to select only the communities that have requested support, or also those with whom the support organization finds it important to work. Although it is preferable to work with communities that have asked for support, some more remote communities may be unaware that they are able to apply for support in development activities. Support organizations may choose to take the initiative in approaching the latter.

Some of the criteria for selecting communities with which to apply the PAD approach may be similar to those used for general community selection. These criteria include: whether the people express a need for improvement, the accessibility of the community, whether the people are willing to invest time and effort in a project applying the PAD approach, the level of equity and equality within the community, and the outcomes of previous management efforts in that community. In accordance with their own development philosophy, support organizations may also include criteria such as geographical location, socio-economic conditions, whether there are underprivileged groups within the community, and political stability.

4.4 The process of community diagnosis

The question of whether a community diagnosis is to be carried out in a participatory way can be looked at from two perspectives: pragmatic and ethical. Pragmatic considerations include how much time is available for the diagnosis, the skills of the staff, how many communities are to be 'covered', as well as the type of information that is needed and how detailed and reliable that information needs to be. Ethical considerations include whether the community members want a diagnosis to be done, and if so, who will decide which areas should be explored, who will make the observations, who will conduct interviews and with whom, and who will determine how the information will be used.

A community diagnosis seeks to gather information that will be used as the basis for planning and implementing development activities, and to prepare people for action. The assessment will include issues such as the roles of men and women in local management, the effects of gender on the efficiency and use of water supplies, environmental concerns such as water source protection and watershed management, and issues of cost recovery and community-based financial management. The outcomes of a community diagnosis provide insights into problems that have negative effects on the management of the water supply system, the local knowledge and resources available to improve the existing situation, and strategies to resolve these problems. Community diagnosis has a number of distinguishable elements:

- building and maintaining rapport;

- establishing a local PAD team;
- collecting general and factual information;
- determining the range of topics of interest for further exploration;
- screening indigenous knowledge and existing management practices for possible application in water supply management;
- collecting detailed information on identified topics: problems, potentials and available resources;
- prioritizing problems, identifying the root causes of problems and establishing selection criteria;
- identifying and selecting potential solutions and possible problem-solving strategies; and
- providing feedback to the community.

Although community diagnosis is often seen as a step in development that has a clear beginning and an end, experience has shown that it is a continuous process, and that it is also iterative: newly revealed facts trigger new questions that require further exploration. Once action to improve a problem situation has begun, the community will probably run into unexplored areas that require renewed or further investigation.

4.5 Tools fact sheets

(see next pages)

Rapid Rural Appraisal (RRA)[14]

Application possibilities in the planning cycle

Vision	Possibilities for change	Way/approach	Concept/strategy	Operational plan	Plan adjustments	Monitoring, evaluation
• •	• • •	• •	---	---	•	• •

--- : least appropriate; •: some appropriateness; • • : appropriate; • • • : very appropriate

Similar / related approaches

Participatory Rural Appraisal (PR); Famers First; Participative Learning Methods (PALM); Approach Development; Action Research

Brief description

The RRA approach enables to rapidly and inexpensively assess the most important features of the living conditions of an urban or rural population. The assessment is done primarily by an interdisciplinary team (including at least one sociologist) and takes place in the field. RRA is designed as an ongoing learning process for both local as well as external participants. A conscious attempt is made to avoid misrepresentations with regard to staff selection, timing, season, route, etc. Tailor-made tools, some of which are developed locally at the time, are used, among which : a) semi-structured interviews; b) historical profile; c) ranking of values; d) seasonal charts; e) pocket chart; f) participatory problem analysis; g) joint field visits; f) direct observations, etc...

Advantages

- Related to both problems and potentials
- Promotes competence and reinforces independence
- Appropriately accurate
- Compares and takes into account different opinions
- Evaluates local know-how and technology together with the communities
- Builds trust and understanding within the community
- No special methodological knowledge required by local participants
- Tools can be applied in a flexible fashion (encourages creativity)

Limitations

- Leads to a important amount of collected information (not always used)
- Raises expectations in the community
- Findings need to be elaborated further for practical implementation
- Situation-specific and thus difficult to compare from one place to another
- Can require a lot of time
- Requires knowledge of participatory techniques, openness

[14] Reference document : Mc Cracken / Pretty / Conway : Introduction to RRA dor agricultural development, IIED, 3 Endsleigh Street, London WC1H 0DD, UK (1988), in "Cooperation planning – A working Aid for beginners and for more experienced planners", Swisss Development Cooperation, Evaluation Service, CH – 3003 Berne, Switzerland (1993)

Mind mapping[15]

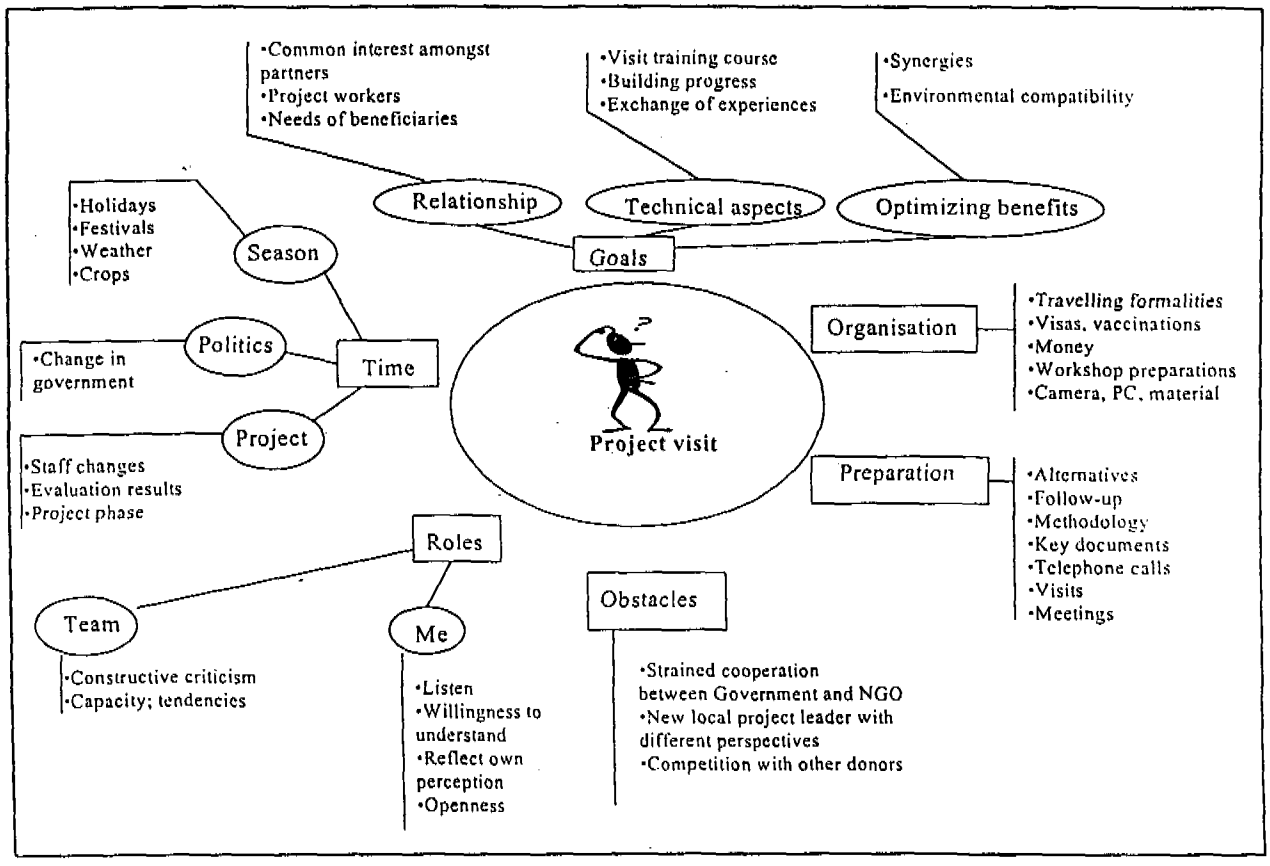
Application possibilities in the planning cycle

Vision	Possibilities for change	Way, approach	Concept, strategy	Operational plan	Plan adjustments	Monitoring, evaluation
• • •	•	---	•	---	---	---

--- : least appropriate; •: some appropriateness; • • : appropriate; • • • : very appropriate

Brief description

Mind mapping facilitates the overview on a central theme. Thought processes are brought together in a spontaneous-associative way and identified with key words or symbols. In this way a chosen theme is assessed from different perspectives and a "map of landmarks" emerges. The landmarks are classified and organized into a branching arrangement, thus enabling classification into further branches.



Advantages

Open, expandable
Provides an overview at a glance
Very versatile

Limitations

Rough analysis and overview
Emphasizes linear relationships

[15] Reference document : Buzan T. : Kopftraining, Anleitung zum Kreativen Denken, Munchen (1990), in "Cooperation Planning – A working Aid for beginners and for more experienced planners" Swiss development cooperation, Evaluation service CH 3003 Berne, Switzerland (1993)

Successes – Weaknesses – Opportunities - Threats (SWOT)[16]

Application possibilities in the planning cycle

Vision	Possibilities for change	Way, approach	Concept, strategy	Operational plan	Plan adjustments	Monitoring, evaluation
• • •	---	•	•	---	• • •	•

--- : least appropriate; •: some appropriateness; • • : appropriate; • • • : very appropriate

Brief description

SWOT is a simple, flexible and versatile working tool for situational analysis in groups. It has the advantage that it can easily be understood in an intercultural setting. It records the positive and negative experiences (successes and weaknesses) of a present situation, as well as anticipate the future opportunities and obstacles (Threats) that are most likely to arise in a given situation.

Review of present situation	Anticipation of future situation
Successes Positive experiences	**Opportunities** *Assessment of potentials*
Weaknesses *Negative experiences*	**Threats** *Anticipation of obstacles*

Advantages

Simple (partners can quickly apply method themselves)
The joint review provides clarity on different opinions
Enables the participation of socially weaker parties on an equal basis
No special material is needed

Limitations

SWOT does not offer any solutions; it merely serves to provide clarification and to structure opinions
The moderator should have basic knowledge of visualization methods

[16] Adapted from "Cooperation Planning – A working Aid for beginners and for more experienced planners" Swiss development cooperation, Evaluation service CH 3003 Berne, Switzerland (1993)

Creativity Workshop[17]

Application possibilities in the planning cycle

Vision	Possibilities for change	Way, approach	Concept, strategy	Operational plan	Plan adjustments	Monitoring, evaluation
•	• • •	• • •	---	•	•	•

--- : least appropriate; •: some appropriateness; • • : appropriate; • • • : very appropriate

Brief description

This workshop method provides an organizational framework for the participatory examination of problem situations and joint problem solving. The participants are divided into large groups and the workshop takes place in five steps over one or two working days. The five steps consist of the following :

1. **Preparatory phase :** Tuning in; setting a pleasant atmosphere; participants get to know each other, exchange motives; needs and goals are formulated, procedures and working techniques determined (visualization with sheets of paper or cartons)
2. **Criticism phase :** Problems are presented, criticism expressed; exaggeration is allowed; selection of themes from the critical contributions, re-formulation of critical themes into goals.
3. **Utopian phase :** Build a creative atmosphere; criticism is not allowed; present dreams, utopian visions and ideal solutions without thinking of the limitations set by reality (brainstorming); selection of the most interesting visions.
4. **Realization phase :** The results are examined and studies more closely; priorities are set; select a proposal; first steps for an implementation plan are decided upon.
5. **Permanent Workshop** (in smaller core groups): The proposal chosen in the realization phase is expanded and refined; project designs emerge; only designs which are feasible with regard to subject and reality (opposition, constraints, resource requirements, etc.) are considered; project goal is set;

Advantages

Procedures are democratically determined by the participants
Exaggeration in not limited, but encouraged so as to trigger creative associations
The concept combines a playful approach with analysis

Limitations

Workshop leaders must be experienced and well versed in a repertoire of possible working techniques so that specific results can be achieved; Each phase requires clear and specific rules; In order to avoid both euphoria and resignation, it must be made clear at the beginning which criteria will be used to evaluate and prioritize the criticism and utopian suggestions;This method is not suitable for socially differentiated groups.

[17] Adapted from "Cooperation Planning – A working Aid for beginners and for more experienced planners" Swiss development cooperation, Evaluation service CH 3003 Berne, Switzerland (1993)

Scenario writing[18]

Application possibilities in the planning cycle

Vision	Possibilities for change	Way, approach	Concept, strategy	Operational plan	Plan adjustments	Monitoring evaluation
•	• • •	---	---	---	---	---

--- : least appropriate; •: some appropriateness; • • : appropriate; • • • : very appropriate

Brief description

Scenario techniques are used in the design of alternatives views for the future. They are particularly suitable for dealing with long-term problems whose solutions depend on many variables (for example energy issues, development of transportation, promotion of training, etc..).

In the case of difficult questions, the drawing up of scenarios undergoes numerous steps. Firstly, the task is defined in simplified terms and the scope of investigation is set. Then the environment and its influencing factors are assessed with regard to possible future developments : the anticipated history is written in advance.

As a rule a "probable", an "optimistic" and a "pessimistic" alternative are drawn up. These alternatives then form the possible scenarios in the search for specific solutions.

The sequence of steps is not strictly predetermined. Different planning and working techniques may be used according to their suitability.

Suggested steps:

- Situation analysis : (Delineation of problems, relationship with environment, initial situation)
- Prognosis phase : (Alternative trends, possible future events, situational cross roads, selection criteria)
- Programme phase : (Development of scenarios, alternative strategies, programmes)

Advantages

Suitable for complex, long term problems
Widens the planning horizon
Promotes development oriented thinking

Limitations

Time-intensive
Demanding with regard to informational requirements and interdisciplinary proficiency
Open to manipulation

[18] Adapted from "Cooperation Planning – A working Aid for beginners and for more experienced planners" Swiss development cooperation, Evaluation service CH 3003 Berne, Switzerland (1993)

Morphological box[19]

Application possibilities in the planning cycle

Vision	Possibilities for change	Way, approach	Concept, strategy	Operational plan	Plan adjustments	Monitoring, evaluation
---	---	• • •	---	---	---	---

--- : least appropriate; •: some appropriateness; • • : appropriate; • • • : very appropriate

Brief description

The morphological box enables the systematic search for alternative solutions for a clearly defined problem. Possible solutions are broken up into elements and the most important characteristics of each element are identified (possibly by brainstorming). These elements and their characteristics are then arranged in a morphological box. This facilitates assessing and combining solutions and their characteristics until the most suitable variation (s) is found.

For example : Plot irrigation

Elements	Characteristics		
	1	2	3
Source	River	Ground water	Rain water tank
Pump	Diesel	Hand	Electric
Distribution	Canal	Pipes	Pipes & canal
Payment of water	Per unit volume	Per unit time	Flat rate
Organisation	Individual	Committee	Municipality

Alternative 1

Advantages

Suitable for clearly defined problems where an overview of solution combinations and variations is important

Limitations

Less suitable for complex problems requiring a high degree of analysis

Assess alternatives may need much effort and time

[19] Adapted from "Cooperation Planning – A working Aid for beginners and for more experienced planners" Swiss development cooperation, Evaluation service CH 3003 Berne, Switzerland (1993)

Utility value analysis[20]

Application possibilities in the planning cycle

Vision	Possibilities for change	Way, approach	Concept, strategy	Operational plan	Plan adjustments	Monitoring, evaluation
---	• •	• • •	---	---	---	• •

--- : least appropriate; •: some appropriateness; • • : appropriate; • • • : very appropriate

Brief description

Utility value analysis enables the evaluation, assessment and selection of different options for introducing change. This involves decision-making which depends on factors which are both quantitative and objective as well as qualitative and subjective. By using utility value analysis, the situation is presented in a transparent way and the evaluation criteria of all the participants are clearly disclosed. Utility value analysis involves the following steps :

1. Setting limits to the task (objectives, situation analysis, identification of shortcomings)
2. Presentation of alternative solutions
3. Development of assessment criteria (E)
4. Weighing of each criteria (P)
5. Assessment of alternatives, (i.e., criteria E varies from 1 to 10)
6. Calculation of the utility value (E x P)
7. Comparative evaluation (horizontal : individual criteria; vertical : overall impression) and decision-making

For example : Choosing the site for the project office of a development project

Assessment criteria	Weighing	Solution 1 (outside project zone)		Solution 2 (in project area)	
	P	E	E x P	E	E x P
Accessibility for villagers	30	3	90	10	300
Travelling effort for staff	15	3	45	7	105
Premises	10	5	50	2	20
Partner contacts	20	6	120	3	60
Policy agreements	10	5	50	1	10
Attractiveness	15	6	90	3	45
Totals	100		445		540

Advantages

Complex problem formulation are made accessible to all participants

Human and intuitive components of assessments are emphasized at the same level as objectives

The risk of wrong decisions by individuals is reduced

Criteria and their weighing can be used as a monitoring basis

Limitations

Assessment and weighing figures should be documented so that they are comprehensible to outsiders; If important decision makers are not present, results have less value

[20] Reference document : Voelkner J. : Planungsmethoden in Verwaltung und Wirtschaft, Regensburg-Berlin-Bonn (1992) in "Cooperation Planning – A working Aid for beginners and for more experienced planners" Swiss development cooperation, Evaluation service CH 3003 Berne, Switzerland (1993)

Task chart[21]

Application possibilities in the planning cycle

Vision	Possibilities for change	Way, approach	Concept, strategy	Operational plan	Plan adjustments	Monitoring, evaluation
---	---	---	---	• • •	---	---

--- : least appropriate; •: some appropriateness; • • : appropriate; • • • : very appropriate

Brief description

Task charts are used to organize work procedures. The functions of the staff at every step are indicated diagrammatically in a chart. In its simplest form, the compiling of an annual report can be depicted as follows :

Tasks / Activities	Project leader	Consultant	Section Head	Technical assistant	Administrator	Community
Review experiences	**Plan / Dec.**	**Plan / Dec.**	Plan / **Impl.**	Impl.	---	Dec. / **Impl.**
Organisation Arrange report	Dec.	**Dec / Impl.**	Impl.	Impl.	Info	---
Editing	**Plan. /** Impl.	Plan./ Impl.	**Impl.**	Impl.	Impl / contr.	---
Approval	**Coord**	---	Coord	---	---	---

Plan. = Planning Dec. = Decision-making Impl. = Implementation
Contr. = Control Info = Information Coord = Coordination
Bold letters indicate main responsibility; small letters indicate lesser responsibility or co-responsibility

Advantages

The organizational sequence becomes transparent
Encourages allocation of responsibility
Provides a good basis for job descriptions

Limitations

Graphical over-simplification

[21] From "Cooperation Planning – A working Aid for beginners and for more experienced planners" Swiss development cooperation, Evaluation service CH 3003 Berne, Switzerland (1993)

Bar chart (Gantt – chart)[22]

Application possibilities in the planning cycle

Vision	Possibilities for change	Way approach	Concept strategy	Operational plan	Plan adjustments	Monitoring evaluation
---	---	---	•	• • •	•	---

--- : least appropriate; •: some appropriateness; • • : appropriate; • • • : very appropriate

Brief description
Gantt bar charts are used for the chronological planning of tasks. Individual working steps are listed on the activity axis of the chart. The duration of the activities is indicated on the time axis by bars.

For example : Programme Evaluation

Activities	Duration (days)	Implementation time span (months)									
		1	2	3	4	5	6	7	8	9	10
Preparation	8										
Field investigation	20										
Analysis of results	5										
Preparation of Workshop	3										
Workshop	4										
Follow-up											

Advantages
Graphic and simple
Wide selection of PC – Programmes

Limitations
Updating can be difficult
Interconnections between activities may not be easily recognizable

[22] From "Cooperation Planning – A working Aid for beginners and for more experienced planners" Swiss development cooperation, Evaluation service CH 3003 Berne, Switzerland (1993)

Flow charts[23]

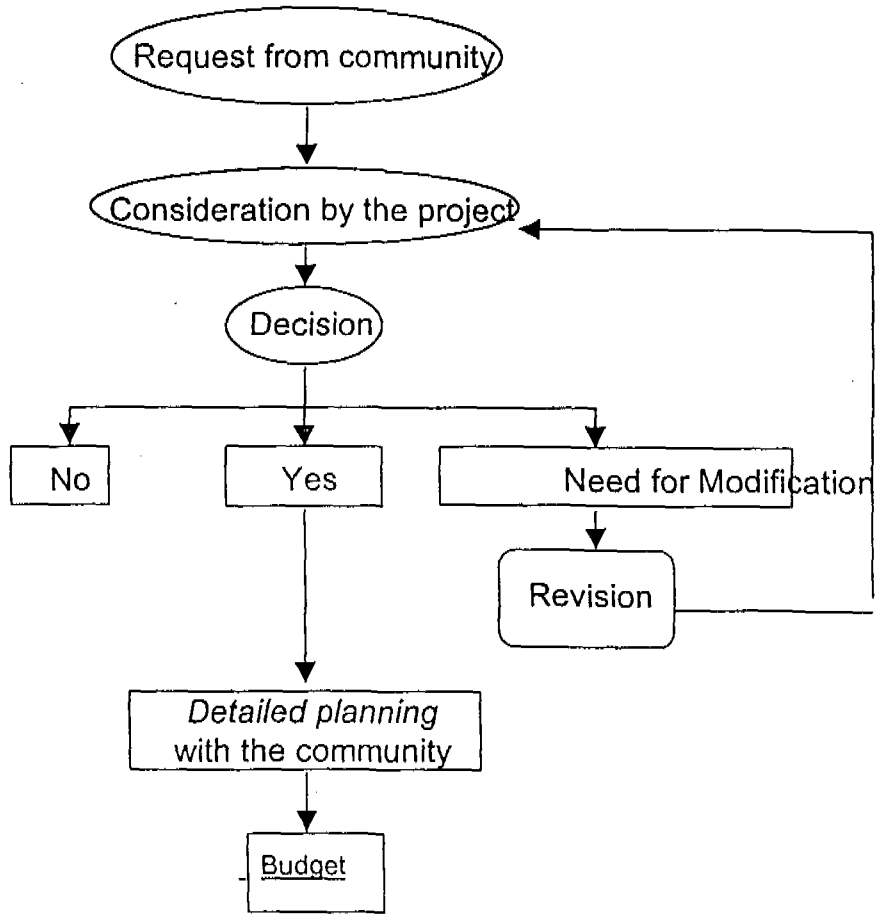
Application possibilities in the planning cycle

Vision	Possibilities for change	Way, approach	Concept, strategy	Operational plan	Plan adjustments	Monitoring evaluation
---	---	---	•	• • •	---	---

--- : least appropriate; •: some appropriateness; • • : appropriate; • • • : very appropriate

Brief description

The sequence of the activities of a process is structured in a transparent way in a flow chart. The steps of each activity are represented by symbols such as "Start", "develop", "Check", "Decision", etc. For example : Request to rehabilitate water supply system



Advantages

Simple, easily learnt

Suitable for planning and control of routine tasks

Limitations

Suitable only for specific processes

Unsuitable for time related planning

[23] From "Cooperation Planning – A working Aid for beginners and for more experienced planners" Swiss development cooperation, Evaluation service CH 3003 Berne, Switzerland (1993)

Historical line

Application possibilities in the planning cycle

Vision	Possibilities for change	Way, approach	Concept, strategy	Operational plan	Plan adjustments	Monitoring, evaluation
• • •	•	---	---	---	---	• •

--- : least appropriate; •: some appropriateness; • • : appropriate; • • • : very appropriate

Brief description

This tool consists in collecting the most important historical events and facts of the community in a chronological way. This especially used to highlight the history of the community, the life of the community organisations, the history of water supply and the chronology of a project.

It is done through a series of questions and a pre-established check list which is discussed with the community on a specific theme. It is proposed to use a large sheet of paper, or a board which is divided vertically into two parts : the left part is to record time, and the right is for recording the events and facts which have happened.

Spring 1994	*First visit of Provincial staff*
Summer 1995	*Visit of community at Provincial headquarters*
September 1995	*Second visit of staff and start of investigations*
January 1996	*Start of construction of well and installation of pump, as well as training of community*
May 1996	*Handing over ceremony*
December 1996	*First breakdown*
February 1997	*Repair by specialized team*
December 1998	*Second breakdown*

Advantages :
Helps to get a common understanding of a series of events and their relationship in time. Very good for starting a problem analysis together with the community
Simple and easy to use
Limitations:
Provides mainly a chronological vision of events . Communities do not always have precise sense of time. Questions have to be well prepared before starting the exercise and allow all members to express themselves.

Mapping

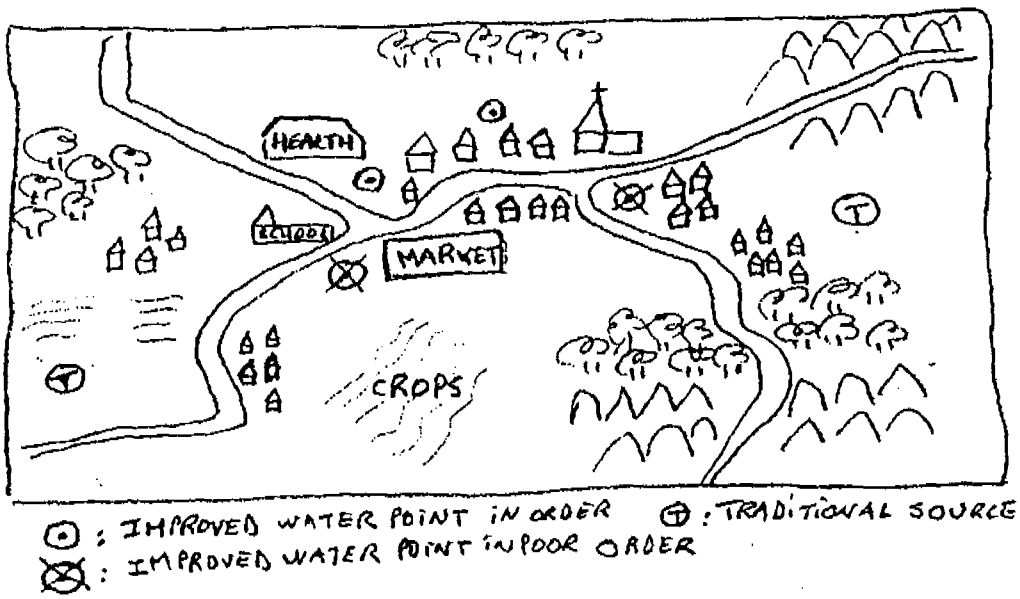
Application possibilities in the planning cycle

Vision	Possibilities for change	Way, approach	Concept, strategy	Operational plan	Plan adjustments	Monitoring, evaluation
• • •	•	---	---	---	---	• • •

--- : least appropriate; •: some appropriateness; • • : appropriate; • • • : very appropriate

Brief description

The purpose of mapping is to gather information about a community by having its members create their own village map. It is also used to have information about existing problems and to perceive the value which community members give to certain situations. It is proposed to community members to draw a map either on a sheet, a board or even the soil, and highlight the following points : main localisation of settlements and distribution of population including main topography; identification of health centre, schools, shops, market, church; localisation of water points, zones of infection or problems, water source and distribution, localisation of latrines or garbage disposal; specification of which points have continuous or seasonal variations, the type of water, functioning; where is the population with the lowest willingness to pay; identification of the economic activities of men and women.



Advantages:
Provides a common understanding about a village setting and its problems
Is very participatory and communities enjoy this work
Simple and easy to understand

Limitations
Information might need to be validated in terms of geographical precision
Tool needs to complemented by a problem analysis
Requires time

Venn Diagram

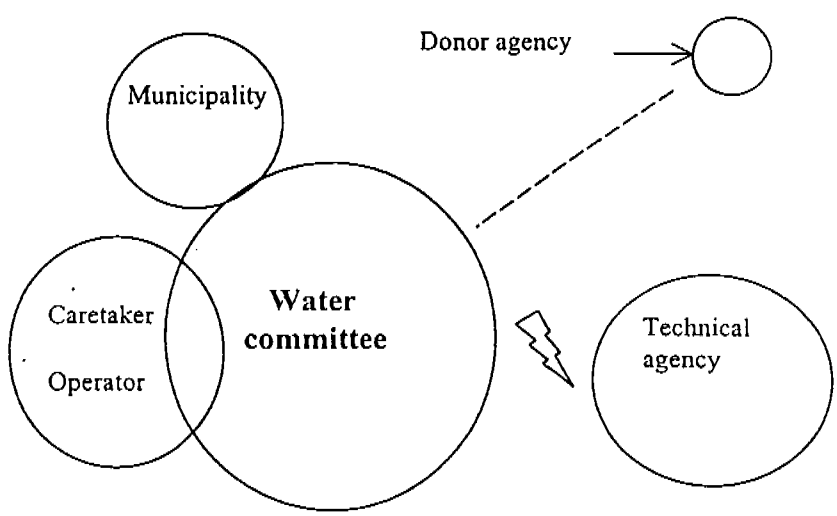
Application possibilities in the planning cycle

Vision, policy	Possibilities for change	Way, approach	Concept, strategy	Operational plan	Plan adjustments	Monitoring, evaluation
• • •	•	---	---	---	---	• • •

--- : least appropriate; •: some appropriateness; • • : appropriate; • • • : very appropriate

Brief description

Venn Diagram is a graphic representation which provides a global vision of institutional and social relationships within and without a community. It uses circles to represent institutions or groups of people. The size of the circles represents the importance of the role of these institutions or group of people (small circle = little importance; medium circle = medium importance; large circle =- major importance). The distance between the circles indicates the relationship between institutions and groups of people (intersection = collaboration, co-ordination; touching circles = contacts; circles apart = distant relationships which increase with the distance between circles). An additional qualification can be given by lines or arrows between circles (= conflict; ------ = intermittent relationships; etc..)



Advantages :

Provides a rapid and concrete vision of interrelationships and importance of various actors
Shows potential problems, and constitutes a basis for further analysis;
Should be done with different groups at different times.

Limitations :

Very subjective; results will vary considerably if done by community members, or by don't agency for instance.
Information resulted from the discussion needs to be also recorded.

Community walk

Application possibilities in the planning cycle

Vision	Possibilities for change	Way, approach, strategy	Concept, strategy	Operational plan	Plan adjustments	Monitoring, evaluation
• • •	•	---	---	---	---	• • •

--- : least appropriate; •: some appropriateness; • • : appropriate; • • • : very appropriate

Brief description

A community walk consists in observing community conditions in order to appreciate a situation or to see if goals have been met, while walking through a community. A community walk can also consist in small visits to families, with informal discussions, about water supply, sanitation, and hygiene, while appreciating the general in-house situation. The community walk should be done in small groups, as large groups attract too much attention. Each group records what it sees, and should be planned at the time of the day when water and sanitation activities are most relevant. Here is a list of major relevant points to be observed :

- *General environment conditions*
- *Type and state of settlements*
- *State and functioning of water source, distribution and supply*
- *Cleanliness around water points*
- *Hygiene practices for the transport and storage of water*
- *State and functioning of private and public latrines*
- *Evacuation of used water*
- *Garbage disposal*

Advantages :

Direct observation and contact with reality for project staff

Limitations :

Needs time

Information collected should be well organized, other wise there is a risk that the information will not be used

All information should be recorded, as not everything can be remembered by heart.

Pocket chart

Application possibilities in the planning cycle

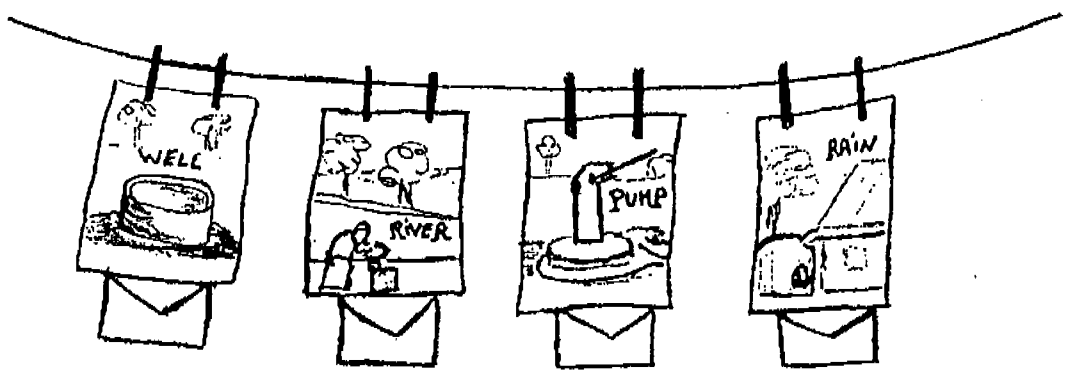
Vision	Possibilities for change	Way, approach	Concept, strategy	Operational plan	Plan adjustments	Monitoring, evaluation
• • •	•	---	---	---	---	• • •

--- : least appropriate; •: some appropriateness; • • : appropriate; • • • : very appropriate

Brief description

Pocket chart is a very effective method to collect information about people's perceptions, habits, desires and will. It provides quantitatively valid information by a system of vote, and further allows to hold discussions with community members. The method can be divided into three phases : Phase one : Preparation of the tools and explanation to the community; Phase two : vote; Phase three : discussions.

Simple version



Drawings are prepared before hand preferably by local artists to which are attached envelopes. In the case of water supply, each drawing represents a possible water supply option (or sanitation option or hygiene behaviour, etc.., for other cases). Women are given pink (or red) little pieces of papers (or round stones), while men are given blue pieces of papers. The facilitator asks the group a first question : "Where do you collect water regularly now?". Community members go and vote, by putting their piece of paper in the selected envelop. Voting should preferably be done separately, as one can influence another. Results are then shared with group, and discussions are held, asking the community about their comments and explanations on the results. A second question could be formulated : "Where would you like to go and get your water?", with the same procedure.

Advantages

Provides statistical information

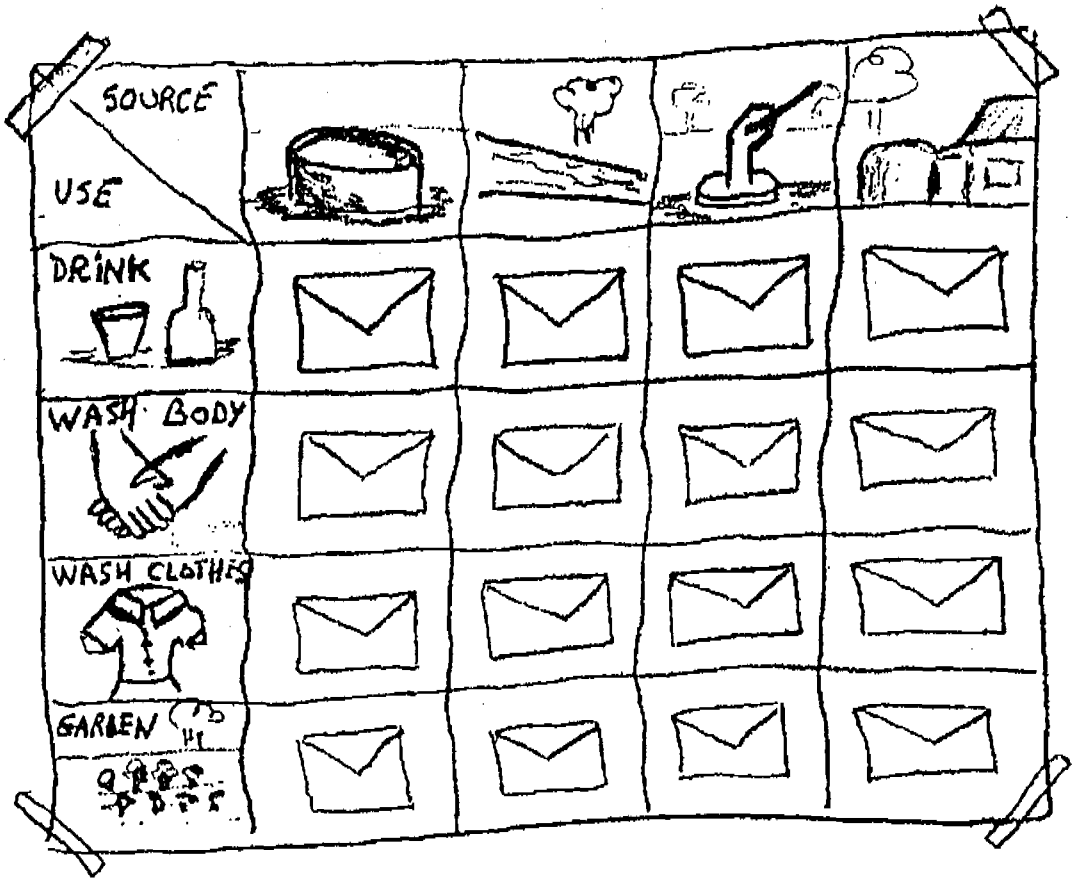
Very participatory tool, and problems can be discussed immediately

Limitations

Needs to be acquainted with the method

Community members should be able to identify them selves with the pictures

Matrix version



A matrix is prepared on a large piece of paper, with drawings locally made. Community members are given four small pieces of coloured paper (as in above). The facilitator can ask as a series of first questions " "Where does the water you drink comes from? Where does the water you wash your body with comes from? Where does the water you wash your clothes with comes from? Where does the water you water your garden with comes from?" . Results must be shared and discussed. Another series of questions can be linked to the water source, community's wish to use in the future and for what purpose.

Advantages:
Same as above

Limitations :
Same as above and limitations due to the understanding of certain communities about the use of matrix. The matrix might seem complicated with too many envelops every where. If the situation arises, it is possible to ask community members to vote row by row.

Priority ranking

Application possibilities in the planning cycle

Vision	Possibilities for change	Way, approach	Concept, strategy	Operational plan	Plan adjustments	Monitoring, evaluation
• • •	•	---	•	---	---	• • •

--- : least appropriate; •: some appropriateness; • • : appropriate; • • • : very appropriate

Brief description

In quite a number of circumstances, choices have to be made, or priorities have to be defined and set. This tool is in a decision-making tool, which uses a matrix format. A set of issues is clearly defined, which can be activities or problems. Participants are asked to choose individually or by small groups five issues out of the total and to prioritise them, according to a set of criteria which have been previously agreed with. Choosing by groups can help to discuss the issues more in detail before prioritising them.

For example, determination of priorities on use of water for water improvement project (n = 10 people or groups participating)

Possible use of water	Number of people or groups who have chosen this use (x)	% of people or groups who have selected this issue x/n %)	Priority given to this use (y)	Mean average for priority given Y/n
Drinking	*10*	*100%*	*1,2,1,2,1,1,1,2, 1,1*	*1.3*
Cooking	*9*	*90%*	*2,1,2,3,2,3,2,3, 2,4*	*2.4*
Washing body	*5*	*50%*	*4,5,2,3,4,3,3,3, 4,5*	*3.6*
Washing clothes	*6*	*60%*	*4,4,5,3,2,4,3,5, 4,4*	*3.8*
Cleaning environment	*2*	*20%*	*5,5,5,5,5,5,5,5, 4,5*	*4.9*
Gardening	*7*	*70%*	*2,3,2,3,2,3,2,3, 2,3*	*2.5*
Brewery	*3*	*30%*	*5,4,5,4,5,5,5,5, 4,5,*	*4.7*
Other (to be specified)	*2*	*20%*	*4,5,5,5,5,5,5,4, 5,5*	*4.8*

According to the % and to the mean average, are selected drinking, cooking and gardening as the first three priorities. If doubt subsists, discussions should be held.

Advantages :

Helps to come with a decision democratically

Is concrete and can be quantified

Limitations:

Participants may not agree on criteria for selection and prioritisation

Use of matrix could be complex in certain communities

Unit 8 : Field visit

1. Outline of session

Objectives

- To assess the operation and maintenance status of water supply and sanitation facilities within a
- To analyze field visit results

Methodology

1 . Field visit
2. Analysis done in class room

Materials

✓ Transportation means
✓ Participants should bring a small notebook
✓ Proper clothing for field work
✓ Flip chart and markers for class work

Handouts

✓ Information about the community
✓ Exercise sheet

2. Notes for the trainer

Preparation

The purpose of the visit is to give the participants an opportunity to look at the operation and maintenance arrangements in a particular community. The field visit programme will depend on the proximity, size and willingness of local communities to be involved in the course in this way. The course group will have to divide into smaller groups in order to work efficiently and to reduce the disturbance of the community to a minimum.

Communities should be contacted beforehand to ensure timing and that the committee and users are ready to receive a delegation of participants. The community should be given a full programme of the visit with its objectives. Arrangements have to be made about transport and about food.

If a community is large enough to accept the complete group then only one community need be contacted and prepared for the visit. However, if the course group is large and communities small then it may be necessary to allocate course sub-groups to different communities. This may entail more time in preparation but it will be better for the purposes of the field visit. It will also allow participants to compare their findings from different communities within the same locality. This, in itself, may indicate different aspects of O & M and therefore be of value to the course.

It is suggested that visits by the sub-groups can be made in the morning. This will be followed by a general meeting in the afternoon where all the sub-groups meet with district staff of the government agency responsible for water. This will give an opportunity for participants to meet separately with users, local operators and caretakers, community leaders and government staff. Within each community visited, participants should divide into smaller groups in such a way that each of the above actors can be observed and interviewed on their own, if possible, to avoid them influencing each others responses.

The timing of the morning visit may be crucial to the usefulness of the field visit as a whole. Many of the activities associated with rural water supply take place very early in the morning. Women i-nay traditionally collect water before, or at, sunrise. Operators will open valves, start pumps, dose tanks with chlorine, etc. at the start of the day to have sufficient water for early collection. The next peak of water collection may be in the late afternoon/early evening, which will be too late for the field visit. Arrangements may have to be made to ensure an early arrival in the community, or communities selected to visit and participants should appreciate the importance of an early start!

Proposed program of field visit

- Arrival at community
- Discussion during 1 hour and 30mn with the representatives of the water committee
- The group can have a visit of the water supply treatment plant or pumps, with the caretaker and operator (1 hour)
- Division in groups (geographical area for example)
- Each group does social walk within the community, observing general

situation (environmental sanitation) and visiting users in their homes, asking them questions regarding the water supply, visiting the latrines and observing hygiene (1 hour)

Analysis of field results

Once back in the classroom, the same day, or the next day, each group will do a SWOT analysis, and then report back in a plenary.
The final results can be sent to the community with an accompanying letter of thanks.

Exercise sheet

Check-list for field visit

1. ***Environmental aspects***
   - Protection and preservation of water source and water point
   - Quantity and quality of water
   - Waste water management
   - Environmental sanitation

2. ***Community aspects***
   - Structure and functioning of community organization
   - Participation of women
   - Ownership feeling
   - Satisfaction of users
   - Management capacity of committee
   - Technical capacity within the community

3. ***Technical aspects***
   - Complexity of operation and maintenance of the system
   - Spare parts availability
   - Training received for operator
   - Dependency on chemicals and fuel
   - Preventive maintenance
   - Tools
   - Water quality control

4. **Institutional factors**
   - Technical assistance
   - Monitoring and follow-up
   - Relationship with the municipality and other actors

5. **Financial factors**
   - Tariff, and what does the tariff cover ?
   - How are other costs financed ?
   - Non payments, and sanctions
   - Willingness to pay
   - Financial management
   - Use of funds

Processes
- How was the project introduced ?
- How did the community participate ?

Observation
- Domestic hygiene and hygienic state of latrines
- Environmental sanitation in general

Exercise sheet **FIELD VISIT ANALYSIS**

Field visit results will be analyzed with the SWOT method
Successes; **W**eaknesses; **O**pportunities; Threats

1. Analysis of the present situation

What are the successes in terms of operation and maintenance (see check list) ?	What are the Weaknesses in terms of operation and maintenance (see check-list) ?

2. Analysis of the future situation

On the basis of the successes and weaknesses of the present situation , what are the potentialities to improve the O&M situation ?	On the basis of the present situation, and the general context, what are the possible threats or obstacles which the community will have to overcome?

4. Background information

4.1 Observation

It is not possible to remember everything, especially when making observations in a short period of time. Therefore, a notebook is recommended for recording observations during the field visit. Recording observations almost immediately means there is less pressure to make an interpretation before all the facts are known. Observations should be recorded, interpretation will come later.

It must be said that the situation observed is influenced by the observer. Participants must be aware that their presence alone will influence the behaviour of people in the community. The fact that the field visit has been organized in advance may mean that the community has made a special effort to, for example, clean the well surroundings. Visitors will attract attention. People may react in a way which they feel will satisfy the visitor rather than react in their natural manner. Participants should remember this when making their observations and drawing conclusions.

4.2 Interviews

There are several types of interviews which can be used in information collection.

- *Free interviews*
In a free interview the topic is introduced but then the discussion and subjects covered are left to the respondent to decide. In this way the interviewer gets a good idea of what the respondent thinks is important, not what the interviewer has decided is important. However, the interviewer has to be a good listener and questioner. Questions have to motivate the respondent and need to be followed up with carefully worded responses and further questions which do not reflect any bias the interviewer may have. This type of interview is for experienced field workers with interviewing experience.

- *Focused interviews*
For a focused interview a checklist is prepared and the respondent is asked to provide information about the items on the list. A checklist will help to ensure that all items are covered, and that the interviewer is not diverted away from the essential information
required.

In the course of a focused interview it may happen that the respondent may give information or want to discuss an issue not on the list. It is important to give respondents the opportunity to contribute their own thoughts and this can be done at the end of the interview after going through the checklist first.

In the short time available it will not be possible to collect a great deal of quantitative data. Questions requiring numbers for answers might be included in a focused interview. However, participants must be realistic about the information they will be able to gather. They should not expect, for example, community members and supply caretakers to be able to readily give such information. Records may contain sensitive information. Only if people seem willing to show them should participants ask to see any log books and record sheets.

Participants should choose people to interview carefully. Ask caretakers about the difficulties they encounter in their maintenance activities, and ask the users how often the system is broken down. The same questions can be asked of different people. If the caretaker and then a user are asked the question: "how often is the system broken down9" the answers may be different. The caretaker may want to give the impression of a job well done. A user will want to indicate the difficulties in the hope of improving the supply.

Aids to effective interviewing

The following suggestions are to aid the collection of information through interviewing.

Prepare a checklist

As in the focused interview, prepare a checklist of the information required. The list does not need to be in great detail but it should be used as a guide. Use key words as a way to remember main issues and particularly important bits of information required.

Introduce yourself

Participants may feel under pressure to gather as much information as they can in a short period of time. But they should not rush in with a long list of questions. Participants should at first introduce themselves and explain what the field visit is about. It is important to explain how the information will be used. If people feel, for example, their answers may result in higher water bills then responses may be affected as a result.

General to specific

It is recommended to start with general questions and move to more specific questions later. General questions help to set the scene and put into context the more specific questions. This helps to avoid misunderstandings about what it is the questions are about

Module 4

Planning

UNIT 1 : PLANNING TOOL 2

UNIT 2 : INDIVIDUAL ASSIGNMENTS 14

UNIT 3 : PRESENTATIONS..... 18

Unit 1 : Planning tool

1. Outline of session

Objectives

- To review a set of existing planning tools
- To get acquainted with the planning phase of the OOPP
- To develop a planning matrix

Methodology

1. Introductory note
2. Focused discussion on existing planning tools
3. Presentation on OOPP planning matrix
4. Group exercise on the development of the planning matrix

Materials

- ✓ Overhead transparencies
- ✓ A flip chart and masking tape
- ✓ An overhead projector with a screen or a white wall
- ✓ A large sheet of (craft) paper stuck on the wall for drawing the planning matrix
- ✓ A set of cartons for filling in the matrix

Handouts

- ✓ Copies of all transparencies

2. Notes for the facilitator

Introductory note
The fourth module will be mainly dealing about planning issues, and introducing a planning methodology derived from the OOPP, as mentioned in Module 2. It will also propose the participants to develop an individual or group work on the basis of their own situation and what they have learnt so far in the course.

Focused discussion on existing planning tools
The facilitator will ask the participants what are the planning tools which they are using in their professional life, and ask them to describe them, while the facilitator writes down the main points on a flip chart. This session can be further detailed if needed, if the session on working and planning with communities has not been completed. Indeed some of the tools, which are mentioned and extensively described, can be used at this stage if necessary.

Presentation on OOPP Planning Matrix
It is proposed to the facilitator to describe the various sequences of the second part of the OOPP methodology using the overhead sheets. The planning matrix is linked with the work done with the objective tree.

Group exercise on development of matrix
The facilitator will recall the results reached with the objective tree done earlier, and the strategic objective selected. On the large sheet of paper of the wall he will need to prepare the following (which is an adapted version of the original ZOPP) : see overhead sheet.

The facilitator will start with the participants to select the main objective, which actually comes from the objective tree, as one of the higher up main objectives. The group should the determine what is the overall objective of the programme or project (contribution to sustainability; or improved health status; etc...)

The results correspond to the priority objectives which have been identified in the strategy selection, earlier in the course right after the construction of the objective tree. The suppositions can also be derived from the tree, as the objectives which are more difficult to reach or as objectives which are critical; some other suppositions regard political will, access to financial resources; coordination between actors; etc...It is actually quite easy to build a planning matrix, once a preliminary analysis has been done. The main components are directly derived from the objective tree.

The facilitator will then ask the participants to divide into smaller groups (number of groups depend on the number of results identified), each group having the task to identify main activities (maximum 6 or 7)which will lead to the result. They will be asked as well to determine indicators and means of verification for this indicator. The groups share then their results in plenary by pinning or sticking on the matrix on the wall, their corresponding cartons. The facilitator should encourage the participants to comment and propose other activities if needed.

. Overhead sheets

Planning phase

A. Elaboration of planning matrix

B. Identification of important suppositions

C. Identification of activities which will lead to the achievement of the results

D. Formulation of indicators

E. Determination of resources

F. Check sequence of matrix

G. Elaboration of a time schedule

Overhead sheet

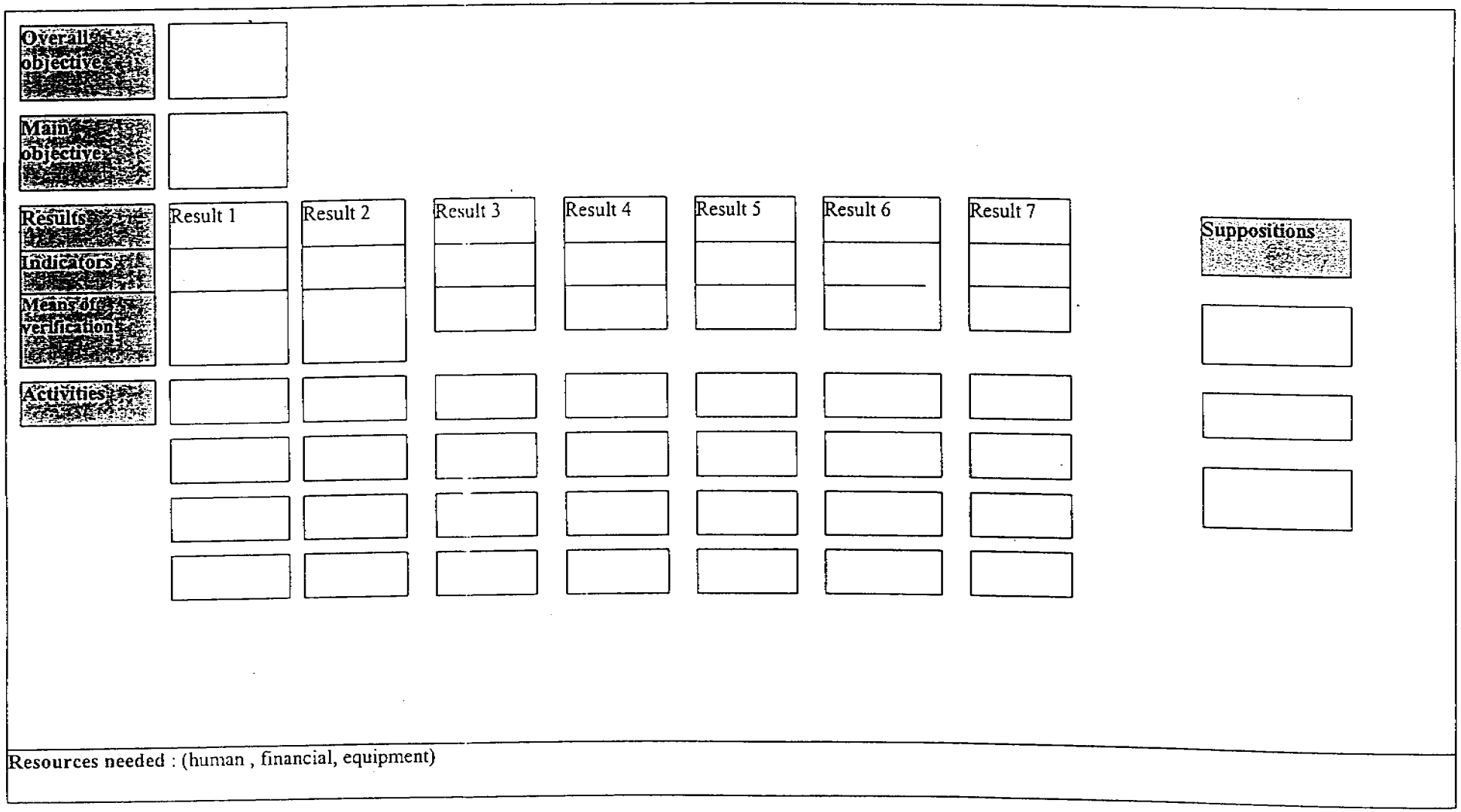
A. Elaboration of planning matrix

1. Selection of the main objective from the objective tree

2. Selection of the overall objective (top part of the objective tree)

3. Identification of the main objectives (results) that will contribute to the main objective (from the strategic analysis). The results must be independent.

4. Construction of the structure of the matrix (see next page)


Overall objective
Main objective
Results
Indicators
Means of verification
Activities
Result 1
Result 2
Result 3
Result 4
Result 5
Result 6
Result 7
Suppositions
Resources needed : (human , financial, equipment)

Overhead sheet

B. Identification of important suppositions

1. Identify conditions for the development of the project

2. Identify conditions for the sustainability of the main objective

3. Evaluate probability of reaching the results, without project intervention

4. Write down the conditions or suppositions in the matrix

Overhead sheet

C. Identification of activities which will lead to the achievement of the results

1. Identify some of the objectives in the objective tree which can be reformulated as activities

2. Identify other activities which will lead to the result

3. Prioritize activities and place them below the result to be achieved

4. If the project is on-going :

   - Check if the activities can be included in the project

   - If not possible, may be some other results need to be identified

Overhead sheet

D. Determination of indicators

(see session on monitoring)

1. Formulate indicators, for each result to be reached (responding to the following characteristics : What ? How much ? When ? Who ? Where ?

2. Identify means of verification, including external information sources

3. Place indicators under each result in the matrix

Overhead sheet

E. Determination of resources

1. Determine human, financial and technical resources which are necessary to develop the activities

2. Determine the costs for each needed resource

Overhead sheet

F. Check sequence of matrix

1. Check of the results are sufficient to reach the objective

2. Check if the activities are sufficient in order to reach the results, and the formulation of the indicators

3. Determine possible ways to overcome conditions and suppositions, as well as possible resistance to change, as well as ways to resolve them

Overhead sheet

G. Elaboration of time schedule

1. Elaboration of a general time plan for the duration of the programme or project, with the major activities (long term)

2. Elaboration of an action plan (short term) of immediate activities up to the coming six months, which are necessary to start the programme and project

Unit 2 : Individual assignments

1. Outline of session

Objectives

- To identify individual assignment's themes
- To develop problem and objective trees
- To develop a planning matrix

Methodology

1. Introductory note
2. Choosing the theme for the individual assignments
3. Individual work with coaching

Materials

- ✓ Overhead transparencies
- ✓ A flip chart and masking tape
- ✓ An overhead projector with a screen or a white wall
- ✓ Material for the participants (white sheets, and small pieces of colored cartons for the making of the trees and planning matrix)

Handouts

- ✓ Copies of all transparencies

2. Notes for the trainer

Introductory note
This unit covers several sessions, and its purpose is to try to apply all what has been learnt into a concrete project that the participants will develop themselves with some assistance from the facilitator. It is an essential part of the course as it allows for the participants to develop a project proposal with guidance, and focused on the problem of operation and maintenance.

Choosing the theme for the individual assignments
The facilitator might want to choose to ask the participants to think about a theme they will want to develop, already the day before, as this thinking process might take some time. Here are some criteria for selection:

- The theme should be about any of the issues related to operation and maintenance as we have seen in this course.
- The theme is chosen from one's own professional life.
- The theme should be phrased as a problem.
- The problem should be formulated as precisely as possible, thus avoiding general statements.
- The problem should be part of the project in which the participant is working directly or indirectly.
- The participant should have a possible direct or indirect influence on solving the problem.

The end result of this theme identification is a carton on which the problem is written. It happens that some participants are enable to formulate such a theme. In such a case, participants are asked to describe their professional activity, and together with the facilitator try to formulate a problem which they are facing according to the above mentioned criteria.

It can be that participants from a same project or department decide to be together and develop the whole individual assignment together.

Individual work with coaching
The participants are then asked to analyze their problem, and draw a problem tree. Same for the objective tree and planning matrix.
They should be given all the necessary material (paper, small cartons and tape) for this work. This work needs concentration and time, and so the facilitator will try to create a general good working atmosphere and enough space for each one to develop its work. In many cases, it has been useful to pin the sheets on a wall.

This individual assignment needs personal guidance and assistance, which we call here coaching. Coaching is not watching, coaching is not controlling, coaching is not telling the participants what to do. Coaching is guiding the participants into their work, helping them to broaden up their thinking, reminding them about the working procedure and methodologies, stimulating them. Coaching requires to spend some time with the participants. For a big group, this will be impossible to do with just one facilitator; it is therefore absolutely necessary to have an additional course assistant who are acquainted with the OOPP methodology to help in coaching.

Some participants go faster than others; it is recommended to ask them to help others in their work as well. Experience has shown that participants could have problems in analyzing their problem in a logical way. It is essential then to go back to the methodology, but also to propose some "short cuts", if necessary. One of them consists in grouping identified problems by entity (for example : technical; institutional; financing; community; legal; etc...), and make an analysis within each entity, knowing that these entity are directly explaining the main problem.

Overhead sheet

Criteria for the identification of the theme for individual assignments

- The theme should be about any of the issues related to management, operation and maintenance of rural water supply and sanitation services.
- The theme is chosen from one's own professional life.
- The theme should be phrased as a problem.
- The problem should be formulated as precisely as possible, thus avoiding general statements.
- The problem should be part of the project in which the participant is working directly or indirectly.
- The participant should have a possible direct or indirect influence on solving the problem.

Unit 3 : Presentations

1. Outline of session

Objectives

- To show presentation techniques
- To develop individual presentations
- To run the presentations

Methodology

1. Introductory note
2. Small lecture on presentation techniques
3. Preparation of the individual presentations
4. Running of the presentations

Materials

- ✓ Overhead transparencies
- ✓ A flip chart and masking tape
- ✓ An overhead projector with a screen or a white wall
- ✓ Material for the participants (white sheets, cartons, markers, transparencies, possibly computers)

Handouts

- ✓ Copies of all transparencies

2. Notes for the trainer

Introductory note

This is the final part of the course, where the participants will have the opportunity to present the result of their work in front of a panel of colleagues, in order to get some feed-back, and possible recommendations. It is also the opportunity to brush up some of the presentations skills, which is a part of professional life. Communication is essential, and it is already in some way to promote one's work. A project can have the most perfect design, but if a professional is not capable of transmitting to its team, colleagues, and management, the main ideas contained in the project, it can be useless.

Small lecture on presentation techniques

It is proposed to give to the participants some advise and hints on how to organize their presentation in an effective way as well as to recall some basic principles about presentations techniques.
The facilitator can use for this the information contained in the overhead sheets or the background information.

Preparation of the individual presentations

Participants will then prepare their presentations, trying to reflect as much as possible the main elements of their individual assignment. Sufficient material should be made ready in terms of transparencies, sheets, markers, and possibly computers. The facilitator should remind that the participants will have 15 minutes to present and 15 minutes to answer questions and for discussions.

Presentations

It is essential to keep a good and rigorous time control of the presentations. If there are too many, presentations with two and three similar themes can pass one after the other, and comments with questions done after, for all three of them.

Here are some hints to keep good control of time :

- Prepare beforehand a detailed programme, to be handed to the participants only just before the presentations (so that everyone comes prepared, as everyone has the probability of being the first one to start)
- Ask one of the participants to keep track of time
- Show a yellow card when there is three minutes left, and a red card when it is time to conclude.
- Focus the discussions.
- Keep up to your programme as much as possible.

2. *Overhead sheet*

Proposed structure for a presentation

Introduction	Content of presentation			Conclusion
	Problem analysis	Objectives / possible solutions	Plan of action	
• *Greetings* • *Introduction of who you are and what you do* • *Introduction of the topic and of its interest* • *Background of topic* • *Presentation of the various parts of the presentation*	• *Presentation of the main problems which are linked with the topic* • *Give the argumentation for this analysis* • *Describe with concrete examples*	• *Presentation of the main objectives or possible solutions that will contribute to resolve the situation* • *Explain the choice of your strategy*	• *Description of the main activities which are planned to solve the situation* • *Explain the possible obstacles (assumptions) that the project could be facing, and how to resolve them as well*	• *Rapid review of the main points of the content of the presentation* • *Promote some key messages that you would like the audience to remember after your presentation* • *Open the presentation for the discussion with the audience, with a question or a comment*

4. Background information[1]

4.1 Communication versus information

Communication should not be mistaken for information. The person who informs is expressing a series of ideas, experiences and concepts to a public who does not have the possibility to respond. In this case, the public is often invisible, since it receives an information through a mass media tool, inhibiting some kind of personal relationship.

The person who communicates has in the contrary the immediate possibility to exchange concepts, ideas and experiences with its audience. Communication is an experience which is very important in the process of project development, since there is not a situation which can resolved only by one actor; a project needs exchange and relationship between persons and various actors.

4.2 Preparing a conference

One should take enough time for preparing his or her conference, and keep in mind :

- The time allowed for the presentation
- The target audience
- The topic of the presentation
- The objectives of the presentation

Short conferences are the most difficult ones to prepare, because one needs to be synthetic, concrete and up to the point rapidly. And it takes some time to relate with an audience.

For small groups of 5 to 6 persons, the presentation can be done in the form of a conversation, and the use of audiovisual material can be limited to graphics or general drawings. One should however keep in mind the additional time taken by the possibly frequent interventions of the audience.

Presentations to groups between 10 and 30 persons are quite common. It is important to always keep the visibility between the participants and the lecturer, because the this contributes to a better communication. You can arrange the sitting to make people feel at ease, and this requires for the lecturer to prepare the room in advance.

4.3 Physical expression

Communication is not a mean which emerges spontaneously. It is the result of a search and of changes of attitudes of persons.

When in front of an audience, the lecturer must not only use audiovisual material but also use his body as a communication tool, such as for example :

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[1] Adapted from "Presentación de conferencias" by Diana Margarita Valquez, CINARA / IRC course material 1995; Cali, Colombia

- The tone of the voice; a clear diction.
- The use of the space between the lecturer and the participants is important, because it establishes or breaks levels of communication; someone who always stays far away in front of its audience, is breaking this space (same applies for the one who stays always by its flipchart or by the blackboard).
- The hands help to give some emphasis to the speech. It is quite annoying to see a lecturer with is or her hands in the pockets.
- The movements should be abrupt, since it can break the concentration of the audience. It is generally advised to be calm and constant, since this allows a relative integration.
- The art of pedagogy gives quite an important place to the face. Face is seducing, but a face fixing only one person is intimidating. The face should always face the audience.

4.4 The structure of the presentation

A well structured presentation increases its effectiveness. Indeed, it would be unjust to ask the audience to make the necessary effort of organizing your lecturer, in their minds.

The course proposes to organize the presentations according to a format which can be found in the overhead sheet. It is mainly divided into 3 parts :

1. *an introduction*: in which the lecturer greets the audience; introduces himself or herself; introduces the subject and its interest; presents the various movements of his or her presentation
2. *development of content* it self divided into 3 parts :

   an analysis of the problems: showing the main problem which are linked with the topic, while giving some concrete examples;
   an analysis if the objectives or possible solutions to overcome these problems, with some examples and an explanation about what would be the best strategy and why.
   An action plan presenting the main activities to be implemented

3. *a conclusion* : with a brief overview of the points developed in the second part; key messages about your topic and your presentation which you would like the audience to remember, and some opening reflection in order to facilitate a possible discussion after the presentation.

4.5 The use of audiovisual material

The use of audiovisual material is highly recommended, and is meant mainly to assist your presentation by raising the major ideas and key words. It is important to spend some time before a presentation to get familiar with the equipment, and to look for assistance if needed.

Flip charts
Can be filled in during the presentation, as a means to highlight main ideas.
Can be prepared before the presentation with drawings or text; it is possible to refer to previous sheets, if needed.
Can be used to keep record of discussions.

Cannot be used for an audience larger than 30 persons, as letters become too small. If sheets are prepared before hand : plan on a small sheet first, what is going to be on the large sheet; use concise language, which will be further developed verbally; on each sheet develop one major idea; letters should have a height of at least 3 cm; it is advised to use dark colours, as it is difficult to read yellow, orange or red from far away; you can make small annotations on the sheet in pencil to help you remember what to say; when you don't use the flip chart, return to a white sheet, in order to avoid distraction.

OOPP material
It is strongly advised to avoid presenting the problem and objective trees as they have been made in a small format during the individual assignments; mainly for two reasons: a) it is almost impossible to read what is written on the cartons; b) the audience does not have the time to go through the whole analytical thinking which the participant has made; instead it proposed to select some major elements and ideas, and prepare larger cartons which can be read from far away.

Overhead transparencies
Used to synthesize ideas and present to the audience a logical sequence of ideas.
Used to present to present specific data.
Used to keep the attention of the audience.
Should be avoided :
To use too many words on a transparency since the audience will be concentrated on what is written rather than on what your are saying.
To write with small letters
To photocopy a textbook or a report, as it is practically unreadable.
To use too many transparencies.

4.6 The discussion

A presentation is generally followed by a discussion. There are various forms of interventions from an audience: questions of clarification; comments and recommendations; critics; silence.

Questions of clarification should be anticipated before hand if possible, as the audience might ask for more explanation on a specific element or about a the context; however, it is possible that you do not know the answer to the question; it that case you can return the question to the audience and ask for another participant to respond; or say that you note the question for further clarification at a latter stage.

Comments and recommendations are welcome, but they can be sometimes out of context; it is important to keep the focus on the topic. Key recommendations should be noted down. Critical comments are normal, and should also be anticipated. The lecturer should not try to defend his or her self but rather reformulate calmly the reason of his choice. If arguments arise in an uncomfortable way, you can propose to hold a specific discussion on this topic a latter stage.

Silence is sometimes heavy to bear for a lecturer after a presentation. One can ask a question to the audience. If silence persists, in many cases, it is because the a question is not well understood, or out of context. The question should then be reformulated.