

Water-supply management

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Water-supply management includes all the activities aimed at ensuring the sustainability, the correct use and the rational exploitation of water resources and water-supply installations. It also includes actions to ensure equal access for all the population to the water supply.

The long-term resolution of problems related to access to water will largely depend on the way the water resource and installation are managed. Deficiencies in this management are responsible for damage to the environment, contamination and overexploitation of aquifers, low food production, failure in existing water and sanitation systems, poor sanitary conditions and inequities in access to water within communities. These problems are a consequence of stalled development and inappropriate water use and demand.

Water management concerns not only drinking and domestic water, but also water for irrigation, animals and industry. These uses require higher quantities of water than domestic consumption. Agriculture takes approximately 70% of the water used in the world, and many irrigation techniques involve substantial losses (up to 60%) because they are not appropriate or because they are poorly managed.

In general, water availability and quality can be ensured through:

- Rational exploitation of the water resources. The conservation of these resources should guarantee sustainable use.
- A comprehensive strategy for the development of water demand in relation to water availability.
- Good operation and maintenance of facilities in order to optimise the water supply (many urban systems have losses of up to 30% of the water supplied) and preserve water quality.
- Control of consumption to avoid wasting water.
- Improving irrigation techniques and systems, as well as selecting environmentally appropriate crops to reduce water consumption significantly.

Appropriate management involves the integration of both water and sanitation components. Wastewater is an extension of the water-supply system, and excreta disposal, refuse management, drainage and other sanitation activities are also a major concern because they have an important influence on water sources and supplies, and they are complementary in their objectives to reduce health risks.

The causes of poor water-supply management include lack of capacity and knowledge, poor organisation, and absence of the habits and willingness required for appropriate management. Therefore, a big part of the solution must involve social aspects, developing awareness, training and organisation.

This chapter will focus mainly on the scale of the community, and it is concerned with the management of water and sanitation systems rather than the management of water resources, prioritising the importance of an equitable supply, the proper use of facilities and the sustainability of systems. Communities must be integrally involved in the management of their resources, and this implies their participation in all the management mechanisms.

1 General objectives

The key to good water-supply management is the choice of appropriate technology. It is essential that the technology is selected to match the needs, capacities and desires of the community. The ability of the community to understand, operate and pay for maintenance is essential to the sustainability of the system. In many cases, low-cost solutions and existing local technologies will be the best option. The initial cost of the system is an important factor for consideration as well, because it is often directly related to operation and maintenance costs. Many projects fail because the technology used is not appropriate to the capacities and needs of the communities.

There is no standard model for the management of water systems. There are many different contexts, each with specific factors to consider: characteristics of the resource, technology of the water system; needs, demands and development level of the community; community organisation; social and political mechanisms; level of involvement of the people; technical capacities; availability of equipment and materials; willingness to pay and to participate in management; community versus private approaches; and others. Defining and setting up a management system requires a full assessment of the situation. Integral to that assessment is the participation of communities from the beginning of the process. This chapter presents recommendations and key elements to take into consideration when establishing a water-management system.

During a crisis, problems are not only related to the lack of facilities but also to a loss of social organisation and capacities. The organisation of the communities to manage their water systems can also have an impact in the recovery of the community, helping the strengthening of social ties.

Water and sanitation projects must promote active management by the community. When determining an appropriate management regime, it is necessary to undertake the following steps:

- Analyse the available water resources and determine appropriate exploitation.
- Determine what is a sustainable water system, including an appropriate level of maintenance.

- Guarantee enough quantity and proper quality of water, with equal access for every member of the community.
 - Ensure access to water for vulnerable populations.
 - Establish a cost-recovery system to ensure consumers can pay for operation and maintenance.
 - Promote proper use and handling of water (integration in hygiene-promotion programmes, see Chapter 15)
 - Promote safety in relation to the construction and use of the facilities.
 - Put mechanisms in place to sensitise communities through appropriate management and to promote participation.
 - Use methods to empower women to participate in the design and construction of the water supply as well as the management scheme.
 - Integrate regional and national water policies: those policies should promote the active role of the communities in water management, providing the tools and proper methodologies to do it. Systems must also be designed following those policies, and advocacy should be done to encourage better policies that take communities into consideration.
- ACF advocates for universal access to water as an important element in the fight against hunger.

2 Types of management

Various management schemes exist and must be adapted to each specific context that is characterised by a certain set of needs and factors. Table 16.1 shows how different factors should be taken into account when designing the key elements of a water-supply management system.

2.1 Actors in charge of water-supply management

Management of the water resource and provision of water supply are two different tasks, each involving specific requirements and responsibilities. Both areas of management must be established and regulated according to the laws of the country.

Water-resource management should be under the control of governments and communities. In cases where water resources are shared between different communities, it will be necessary to have a clear agreement between them (sometimes this involves different countries), and procedures and rules must be established in order to have fair distribution and avoid possible conflicts.

There are three main actors who may be in charge of the management of water-supply provision: the private sector, the public sector and civil society – which can be the community itself and/or NGOs. (NGOs and other organisations can participate in this process but normally they will not be in charge of the direct management of the water supply in the long term.) In some cases there is joint

Table 16.1: Factors for consideration when designing a water-supply management system.

Issue	Factors	Key elements in the management
Water-supply system	Type of water supply (technology used) Size of water system	Operation and maintenance requirements Cost
Community	Number of users Social structure and local organisation Existing capacities Coping mechanisms, economic situation	Water-point managers Distribution of tasks Cost-recovery system Relationships between actors
Context	Emergency requirements Role of public administration	

management of water services, through a steering committee that includes private companies, public structures and community representatives.

This chapter will not enter in depth into the debate about public versus private services (see Box 16.1). Each situation requires specific analysis to define the appropriate management system. However, it is important to remember that the aim of a water-supply project is to ensure equitable and sustainable water access for all the community. At all times, the existing management mechanisms must be analysed and considered in the light of this aim.

Community management is a good solution for small-scale systems and it is probably the most appropriate (or common) system in many humanitarian and development contexts. In areas with community-managed systems, operations must be determined and accepted by the beneficiaries in order

Box 16.1

Private and public management.

Private versus public management is an important issue for many organisations working in water and advocacy, and it is mainly related to urban water supply and the involvement of water companies. There are several levels of discussion that are important to clarify:

- Provision of safe water normally involves costs, and so water consumption requires some form of payment, whether for private or public services. Payment for private services includes a provision for profit.
- Private management only concerns 10% of the water supply for the world as a whole, and between 2 and 5% in the developing countries. Globally, this is not the most important issue in relation to water-supply problems:
 - Rural areas are not normally concerned by this issue.
 - Privatisation is not generally an issue for the availability of water used for agriculture, which is the main consumer of water.
 - Health problems related to water and sanitation are not only related to who manages the supply, but are affected by many other factors, such as hygiene etc.
 - Much funding is provided to support the privatisation process, excluding other possible solutions that maybe more appropriate in contexts with major needs. On the other hand, advocacy against privatisation is the main issue for discussion in many forums and diverts activists from work on other important matters.
- Many organisations criticise the strategy of big donors such as the World Bank and the International Monetary Fund, that strongly support private management instead of providing more support to the public sector and the development of water policies.
- There have been some big cases of corruption concerning water companies, but corruption does not only concern the private sector. Discussion regarding privatisation at this point is concerned more with actual practice than the efficiency of privatisation models as such, or general assumptions regarding rights. The water companies involved in these cases have an important responsibility even when they do nothing strictly illegal.
- There are divisions of opinions regarding the greater efficiency of private management compared with public management (if the appropriate investment is made). A key difference is that private companies can normally provide the substantial investment that is required for some situations. Efficiency is more related to the existence of competition and options for choice, whereas monopolies appear to be less efficient, though both public and private structures may be monopolies.
- There should be a clear policy in each country to regulate how public and private structures operate. This policy must guarantee that service providers ensure equitable access, with special policies for poor and vulnerable groups, and that they limit environmental impacts. Even in the absence of legal or contractual obligations in this field (which is common in many countries where legal frameworks and/or regulatory capacity are not strong), companies should be encouraged to act ethically in the areas of environmental protection and social responsibility, rather than to take advantage of regulatory freedom to increase profits.

to reduce the risk of possible conflicts and misunderstandings. This type of management is broadly developed in Section 3.

ACF programmes normally support community or public management, but there are also experiences where private water-point owners are supported. Activities are focused on the strengthening of local organisational structures through the provision of resources and the training of personnel. It is important to involve the communities in the management, including vulnerable groups.

The main conclusion is that water-management mechanisms must be regulated by a clear and effective policy which ensures that systems are efficient and that the needs of the public are met. Organisations working with vulnerable communities should contribute to the development of these policies in order for those communities' concerns to be reflected.

In developing countries, large corporations tend to be interested in large cities, and their involvement can range from the construction of infrastructure to contracted management of the water system. These international companies often create local subsidiaries or partnerships with local companies.

Systems managed by private companies do not necessarily mean higher prices for water. Some experiences show that the poor generally pay more for water from the informal sector (water sellers etc.) than they do when they have a formal system. Prices must be regulated by the local authorities and must be covered by a clear policy.

Private companies that make big investments in the water-supply systems of many cities may negotiate long-term contracts for supplying water (up to 20 years in some cases). This is not a good option because if the management is not well done or if it is not the most appropriate arrangement, it is complicated to change.

Private management also varies from large water companies to private owners for individual water points. Regarding *individual private water points*, in many cases the owner of a water point (well, borehole or a connection to a distribution system) delivers water to other people in the community. The owner may obtain direct profits from delivering the water and normally has an incentive to maintain the water point.

It can be appropriate for projects to support the improvement of privately-operated water points when community access is guaranteed and there is no discrimination. Establishing rules with the owners, the community and the authorities is recommended: topics to address include the price of the water and how the price is negotiated, and the promotion of equitable access.

Equitable access can require special arrangements for vulnerable populations (cheaper rates or reduced rates in exchange for labour for example) and for public places (supplying a certain quantity of water free to schools and hospitals). One argument for convincing the owners to provide these arrangements is to explain that the improvements in their systems will increase water sales and consequently their profits.

Water-supply systems can also be managed by a regional body or local government. Some experience shows low effectiveness of those systems due to the risk of corruption and lack of skills. Often decisions are made politically. Interests can change when governments change, and people may be employed because of nepotism rather than skill. Consequently, maintenance can be poor, which compromises the sustainability of the system.

Again, the existence of a policy to avoid these problems and placing the responsibility for certain duties in professional hands, rather than depending on politicians, is the key to improving management.

In conclusion, there are several experiences (with public or private management) where vulnerable areas are marginalized and receive either a poor quality service or no service at all. This can be due to a lack of capacities or an absence of political interest and, in the case of the private companies, a perception of a high risk of non-payment. The authorities have a responsibility for developing pro-vulnerable water-supply policies. Another problem is the absence of participation of the communities in management, which can create inequities and social conflicts as experience has shown.

- Every system (private, public or community-based) should guarantee the following:
- transparency in management (all the information must be available to everyone);
 - active participation of the community in management;
 - access to water for all, and especially for the most vulnerable (taking into consideration affordable prices for all);
 - proper use of the system (maintenance and improvements guaranteed);
 - sustainability of the system;
 - protection of the environment.

2.2 Context and management

2.2.1 RURAL AREAS AND ISOLATED AND DISPERSED COMMUNITIES

Isolated areas are often ignored by governments and can be extremely vulnerable. Advocacy is an important part of project implementation and should aim to ensure that the needs of marginalized populations are heard and taken into account by decision makers.

Small isolated communities need low-cost solutions that can be managed with a minimum of outside support. Access to spare parts and consumables can be a major concern and skilled people are often difficult to find. Training the community in the management of water-supply systems and choosing a technology that ensures that operation and maintenance are appropriate to the human and financial resources available are essential for guaranteeing sustainability. The specific case of pastoral communities is illustrated by Figure 16.1 and explained in Box 16.2.

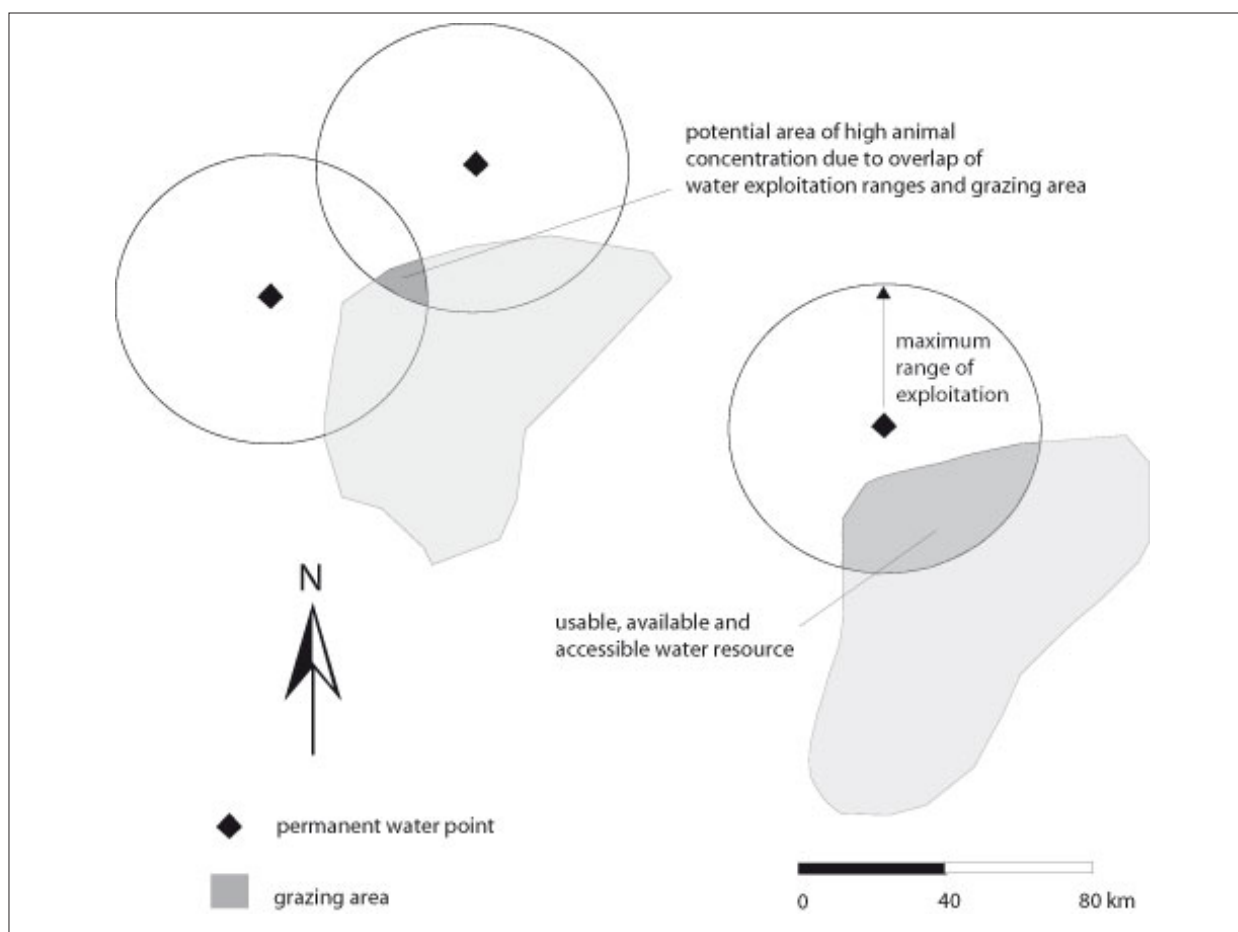


Figure 16.1: Management in nomadic and pastoral contexts.

Box 16.2

Management in nomadic and pastoral contexts.

People with a traditional nomadic lifestyle and can be affected by conflict or climatic changes in unique ways. Water points for nomads and pastoralists are often characterised by temporary use, with adequate water quantity for animals and people, rather than quality, as the main objective. The survival of nomadic communities depends on their ability to provide for their animals' basic water and pasture needs.

Any technology chosen must guarantee the provision of water. If a system fails it can put the whole community in danger. Experience shows that traditional systems are the best option because they require only very basic maintenance and there is no need for spare parts or consumables. Water committees and a cost-recovery system can easily fail, so the main guarantee of sustainability is the quality of construction of the water points.

The most common types of water point are:

- Open wells or combined wells (see Chapters 8A and 8D) where the water is drawn by traditional means such as pulleys, animal traction, or a shaduf. Training must focus on well cleaning.
- Ponds (in some places called birkads). Training must focus on drainage area and pond maintenance (see Chapter 19).
- Surface water.

The management of water can be complicated and must be adapted to the existing social mechanisms (nomadic habits, division of areas by social groups etc.). Water management also involves the location of the water points. When locating new water points, social aspects need to be considered in order to prevent conflicts between different pastoral clans or between pastoralists and cultivators. Local laws concerning access to water points such as grazing rights and rights of way, especially for livestock in cultivated areas, must be analysed before any water supply is constructed. In Afar, Ethiopia, when wells or boreholes, which are considered both as water points and private assets, are constructed in public grazing land, this land becomes private, thus overriding previous rules and traditional regulations.

Conflicts and changes in rainfall affect traditional nomadic routes, and new water points can be required. New systems must be planned and designed taking into account many factors: the existence of water resource, pasture, possibilities of conflicts. When a new water point is constructed, often nomads bring more animals to the area and create a situation where there is potential for an increase of animal diseases and overgrazing. In Mali, ACF's programme used satellite images and geographical information systems (GIS), as decision-making tools to locate wells while minimising overgrazing. Figure 16.1 shows an example of GIS analysis.

In sparsely populated areas, where the sense of community may not be strong, a household approach can be the best option (family water points, household water-treatment, hygiene promotion).

The most common solution in rural areas is freestanding individual water points such as open wells or handpumps or small-scale water piped systems. It is important to consider relevant national and regional policies in order to choose the right technology and to define the appropriate management arrangements (make-up of committees etc.). Low-cost technology and construction with local materials are a good ways to improve sustainability.

2.2.2 URBAN AND PERI-URBAN AREAS

Rural-to-urban migration is an increasing problem, with 50% of the world's population currently living in cities. Urban populations are increasing as people continue to move to cities in search of better economic opportunity or security, in the case of conflict situations. More vulnerable people concentrate in low-income suburbs where there are poor living conditions. Cities are 'melting pots' where various social, cultural, ethnic and religious groups come together. As living conditions can be difficult, tensions may arise. This factor must be a strong consideration when choosing the location of water points and deciding on management arrangements, in order to avoid conflicts or impeded access to water.

Piped water systems are most common in cities. Due to the size and complexity of the systems, management is normally the responsibility of the municipality. In some cases, the municipality contracts the responsibility to a private company. Though not common, it is beneficial if the community has a formal role in the management of the system. NGOs can advocate for this. Ensuring that the community has a voice in decision making is likely to ensure a better understanding of the needs of the poor by senior management.

Of primary concern are the poor and marginal areas of large cities, including peri-urban areas. Water services often do not reach these areas for a variety of reasons, including lack of political will, unresolved land tenure issues and lack of financial resources to extend water-distribution networks. Furthermore, peri-urban areas often lie outside the area of the municipality's responsibility. These areas are often densely populated and lack adequate sanitary infrastructure. Combined with lack of water, these three factors create a high public health risk. When people do not have access to the formal water-supply network, they obtain water from a variety of informal private sources, such as from private wells (e.g. in Monrovia, Beira, Kabul or Mogadishu), or buy water from water vendors who supply water using water trucks, donkey carts etc. The water quality is usually poor and prices are high and represent an important amount for many families (mainly during periods of scarcity, when prices increase). An option for short-term intervention can be to improve water quality by working with vendors. In Khartoum, ACF introduced washing areas for donkey carts in some peri-urban districts and made some improvements to the carts. ACF is also involved in negotiations with vendors to have agreements on the price of water and on the management of the supply. However, ensuring the quality of those systems is difficult in the long term and prices remain high for many people. Marginally improving small-scale provider service will not resolve the larger problems of unequal access to a municipal system that should be providing water to the entire population.

2.2.2 EMERGENCY WATER SUPPLY

Natural or man-made disasters cause loss of life and economic opportunity, and increase the vulnerability of the poor. Both water infrastructure and a community's social structure can be damaged or destroyed, affecting water management badly. Displaced populations can create refugee camps and informal, unserved temporary settlements. As a consequence, people's most essential needs may be not be met and emergency response is required.

Emergency response must be rapid and effective. The population concerned must be involved in the management of emergency water provision (see Section 2.3.10), though in displacement emergencies, external support is necessary. People's social networks and support systems are disrupted along with their sources of income and food. Setting up independent water committees in situations like this may not be the most appropriate solution. Beneficiary participation should be promoted to the extent possible; however, it is important to understand that in some cases, particularly in the first moments of a crisis, it is very possible that people are not prepared, either physically or psychologically, to be involved in any activity beyond their own personal survival.

When participation is possible, affected people can be involved in general camp management in the case of refugee or displaced-people's camps, through the creation of Water and Sanitation Committees. These committees can be used to develop management arrangements, in the post-emergency phase, when the response requires more self-sufficient solutions. All actions should be coordinated with the local authorities, even if they are overwhelmed and able to contribute little.

When the emergency response is focused on the rehabilitation of the existing infrastructure, the best option for management is to reinforce the existing system through the involvement of the personnel normally responsible. Careful attention must be paid to the type of external assistance provided, because a surplus can lead to a dependency that will have negative effects in later phases.

2.3 Management by type of water-supply system

Not all water-supply systems require the same level of management. A handpump does not have the same management requirements as a large urban water-supply system. Daily operations, maintenance and service inputs are completely different and need a different organisational structure and resources.

Quality construction is always a first step to sustainability and it is essential, particularly in cases where the community cannot ensure proper operation and maintenance.

Management organisations need to be adapted to the type of water-supply system and technologies. Examples are presented below.

2.3.1 SPRINGS AND STREAMS

Springs can be captured and protected at the source, and the water collected in a small tank and distributed through a tap. Alternatively, several surface-water sources are collectively channelled to small gravity-fed networks.

Routine operations do not require consumable materials and often do not require a regular operator. Maintenance depends on the quality of the construction and the exposure to natural or human hazards. Protection of the natural environment surrounding the water source is key to maintain its yield. Deforestation of the immediate area can lead to erosion, which causes a loss of soil and this can cause deterioration of the constructed catchment.

- Management tasks: the main issue is protection of the water source against erosion and contamination, through regular cleaning and preservation of the vegetation in the catchment area. Basic repair of the structures built will be needed, but not on a regular basis.
- Cost-recovery: routine operations do not necessarily incur cost. Often, cleaning and basic repairs can be performed through voluntary community work.
- Actors involved in management and training: few people are required for operating and maintaining a water supply: even one can be adequate. Training should focus on cleanliness and protection of the water source.

2.3.2 OPEN WELLS

- Operation and maintenance requirements are low. Operation does not require consumables, and repairs can be done mainly with local materials.
- Management tasks: the main concern is keeping the water clean and using the well properly. Maintaining the water-drawing system (ropes, pulleys etc.) is a primary task. Also, periodic disinfection is necessary to maintain clean water and this can be organised by the community. Eventually, basic repairs of the construction will be needed.
- Cost-recovery: daily operations do not incur costs unless someone is paid to draw the water. Cleanliness and basic repairs can be ensured through voluntary community work and do not require a regular payment system.
- Actors involved in management and training: direct management will not require many people and even one may be adequate. Training should focus on well cleanliness and protection of the water.

2.3.3 HANDPUMPS

– Operation inputs are low as there is no need for consumables and, depending on the pumps, maintenance should require low to medium attention. Low-cost handpumps are relatively easy to repair and the cost per repair is low, though they may need more frequent repairs. Repairing pumps can require specific skills, tools and spare parts. It is important to be sure that spare parts are available. If a standard type of pump exists in the region, it is best to choose this technology as spare parts and trained technicians are more likely to be available.

- Management tasks: the main issues are to ensure that the handpump is correctly used and greased to ensure proper function; to maintain and clean the surface protection and the drainage; and to prevent and repair any breakdowns by replacing worn or broken pump parts. Basic repairs of the well itself or the surface protection may also be needed, but not on a regular basis. The well or the borehole will also require cleaning.
- Cost-recovery: operations will have a cost if a person is responsible for drawing the water. The community can pay for the cost of the spare parts and repairs either by having regular payments (by quantity of water used or through monthly fees) or by raising funds when a problem occurs. There are regular maintenance costs as parts will require regular replacement. It is advisable that the community or the owner of the pump has the means to buy a new pump when it is necessary to replace it. Pumps range in cost from 100 euros to 3 000 euros. There is also a considerable range in the cost of spare parts, depending on the type of pump.
- Actors involved in management and training:
 - caretaker (private, or someone chosen by the government or community): training focused on proper use, basic maintenance and cost recovery;
 - repair and maintenance personnel (i.e. handpump mechanics): training on maintenance and repair. Agreements with communities for costs;
 - spare-parts suppliers: ensuring the availability of spare parts and regulation of prices (in agreement with communities and pump mechanics). Providing information on prices.

2.3.4 WIND PUMPS

Management requirements are similar to handpumps and they do not require operators. Maintenance and repair can be a little more difficult than handpumps and depend on the local wind patterns. If these are not stable then the wind-pump mechanism can suffer more wear and possibly damage, and requires more maintenance. Wind may not be adequate during parts of the year, which can interrupt water supply. This can lead to a loss of interest from the community in maintaining this system. The price range, depending on the models, is generally higher than for handpumps.

2.3.5 MOTORISED / ELECTRICAL PUMPS

- Operations require skilled personnel and consumables such as electricity or fuel. Maintenance requires mechanical and electrical skills and a qualified person must be responsible for the repairs. Spare parts may not be easily available and this factor should be considered when choosing pumping equipment.
- Management tasks:
 - control the operating hours per day (how many hours depends on the system) in order to prevent the pump and generator from overheating and to avoid over-abstraction of water;
 - ensure the electrical system is working properly;
 - manage consumables (purchase, storage and proper use) and periodic maintenance (oils, filters etc.);
 - manage the payment system;
 - repair damages.
- Cost-recovery: the system is best based on regular payment (per quantity of water, per connection or on a periodic basis). The total cost must include operation and maintenance. See Section 3.7.
- Actors involved in management and training:
 - private owner or committee: general management, training focused on cost recovery;
 - caretaker: training focused on operation and basic maintenance;
 - mechanics: training in mechanical and electrical repairs;
 - spares suppliers.

2.3.6 SOLAR-POWERED PUMPING SYSTEMS

- Operation is automatic and does not require consumables. Most maintenance tasks are simple, but some repairs will require a high degree of expertise. A specialised company must be operating in the area to guarantee repairs. The pump will require the same maintenance as a normal motorised system.
- Management tasks:
 - keep the solar panels and system safe and clean;
 - ensure the electrical system is working properly;
 - manage the payment system. Because the system does not need consumables people may be reluctant to pay on regular basis;
 - repair damages, generally by using a specialised company.
- Cost-recovery: it is recommended that the system is based on regular payments (per quantity of water, per connection or on a periodic basis) because repairs can have a significant cost. Promotion of this type of payment system is important as people are not aware of potential costs since there are no regular consumable purchases. Cost-recovery can be difficult for a solar system because it appears to run at low cost. However, the cost of occasional repairs, along with regular operations-personnel salaries and depreciation add up and cannot usually be raised in a short period of time.
- Actors involved in management and training:
 - private owner or committee for general management and cost recovery;
 - caretaker: training in operation and basic maintenance;
 - company or specialised organisation in charge of repairs.

2.3.7 RAINWATER HARVESTING

- Rainwater harvesting systems capture rain from building roofs and other catchment areas. They are often installed at the building level, collecting water from houses or public buildings such as schools or hospitals. It is difficult to maintain the quality of rainwater, so it is often used for other purposes when there is a suitable alternative supply of drinking water.
- Operations do not require consumables and maintenance, and can be done mainly with local materials.
- Management tasks: the main concern is keeping the water clean by ensuring the cleanliness of the roof, gutters and tank. Also, it is important to use the system properly. In some cases a pre-treatment can be installed in the form of a small sedimentation tank or sand filter. This addition requires special attention for maintenance. Basic repairs on the roof, gutter, tank and taps will be needed, but not on a regular basis.
- Cost-recovery: operations do not incur costs, and maintenance costs are low if the system is well constructed.
- Management responsibility: mainly private owners or staff in the institutions (schools, hospitals etc.).

2.3.8 SURFACE RESERVOIRS (PONDS)

There are two primary situations where the creation of surface reservoirs is appropriate. The first is in dry areas with short and heavy rainfalls. Ponds can be constructed to collect runoff and are used only during a period of the year. These types of runoff-collection ponds are common in pastoral contexts and are used mainly for livestock. The second situation is in high-rainfall areas where ponds collect rainwater directly, without runoff (they function as an impluvium). These systems are a valuable water resource where springs and other groundwater sources are scarce. See Chapter 19.

- Operation and maintenance is not complicated but require a high level of community involvement in order to maintain the runoff system (where present) and ponds, avoid losses and

ensure protection from major contamination. For runoff systems, water quality is difficult to ensure. Efforts are more focused on ensuring quantity of water through dryer times.

– Management tasks:

- maintenance of the runoff system, fences and other protections to keep animals away from the ponds;
- cleanliness and repair of the pond; in some cases covering with branches to reduce evaporation;
- maintenance of the water-drawing systems, such as channels or access jetties, or pumps in some cases; maintenance of filtration trenches.

– Cost-recovery: cleanliness and basic repairs can be carried out through voluntary community work, and provision of tools may be required. Large pond repairs can be expensive if machinery or a large amount of cement is needed. Except in private systems, periodic payment is complicated and a cost-recovery system will be difficult. As high-cost repairs are difficult for the community to cover, it is important to ensure periodic community-led maintenance

– Management responsibility: whether a private or community supply, labour is needed for maintenance.

2.3.9 WATER-TREATMENT AND DISTRIBUTION SYSTEMS

– A water-treatment and distribution system requires joint management of all its component parts including the catchment system (borehole, spring, river etc.), pumping system (if it exists), treatment, storage, pipelines and distribution points. The system is more complex than an individual water point and therefore requires a higher degree of management. The complexity of management and the skills required depend on the size of the system and the choice of technology.

– It is necessary to define operations, maintenance and cost-recovery policies clearly. Participation of representatives from the community is required, to have an equitable supply.

– If a sewerage system also exists, management should be co-ordinated with the water supply.

– Before planning the design of a water-supply system which will serve different communities, where there is a risk of conflict between them over the management of the supply (there are several examples of one community sabotaging the system to prevent water reaching another community) it is better to build separate systems or take measures to reduce risk (different pipelines in some places etc.).

– The main tasks are:

- control of all the actors involved in the management and use of the system, especially re the supply (hours and quantity);
- treatment of water (if needed): consumables, process, maintenance;
- maintenance and repair of the supply system: construction works and plumbing, leakage control;
- water-quality control;
- payment system (contributions);
- co-ordination of the different actors and involvement of the community in managing the system.

– Cost-recovery: the total costs recovered must include all operations and maintenance expenses. See Section 3.7.

– Management roles:

- operation and maintenance staff, normally contracted, receiving a salary on a monthly basis;
- fee-collection staff;
- management committee, with representatives of the community, public authorities and, in some cases, private companies. If the system is small, some of the committee members can also carry out the maintenance;
- spares suppliers.

2.3.10 EMERGENCY SITUATIONS

The first priority in emergencies is to guarantee a minimum quantity of safe water. Common techniques used in emergencies are water treatment (see Chapter 12) and water trucking (see Chapter 17B). Both activities require significant organisation and specific emergency materials and equipment for treatment and distribution.

Emergency water-supply systems

- Operation and maintenance of the emergency water supply: motor pumps, flexible hoses, transportable tanks etc. (for more details on emergency equipment, see Chapter 17).
- Water treatment and water-quality control: if required, flocculation and chlorination procedures, water-quality monitoring (turbidity, residual aluminium, if aluminium sulphate is used, and residual chlorine).
- Monitor consumption and ensure equitable distribution. This is necessary and can be difficult due to the scarcity of safe water. Awareness among users is a starting point, but conflicts within the community (or between communities) can occur. Measures can be taken to avoid these problems, such as installing water-saving taps (such as Talbot taps) to reduce losses, and controlling the quantity supplied to each family with methods such as distributing tickets or registering containers.

Water trucking

- Bringing water to a population by trucks requires a great deal of organisation. The water should be delivered to water tanks at central points, rather than directly to people. Delivery must avoid direct distribution, and instead focus on transporting water to central points.
- Water distribution is done at specially constructed points, such as a tank with tapstands. Water is chlorinated and its quality is monitored. The community should be involved in the preparation and installation of the systems, including activities such as making the platform for the tank, surface preparation for the tapstand and controlling the supply. A committee can be set up within the community to be responsible for the chlorination of the water (one or two people in charge) and distributing it (one or two people).
- General management of the system: primary actors include the water-truck operator, communities, and authorities. Main tasks are:
 - informing the community and other actors of the planned system, and obtaining agreements;
 - organising transport, including the creation of a movement schedule for the trucks, overseeing payments for the drivers, renting the trucks, cleaning truck tanks, and ensuring maintenance of the trucks;
 - setting up a committee responsible for the emergency distribution points, to involve the community in construction, control of the supply, chlorination (training may be required) and water-quality monitoring (residual free chlorine). If involvement of the community is difficult, salaries may need to be paid;
 - authorities must be involved in supervision of the system.

3 Community-based management

Community participation is important in any management system. However, in the case of small-scale water supply systems it is the main priority, particularly in rural and peri-urban areas of developing countries and vulnerable zones affected by conflicts or disasters.

When public authorities do not have the capacity to manage a water-supply system, community-managed infrastructure is the best option for ensuring sustainability.

3.1 How does it work

In community-based management, the community is responsible for the water system. Water management requires that adequate technical skills, labour and funds are available within the community.

Figure 16.2 illustrates the different actors involved and the relationships between them.

There must be clear policies and rules defining the roles of all actors involved and guaranteeing all necessary inputs required to sustain the system:

- The water committee is a group of people elected by the community, and is responsible for the direct management of the system (cleaning, maintenance, minor repairs, operation etc.) and the collection of funds for operation and maintenance. The relationship between the committee and the rest of the community has to be clear and transparent. The committee organises and mobilises people to collaborate, contribute and respect the rules for correct use of the water system.
- Water committees are responsible for hiring technicians and other professionals to repair the system in the case of a breakdown in service. Prices and rules must be agreed between water committees and mechanics and depend on the type of labour needed. Programmes are focused on mechanic selection, training and strengthening of their capacities.
- Spare-parts availability should be guaranteed through local structures or local retailers. Market access and supply must also be arranged involving the water committees.
- Local authorities should play a supervisory role in supporting the system and be involved in the definition of rules. It is useful if they encourage the establishment of new organisations or businesses if these are necessary (i.e. water committees, mechanics or spare-parts retailers). Water committees should be recognised by local authorities and establish a solid working relationship. Local authorities can be a training resource for water committees and should take an active role in ensuring they continue to function. This role can initially be played by the implementing agency but it must be handed over to the local authorities at the end of the programme.

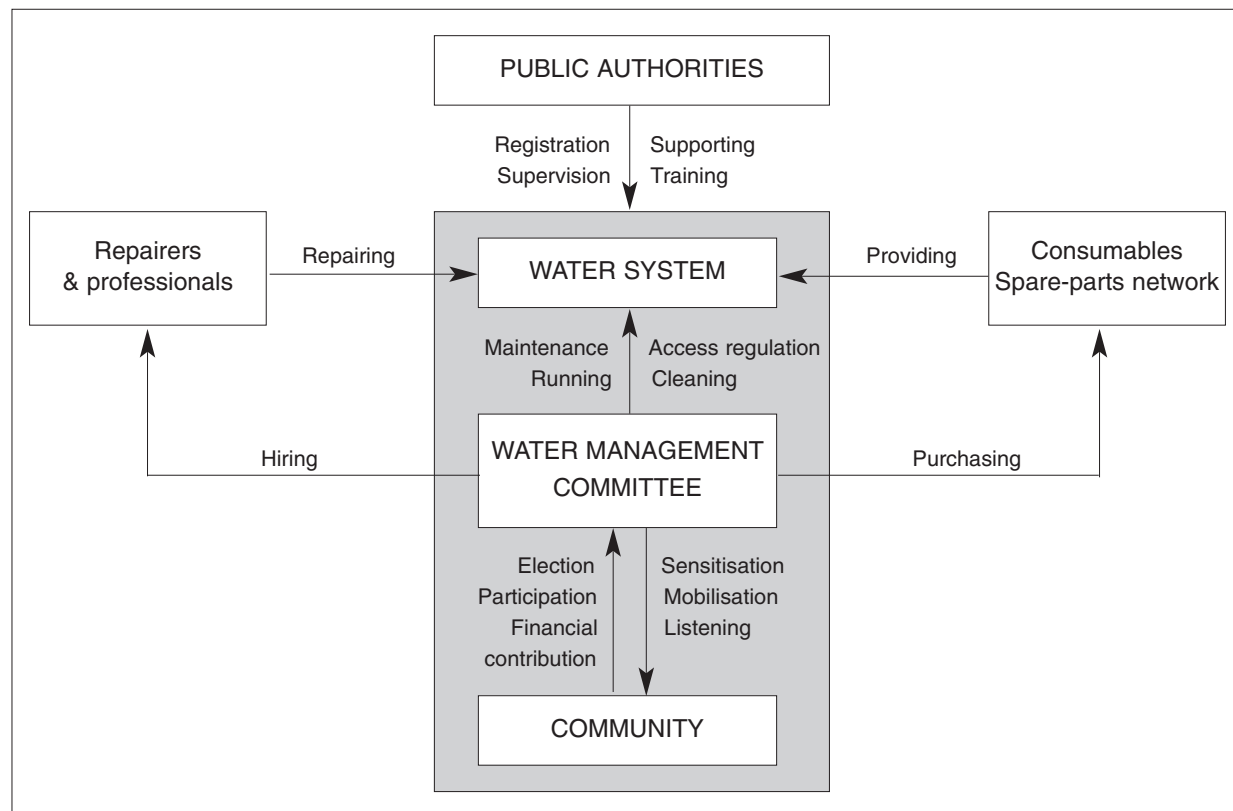


Figure 16.2: The actors and activities of a community-managed water supply.

3.2 Water committee

The water committee is the group of people chosen by and from the water-supply users, and will act on their behalf to organise the management of the water service in a community.

There are no fixed rules about how the committee is organised, how many people must sit on it and other such basics. The committee has to be designed in an appropriate way for each specific context and within existing structures (sometimes a water committee already exists when a project starts). Nevertheless, the model below has been used as the basis for water-committee design in many communities involved in ACF programmes.

3.2.1 FUNCTIONS OF THE WATER COMMITTEE

The main tasks of a water committee are:

- Guaranteeing equitable access to the water supply for the entire population.
- Collection of fees from the users and transparent use of funds.
- Daily maintenance (purchase of consumables, turning on/of the pump, opening/closure of valves, chlorination etc.) and repairing of the system in the event of simple breakdowns.
- Organising the cleaning of the water system and its environs by the community of users.
- Purchase of spare parts or tools if necessary.
- Hiring professionals to repair the system in the event of a complex breakdown.
- Training the community to encourage the correct use of the water supply and safe hygiene behaviours.
- Co-ordination with, and reporting to, local authorities and appropriate agencies.

These tasks should be carried out following a few basic rules:

- All members must be volunteers, elected by the community.
- They must work for the general interest of the community.
- It is important to have sufficient representation of various interests on the committee, including meaningful representation of both women and men.
- The committee should report regularly to the rest of the community and the local authorities on their activities and finances.

3.2.2 COMMITTEE MEMBERS

3.2.2.1 *President*

The president is the facilitator and co-ordinator of the group. Through their authority, they facilitate the decision-making process and are responsible that the committee functions. They also ensure the links between the different members of the water committee and organise regular meetings with the population.

A good president must be:

- motivated;
- able to read and write;
- available: it's preferably to live in the village in order to carry out the role;
- respected and trusted by the community.

The main functions are:

- to organise regular meetings with the other members of the committee in order to explain what has been done and also to discuss the problems encountered;
- to make decisions in consensus with the water-committee members;
- to mediate between the population and the other water stakeholders;
- to mobilise the population around the water system, sensitising people about the importance of good use and maintenance of the system;

- to assist the others members of the water committee in their tasks;
- to collect information about the community concerned;
- to regulate the use of water by following basic rules.

3.2.2.2 Technician

The technician is responsible for operation and maintenance of the water system. The population should assist the technician in carrying out the necessary activities.

As this role is completely technical, it will depend on the type of water supply constructed.

Table 16.II lists possible tasks for a technician maintaining a handpump and a small gravity-fed system.

Table 16.II: Role of the technician.

Gravity-fed distribution system	Handpump
Regular cleaning of the catchment and reservoirs	Regular servicing of pump: cylinder, piston, seals, rising main etc.
Valve management	Replacing worn-out parts of the pump
Servicing pipelines	Repairing simple breakdowns
Repairing leaks	Reporting the state of the pump to the other members of the committee
Installing new connections upon authorisation from the president	
Reporting the state of the system to the other members of the committee	

3.2.2.3 Treasurer

The treasurer is responsible for collecting user fees and managing the budget of the committee. It is a key position and it is important for the treasurer to work transparently in order to be trusted by the community.

The treasurer is responsible for:

- collection of the fees;
- administration of the accounts;
- purchase of materials needed for maintenance and operation;
- maintenance the accounts book;
- attending committee meetings.

In order to be able to fulfil these duties, the treasurer must know how to read, write and count without difficulty. They must also be organised, reliable and honest. It is better if the treasurer lives in the community and is thus available to community members. In some countries, this work is done better by women than men as they are viewed as more trustworthy holders of money.

The money, documents and books have to be kept in a safe place. It may be possible to open a bank account or have access to a safe location in the local administration in order to improve safety. It is safer to have a stock of spare parts than to hold cash.

Fee collection

To keep track of the payment of user fees, the treasurer should keep one record sheet per family with the name of the family, the number of people in the family and an entry for each monthly payment.

The treasurer should also create a balance book and start a new page each month, as shown in Table 16.III.

Table 16.III: Example of an accounts book.

Date	Type of operation	In	Out	Remaining	Signature
01/02/04	Balance at end of January			22 000	
05/02/04	Total monthly collection	6 000		28 000	
13/02/04	Purchase of a new piston		3 600	24 400	
20/02/04	Fence construction		1 200	23 200	
01/03/04	Balance at end of February			23 200	

At the end of the month, the accounts sheet must be closed and the amount of money remaining in the cashbox must be checked against the one written on the book – it should be identical.

ACF provides a book, calculator and office materials to the treasurers of the committees at the end of their training.

Purchase control

The decision to make a significant purchase must be taken among the members of the committee. The population should also be informed about these purchases. The committee should always keep a small reserve of cash, in order to be prepared for unforeseen problems.

A purchase must always be justified by a receipt. On this receipt must be written:

- date of purchase;
- detail of purchased items;
- amount of money spent;
- name and signature of seller and purchaser;
- the receipts are to be kept in a safe place and classified by chronological order.

Every water user has the right to view the expenses and check the accounts. The treasurer must report to the committee and the population each month regarding the accounts.

Monthly report

After having closed the monthly accounts, the treasurer must make a detailed report of expenses and income, and the money remaining in the cashbox. Table 16.IV shows an example from East Timor.

Table 16.IV: Example of a monthly accounting report in Salau, a village in East Timor.

Type of operation		July 2001
Balance at the end of June	+	5.00 \$
July taxes collected – 75 families	+	7.50 \$
July expenses		
– 1 tap for tapstand N°13	–	0.80 \$
– 1 wire brush	–	0.90 \$
Balance at the end of July	–	10.80 \$

3.2.2.4 Hygiene promoter

The hygiene promoter is responsible for the cleanliness of the water point and the surrounding environment, as well as providing education to the population on good hygiene and avoiding water-related diseases. The role is similar to the one described for the community hygiene facilitators in Chapter 15.

3.2.2.5 Reforestation person

In gravity-fed water systems, the conservation of the forest and vegetation around the spring is important for maintaining the yield of the water source. Therefore, it may be useful for the committee to include a person responsible for protecting the surrounding forest and to plant trees where deforestation is a problem. This person can be trained in forestry, agriculture and environmental issues.

3.3 Repairer

Repairers (plumbers, mechanics, masons etc.) can be trained in maintenance and equipped with tools and other resources (e.g. bicycles) to repair the system when the work required is beyond the capacity of the committee technician. These people will receive a payment for the work done. Fixed rates should be established for foreseeable tasks. These rates can also be used as a guide for unforeseeable tasks. The contract between the community and the repairer should be clear and accessible for all users. Box 16.1 contains the main points to consider for the selection and training of repairers.

The demand in the area covered by a repairer has to be large enough to make this job reliable.

Selection

- Existing professionals who are interested in the job.
- Long-term residents in the area.
- Technical skills.
- The area is not covered by other repairers.
- Special attention must be paid to selecting women where possible.

Training

- Spare-parts identification and system mechanics.
- Detection of problems and repairs.
- System maintenance.
- Contacts and contracts with water committees.
- Repair reports.
- Tools/spare parts management policy.

3.4 Spare-parts network

Supply of spare parts can be provided by the government or by NGOs, but this system is not sustainable in the long term. The most sustainable option is to involve local retailers who sell the parts to the water committees or repairers as needed. Local retailers will get involved if they see a possibility for profit so it is very important to create a real demand for spare parts for this system to work. The main concern of the vendors is the risk of losing money. Some programmes in Mozambique and Northern Uganda have supported this sector through a loan of spare parts on a 'sale-or-return' basis to minimise the vendors' risk until a more regular trade is established. Price of the parts must consider the item cost, the cost of transport and the profit for the sellers. Communities must be informed of where spare parts are available.

Training of spares suppliers

- Spare parts identification.
- Stocking procedures and stock-record management (stock cards etc.).
- Unit prices and retail profits.
- Stock replenishment.

3.5 Local authorities

The local authorities are responsible for supporting the entire management system in the long term. If a NGO is playing this role for some time, then the local authorities must be involved from the beginning in order to be able to hand over these duties.

Role of local authorities in community-based water management

- Regulation and policy on community-based management.
- Co-ordination of different stakeholders (external agencies, private companies etc.).
- Mobilisation of communities and establishment of water committees. When local authorities do not have the capacity to do this, an external agency can play this role.
- Legal registration of the committee and the water system, as well as management of a data base with all the information concerning water infrastructure, communities etc.
- Monitoring and training of water committees.
- Monitoring and training of repairers. Supply and renewal of tools.
- Co-ordination between the principle actors: water committees, repairers and spares suppliers.
- Agreements on price rates for works and spares.
- Repairing major breakdowns: in some countries the government takes responsibility for repairing the water system if the cost of repair cannot be borne by the community.

3.6 Launching a community management system

Programmes must be focused on community organisation in order to set up a management system. The first step is the mobilisation of the community in order to define the management system. Communities must be involved from the beginning of the project (identification of needs) to the end (when they must manage independently).

3.6.1 WATER MANAGEMENT IN THE ASSESSMENT PHASE

As mentioned in Chapter 15, the involvement of the community and the use of participatory techniques in the needs assessment is a key point for achieving sustainable systems. The following points should be considered in order to define an action plan for launching an effective water-supply management system:

- Priority needs and requests of the community.
- Social structure, who is currently managing the water resources, and who will be managing the new/rehabilitated system. Explore possible conflicts.
- Economic situation of the families (for example, their ability to pay the maintenance costs of the system).
- Existing payment structures and/or people's willingness to pay for water.
- Motivation and ability of the people to contribute labour or money to the construction, operation and maintenance of the water system.
- Current management of their existing water-supply structures.
- Existing groups whose activities are related to health, water and the environment (health workers, water committees etc.).
- Standard materials and equipment used for water supplies in the region (type of pumps, pipes etc.).
- Local availability of spare parts.
- Technical skills of the people: availability of personnel able to maintain and repair the water system or with the capacity to learn through training.

A participatory baseline survey enables the community's needs to be identified and prioritised. After this, a meeting is organised with community members. With the help of participatory rural

appraisal (PRA) tools, a discussion is carried out with the community about the problems identified (water availability, distance to a water source, primary diseases and their causes etc.) and possible solutions. At this point, some suggestions for solving these problems are made, with an explanation of how the community can be helped to reach the objectives set.

3.6.2 ESTABLISHMENT OF THE MANAGEMENT SYSTEM AND AGREEMENTS WITH THE COMMUNITIES

Once needs and capacities are identified, it is necessary to define the participation of the community in the implementation and management of the system. An agreement including the main rules and regulations is signed between ACF and the community. Local authorities witness all project agreements.

Next, ACF and the community discuss how the work will be carried out and how the system will be managed. The ACF model (as described above) can be suggested and adapted to the particular community. The community will develop their model, choose the committee members and set up the management system in relation to their needs and perspective.

Regular meetings with the community on the progress of the project will allow for easier identification of problems encountered during implementation and provide a co-operative structure to find the required solutions. The involvement of all the community members in the implementation process can instil a sense of ownership and is a primary factor in the sustainability of water-supply management.

3.6.3 ESTABLISHMENT AND ELECTION OF THE WATER COMMITTEE

During the initial meetings with the community, people generally voice a problem with water-point maintenance. The idea of a water-supply management committee is presented and discussed as a solution. The community then decides on a set of selection criteria that is used to help people elect trustworthy and hardworking people to the committee. The gender issue is also discussed as both women and men must be involved, considering women's major role in water collection and management. When all relevant issues are agreed upon, a date is set for the election of the committee.

Another concept that can be introduced is a system of periodic elections in order to guarantee the possibility of committee-member turnover. It is worth considering that sometimes the management system does not work because of certain people and not because of the system itself.

3.6.4 COMMUNITY PARTICIPATION DURING CONSTRUCTION

As the water-supply installation will belong to the users, they should contribute to construction by providing manpower and materials locally available or by paying for part of the implementation activities.

Through the committee and the head of the village (or some other appropriate leader), the community arranges the distribution of the work needed for construction. Some examples include:

- *Well digging*: this work is done by community members supervised by ACF technicians. In the agreement between ACF and the community, the head of the village commits to provide 2 to 4 people per day, usually men, for doing this work.
- *Drilling*: community members clear the way to the place chosen for the borehole, dig the settling pits and help to offload the materials from the truck. They do not participate directly in the drilling operation, which is managed by the ACF drilling team.
- *Pipe laying*: one of the heaviest tasks in the construction of a water-distribution system is the excavation of trenches for burying the pipe. The total length of pipe to be buried will be divided by the number of participants and they will dig the trenches. The installation of the pipes will be done by skilled plumbers (employed by ACF), often together with community members.

– *Masonry works*: some communities have masons able to construct water tanks, tapstands, aprons etc. The work of the mason is usually paid because of the volume of work and the skills required. However, assistance and materials, such as sand, gravel or water, are provided by the community. When the volume of work required per person is very high, the idea of cash or food-for-work can be considered.

In some cases, such as Indonesia, ACF just distributes the materials, works out the technical design and advises as the construction works are carried out by the communities.

As the implementation of the work can sometimes involve risks, community members should be aware of these risks, and safety has to be managed by the representatives of the community.

The community contribution can be also financial. For example, in Bolivia, a financial value is established for a day of manpower. After calculating the hours of work per person that are necessary to finish the construction, people can contribute with their work or with the equivalent amount of money or other resources. The money collected is used for paying the people working extra hours, for buying tools and organising activities, or can be kept for future expenses.

3.6.5 COMMITTEE TRAINING

In order to make the water-system management more sustainable it is important to train the committee members to carry out their functions appropriately. Participation in the construction phase also serves as a short technical training for the technical members of the water committee. Combined training courses for committees from several communities allow the sharing of different experiences and points of view, and also increases the status of the committee members.

The following list is an example of a four-day committee training course carried out by ACF in Moyo (Uganda).

- Introduction and opening remarks.
- Participants' expectations, fears and dislikes.
- Participants' concerns.
- Course objectives (broad and specific).
- Composition and roles of the water committee.
- Water (its importance, cycle, sources, uses, qualities of each source, contamination, simple purification methods).
- Water-related diseases, prevention, and control.
- The safe-water chain.
- Guidelines for keeping water source, and water from the source, clean.
- Environmental sanitation.
- Hygiene (personal, family, food, and community).
- Communication and mobilisation skills.
- Leadership skills.
- Co-operation and self-help.
- Water-fee management and proposed guidelines for water-supply sustainability.
- Community-based management system.
- Participants' action points and the way forward.

3.6.6 HANDOVER OF WATER SUPPLIES

It is recommended to organise an official event in which a handover document is signed by the implementing organisation, the members of the committee, the head of the community and a representative of the public authorities if possible (Water Department, Health Ministry or District Authority etc.).

This document should mention that the owner of the water-supply system is the community, which has responsibility for maintenance from the moment of signature on. Sometimes the handover

is preceded by a test or guarantee period during which the community uses the facilities, in order to ascertain that they are fully prepared.

It can also be positive to provide a set of tools (for cleaning, maintaining or repairing the water system) and spare parts to the committee to start their activities. These are handed over together with the water-supply system.

3.6.7 MONITORING AND FOLLOW-UP

This is one of the most important steps in a programme that aims to support the community management of a water-supply system. Regular visits and advice are usually required before the committee becomes a self-sufficient institution able to manage the water system independently.

Issues to be monitored by the field worker in a follow-up visit are:

- general state of cleanliness of the water-supply facilities and surroundings;
- if the water system is in good condition and working properly;
- quality of the water;
- accounting: money collected, expenses, money in reserve;
- breakdowns occurred and solutions implemented, parts replaced;
- frequency of system maintenance;
- stock of spare parts.

Frequency of committee meetings.

The most frequent reasons for community-based management failure are presented in Box 16.3.

Activities supporting the committees can be organised after the completion of the construction phase to reinforce either water-committee capacities or their motivation. In Uganda, competitions were organised between different committees, with points awarded for water-point condition, the stock of spare parts and other indicators of good management. The prize was a kit of cleaning tools, spare parts etc. These competitions promoted competence and gave the opportunity to share ideas among the participants.

In some villages in Guatemala, the water festival has become an important date that almost everybody celebrates. Plays and music related to water topics are prepared each year by villages and they compete in a festive environment.

3.7 Cost recovery

Cost recovery is one of the most difficult issues in a community-managed water system, as people are often not prepared to pay for water. As the users are responsible for the service, it is important that they pay the operations and maintenance costs. This must be discussed, understood and accepted by the users and outlined in the first agreement signed between the community and the implementing partner. Normally users periodically contribute an amount established by the whole community (yearly, monthly or at another agreed time interval – see Section 3.7.2). The person responsible for the collection is the committee treasurer, who maintains a complete and exact record of expenses and fees paid.

There are a few ways to promote fee payment at the beginning of a project. One is to offer a small amount of money to the committee, once they themselves have collected a certain amount, as an incentive.

A point to consider is that it is easier to establish a payment culture in systems that require consumables and regular maintenance than in systems where the results of the payment are not evident, such as systems with solar pumps or handpumps.

3.7.1 PRINCIPLES OF CONTRIBUTION

The total amount of money collected has to cover the operation and maintenance of the water system delivering the necessary quantity and quality of water for its users.

Box 16.3

Main community-based management failures.

Community-based management needs time to become self-reliant and programmes must ensure a long period of follow-up and support. Short programmes must address this point and try to ensure that a local structure follows up with the water committee. Short programmes must manage long-term needs with short time-lines. If the system fails because the water committee was not properly prepared, a loss of community trust can occur.

Main system failures include:

- Management requirements are not achievable by the community because the water-supply system is not appropriate (in this case it is necessary to change the system).
- The community does not trust the water committee and stops payment of fees.
- Water-committee members are not fulfilling their duties.
- There is no transparency in the accounting and money is missing.
- Part of the community stops paying and then others stop also because they don't want to be among the few paying when others are not.
- Repairers are no longer available.
- No spare parts are available.

Once these problems arise, it is necessary to work closely with the communities to resolve them. This involves promotion and sensitisation within the community, with a focus on strengthening the capacity and performance of the committee. Suggesting the possibility of changing some members of the committee may be appropriate in some cases.

The most difficult problem to solve is when some water users are not contributing, and in these cases it is important to avoid conflicts within the community. There may be severe repercussions for non-payers and the lack of payment could be due to a lack of funds rather than a lack of cooperation. Ensuring that vulnerable people still have access to water is most important.

- In more complex water-supply systems, the rates can differ from one user to another depending on:
 - the type of connection: the contribution may be different depending on where the water is delivered:
 - . water points in public places such as schools, hospitals, places of worship, municipalities etc.;
 - . household connections;
 - . businesses, particularly where water is a raw material (extra charge);
 - the level of water consumption: measured by a meter at each connection, the number of buckets filled at the hand pump etc.
- Exemptions: as water has to be accessible for everyone, nobody should be excluded from the water service due to inability to pay the fee. Extremely poor families could be exempted and other solutions such as an equivalent labour contribution can be substituted.
- New connections: if users are added to the system after construction, they should pay an initial contribution equivalent to the work done by others during the construction or rehabilitation of the system, in addition to the cost of the connection.
- If non-payment is not justified, it is important that an agreed system of recourse is in place. A supplementary charge, or cutting the service until payment is made, are possible options. This issue should be addressed during the formulation of the management arrangements with the community in order to ensure that all non-payers are treated equally and reasonably. If such a system is not in place, payers will see that non-payers receive the benefit of water without contributing, and there will be little incentive for them to continue paying fees.

3.7.2 COLLECTION SYSTEMS

There is no fixed rule concerning how often people should contribute and how. It depends on several factors such as the type of system, the economic status of the users, agricultural cycles etc.

Fixed periodic contribution

This method enables a certain amount of money to be set aside to pay for repairs that otherwise would not be affordable. It can be made at an agreed time interval such as monthly, yearly or just after a harvest (when cash is available). This contribution is made by household, family or connection and is sometimes different depending on the type of connection.

Occasional contribution

People pay when there is a problem to resolve or a part to replace. This system may be more desirable when there are no regular costs such as consumables or hired staff. Also, if maintenance costs are low, such as for handpumps (e.g. suction pumps or rope-and-washer pumps) or for open wells, this may be the appropriate system. Activities such as parties, games, competitions, local lotteries etc. can be used to encourage people to contribute.

According to consumption

People pay for the amount of water consumed. This is a more common payment system when there are regular operational costs. Ways of measuring the quantity of water consumed will vary. Examples include measurement by container, by flow meter or by hours of use of the connection.

3.7.3 USER-FEE ESTIMATION

Normal operation and maintenance costs have to be covered by the community's financial contribution. If the system has been properly designed and the technology chosen is appropriate, the amount should be affordable for all the users. The right level of payment may not be easy to establish and it is recommended that the expected expenses across the life of the system installed are considered.

The total cost of system operation and maintenance should be calculated and communicated to the community. It is then the responsibility of the community to decide the user fees. The total costs include:

- *Operations costs*: expenses for daily operations (fuel, oil, electricity, chlorine, aluminium sulphate, salary of operators etc.)
- *Maintenance costs*: expenses incurred to prevent or to repair damages in the water-supply system (replacement of a joint, servicing of a pump, repair of a leak etc.). To determine this cost it is necessary to know:
 - type of maintenance (preventive and corrective);
 - anticipated frequency of maintenance;
 - materials and equipment required;
 - lifespan of the different parts of the water system and maintenance equipment;
 - water analysis and frequency of testing;
 - environmental services: aimed at preserving the water resources (reforestation, maintenance of protective fences etc.).
- *Administrative costs*: expenses for maintaining the physical and human support structure (trainings, stationery etc.).
- *Depreciation costs*: the objective here is to create a fund, through periodic contributions, so the community can afford to replace/rebuild the system at the end of its lifespan.

Once these costs are established, the community will decide on the type of contribution and the amount to pay by user or family.

The boxes 16.4 and 16.5 contain examples from Ivory Coast and Honduras showing different ways of calculating the contributions necessary for maintaining a Vergnet handpump and a gravity-fed system.

Box 16.4

Example of user-fee estimation: Vergnet handpump in Ivory Coast.

Costs to be covered by the users:

- Operations costs: none, no consumables and every user is responsible for fetching their water.
- Maintenance costs: depend on the intensity of use and the type of the pump. Mechanics report that during the first year the costs are minimal. However, costs increase over time, reaching a maximum between the 7th and 10th year (replacement of the balloon, the cylinder and the treadle).

Figure 16.3 shows the trend of the V4C pump maintenance cost over time (sources: craftsman-repairers interviews and data of SAHER – the replacement parts supplier, based on long experience). It shows clearly that regular contributions must be made from the moment the pump is installed in order to cover the costs that are incurred after several years of handpump use.

To ensure longevity of the pump, the committee must collect 60 €/year from the beginning so as to ensure there is not a large, unaffordable payment after seven years. According to *l'Hydraulique villageoise* (the public water department), the committee collects at least 90 €/year.

ACF field workers surveyed the number of families using each pump. The number varied from about 30 to 100 families per pump. In the most unfavourable case (contribution of 90 €/year for 30 paying families), the sum paid per family per month for drinking water is 0.26 €. In comparison, 1 kg of rice in Ivory Coast costs 0.38 €.

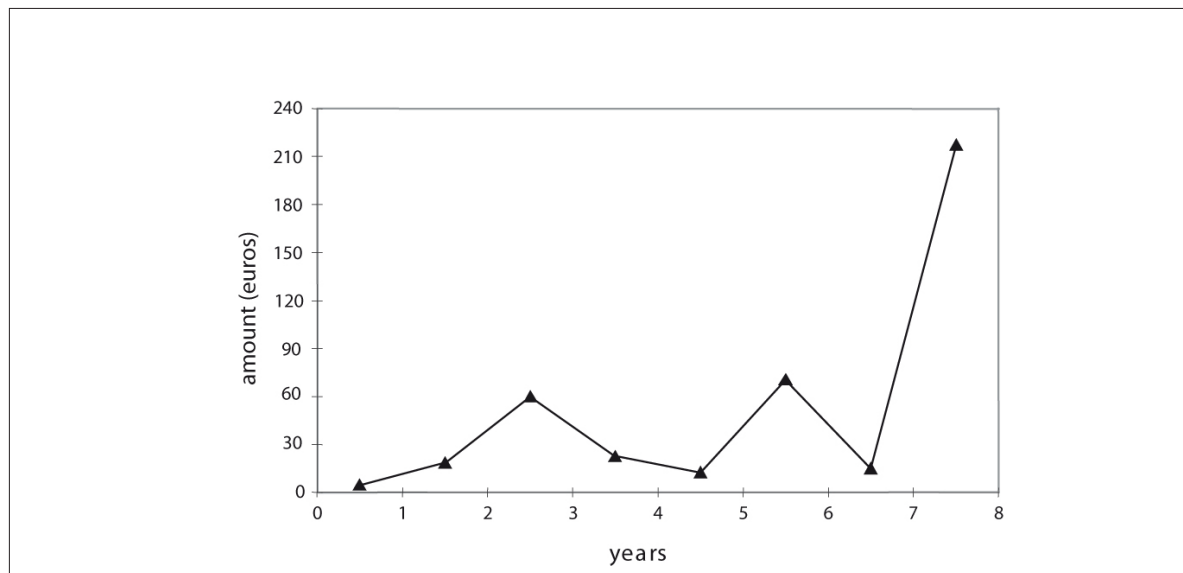


Figure 16.3: Maintenance costs versus years of use for the V4C handpump.

Box 16.5**Example of user-fee estimation: water network in Yusguare (Honduras).**

The water supply in Yusguare is a urban system fed by four pumping stations installed on wells and one surface-water source. The system delivers water to 438 families through private household connections. The storage capacity of the four water tanks is 350 000 litres. The calculated costs are indicated in the following tables.

OPERATIONS COSTS

Nb.	Description	€ per month
1	Operator's salary	120
2	Pumping costs (electricity)	227
3	Chlorine	80
4	Miscellaneous	5
TOTAL		432

MAINTENANCE COSTS

Nb.	Description	Cost in €	Quantity per year	Monthly cost in €
<i>Tools</i>				
1	Machete	7	1	0.58
2	Hoe	4.5	1	0.38
3	Shovel	3	1	0.25
4	Iron bar	11.5	1	0.96
5	Pickaxe	7	1	0.58
6	Saw	1	2	0.17
<i>Materials</i>				
7	Anticorrosion solution	4	1	0.33
8	Sandpaper	0.5	1	0.04
9	Spanner 36"	35	0.2	0.58
10	Gate valve 3"	19	0.5	0.79
11	Gate valve 1 1/2"	5	0.5	0.21
12	PVC pipe - 1 1/2"	4	4	1.33
13	PVC pipe - 1"	2	4	0.67
14	PVC pipe - 3"	14	3	3.50
15	Cement	3.5	3	0.88
16	PVC glue	5.7	0.25	0.12
17	Water analysis	18	4	6.00
18	Environmental services	22.7	12	22.70
TOTAL				40.1

ADMINISTRATIVE COSTS

Nb.	Description	Unit cost in €	Quantity per month	Monthly cost in €
1	Stationery	22.00	1	22.00
2	Per diems	4.00	3	12.00
3	Training	3.50	1	3.50
4	Technical support	4.00	1	4.00
TOTAL				41.5

DEPRECIATION

Description	Cost (€)	Quantity	Lifespan (years)	Yearly depreciation	Monthly depreciation
Electrical pumping equipment	1360.54	4	10	544.22	45.35
Wells	1723.36	4	30	229.78	19.15
Surface-water intake	544.22	1	25	21.77	1.81
Elevated concrete tanks	1587.30	1	25	63.49	5.29
Simple concrete tanks	1350.00	3	35	115.71	9.64
PVC pipeline	4.45	1800	30	267.00	22.25
GI pipe	16.33	167	40	68.18	5.68
TOTAL			109.18		

CALCULATION OF THE CONTRIBUTION

Description	Cost in €
Monthly operations costs	432.00
Monthly maintenance costs	40.10
Monthly administrative costs	41.50
Monthly depreciation costs	109.18
TOTAL COST	622.78

Number of families: 450

Number of families paying: 405

Cost per user = total cost / number of contributors = 1.40 €/ month

This rate is adjusted each year for inflation. For the year of this example (2002), the inflation rate was 7.70%.