Operation and Maintenance for Rural Water Services

Sustainable solutions

Background report for WELL Briefing Note 15
by Peter Harvey (WELL planned work)

WELL
RESOURCE CENTRE
NETWORK FOR
WATER, SANITATION AND
ENVIRONMENTAL HEALTH

Water, Engineering and Development Centre
Loughborough University
Leicestershire
LE11 3TU UK

WELL@lboro.ac.uk

London School of Hygiene & Tropical Medicine
Keppel Street
London
WC1E 7HT

WELL@lshtm.ac.uk

IRC International Water and Sanitation Centre
P.O. Box 2869
2601 CW
Delft
The Netherlands

WELL@irc.nl

www.lboro.ac.uk/WELL

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The proportion of people without access to safe drinking water is significantly higher in rural areas than urban areas throughout the less-developed world. For example, 56% of people living in rural areas of sub-Saharan Africa and 34% of those living in rural Latin America lack access, as compared to only 17% and 6% of their respective urban populations (UNDP, 2003).

In order to meet the Millennium Development Goal (MDG) for water and to halve by the year 2015 the proportion of people without sustainable access to safe drinking water, huge international investment and effort is still required. This task is made even harder by the low levels of sustainability prevalent in low-income countries.

It is estimated that 35% of improved rural water supplies in sub-Saharan Africa are out of service at any given time (RWSN, 2005). This means that each new water system provided effectively costs 50% more than estimated. Unless sustainability levels can be improved the funding gap will only widen and the MDG target will never be achieved.

Effective operation and maintenance (O&M) of water systems is essential if rural water services are to be sustained. The vast majority of rural water systems in low-income countries rely on community management of O&M, which has had limited success to date. This is due, in no small part, to the project approach in which the implementing agency leaves the community to manage their system without any ongoing external support.

If community management of O&M is to be effective, rural water strategies must be developed which facilitate the provision of institutional support to communities. This should incorporate technical, social and financial planning and capacity building for long-term service provision. Realistic strategies must also be developed to ensure sustainable provision of equipment and spare parts for O&M.

There is also a strong need to investigate alternative management options for rural water supply O&M. Due to the predominance of community management there are relatively few cases in which alternative models have been used, but where they have been there is evidence to suggest that some of these could be applied successfully on a larger scale. Public-private O&M management options also have the potential to remove many of the problems related to supply chains and spare parts.

Governments must recognize and accept that rural water services require some level of ongoing subsidy, whether this is for regulation, monitoring or technical and managerial support. The levels of such subsidies are likely to be considerably less that those for urban water services.

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CBO Community Based Organization

ESA External Support Agency

MDG Millennium Development Goal

NGO Non-Governmental Organization

O&M Operation and Maintenance

POOM Private Ownership, Operation and Maintenance

PPOM Public-Private Operation and Maintenance

VLOM Village Level Operation and Maintenance

1. Introduction

1.1 Rural water services

Around 6% of the global burden of disease is water-related, and diarrhoeal and related diseases are responsible for the death of two million people a year, most of them children under five (WHO/UNICEF, 2000). The provision of safe water supply, accompanied by adequate sanitation services and hygiene education, represents an effective health intervention that significantly reduces morbidity and mortality related to diarrhoeal disease. In addition, access to safe drinking water reduces the burden on fetchers of water, especially in rural areas where the need to walk many miles to collect water is common, and frees up their time for more productive use.

The proportion of people without access to safe drinking water is significantly higher in rural areas than urban areas throughout the less-developed world. For example, 56% of people living in rural areas of sub-Saharan Africa and 34% of those living in rural Latin America lack access, as compared to only 17% and 6% of their respective urban populations (UNDP, 2003). The Millennium Development Goal (MDG) for water agreed at the United Nations in 2000 is to halve by 2015 the proportion of people without sustainable access to adequate and affordable safe drinking water (Annan, 2000). This goal will be much harder to achieve in rural areas than in urban areas in the developing world due to the low levels of existing coverage. This is further compounded by the fact that existing services demonstrate limited sustainability throughout the continent.

It is estimated that 35% of improved rural water supplies in sub-Saharan Africa are out of service at any given time (RWSN, 2005). This means that each new water system provided effectively costs 50% more than estimated. Unless sustainability levels can be improved the funding gap will only widen, the MDG target will never be achieved and rural populations will continue to be denied the basic human right to water.

1.2 Operation and maintenance challenges

Effective operation and maintenance (O&M) of water systems is essential if rural water services in low-income countries are to be sustained. Such water services are typified by low-cost technologies which are relatively inexpensive to operate and maintain. Despite this, many systems fail due to an inability or unwillingness among water users to maintain and repair technologies.

There are several key challenges that must be overcome if operation and maintenance is to be effective and sustainable. These include:

- Government policies and strategies which place emphasis on community management without addressing the need to provide institutional support to communities;
- Lack of long-term financial planning for O&M;
- Inappropriate technology, lack of technical skills and ineffective supply chains for spare parts; and
- Insufficient Government, civil society and private sector capacity to undertake, support and regulate O&M activities.

1.3 Rural water strategies

Many governments in the South have ambitious targets for increasing rural water supply coverage in line with international targets such as the Millennium Development Goals. In general, these national targets include time-bound percentage coverage figures and set appropriate

service levels in terms of litres per person per day, water quality standards and distance of water points from dwellings. Many countries have developed rural water supply strategies in order to reach these targets. These strategies may be in the form of five or ten year operational plans, or may cover longer time periods, and are typified by the following:

- A decentralized approach to service delivery in which the role of the public sector at all levels is mainly to monitor, regulate and facilitate the performance of stakeholders in O&M;
- A demand responsive approach to the delivery of community based water supplies, for which users are responsible for managing O&M and cost-recovery to ensure sustainability;
- Private sector provision of all goods and technical services including the provision and distribution of spare parts.

Many national strategies are influenced by external donors and international organizations, and hence there is a significant degree of uniformity of policy among different countries, at least on paper. As a result, despite local differences in culture, environment and politics, many effects of policy and strategy are region-, rather than country-, specific.

2. Making community management work

The community management model allocates responsibility for ongoing management of a water supply to the community of users. This means that the community, usually by means of a water committee or alternative Community-Based Organization (CBO), is responsible for managing maintenance activities to ensure that the water service continues to operate on a sustainable basis.

Community management of O&M, often known as Village Level Operation and Maintenance (VLOM), is based on the following key principles:

- the user community owns the water supply and has made a contribution (in cash or in kind) to its installation;
- the user community sets and collects water tariffs to finance ongoing O&M;
- the user community manages and finances operation, maintenance and repair activities; and
- the government (or implementing agency) provides ongoing support to the community.

Although the community management model remains by far the most widespread for rural water supplies in low-income countries, it has failed to deliver the levels of sustainability that were initially anticipated. While community management is based on the well-intentioned principle of encouraging ownership and empowering communities, it also acts as a convenient concept for shifting responsibility for ongoing operation and maintenance, and hence sustainability, of services from facility-provider to end-user. Community 'sensitization' or 'mobilization' is designed to instil a sense of ownership and responsibility, but this does not automatically lead to a willingness to manage or finance a water supply over a prolonged period of time. Consequently many facilities fall into disrepair soon after installation or as soon as anything goes wrong with the system.

The assumption that supporting community-based O&M is a less onerous task than running a centralized maintenance system has not been borne out in the field (WHO, 2000), and at present there is little evidence to suggest that governments have facilitated VLOM effectively on their own (Colin, 1999). This may be because Government authorities and support agencies do not understand the need for appropriate support systems, perhaps in part because the development of the VLOM concept created complacency (Ockelford, 2002). There has been a widespread misconception that services can be managed autonomously by communities, and that governments can be side-stepped in the process of service delivery by external support agencies (Carter, 2002). This may explain why there is often a lack of understanding among governments and a misplaced perception that community management means that systems will be 'self-sustaining' (Box 1).

Box 1. Government policy and community management

The National policy for water resource management in Kenya states that:

'The basic solution to the problems in operation and maintenance of water supply schemes … lies in the full involvement of the users'; and

*'The Government will continue to promote the development of water systems that are **self-sustaining** and where the beneficiaries themselves are encouraged to take full responsibility for operating and maintaining systems.'*

Ministry of Water Resources, 1999

There remains a strong need for re-examination of assumptions surrounding community management and a new approach to institutional support to communities. Carter et al. (1999) defines a 'sustainability chain' for community water supply consisting of motivation, maintenance, cost recovery and continuing support. Even stronger institutions than at present are needed to promote and support community management, and adequate funding is still required for agencies to be able to perform their essential supportive role (Davis & Brikké, 1995). This is backed up by new strategies developed by implementing agencies that recognize the need for institutional support and the need to budget for this accordingly (Nedjoh et al., 2003). Such support is not a stop-gap or short-term measure, but should be ongoing.

The term 'scaling-up community management' is now increasingly used to refer to the need to increase sustainability and coverage by creating institutional frameworks for community managed services, using a learning approach which includes all relevant stakeholders and allows for local context (Schouten & Moriarty, 2003). This requires political support and involves calculating the full costs of implementing the community management model; promoting appropriate low-cost technology; building capacity at all levels; and providing adequate financing from communities, government and the private sector (Lockwood, 2004).

2.1 Institutional support for community management

The first step is to recognize that support is required if community management is to deliver sustainable solutions. The second is to determine what that support should entail. Appropriate institutional support comprises the following components:

- Encouragement and motivation;
- Monitoring and evaluation;
- Participatory planning;
- Capacity building; and
- Specialist technical assistance (including financial support where required).

Institutional support is best provided by a local government institution (since it should remain operational in the area indefinitely), although where this is not possible a Non-Governmental Organisation (NGO) or stakeholder group can fulfil this role. One way in which appropriate institutional support can be provided is by means of a district water and sanitation team which may include water, environmental health and/or community development staff. Monitoring and evaluation strategies are essential to determine the status of water facilities, financial and human resources, and environmental issues. Based on monitoring results, participatory planning exercises should be undertaken with communities experiencing difficulties. These can address technical problems or difficulties experienced by CBOs, such as lack of willingness to pay among users or lack of competent mechanics. Such teams can also provide specialist technical assistance if required, for which there is likely to be some charge made to communities. The last important aspect is the need for capacity building and institutional strengthening. This applies to CBOs and local government institutions themselves.

It is important that external support agencies (ESAs) work in partnership with government institutions from the onset of programmes. The capacity of institutions must be considered if they are to be able to fulfil the necessary support role effectively, and appropriate institutional strengthening may be required at various stages.

2.2 Financing institutional support

This institutional support obviously has a cost associated with it, and appropriate investment strategies are required to meet this. Figure 1 illustrates the forecast of the coverage level of safe drinking water based on sustained investment in the rural water sector including as well as excluding a budgetary allocation for institutional support for community-based O&M.

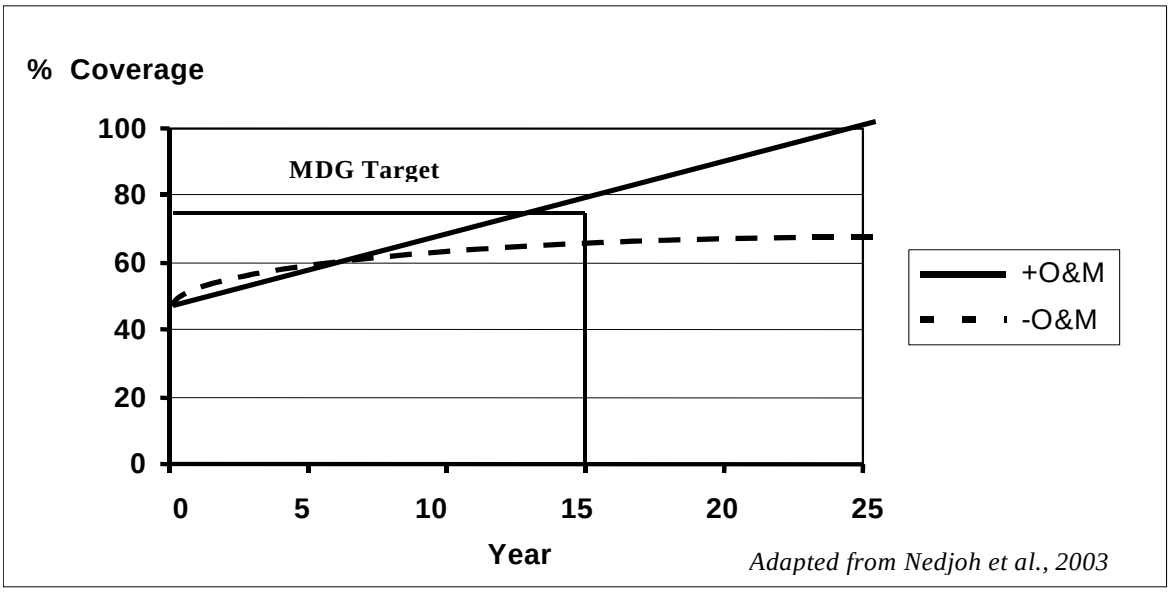

Figure 1. Prognosis model for institutional support for O&M

This is based on a prognosis model developed by the Community Water and Sanitation Agency (CWSA) in the Volta Region of Ghana (Nedjoh et al., 2003) but has been adapted for generic application. The broken line illustrates the scenario where investment is made for increasing service coverage but no money is used for O&M support, while the continuous line illustrates the scenario where 6 per cent of total investment is used for O&M support. This is based on the annual investment of $2 million per year for a region with a total population of approximately 1,200,000 people, half of whom have access to water in year zero. The model indicates that without O&M support the coverage level would increase from 50 per cent and stabilize at around 67 per cent, whereafter the breakdown rate would equal the rate of new constructions. To reach a higher coverage level, significantly higher capital investment would be needed.

The MDG target of halving those without access to safe drinking water by 2015 is superimposed on the graph, assuming that there was 50 per cent water coverage in the year 2000 (year zero). With O&M support this target could be achieved with appropriate investment levels, and 100 per cent coverage achieved by 2025. After this the capital investment could be reduced greatly to cover only the breakdowns. Without O&M support the MDG target would not be achieved.

2.3 Building institutional capacity

In order for the different partnership models described to be successful it is essential that the different institutional stakeholders have sufficient capacity to fulfil their respective roles. Capacity building and sustainability are closely related. Without adequate, appropriate capacity at different levels of government and at local level, services will not be sustainable (Abrams, 1996). Capacity building is a broad term, for which a range of definitions have been developed. It can apply to the water sector in a particular country or region, or it can apply to specific institutions, organizations or communities. The following definition (adapted from Abrams, 1996) is applied to institutional capacity.

Capacity building is the process whereby an institution equips itself to undertake the necessary functions of governance and service provision in a sustainable fashion. The process of capacity building must be aimed at both increasing access to resources and to changing the power relationships between the parties involved. Capacity building is not only constrained to officials and technicians but must also include the general awareness of the local population regarding their services.

Capacity building comprises the following components:

- Human resource development;
- Institutional reform and restructuring;
- Development of an appropriate operating environment;
- Provision of physical and financial resources;
- Impact assessment and follow-up training.

3. Alternative management models

While community management can be effective where there is an appropriate supporting institution, it must be accepted that in many cases it is not a sustainable solution to rural water supply O&M. Consequently, there remains a strong need to consider and investigate alternative O&M management models.

3.1 Public-Private Operation and Maintenance

While many government policies promote privatization, private sector involvement in rural water supply provision has been limited largely to installation of new facilities and provision of spare parts for repair. There are relatively few cases in which the private sector is responsible for ongoing rural water service provision, including operation and maintenance. Where this is the case however, the Public-Private Operation and Maintenance (PPOM) approach is based on the following key principles:

- The water supply is owned by the user community;
- The user community is responsible for financing routine O&M ;
- A private sector company is paid by the community to undertake maintenance and repair activities and to ensure that water systems remain functional;
- The public sector is responsible for regulation of the private sector and for providing additional funding/subsidy .

There are various ways in which the PPOM approach can be applied; one such example is the Total Warranty Scheme (Box 2) whereby water users pay a warranty to a local private enterprise to ensure that water systems are maintained.

Box 2. Total Warranty Scheme

In the late 1990s the community maintenance model was deemed to be failing in Mauritania, mainly due to problems with access to spare parts and lack of qualified mechanics. The handpump manufacturer Vergnet therefore decided to pilot the *Total Warranty* concept on 75 water points. The manufacturer's commitment was to support and train the local enterprises. The users paid an annual contract fee (equivalent to US$1.50 per person per year) to the local enterprises, which were responsible for all aspects of pump maintenance. The government administration role was one of regulation.

After the pilot project had been running for two years an evaluation found that 60% of the villages had paid the enterprise, and 20% had paid half. Where the cost recovery rate was low, systems were not operating. Vergnet decided that, based on the pilot results, the *Total Warranty* concept should be further developed in Mauritania and elsewhere.

Bernage, 2000

An alternative PPOM model is the Water Assurance Scheme (WAS) which is similar to the Total Warranty Scheme, but with a crucial difference. Instead of the manufacturer providing a warranty on a piece of equipment, WAS places the emphasis on the ongoing provision of safe, adequate and accessible water regardless of the technology involved. Rural communities pay a monthly premium to an indigenous private company, which is regulated by local government. For as long as the premium is paid, the company provides an annual maintenance and water monitoring service, and is responsible for any system repairs required. Although most PPOM models have yet to be attempted on a large scale evidence suggests that they have considerable potential,

especially where community management is ineffective. Forming Rural Utility Groups and Leases (FRUGAL) is a PPOM approach recently developed by the Water and Sanitation Program (WSP) of the World Bank whereby

3.2 Private Ownership, Operation and Maintenance

Community ownership is often cited as a prerequisite for rural water supply sustainability, yet there is little evidence to support this (Harvey & Reed, 2004). Just because a water system does not belong to a community does not mean that they will be unwilling to pay for water from it or that it will not be sustained. Indeed, privately owned water systems may be better sustained because there is clear responsibility and incentive for O&M (Box 3).

Box 3. Private ownership of water systems

In Bugiri, Uganda, there is an ancient handpump which was fitted to a privately drilled borehole in the 1950s. According to the many people who collect water there every day, it has broken down several times but the owner has always repaired it within a day of it breaking down. The main reason for this is because he is making an income when the pump is working but he is not getting anything when it's broken down. For this service, local households are willing to pay 50 Uganda shillings (US$0.03), per 22 litre jerrycan and there is a line of yellow jerrycans every morning put there by their owners. The jerrycans are filled by the caretaker and his helper who are paid by the owner. People then come and collect their full jerrycans and pay the caretaker.

Wood, 2001

Private Ownership, Operation and Maintenance (POOM) is based on the following key principles:

- The water supply is owned by a private individual or company;
- The user community pays the owner for water from their facility; and
- The public sector (where effective) regulates the private operator to ensure that users pay a fair price for water.

The most simple POOM model is that in which the water system is owned by an individual within the community of users, but this role may also be performed by a private company as is adopted by the Handpump Lease Concept (Box 4).

Box 4. Handpump Lease Concept

In Lubango, Angola, the local water company owns several hundred handpumps, while the communities they serve own the boreholes or wells on which they are installed. Each family pays an equivalent of US$0.40 to the pump caretaker each month, which is within their financial means and for which they receive an ‘official invoice’. Half the revenue raised pays the pump caretaker’s salary and half goes to the water company. Some handpumps serve over 50 families and raise $240 per year, $120 of which goes to the water company. Meanwhile the water company estimates an average maintenance cost of only US$30 per handpump per year, resulting in a healthy profit.

Van Beers, 2001

Ideally, private owner-operators should be regulated by government but where government structures are ineffective POOM systems may be self-regulating, since water users will not pay for water if they judge the cost as excessive.

3.3 Advantages over community management

Alternative management models involving the private sector have a number of advantages over the community management model but that is not to say that they will be more effective in all cases. The choice of O&M model will depend on the local context but given the current low levels of sustainability it is key that more than one approach is considered. The relative advantages and disadvantages of the three generic management models are summarized in Table 1.

Table 1. Different O&M management options compared

Maintenance option	Advantages	Disadvantages
VLOM	Fast initial response to problems Community in control of own affairs Develop pride in own achievements	Needs motivated people Needs appropriate local skills and tools Difficulty in accessing spare parts
PPOM	Easy access to spare parts Concentration of skills and resources Community choice and freedom	Potentially higher cost Potentially slower response times Needs active government regulation
POOM	Easy access to spare parts Clear ownership and responsibility Concentration of skills and resources Strong incentive for rapid repair	Ownership removed from community Limited application due to high initial cost to owner

4. Supply chains

A major challenge for sustainable rural water services is the provision of equipment and components required for ongoing operation and maintenance. This is particularly relevant to pumping technologies such as handpumps and solar-powered, wind-powered and conventionally-powered electrical pumps. Many attempts have been made by implementing agencies to encourage sustainable private sector supply chains but these have had limited success to date due to lack of commercial viability (Box 5).

Box 5. Commercial viability

In Kalomo, Zambia, the district water and sanitation committee (consisting of governmental and NGO personnel) helped establish a private spare parts supplier by providing spares to an existing hardware store in the town to act as a seed fund. This venture failed because the owner did not use the money from sales to replenish the stock of spares, due to low turnover and profitability. Consequently, the district committee itself now stocks and supplies spares to communities.

Harvey & Skinner, 2002

The density of water systems in most rural areas is relatively low, which means that private sector supply chains for spare parts will not be sustainable unless at least one of the following three criteria is met:

- Spares supply is strongly linked to the supply of pumps and related services;
- Community management of maintenance is replaced with more centralized public–private systems; or
- Technologies are installed which use 'standard' spares that are already available.

Even where one these criteria is met, however, this should not be taken as a guarantee of sustainability, since further implementation studies are required. If none of these criteria are fulfilled then alternative strategies for spares supply, such as subsidy and non-profit approaches, must be adopted.

4.1 Procurement and service linkages

It is clear that strengthening links between pumps, services and parts can increase the viability of supply chains. Procurement practices of donors can have a major influence on this and can stipulate roles and responsibilities of manufacturers within contracts. This requires a shift from selecting pump suppliers by lowest price internationally, to selecting local suppliers who can also provide spares and related services. This may result in slightly higher cost to the donor in the short term but is a more sustainable long-term option. Government decentralization policies can also contribute by encouraging the procurement of pumps and services at district or local level. Where successful, this approach can stimulate supply chains down to district level, which may or may not provide sufficient coverage. Its sustainability remains dependent on adequate ongoing demand for pumps. The viability of this approach will be limited in any given situation and may do little to increase accessibility to spares in sparsely populated areas with poor transport routes.

4.2 Public–private maintenance systems

It can be argued that the community management of maintenance option creates unreasonable demand on spares supply chains. Where VLOM is replaced by PPOM, the needs of the supply chain are considerably reduced. Instead of needing spares outlets in most rural towns, these will

be needed only in the larger regional settlements where private companies can access them. PPOM and POOM models such as the Total Warranty Scheme, Handpump Lease Concept and Water Assurance Scheme place the responsibility for spares procurement with private service providers who have greater mobility than rural communities. The application of this approach may be limited by the density of communities served, the willingness of community members to pay for services, and the capacity of the private sector.

4.3 Appropriate technology

The simplest solution to the spare parts conundrum is to use only simple technologies which do not require specialist spare parts and components. Invariably, the more complex the technology used, the longer (and hence more complex) the supply chain needed to support it (Oyo, 2002). Technologies such as the Rope pump, Bucket pump and locally developed pumps such as the Bush pump or AFRI-pump remove the need for complex technology-specific supply chains. While some pumps use standard factory components it is more important that they use spares which can be found in the average rural hardware store (or be fabricated in a local workshop). Likewise, it is important that tools for repair are widely available. A study by International Development Enterprises in Bangladesh showed that the rural poor often prefer cheaper, shorter-life technologies in spite of the need to repair or replace them more frequently (Oyo, 2002). This suggests that the argument for high quality technology and parts may be externally driven rather than demand responsive.

4.4 Subsidies

If the predominant procurement practices, maintenance systems and technologies remain as they are, alternatives to the traditional private sector business approach must be developed. Many supply chains are currently subsidized by governments or donors. This may involve direct subsidy of retail prices to reduce costs to users or, more commonly, subsidized storage, transportation or promotion. In investigating subsidy options it is important to assess their sustainability. Subsidies from external donors or support agencies are likely to be unsustainable by definition and appropriate phasing out or transfer strategies should be implemented. Subsidies from government or the indigenous private or non-profit sector may, however, be the most sustainable option where a pure business approach is not possible.

A non-traditional approach to private sector participation in supply chains is to seek subsidies from the private sector, in the form of sponsorship (Baumann, 2000). There are several ways in which this could be implemented. One approach is for the company to pay advertising fees directly to the spares retailers to display sponsorship slogans and logos on signs used to promote spares outlets. Alternatively, a large company with widespread visibility could add spare parts to the products it distributes and advertise the fact that it is supporting rural water supply. The sponsorship approach has not been tried on a large scale to date, but can make effective use of the social incentive of helping ensure clean water is available to poor rural communities, and the good opinion gained from this.

The use of non-profit-making organizations (such as churches) in spares provision has been suggested as a more viable alternative to the private sector approach for many situations (DeGabriele, 2002). Recent research in Malawi has indicated that indigenous religious organizations provide a viable long-term option, so long as they have a reliable funding base, and examples are given of supply chains that have been in operation for 10 to 20 years (Alexander, 2003). Although the number of such organizations with adequate capacity, stability and motivation may limit coverage, they have proven to provide an effective alternative where the private sector approach is unsuccessful. They should not, therefore, be automatically dismissed as unsustainable.

5. Sustainable O&M: the future

Policy

Strategies

Financing

Pilot studies

Courage to change