Datum: 25 jul, 2007



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**Aanvraag nr: 1320940**

Uw referentie(s): A085379549
DOC/CF23JUL2007

**Artikelomschrijving:**

Aantal kopieën: **19**

Artikel: COST DETERMINATION
Auteur: HARVEY, PA
Titel: WATER POLICY
Jaar: 2007 Vol. 9 Nr. 4 Pag. 373-391
Plaatsnummer: E-9398

Water Policy 9 (2007) 373–391

# Cost determination and sustainable financing for rural water services in sub-Saharan Africa

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Received 19 December 2005; accepted in revised form 29 March 2006

## Abstract

Access to safe, sufficient and affordable water in rural Africa will not increase unless sustainable financing strategies are developed which ensure the sustainability of existing water services. There is a strong need for international donors and national governments to confront the true costs associated with sustained service provision in order to develop practicable long-term financing mechanisms. This paper presents a systematic approach that can be applied to determine the overall cost of service delivery based on respective cost estimates for operation and maintenance, institutional support, and rehabilitation and expansion. This can then be used to develop a tariff hierarchy which clearly indicates the cost to water users of different levels of cost recovery, and which can be used as a planning tool for implementing agencies. Community financing mechanisms to ensure sustained payment of tariffs must be matched to specific communities and their economic characteristics; a blanket approach is unlikely to function effectively. Innovative strategies are also needed to ensure that the rural poor are adequately served, for which a realistic, targeted and transparent approach to subsidy is required.

*Keywords:* Africa; Developing countries; Financing; Rural water supply; Sustainability

## Introduction

In the year 2000, the United Nations, through the Millennium Development Goal (MDG) for environmental sustainability, set the international target to halve the proportion of people without sustainable access to safe drinking water by the year 2015 (Annan, 2000). Estimates of the annual investment required to finance this target vary enormously, but the majority are almost certainly underestimates since they do not account for maintenance and rehabilitation of existing infrastructure, nor consider the costs of maintaining the institutions and support services required for service sustainability (Fonseca & Cardone, 2004).

doi: 10.2166/wp.2007.012

Rural sub-Saharan Africa has the lowest water service coverage of any region in the world at 45% in the year 2002; if current trends continue the MDG target will not be met, primarily because of conflict and political instability, high population growth rates and low priority given to water and sanitation (WHO/UNICEF, 2004). This major challenge is exacerbated by limited sustainability of existing rural water systems, with an estimated 35% of systems in sub-Saharan Africa being out of operation at any given time (Baumann, 2005). Before ambitious coverage targets can be considered, it is essential that both existing and new rural water services are sustained. One of the main reasons for poor levels of sustainability is the prevalence of unacceptable, unaffordable or impracticable financing strategies (Carter *et al.*, 1999). The development of sustainable financing mechanisms is therefore imperative to ensure sustainable service provision. This cannot be achieved unless realistic long-term costs are determined. There has been far too little attention given to this issue by donors, governments and implementing agencies in the past, and consequently few countries have realistic policies, operational strategies or plans for sustainable financing for increased service coverage, particularly for the poor (Fonseca, 2003).

The current situation has arisen primarily owing to the policies and practices of international donors and western development agencies. The development project approach adopted has provided a convenient concept to abrogate responsibility for long-term service provision from implementing agencies, be they non-governmental organizations (NGOs), bilateral agencies or governmental authorities, to poor rural communities. The presumption that once a new water supply is constructed and "handed over" to the user community it can be sustained by community financing of operation and maintenance (O&M) is over-simplistic, especially since the long-term O&M costs are neither calculated nor communicated to water users. This simplistic approach is reflected in the western-influenced policies and strategies of many African countries. A brief analysis of the 20 sub-Saharan African countries with completed poverty reduction strategy papers (PRSPs) reveals that 85% of those countries have an emphasis on community management and financing of rural water supplies in key national strategy documents, yet these do not adequately address the determination, nor affordability, of associated costs. If this does not change then sustainability levels will remain unacceptably low and the proportion of people without access to safe drinking water in rural Africa will remain unacceptably high.

This paper, based on research on sustainability of rural water services in sub-Saharan Africa, with a particular focus on Ghana, presents a systematic approach that can be used to estimate the true cost of sustainable service delivery to the consumer. It also identifies potential financing mechanisms which ensure service sustainability for the rural poor.

## Cost recovery

The term "cost recovery" is routinely referred to in rural water projects and programmes but can be applied in many different ways. In general, cost recovery refers to the practice of charging users the full (or nearly full) cost of providing services (MacDonald & Pape, 2002). Full cost recovery means reimbursement to service providers of both recurring and non-recurring costs associated with construction, management, O&M, rehabilitation and expansion of water systems. Costs include, but are not limited to, the costs of community mobilization, planning, design, administration, construction and O&M. Full cost recovery for rural water services in Africa is rarely, and probably never, achieved because:

- the cost of systems is significantly beyond the means of most rural communities; and

- the political and humanitarian desire for improved access to water, and definition of water as a "right", mean implementers are reluctant to seek full reimbursement.

Whereas during the Second World Water Forum in 2000 full cost recovery was advocated, during the Third Word Water Forum in 2003 the concept of sustainable cost recovery emerged, in which the general necessity for subsidies, especially for the poor, was acknowledged (World Water Council, 2004). Whilst it is generally agreed and widely accepted within the donor community that users should pay for operation and maintenance costs, there is no consensus on whether users should pay for capital costs and if so, what percentage is reasonable and how might it be paid (Fonseca & Njiru, 2003). Cost recovery for construction and installation of new rural water systems and facilities is, in practice, negligible. Communities are often requested to contribute 5 to 15% of initial capital costs, which usually means the cost of the water facility itself (e.g. a hand pump installed on a borehole). The costs of mobilization, administration, management and transportation generally remain hidden. Even where communities are expected to make a financial contribution, this is commonly intended to demonstrate demand, instil a sense of ownership and act as an indicator of the community's ability to organize and collect payments, rather than a real attempt to recover actual implementation costs (Deverill *et al.*, 2002). It is generally accepted that user financing of full implementation costs for improved rural water systems is an unrealistic goal. In a rural African context, therefore, the infrastructure development required to ensure increased access to water is likely to remain dependent on external donor support or continuous national government investment (Lane, 2004).

Cost recovery for ongoing service delivery and recurrent O&M costs may be a more achievable target, but evidence suggests that the majority of community organisations and small service providers are failing to generate sufficient revenues even to meet the direct O&M costs of existing systems (Fonseca, 2003). Direct O&M costs comprise those for maintenance, repair and asset replacement. Even where cost recovery for O&M is relatively high this rarely reaches 100%, owing to hidden costs such as subsidy of spare parts provision, supply chains and institutional support from local government or aid agencies (Harvey & Reed, 2004).

Ideally, the water tariffs that users pay should cater for future system upgrade, rehabilitation and expansion costs, as well as ongoing O&M costs. Currently, this occurs very rarely, if ever. One of the main constraints is the need for a transparent, secure and sustainable method of storing and investing money for future use. Community-managed financing mechanisms are rarely able to fulfil these requirements. Private sector service providers could potentially do this but require sufficient incentive and regulation. The second key constraint is insufficient ability and willingness to pay for these costs among users. In many cases it may be unrealistic to expect poor rural communities to finance these costs and this highlights the need for an external institution (ideally local government) to provide appropriate support. This also applies to emergency needs, such as the results of sabotage or natural disasters.

The term cost recovery as applied to rural water services remains generally misleading, since capital costs are simply not recovered, and even where direct O&M costs are met by users, revenues are generally insufficient to recover indirect costs such as the cost of developing adequate institutional capacity to provide support. The term "sustainable financing" is therefore used in this paper since this better articulates the need to "pay for water", i.e. finance the cost of ongoing provision of a water service on an indefinite basis.

## Cost determination

Determination of the real costs of service provision is one of the key problems in developing sustainable financing strategies (Fonseca & Njiru, 2003). Most implementing agencies simply do not address this issue adequately, in part because there is a lack of systematic guidelines to estimate costs. Without comprehensive cost determination, however, it is impossible to inform water users of the true cost of service sustainability to them, or to determine the level of external financial support that may be required. If sustainable financing mechanisms are to be developed, so that rural water services are to be sustainable, the following three categories of cost must first be calculated:

- direct O&M costs;
- indirect O&M costs (institutional support costs) and
- rehabilitation and expansion costs.

*Costing operation and maintenance*

The main consideration when determining direct O&M costs for rural water systems is to incorporate recurrent repair costs and future asset replacement costs. Without considering the need for saving specific sums of money to replace major component parts, the sustainability of most water systems is undermined. One method that can be used to do this is *amortization* whereby equal amounts are set aside every year, taking into account interest rates. These amounts can form part of the O&M tariffs charged. A four-stage process that can be used to determine appropriate tariffs is outlined below. The India Mark II hand pump is used as an example to illustrate the process. This was selected since hand pumps remain the principal technology for improved rural water supplies in sub-Saharan Africa (RWSN, 2005) and the India Mark II is one of the most common public domain hand pumps, which has been adopted as a "standardized" pump in several African countries, including Ghana. It is accepted that there are many other rural water technologies in addition to the conventional hand pump, and the process developed, as presented here, can also be applied to them.

1. *Recurrent O&M costs*: the first step is to calculate recurrent O&M costs, which include replacement of minor components and routine preventive maintenance, and any wages associated with these. Table 1 gives an example of components, costs and estimated frequency of replacement for an India Mark II hand pump. The total annual cost of components, $C$ can be determined by dividing each unit cost by the estimated frequency of replacement and summing these.

The annual cost of components may vary considerably, even for the same technology, and depends on the local environment. For example, hand pumps operating in areas of deep, aggressive (low pH) groundwater which are subjected to heavy usage, may have much higher O&M costs than those operating in shallow, neutral conditions with low usage. The only reliable way to obtain guidance for costs in specific local conditions is through appropriate monitoring.

Once the total annual cost of components, $C$, is determined the annual maintenance cost, $M$, can be determined by adding the required labour and transportation cost, $L$. This will vary depending on the local economy and type of maintenance system utilised.

$$\text{Annual maintenance cost, } M = \text{Annual cost of components, } C + \text{Labour/transport costs, } L \qquad (1)$$

Table 1. Example of recurrent O&M component costs for an India Mark II hand pump[a].

| Component | Estimated frequency of replacement, $f$ (year) | Unit cost, U (US$) | Annual cost, $U/f$ (US$) |
|---|---|---|---|
| O-ring seal | 2 | 1.60 | 0.80 |
| Cup leather | 2 | 1.00 | 0.50 |
| Chain | 3 | 3.60 | 1.20 |
| Handle axle | 3 | 6.00 | 2.00 |
| Axle bearing | 3 | 7.50 | 2.50 |
| M12(10 nut | 1 | 1.50 | 1.50 |
| M12(50 nut | 1 | 1.50 | 1.50 |
| Foot valve rubber | 3 | 6.00 | 2.00 |
| Piston valve rubber | 2 | 1.00 | 0.50 |
| Grease | 1 | 2.50 | 2.50 |
| Total annual cost of components, $C$ = | | | 20.00 |

[a] Based on data from Ghana. This is an example only; $f$ and $U$ will depend on local economy, quality and age of equipment, environmental conditions and usage pressure.

Using the example in Table 1 and average figures obtained in Ghana, assuming the area pump mechanic has to make an average of two visits per year and charges US$5.00 per visit, plus US$2.50 for transportation, the total annual cost of labour and transportation is US$15.00. Therefore:

$$\text{Annual maintenance cost,}\ \ M = C + L = 20.00 + 15.00 = \text{US\$35.00} \tag{2}$$

Since the costs are relatively low and are set in hard currency, any inflationary increases are not considered since these are likely to be negligible.

2. *Current replacement costs*: the second step is to calculate the current replacement costs and the projected lifespan of major components which are likely to need to be replaced. Depending on the technology and environment this may be based on the replacement of the entire facility (e.g. hand pump) or specific components of that facility. Table 2 gives an example of the major components of an India Mark II hand pump which may need replacing after a five-year period of use, and their respective costs.

Once calculated, the estimated replacement cost should be compared to the total current cost of a complete facility. For example, in some cases the cost of a complete hand pump may be lower than or similar to that of the component parts, particularly where pumps are ordered in bulk. If this is the case the entire hand pump could be replaced after five years rather than the major components listed.

The current replacement cost, $R$ is the current cost of complete facility or major components and $n$ is the estimated number of years before replacement. The value of $n$ may be greater than 5 and will depend on the particular technology, model, manufacturer and conditions under which it is operating.

3. *Annuity*: the next step is to calculate the annual amount or *annuity* which needs to be put aside each year to meet future replacement costs. This is based on an annuity factor (AF), which is a function of the expected lifespan of the equipment in years ($n$) and the interest rate ($r$) in the local economy (Wedgwood & Sansom, 2003). This does not consider inflation but allows for devaluation, which is especially important for imported components and overrides inflation effects in many developing countries. The following equation can be used:

$$\text{Annuity,}\ A = \frac{\text{Current replacement cost,}\ R}{\text{Annuity factor}\ (AF_{r,n})} \tag{3}$$

Table 2. Example of 5-year replacement costs for an India Mark II hand pump[a].

| Component | Unit cost (US$) |
|---|---|
| Hand pump cylinder | 115.00 |
| Foot valve | 8.00 |
| Hand pump tank | 22.00 |
| Hand pump head | 81.00 |
| 10 Connecting rods | 80.00 |
| Apron and drainage repairs | 30.00 |
| Total replacement cost, $R$ = | 336.00 |

[a] This is an example based on data from Ghana, which identifies components requiring replacement five years after installation, assuming that stainless steel riser pipes are used. Where galvanised iron pipes are used which are likely to be subject to corrosion, these should be included in the cost estimate.

Annuity factors are based on number of years and interest rates and can be read directly off financial cost tables. In order to adjust for inflation the annuity can be multiplied by the cumulative inflation rate.

4. *Average annual cost of O&M*: the final step is to calculate the average annual cost of O&M per household. Ideally, the annual amount paid each year (or saved in a communal/private fund) should be slightly higher than the calculated annuity to allow for unforeseen events and inflation. A contingency factor of 20% can be used to compensate for this and will ensure that the users have saved enough to compensate for future price changes for the required component. The household tariff per year, $H$, can be estimated using equation (4), where $N$ is the number of households in the community:

$$\text{Annual household tariff, } H = 1.2\left[\frac{M + A}{N}\right] \tag{4}$$

This is based simply on the total number of households using the facility. To ensure equity, household tariffs can be modified by three factors: the distance from the source, the number of people in the household and "special" factors such as poverty or disability (Deverill *et al.*, 2002). Box 1 gives a worked example for a hand pump water supply.

The household tariffs calculated for low-cost community water systems, such as hand pumps and gravity-fed systems, are generally very low and normally below US$0.50 a month (Harvey & Reed, 2004). The process above can be repeated after five years to assess whether an increase in tariff is required based on the costs at that time. Alternatively, tariffs may be calculated for a twenty-year period from the start of the service, accounting for repeated replacement of major components and/or pumps. Ongoing monitoring and regulation is essential to make appropriate adjustments for changing circumstances. The above process does not include costing for rehabilitation and expansion.

## *Costing institutional support*

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). In recent years there has been a growing awareness and acceptance of the need to provide institutional support for

Box 1 Example of household tariff setting for a hand pump water supply
Using the example for the India Mark II hand pump above:

| | |
|---|---|
| Total annual maintenance cost, | $M = \$35$ |
| Current replacement cost, | $R = \$336$ |
| Estimated number of years before replacement, | $n = 5$ years |
| Approximate interest rate, | $r = 20\%$ |
| Annuity factor (read from table) | $AF_{r,n} = 2.83$ |
| Annuity, $A = R/AF_{r,n} = 336/2.83 =$ US\$119 | |
| Number of households, | $N = 50$ (300 people) |
| Annual household tariff, $H = 1.2\left[\frac{M+A}{N}\right] = 1.2\left[\frac{35+119}{50}\right] =$ US\$3.70 | |

This can then be divided by 12 to convert to a monthly household tariff of US$0.30.

community-based management systems (Schouten & Moriarty, 2003). Appropriate institutional support comprises the following components:

- encouragement and motivation
- monitoring and evaluation
- participatory planning and regulation
- capacity building and
- specialist technical assistance (including financial support where required).

Such support obviously has an ongoing cost associated with it and although this has been largely ignored in the past, some governments are now attempting to address this. Nedjoh *et al.* (2003) cite the case of the Volta Region of Ghana where local government institutions earmark 6% of investment funds to increase access to rural water supply for monitoring and O&M of all new and existing systems. This is based on an ongoing programme to construct 100 new water points per annum, in an area with 500 existing water points. Obviously, institutional costs will vary considerably from location to location and it may be that a direct relationship with expansion investment is not always appropriate. It is essential, however, that the cost of institutional support is estimated and that appropriate budgetary allocation is made for this. Table 3 presents an example breakdown of costs for institutional support which shows the aspects which should be considered and estimated cost ratios for these. These costs are based on consultation with government agencies and NGOs in Ghana and are indicative only.

The above costing example equates to US$100 per supported community per year. Such a cost should not be excessive to a local government authority and for 100 communities is roughly the cost of one hand pump-equipped borehole in many African countries. The figure quoted could be reduced considerably further where institutions support a greater number of communities, where communities develop increased self-sufficiency, or where support from other stakeholders (e.g. non-profit organizations) is available. What is vitally important is that institutions attempt to estimate costs and budget accordingly.

Support costs need to be determined locally and appropriate long-term funding mechanisms sought. If full-cost recovery were to be realised from users, communities would also be expected to meet the cost of institutional support. Using the example of the hand pump water supply in Ghana, this would result in a tariff increase of 100% for an average community of 300 people. It would also mean that they would be required to pay this increase in taxation to local authorities, which would require the establishment of

Table 3. Example breakdown of costs for institutional support.

| Activity | Annual cost per 100 communities (US$) |
|---|---|
| Monitoring and evaluation: quarterly monitoring visits to all communities | 3,000 |
| Participatory planning and regulation: liaison with problem communities and CBOs to develop solutions | 2,000 |
| Specialist technical assistance: advice and intervention for unforeseen technical problems | 2,000 |
| Capacity building: training of stakeholders (staff, communities, private sector etc.) | 3,000 |
| Total annual cost per 100 communities = | 10,000 |

community-based organisations (CBOs) as legal entities and an effective regulatory framework. This remains a far-off goal at present and it is difficult to envisage CBOs ever agreeing to pay local government a proportion of the revenue raised from water users, particularly as there is often a traditional expectation that government should provide water services free-of-charge. The reality is that local government institutions need to develop budgets which recognize the need for such expenditure on a long-term basis.

Even where water supply management systems are not community based, institutional support costs are likely to remain at similar levels. In public-private models community-based support costs would be replaced with those related to regulation of the private sector. The added advantage of this model is that taxation of the private sector has the potential to contribute to funding this support. Although the cost of this would ultimately fall on rural communities, it removes some of the complexities that would be involved if local authorities attempted to recover costs directly from users. Private sector (rather than community-based) delivery of rural water services has been applied only on a small scale and in a small number of African countries, and these have not developed such taxation frameworks to date (Bernage, 2000; van Beers, 2001; Harvey *et al.*, 2003).

### *Costing long-term rehabilitation and expansion*

Any water system has a finite lifespan and will eventually require rehabilitation. In addition, the pressures of population growth on demand for services, and desired service levels among rural communities may change over time. When determining service delivery costs these aspects should also be considered. The cost of long-term rehabilitation does not refer to the replacement of equipment or components (as covered by O&M) but to larger scale measures, such as upgrade of systems. For the example of a hand pump-equipped borehole, eventually the borehole itself may need rehabilitation owing to problems such as siltation, insufficient yield and corrosion of screens or casing. Such measures may entail considerable cost and this must be met by the supporting institution and/or the users of the system.

Currently, most rehabilitation, upgrade and expansion costs are met by the supporting institution, whether government or NGO. Many government policies and strategies do not recognize the need for rehabilitation or, if they do, accept that they will have to finance this. For example, the five-year Rural Water and Sanitation Operation Plan in Uganda states that "Government will support major rehabilitation expenses in the interim, in the long-term it is expected that communities will also take over these expenses". (DWD, 2002). While this is a long-term strategic "expectation", it is a gross overestimation to assume that communities will be able and willing to finance major rehabilitation costs where they often fail to finance the simplest repairs. It is most likely that this will only be achieved, in Uganda and elsewhere, by adopting an incremental process where costs are clear from the beginning. If communities of users are to be expected to finance rehabilitation, even in the "long term", appropriate financing mechanisms must be established in advance. Using the method described above, the "rehabilitation annuity" needs to be estimated in addition to that for replacement. This can be done using the same equation and the current cost of the rehabilitation measure that will eventually be required.

$$\text{Rehabilitation annuity, } A_R = \frac{\text{Current rehabilitation cost}}{\text{Annuity factor } (AF_{r,n})} \tag{5}$$

The "rehabilitation annuity" can then be combined with the recurrent maintenance costs and replacement annuity to calculate the household contribution needed to finance recurrent O&M, medium-term replacement and long-term rehabilitation. This is demonstrated in the following equation:

$$\text{Annual household tariff, } H = 1.2\left[\frac{M + A + A_R}{N}\right] \tag{6}$$

Box 2 uses the previous example of the India Mark II hand pump to illustrate the impact of incorporating rehabilitation costs in household water tariffs. By incorporating the need for borehole rehabilitation in twenty years' time, the monthly household tariff increases by almost two-and-a-half times from the previous value of US$0.30. This may not seem a large amount but has a significant impact on planning and may affect the users' willingness to pay for the service.

The biggest problem with this method is the difficulty in estimating future rehabilitation needs and when that rehabilitation will be required. There is always an element of unpredictability about any system and what the users may demand in the future. For example, in future it may be that a borehole becomes contaminated or damaged and is beyond rehabilitation, meaning a new one must be drilled, or that a community decides it wants a newly available technology. In such situations, adequately financing rehabilitation from the outset is almost impossible. The best option may be to work in a degree of flexibility in tariff setting which allows for some funds to be put aside to contribute to future rehabilitation costs. It remains likely, however, that the majority of these costs will continue to be met by

Box 2 Example of household tariff setting to cover rehabilitation costs

Using the earlier example for the India Mark II hand pump:

Current rehabilitation cost, $R$ = US$1000 (for airlift and hydrofracturing)

$r = 20\%$ $n = 20$ years $N = 50$ households

$A_R = R/AF_{r,n} = 1000/4.67 =$ US$214

$H = 1.2\left[\frac{M+A+A_R}{N}\right] = 1.2\left[\frac{35+119+214}{50}\right] =$ US$8.83

This can then be divided by 12 to convert to a monthly household tariff of US$0.74.

governments or external support for the foreseeable future. A water tax which consolidates taxation funds for upgrading and rehabilitation may be one way in which appropriate finances can be generated.

### *Tariff hierarchy development*

Once the different categories of costs related to service sustainability have been determined, a tariff hierarchy can be developed which indicates the different tariffs that would need to be charged for different levels of cost recovery. Table 4 presents an example for the hand pump-equipped borehole whereby four levels of monthly household tariff are indicated. More complex water supply systems which rely on consumable energy sources such as electricity and diesel would obviously result in higher tariffs, especially for direct O&M costs. This approach can be used as a planning tool when conducting willingness to pay studies with communities and determining what costs can be met by users and what costs need to be met from alternative sources.

The last row in Table 4 is included to facilitate comparison with full cost recovery for the initial construction and associated costs (based on the same interest rate of 20% and repayment spread over ten years). This amount would need to be added to each of the above hierarchy levels if construction costs were also to be met from tariffs. As can be seen, this is a significant amount, even for a relatively low-cost technology, and is highly unlikely to be affordable by user communities.

## Community financing strategies

The importance of an initial contribution to capital costs by the community remains open to debate. Indeed, some studies have shown that a higher demand for a water supply service as expressed through initial payments in cash and/or kind is actually negatively related to sustaining the service (IRC, 2002). This may be because a small percentage contribution leads to high cost solutions which are expensive to sustain. The ability of a community (or its sponsors) to make an initial contribution to project inputs does not necessarily reflect an ability, or willingness, to pay for service delivery costs over time. There is also the danger that once communities have "paid" for their facility they consider that they have already fulfilled their responsibility.

Despite growing acceptance that full cost recovery from rural water users is an unrealistic goal, there is no doubt that community financing of operation and maintenance remains a crucial issue in the quest for sustainable rural water services. The assumption that poor people have no resources at all inevitably

Table 4. Tariff hierarchy example[a].

| Level of cost recovery | Estimated monthly household tariff (US$) |
|---|---|
| O&M (direct costs only) | 0.30 |
| O&M (direct costs and indirect costs) | 0.63 |
| O&M (direct costs) + rehabilitation/expansion | 0.74 |
| O&M (direct and indirect costs) + rehabilitation/expansion | 1.07 |
| Recovery of initial construction costs[b] | +4.23 |

[a] Example for India Mark II hand pump for a community of 300 people in Ghana.
[b] Based on cost of US$10,000 for borehole, hand pump and all associated start-up costs paid over 10 years.

leads to unsustainable subsidies and is usually inaccurate since many people are already paying a high price for sub-standard services (Evans, 1992). Indeed, the poorest people in developing countries pay more on average per litre of water than their better off compatriots (Webb & Iskandarani, 2001). Most communities do have resources and hence the ability to pay (at least something) for service delivery; however, the way in which those resources are managed will influence the ability of communities to access resources when needed, and the value assigned to a water service will affect the willingness to pay for services.

There are a number of key measures that need to be fulfilled to ensure sustainable community financing:

- Ongoing costs must be calculated and this information must be packaged in a way that communities can understand in order to make informed decisions.
- People need to be convinced of the concept of paying for water through appropriate community sensitization.
- Transparent and efficient financial management systems need to be developed.
- Willingness to pay among communities needs to be sustained through ongoing institutional support and promotion of income generation.
- Incremental strategies to phase out unsustainable subsidies, and/or develop mechanisms for sustainable cross-subsidy, need to be developed.

Costing O&M is the first step to ensure that communities are aware of ongoing costs and the financial commitment required to sustain their water systems. This allows them to select the most appropriate technology and system for them. Whatever financing system is to be used, it is essential that users are aware of typical costs from the outset and that those responsible for management are assisted in setting realistic and adequate water tariffs.

Convincing people to pay for water is often not easy in communities, especially where there is a history of receiving services for free. Past activities may have reinforced the perception of poverty and dependency among communities, which retard efforts to encourage them to pay. Political interference can also be a significant barrier to sustainable community financing since politicians commonly make promises of free services to communities for political gain (Komives & Stalker Prokopy, 2000). Changing attitudes can be difficult in such situations and requires considerable time and skills.

Accountability and transparency can go a long way to convince community members to contribute to O&M costs (Tayong & Poubom, 2002). It is important that users can see where their money is going and how it is being used, if they are to be convinced to contribute and to continue contributing. This is why it is sometimes easier to raise funds for the installation of a new facility than for its maintenance. Users may be unclear about why they should pay and what their money is being used for. If the principle of paying for water can be instilled, however, this dilemma disappears.

Community financing strategies need to include appropriate mechanisms for revenue collection and storage and investment of revenue, as well as measures to sustain willingness to pay within the community.

### *Revenue collection*

There are many different mechanisms by which maintenance funds can be collected and stored, and locally appropriate systems should be developed through consultation with communities. The most common funding systems are:

- reactive financing
- monthly tariffs and
- pay-as-you-fetch.

*Reactive financing* simply means that when a system fails or breaks down the community or better-off households club together to pay for repair. *Monthly tariffs* are perhaps the most widespread system whereby each household (or adult) in the community is expected to contribute a given amount each month. *Pay-as-you-fetch* systems require a caretaker to be present at the facility at all times (except when it is locked) to collect water tariffs from the community. Users pay a fixed amount per container which is filled by the caretaker.

The advanced collection of maintenance funds does not necessarily shorten the downtime of a given water system (Batchelor *et al.*, 2000), although seasonal cash flow variations may have a big impact on whether finances can be raised rapidly (van Miert & Binamungu, 2001). Where household tariffs are paid monthly and funds are stored safely, such systems can be highly successful. Revenue collection can be conducted by CBOs or private service providers, but can be a time-consuming process, particularly where non-payers need to be chased up. Traditional leaders and respected community members can play an important role in exerting pressure and deciding where exemption or subsidy is appropriate. The most common problem encountered, however, is that willingness to pay among households is difficult to sustain and this often reduces over time, often because of a lack of trust or confidence in the water management body. Pay-as-you-fetch systems are undoubtedly the most successful in terms of revenue generated but are only possible where there is a year-round cash economy.

### *Storage and investment of funds*

Since most rural African communities live from crisis to crisis and do not have a reliable year-round cash economy one of the major challenges in developing sustainable financing strategies is the need to establish functional mechanisms for storing funds in advance of breakdown. Where transparency and accountability are in place, maintenance funds may be stored in a bank account or with a treasurer. However, rural communities are often situated a long distance from the nearest bank, bank charges commonly rapidly eat away at the investment, or currency devaluation negates the link between funds and imported parts. An alternative strategy is for the treasurer to keep these funds for when they are needed, which relies on considerable self-discipline and the trust of the rest of the community.

In agriculture-based communities, money may be more readily available following harvests than at other times of the year. It is therefore important that alternative ways of storing resources are investigated so that funds can be raised when needed. Rather than use a bank account, communities can opt to run a cooperative whereby the water funds are used to purchase livestock or to support a community farm. Communal agricultural produce can then be sold when funds are required. This has the added advantage of avoiding devaluation effects.

Rotating savings and credit associations (ROSCAs) are cooperative financing strategies which can be used to mobilize savings for very small amounts of working capital and have been practiced for centuries in many parts of the world. Some African examples of ROSCAs include *Susu* in Ghana, *Stokvel* in South Africa, *Tontine* in most of francophone West Africa, "Merry-go-round" in Kenya, and *Chilemba* in Zambia (Williamson & Donahue, 2001). ROSCAs are designed to assist members to save money and regulate their liquidity. This is achieved by creating relationships of debt between members whereby monthly contributions are allocated to each member on a rotational basis. Since the typical ROSCA member dislikes owing the other members they are driven to fulfil their commitment to the ROSCA more reliably than they would be able to independently maintain a regular habit of saving money (Aliber, 2001).

Traditional ROSCAs, such as the "Merry-go-round" scheme in Kenya, have been used to raise capital for community contributions to construction and O&M costs for rural water systems (Harvey *et al.*, 2003). Where there is a history of cooperative financing, it is often significantly easier to raise water revenue. Such schemes can also be used to build up credit worthiness with financial institutions and generate capital for investment and income generation. There is, therefore, potential for the application of ROSCAs to be expanded to meet long-term water supply rehabilitation and expansion costs. However, this will only be successful if communities are convinced that this is their responsibility rather than that of government. There is no well-documented evidence to suggest that ROSCAs have been applied in such a way to date, but this issue requires further investigation.

### *Privately-managed O&M*

Whether systems are managed by the community or the private sector, many of the same issues surrounding community financing apply. For rural water supplies which are managed by a private contractor or individual rather than the community, users regularly pay the contractor to run and maintain the system and may be less concerned about where the money goes and what it is used for, so long as the water supply continues to operate at the desired service level. The storage of funds becomes the responsibility of the private company which removes one level of complexity at community level. This does not, however, remove problems which may occur owing to seasonal cash-flow fluctuations. Private contractors will also need to meet overheads and meet profit targets. These costs must be included in estimating total O&M costs and setting household tariffs. However, where a company is responsible for a large number of systems for many communities, the impact of these costs on each community is likely to become very small. Given the negligible application of privately managed O&M systems in rural sub-Saharan Africa to date, however, it is not possible to assess their potential impacts on community financing adequately.

### *Sustaining willingness to pay*

Services which rely on the users to finance ongoing running costs will only be sustainable if the willingness of users to pay is sustained. Community members who are willing to finance O&M costs in the initial stages may soon become unwilling to do so. There are a variety of possible reasons for this reduced willingness to pay:

- lack of transparency and accountability relating to the water management committee,
- no faults with the facility and therefore no clear reason for paying,
- dissatisfaction with water supply (location, time to queue, water quality/quantity),
- competition from cheaper water sources and
- change in individual priorities.

Perhaps the most effective mechanism that can be used to sustain willingness to pay is appropriate institutional support for communities. Where communities are regularly visited by an overseeing institution to monitor systems this reaffirms the need to contribute to the cost of O&M. The institution can advise communities on how to make best use of unspent funds through investment, can regulate water committees to ensure transparency, and can help to rectify any causes of dissatisfaction with a particular water system. Quarterly monitoring visits provide an ideal mechanism to identify problems early and find sustainable solutions.

The second measure that can assist greatly in sustaining willingness to pay relies on a major mind shift among community members. If water supply users understand that they must pay for water, rather than to maintain a system, many of the obstacles to sustained community financing disappear. Such a mindset needs to be established early on in the community consultation process and, where there are existing facilities installed under different programmes, this is likely to be difficult to achieve. New programmes, however, have the opportunity to develop awareness and place the emphasis on "water" rather than the "facility". If users accept from the outset that they have to pay for water from an improved water supply and that this will always be the case, financing is more likely to be sustained, providing that the service supplied meets the standard demanded by the users.

Another key measure to ensure sustained financing of O&M is to use water to generate income. Where water directly leads to income generation, the problem of community financing may become significantly less since water users have increased incentive to ensure that the system keeps operating and are more likely to have finances readily available to enable O&M. Water-related income generation ventures in rural areas include livestock watering, irrigation for market gardens, block making, beer brewing and food processing. There is little documented evidence, however, of successful income generation from systems designed primarily for the supply of drinking water.

## Pro-poor financing strategies

The United Nations Committee on Economic, Cultural and Social Rights issued a statement in November 2002 declaring access to water a human right and stating that water is a social and cultural good, not merely an economic commodity (World Water Council, 2002). However, the necessary financing and governance structures to guarantee access to safe, sufficient and affordable water are commonly lacking (Mehta, 2004). In order to achieve this aim it is important to find ways in which to serve the poorest and most vulnerable, while ensuring that sufficient finances are generated to sustain services. As has been mentioned, full cost recovery for operation and maintenance from rural communities in Africa, at least on a large scale, has not been achieved to date. This indicates that capital and recurrent costs are routinely subsidized by external support agencies or governments. This should not be a cause for surprise. Most urban water authorities depend on subsidies to cover part of their recurrent costs and virtually all their capital spending on expansion and modernization (Winpenny, 2003). There is, therefore, no logical reason why higher rates of cost recovery should be expected from rural water users, who are in general, poorer.

Subsidy in itself is not a threat to sustainability provided that the subsidies themselves are either transitional or sustainable. The World Panel on Financing Water Infrastructure recommends that subsidies should be "targeted, transparent and, where they are intended to ease the transition to higher tariffs, tapering" (Winpenny, 2003). Inherent within this statement is recognition of the fact that while some subsidies may act as a bridge to the generation of higher revenues, equally some subsidies may be required on an indefinite basis. What is essential is that such subsidies are affordable in the long term and are budgeted for accordingly.

### *Least subsidy option*

One way to ensure that the poor are adequately served is to offer direct subsidies to poor communities. These are likely to be partial rather than total subsidies, and in effect this is often what happens since users rarely meet the full cost of O&M. A formalized version of this is the bidding for least subsidy approach (Figure 1). In this model private service providers bid for the minimum or least subsidy from government to provide water systems at agreed service levels for a period of say, 10 to 15 years. These private companies need to assess and negotiate the community contribution they will get for O&M. The government then pays the minimum subsidy to the company and the communities pay their water tariffs. This model has not been applied to rural water services in Africa to date but its application to other sectors, such as rural telecommunications (Cannock, 2001), demonstrates considerable potential for where services are delivered by the private sector.

### *Community cross subsidy*

Many poor rural people are currently subsidized by other more affluent members of their community. Community management systems often recognize that some households are unable to afford water tariffs and therefore exempt them from payment (Harvey *et al.*, 2003). This is a sensitive issue since it may give rise to internal disagreement or envy and is open to abuse. It is, however, highly effective where community management is strong and allows the poorest and most vulnerable to be supported and

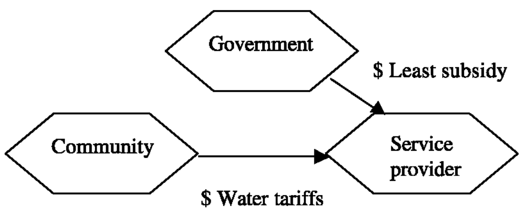


Fig. 1. Least subsidy option.

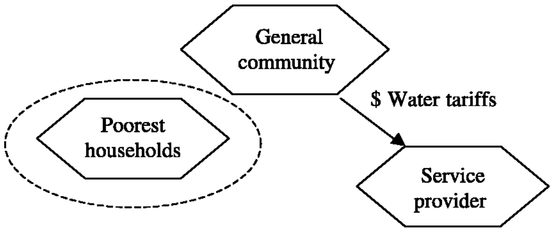


Fig. 2. Community cross subsidy.

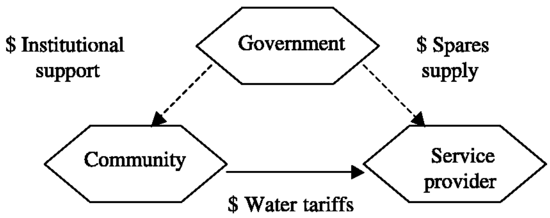


Fig. 3. Hidden subsidies (dashed).

protected by the rest of the community. The service provider in this case may be a CBO or private individual/organization (Figure 2).

This system of cross subsidy within a community is difficult to formalize and relies upon the goodwill and objectivity of the management committee. For privately managed water supplies a more formalized system is to apply individual means-tested water subsidies whereby the poorest households receive a government subsidy and pay less for water. The subsidy may be funded entirely by the government or from other users. This has been successfully implemented for urban water services delivered by the private sector (Gómez-Lobo, 2001) but has not yet been transferred to the rural sector.

### *Hidden subsidies*

Some subsidies for operation and maintenance of rural water supplies are indirect or "hidden". These commonly include support for spare parts supply, storage and distribution, and monitoring, regulation and institutional support for communities. Here, the service provider may be a local mechanic who obtains spare parts from a local NGO or subsidized dealer (Figure 3). It may be accepted that some level of such subsidy is needed, particularly for institutional support, but where possible, attempts should be made to phase out hidden subsidies over time and these costs should be worked into long-term financial plans.

## Conclusions

There is growing acceptance that full cost recovery for rural water services is an unrealistic goal, since the capital costs of water infrastructure provision remain beyond the means of most rural communities. Yet while communities are widely expected to finance recurrent operation and maintenance costs, this goal is still not being realized in many parts of sub-Saharan Africa. One of the reasons for this is an *ad hoc* approach to estimating costs and establishing tariffs. If sustainable financing strategies are to be developed, it is essential that the cost of ongoing service delivery is determined, so that communities, local authorities and implementing agencies are aware of the long-term costs involved and can plan accordingly.

One way in which this can be achieved is to develop a tariff hierarchy that provides estimates of the tariffs required for different levels of cost recovery. This can be done only by conducting a comprehensive assessment of the maintenance, repair and rehabilitation needs for different water system technologies and costing these. The vast majority of implementing agencies do not do this and consequently it is unclear what selected tariffs can be expected to cover and what additional financing may be required. Unless this situation changes, rural water systems are likely to continue rapidly to fall into disrepair and the need for rehabilitation projects is likely to continue *ad infinitum*.

The research in Ghana indicated that direct O&M costs are generally affordable for rural communities but that there is a need to take action to sustain willingness to pay and to develop appropriate community financing strategies which are matched to the specific characteristics of communities. These strategies must consider both how water revenue is collected and also how it is stored or invested.

The costs of institutional support from local government authorities (or substitute agencies) need to be met by public financing and must be budgeted for accordingly. If private sector service delivery becomes more widespread, it is possible that this can be met from tax revenue raised from end users, but this remains a far-off goal at present. The costs of rehabilitation and expansion of water systems can, in theory, be met by user communities but this raises tariffs significantly and is largely dependent on community acceptance of the need to pay for water. This also makes the need for appropriate investment of water revenue even more crucial and new approaches need to be investigated.

There is a need for realism from all stakeholders to identify what costs can be met by water users and what costs need to be met by national or external support. Just as the vast majority of urban water services require some form of subsidy, so do rural water services. This issue cannot be avoided by pretending that the goal of cost recovery for ongoing running costs is currently realistic. There is a need for policy makers and strategic planners in international development agencies and national governments to face up to this issue. They will only do so if sector professionals are prepared to calculate the real costs involved in service delivery and to develop and advocate realistic financing strategies, which will almost certainly need to include targeted and transparent subsidies, at least for the foreseeable future.

## Acknowledgements

The initial research for this paper was conducted as part of a Knowledge and Research (KaR) project "Guidelines for Sustainable Hand pump Projects in Africa" (R7817), funded by the Department for International Development (DFID) of the British Government, and conducted by the Water, Engineering and Development Centre (WEDC), Loughborough University. Opinions noted within this paper do not necessarily represent those of DFID or the project team but are solely those of the author.

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