WASHCost

Working Paper 9

Financing capital maintenance of rural water supply systems: current practices and future options

Catarina Fonseca, Stef Smits, Kwabena Nyarko, Arjen Naafs and Richard Franceys

IRC International Water and Sanitation Centre

March 2013

triple-s
WATER SERVICES THAT LAST

Acknowledgements

The authors would like to thank the peer reviewers of this document: Peter Burr, Jim Gibson, Eric Stowe, Stephen Jones, Ned Breslin and Patrick Moriarty.

Also, we extend our thanks to the WASHCost teams for providing and analysing data on operational and maintenance costs, namely the following researchers:

- Ghana: Dr. Kwabena Nyarko, Bismarck Dwumfour-Asare, Eugene Appiah-Effah and Alex Obuobisa-Darko
- Mozambique: Arjen Naafs, André Uandela andJúlia Zita
- India, Andhra Pradesh: Dr. Mekala Snehalatha, Prof. Ratna Reddy, Dr. Charles Batchelor, Jayakumar Nagaran and Anitha Vooraboina

This Working Paper was edited by Andy Brown.

Contact
Catarina Fonseca: fonseca@irc.nl
Stef Smits: smits@irc.nl

Photo
Dismantling a submersible pump for major repair in Kammiesberg, South Africa (Stef Smits/ IRC)

Design and layout
Tasja van der Veen, info@bingo-graphicdesign.com

WASHCost is a five-year action research project investigating the costs of providing water, sanitation and hygiene services to rural and peri-urban communities in Ghana, Burkina Faso, Mozambique and India (Andhra Pradesh). The objectives of collecting and disaggregating cost data over the full life cycle of WASH services are to be able to analyse expenditure per infrastructure, by service level, per person and per user. The overall aim is to enable those who fund, plan and budget for services to understand better costs and service levels to enable more cost effective and equitable service delivery. WASHCost is focused on exploring and sharing an understanding of the costs of sustainable services (see www.washcost.info).

Triple-S (Sustainable Services at Scale) is an initiative to promote 'water services that last' by encouraging a shift in approach to rural water supply—from one that focuses on implementing infrastructure projects to one that aims at delivering a reliable and lasting service. The initiative is managed by IRC International Water and Sanitation Centre in the Netherlands in collaboration with agencies in different countries (see http://www.waterservicesthatlast.org/).

Contents

Tables

Figures

Abbreviations and acronyms

ACR	A Child's Right (now Splash)
ADERASA	Association of Regulatory Authorities of Water and Sanitation for the Americas
AIAS	Administration for Water and Sanitation Infrastructures, Mozambique
AWSDB	Association of Water and Sanitation Development Boards, Ghana
CAGECE	Ceara Water and Sewage Treatment Company, Brazil
CapEx	Capital expenditure
CapManEx	Capital maintenance expenditure
CBM	Community-based management
CBO	Community-based organisation
CIDA	Canadian International Development Agency
CRA	Regulatory Commission for Water and Sanitation, Colombia
CWSA	Community Water and Sanitation Agency, Ghana
DNA	National Water Directorate, Mozambique
DWSSC	Directorate of Water Supply and Sanitation Coordination, Namibia
GDP	Gross domestic product
GLAAS	UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water
INGO	International non-governmental organisation
LCCA	Life-cycle costs approach
MMDA	Metropolitan, Municipal and District Assembly, Ghana
NGO	Non-governmental organisation
O&M	Operation and maintenance
ODA	Official development assistance
OECD	Organisation for Economic Co-operation and Development
Ofwat	Water Services Regulation Authority, UK
OpEx	Operational and minor maintenance expenditure
PRONASAR	National Rural Water Supply Program, Mozambique
RWSN	Rural Water Supply Network
SANAA	National Autonomous Water and Sewerage Service, Honduras
SISAR	Integrated System for Rural Sanitation, South Africa
SSA	Support services agency, South Africa
SSF	Sustainability Savings Fund
WASH	Water, sanitation and hygiene
WHO	World Health Organization
WSDB	Water and Sanitation Development Board, Ghana

NB: Acronyms are only listed here if they are used more than once in the text. The full version of each acronym is always given upon first use in the text.

Abstract

As part of the effort to increase access to rural water supply over the past decades, large numbers of infrastructure assets have been developed. This has been accompanied by measures to begin to cover the administration, operational and minor maintenance costs of these services, including occasionally the introduction of user charges. However, mechanisms to finance long-term or capital maintenance, i.e., the renewal and replacement of fixed assets, have been less clearly defined and on-going asset management is rarely planned for in programme implementation. Tariffs, where used, are usually set at a level that should cover operational and minor maintenance but not the full replacement costs of assets. A cash accounting approach and the fear that any tariffs would be unaffordable to rural users, has led to a reluctance to introduce cost-reflective pricing in many low-income countries, much as in high-income countries.

In practice, irregular, 'lumpy' capital maintenance costs, which occur for instance when a pump needs to be replaced or a borehole redeveloped, are covered through a combination of any savings made by the community service provider and ad hoc funding by the service authority or an external project or programme. Unfortunately, in many cases, these expenditures are simply not made, resulting in insufficient capital maintenance, which is reflected in high rates of non-functionality and poor service levels.

This working paper provides case-study evidence on current practices around funding capital maintenance, including the levels of funding provided and the resulting impact on services. In addition, it seeks to quantify the range of capital maintenance expenditure required to provide a basic level of service. It also reviews potential approaches to improve the way in which the financing of capital maintenance of rural water supplies is organised. The approaches to financing capital maintenance reviewed in this working paper include regional pooled funds, insurances, pooled front-loaded and end-loaded external contributions. Case studies and examples are drawn from Latin America, Africa and Asia.

Key findings

Sustainability and service levels achieved with investments in rural water supply in developing countries are under-performing. One critical factor is the lack of options for funding the lumpy expenditures required for capital maintenance. As a result:

- In community managed contexts, water committees 'muddle through', scraping together funds from an external party to complement their own savings when systems need large maintenance;
- When tariffs and user charges are collected, often service providers do not raise sufficient funds to cover capital maintenance costs;
- Some governments and organisations have introduced provisions on their budgets for capital maintenance, but expenditure is directed towards other priorities; and
- When governmental expenditure for capital maintenance is used in rehabilitation efforts, value for money is reduced as we let infrastructure fail completely instead of performing regular maintenance.

Potential financiers of capital investment in rural water services should ask themselves how the funding of capital maintenance is arranged and whether funding is likely to be forthcoming. If the answer is no, they should accept that either:

- Their investment in water infrastructure is unlikely to be sustainable and will not provide the envisioned level of service for more than a couple of years; or
- A shift in priorities for financial allocation is required to ensure the investment is not completely lost and services will not suffer from discontinuity.

The case studies described in this paper suggest various options for more organised co-financing of capital maintenance between users and government:

- Ad hoc arrangements which do not require external oversight or regulatory arrangements.
- Specific capital maintenance funds with annual allocations from the national budget, replenished by resources from user charges.
- Other promising mechanisms include insurances and ring-fenced funds at donor/external level.

Recommendations for improving financing of capital maintenance expenditures:

- Making explicit who is responsible for capital maintenance.
- Understanding current and future capital maintenance needs.
- Promoting a more 'regulatory' approach to strengthen accountability mechanisms for capital maintenance.
- Implementing embryonic asset management planning supported by fixed asset accounting.
- Understanding current funding mechanisms for capital maintenance and improving financing modalities.

Illustration 1: Who is responsible for maintenance

Source: Fonseca, Brikké and Kouassi Komlan, 2005, p. 172.

1 Introduction

Infrastructure supports the way society works and the development of public infrastructure is the focus of governments and public finances. For infrastructure to remain useful, maintenance is key. Maintenance is defined as the activities which allow infrastructure to effectively deliver the outputs for which they were built ((Gyamfi, Gutierrez and Yepes Boscán, 1992).

Within the rural water supply sector, it is common to talk about the operation and maintenance (O&M) of infrastructure, as shown by key reference publications on this topic, e.g., Brikké (2000), Schouten and Moriarty (2003), Harvey (2005) and Harvey and Reed (2006). However, the term 'operation and maintenance' fails to distinguish between three types of activities that are qualitatively different: operations, which refers to activities to make the infrastructure work (switching on pumps or sending out water bills), minor maintenance (changing nuts and bolts or greasing pumps) and capital maintenance, which concerns the renewal, replacement or rehabilitation of either the entire infrastructure or its major components (replacing generators, pumps or storage tanks, or emptying latrines) (Franceys and Pezon, 2010). Capital maintenance typically occurs more infrequently but is considerably more costly than minor maintenance. This differentiation is important in clarifying who is responsible for carrying out these tasks and covering their costs, as illustrated in the previous page, and further elaborated in cases in this document.

Since the 1980s, significant efforts have gone into ensuring the appropriate operation and maintenance of water supply services, often by establishing service providers to carry out these tasks and financing mechanisms to cover the costs (Fonseca, Franceys and Perry, 2010). Consequently the main modality for service provision in rural areas has become community-based management (CBM). CBM has undoubtedly brought many benefits and has certainly improved the performance of water supply systems in some cases (e.g., Bakalian and Wakeman, 2009). Nevertheless, it also has many inherent limitations (Schouten and Moriarty, 2003; RWSN, 2010), leading to many communities persistently struggling with sustaining their water supplies, with some succeeding and others failing. This gave rise to the notion of 'islands of success' (Davis and Iyer, 2002). In spite of these limitations, CBM remains the preferred or default management option in many rural areas (Lockwood and Smits, 2011).

In the 1990s, within the context of community-based management models, the concept of cost recovery was addressed in which users would be required to pay some form of user charge or tariff for water supply[1], to (re)cover, at least, the operational and minor maintenance costs. Community-based service providers, it was assumed, would be responsible for setting and collecting tariffs and using the funds to carry out operational and maintenance activities (Komives and Prokopy, 2000; Brikké and Rojas, 2001; Cardone and Fonseca, 2004). Recognising the challenge of ensuring that user charges were 'cost reflective' (i.e., covering all costs), the Camdessus panel on financing introduced the term 'sustainable cost recovery'. This concept was proposed as a way of giving the water sector the financial assurance it needs, while acknowledging affordability problems for the poorest and the need for subsidies in some circumstances (Winpenny, 2003; Organisation for Economic Co-operation and Development (OECD, 2009).

Both the concept and practice of paying some form of user charge for water services to recover costs have become accepted, mainly in the urban water sector. In addition, in community-based management, contributions to capital expenditure have become a synonym for the concept of 'increased ownership' of the service. Over the last decade, more and more service providers in middle-income countries have been able to collect tariffs. For example, Smits et al. (2012) report in a study in Colombia, how they found that levels of non-payment of monthly tariffs are approximately 15%, a significant reduction compared to a decade ago. They argue that this reduction is partly thanks to the consistent work of government and community-based service providers to instil the notion among users that providing services has a cost and that these costs need to be paid for.

1 A user charge refers to all payments, i.e., contributions to capital expenditure, community support mechanisms, one-off repair contributions and/or recurrent expenditures. Tariffs tend to refer only to regular cost recovery of recurrent costs.

However, despite growing acceptance that communities need to make a reasonable contribution to the costs of water supply, there is a lack of understanding and agreement on the extent to which costs can be covered by these contributions. In many lower-income countries community contributions barely cover operation and minor maintenance costs and depreciation of assets is charged for only in exceptional cases (Moriarty et al., 2010). Depreciation is the accounting charge by which service providers build up a reserve to pay for capital maintenance, even though this may not be necessary until some years later. As a consequence, long-term maintenance is often left to entities from outside the community, e.g., local or national government, non-governmental organisations (NGOs) or donors, who have to intervene with rehabilitation projects and programmes.

The Rural Water Supply Network's reported rates of non-functionality across the sector, which are as high as 30-40% (RWSN, 2010), provide a strong indication that existing mechanisms for financing capital maintenance are inadequate. This raises many questions: How big is the gap for maintenance needs? Are there other, more efficient ways of arranging capital maintenance? This paper explores these questions. Its objective is to review current practices for financing capital maintenance and identify alternatives. Specific objectives include:

- describing current arrangements for financing capital maintenance and the extent to which they are able to cover the costs of all necessary capital maintenance activities;
- identifying existing gaps in financing capital maintenance and impacts on service provision; and
- providing an overview of alternative arrangements for financing capital; and maintenance in rural water supply and inspiring organisations in the sector and governments to pilot and document these and other innovative approaches.

The paper starts by providing a conceptual framework for capital maintenance, with definitions and related concepts. It explores how capital maintenance fits within regulatory accounting. Based on this, the methodology for the study is described in section 2. Section 3 summarises current practices for financing capital maintenance, exploring the extent to which there is a gap between actual and required expenditure and highlighting its impact. Section 4 describes alternative arrangements for financing capital maintenance and, finally, section 5 presents the conclusions, and suggests subsequent steps to improve the financing of capital maintenance.

2 Conceptual framework and methodology

2.1 Introduction to asset management

Water supply is a capital-intensive sector and requires costly investments in infrastructure such as pumps, pipes, storage tanks, dams etc. These fixed assets need to be maintained. Most major infrastructure, such as roads, sewers and sidewalks, requires some form of asset management, and water supply is no exception. Asset management is "the combination of management, financial, economic, engineering and other practices applied to physical assets with the objective of providing the required level of service in the most cost-effective manner" (National Asset Management Steering Group, 2006).

Asset management leads to more realistic budgeting and planning and enables considerable cost savings over the medium and long term (World Bank, 1994; Rioja, 2003). An asset management plan makes explicit the costs of regular operation and maintenance, non-regular maintenance, replacement and renewal planned over the life of the asset. This aim is to minimise the costs of service delivery, while ensuring the functionality of each asset in the system. Sometimes asset replacement is passed on to the next generation; the 100-year-old water mains which still supply parts of London, Paris and other major cities are excellent cases in point. In the past decade, to reduce leakage and ensure that growing populations continue to receive the water they need, Thames Water (supplying London) and Eau de Paris have re-invested in replacing over hundreds of kilometres of pipes (Thames Water, 2001). However, as we will see in the remainder of this paper, a structured approach to asset management in the rural water sector in low-income countries has barely moved off the ground.

In Europe, it was a long time before asset renewal and replacement was addressed in a structured way. In his historical overview of water services development in Europe, Barraqué (2009) argues that water supply did not become 'a mature business' until the 1950s, and only then started to face the challenge of ageing infrastructure and asset renewal. Before then the capital maintenance gap was filled largely with public subsidies from national and local authorities, as part of their efforts to universalise access to services. After the 1950s subsidies became scarcer and other ways to account for asset renewal and depreciation were needed, as well as ways to overcome some of the perverse incentives mentioned above. Asset management practices have therefore only started to evolve since the 1980s, driven both by the need for efficient asset renewal and the potential of information technology to capture asset data and maintenance activity. The use of the results for preventive or timely reactive maintenance of assets has reduced the costs of premature failure.

Subsequently, rapid progress has been made in the Western world in applying asset management in the water sector. Shortly after privatisation in England and Wales in 1993, the director of the economic regulator, Ofwat (2007), wrote to the regulatory directors of all water and sewerage companies setting ground rules for the provision of asset maintenance, to include a distinction between the provision for backlog maintenance required to bring assets up to steady state and the long-term maintenance required to deliver on-going 'serviceability'. In the US, without the driver of privatisation, the standard for infrastructure assets for financial statements of national and local governments was developed in 1999 (Garvin, 2008). Since then new rules have triggered the development of accounting procedures, documentation and systems to support the full implementation of asset management in high-income countries.

2.2 Regulatory accounting and asset management

The funds required for asset management planning and the subsequent implementation of capital maintenance are raised through a mix of user charges and budgetary allocations. The amount required is determined through budgeting and accounting procedures. In the context particularly of privatised urban service providers, regulatory accounting is used, whereby a public economic regulator sets the rules for determining how the different service costs are categorised and to what extent present user charges and budgeting have to include provisions for future capital maintenance costs. The concepts underlying regulatory accounting are now being extended to public or community service providers.

The main purpose of regulatory accounting is to monitor and control regulated entities to promote their efficiency and performance (Ferro and Lentini, 2009). In low-income countries regulatory accounting in the water sector is a very recent innovation and is applied mainly to urban utilities, and even then with considerable uncertainty. According to the Association of Regulatory Authorities of Water and Sanitation for the Americas (Asociación de Entes Reguladores de Agua Potable y Saneamiento de las Américas; ADERASA) in many countries in Latin America there is no regulatory control of accounting practices as most entities lack detailed information on cost structures and regulatory norms. This leads to inconsistent accounting information (Férnandez, Jouravlev, Lentini and Yurquina, 2009).

A key aspect of regulatory accounting is to allow for the effects of inflation in asset management. The depreciation charge is normally calculated by determining an average life for an asset (5, 15 or perhaps 30 years) and then dividing the original implementation cost by the assumed life. This gives the annual amount to be set aside for future capital maintenance expenditure. Where inflation is high and the calculation is based only on the historical cost any depreciation reserve is unlikely to be sufficient to pay for renewals. Regulatory accounting therefore uses the concept of 'current cost accounting' whereby the value of the assets is updated each year by an amount reflecting the level of inflation. This ensures that there are sufficient funds to renew assets when the time comes.

The gap in regulatory accounting and asset management for water supply between developed and developing countries is therefore large and is larger still for the rural sector. However, the solution to the problems facing rural water infrastructure over the last thirty years, described in the first section of this paper, can only improve if the asset management approach is gradually adopted by the organisations responsible for funding, planning and managing rural water services.

The rural water sector faces a particular challenge in that the shorter-life, 'appropriate technology' solutions that have been rightly promoted to deliver services sooner rather than later also require capital asset management and maintenance sooner rather than later. Foot valves and rising mains in handpumps do not have the 100-year life of the pipes in London and Paris. The question that has to be addressed therefore is that, if investment in short-life rural water supply assets requires donors to fund capital investment, it is most likely that they will also have to invest in capital maintenance. Economic growth in rural areas is unlikely to deliver a level of wealth and willingness to pay for infrastructure within the lifespan of the typical rural water supply asset.

2.3 Definitions of maintenance

In line with regulatory accounting terminology, this paper makes a distinction between operational and minor maintenance expenditure (OpEx), and capital maintenance expenditure (CapManEx) (Fonseca et al., 2011).

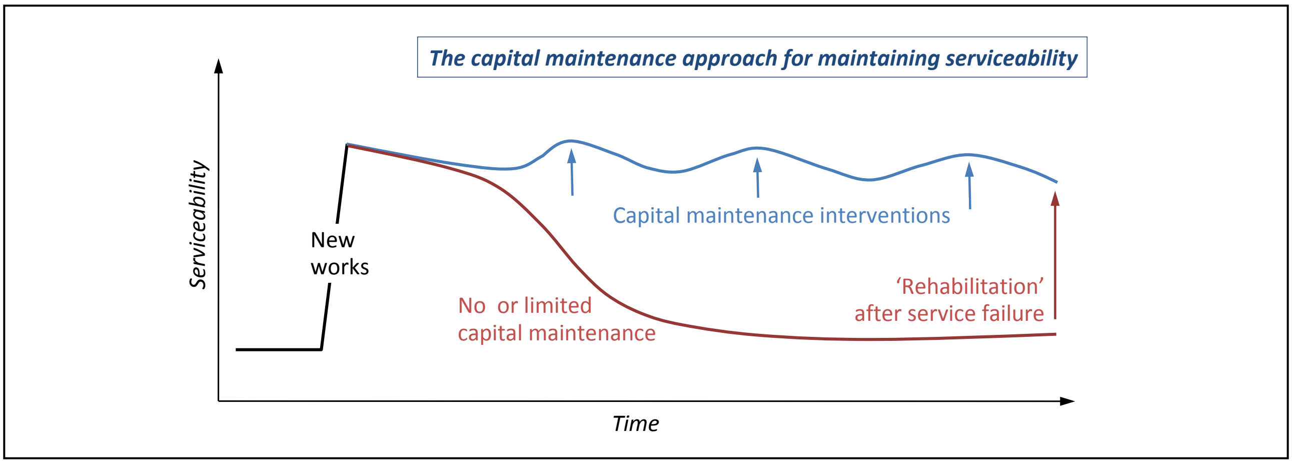
Operational and minor maintenance expenditure refers to recurrent, regular and ongoing expenditure on labour, fuel, chemicals, materials or purchases of bulk water. Minor maintenance is routine maintenance needed to keep systems running at design performance, but does not include major repairs or renewals. Households' willingness to pay for the service provider's OpEx can be affected by the level of their own 'coping costs', i.e., the money they have to spend on achieving a satisfactory level of service (storage, water purification, etc.). Some would argue that a further distinction should be made between operational expenditure and minor maintenance, as they are qualitatively different in nature. Operational costs are typically related to human resources and energy costs (diesel or electricity), while minor maintenance costs are more related to materials. However, both are relatively stable expenditures incurred on an ongoing basis and are different from capital maintenance expenditure, which is bulky and irregular.

Ofwat (2005) defines capital maintenance as how "companies are required to maintain the operating capability of their asset systems to ensure continuity of service for current and future customers". Capital maintenance expenditure meets the costs of renewing (replacing, rehabilitating, refurbishing, restoring) assets to ensure that services continue at a similar level of performance as was first delivered. Examples include replacing a motor on a powered pump or the pump rods, rising main or handle of a handpump, cleaning or re-excavating the base of a hand-dug well, flushing a borehole which no longer delivers the desired flow etc. Renewing these assets, often after some years of operation, ensures the same level of service that users received when the asset was first installed.

Ensuring that capital maintenance takes place is crucial to the sustainability of water, sanitation and hygiene (WASH) services. In figure 1, the red line shows the common decline in service levels in the absence of capital maintenance as a system degrades (for individual assets the decline may not be so smooth). Service failure leads to the need for significant capital expenditure to renew or replace the asset. The blue line shows service levels being maintained as the asset is maintained regularly and more efficiently (Franceys and Pezon, 2010). The red line therefore shows systems being allowed to 'run to failure', with assets being replaced after they have failed. Some argue that this is a valid approach as long as it does not lead to a significant reduction in overall serviceability (i.e., no greater than the dips in the blue line) by ensuring that alternatives are readily accessible if assets are part of a non-networked system, and that asset failures are 'immediately' fixed.

The distinction between ongoing minor maintenance labelled as OpEx and renewals costs charged as CapManEx is often necessarily arbitrary, with accountants recommending that costs be allocated as best fits particular reporting needs. A rule of thumb to distinguish between the two types of recurrent expenditure is that the former tends to be regular – daily, weekly or monthly – and the latter irregular and 'lumpy', i.e., disproportionally large relative to normal operating expenses and likely to occur, for any particular asset, with a frequency longer than a year or two.

Figure 1 **Capital maintenance approach for maintaining serviceability**



Source: Franceys and Pezon, 2010, p.3.

2.4 Methodology

This paper draws on various sources of information. The section on current capital maintenance practices is largely based on the results of the WASHCost project in Burkina Faso, Ghana, India and Mozambique. It draws specifically from primary data on actual expenditure on capital maintenance and on actual service levels. For further information on how this data was collected and processed see Burr and Fonseca (2013). This information was complemented by a literature review of experiences with capital maintenance for rural water supply in developing countries, specifically analysing the case studies prepared by Lockwood and Smits (2011) and Smits et al. (2011) on direct support to service providers, as such support often contains an element of capital maintenance.

To identify alternative options, a further literature review was undertaken to examine arrangements for capital maintenance. This was complemented by the results of interviews and discussions on improving capital maintenance expenditure for rural water supply during WASHCost training sessions, international events and in the four countries where the WASHCost project carried out research.

It should be noted that, as many of these proposals for improvement are still in a conceptual, or at best pilot, stage, there is as yet little evidence on their actual performance. They must therefore be seen as areas for exploration rather than a full assessment of the pros and cons of each approach.

Although the scope of the study is rural water supply, references are made to capital maintenance in urban and small-town water supply, where it is more advanced. Examples are also drawn from sanitation, but it is not explicitly part of the study. In theory, many of the arguments and conclusions made in this study could also apply to collective/public sanitation options but these have not been addressed here.

3 Current arrangements for financing capital maintenance expenditure

What does capital maintenance cost? How is it being financed? This section discusses general trends in the arrangements for capital maintenance in a range of countries, with more detailed examples from the countries where WASHCost undertook research. The results are presented following a typology of how capital maintenance is financed: through user charges and tariffs or co-financing by central or local government or donors. This is followed by an analysis of the real costs of capital maintenance. The section concludes by analysing the impact of these current practices on actual service delivery.

3.1 Capital maintenance financed through direct user charges

Various countries have enshrined the principles of 'sustainable cost recovery', i.e., users pay tariffs that cover all costs, including those of capital maintenance (but rarely including the regulatory accounting ideal of the 'cost of capital'). These principles are also reflected in their policies and regulations for rural water supply (Fonseca, Franceys and Perry, 2010). However, this does not guarantee that service providers follow these policy guidelines and regulations.

In **Colombia**, the Regulatory Commission for Water and Sanitation (CRA) has tariff guidelines that require any service provider – including community-based ones – to include the full cost of assumed depreciation of the assets in the tariffs to ensure sustainability. Affordability is addressed by allowing for cross-subsidies between better-off and poorer users. A study of 40 rural water service providers showed that 23 initially followed the required tariff calculation but eventually decided not to include the costs of depreciation of the assets into the tariff levels, though their tariffs did allow for full recovery of administration, operation and maintenance costs (Smits et al., 2012). The remaining had tariff levels that were not even adequate to cover minor operation and maintenance costs.

In **Ghana**, the by-laws developed by the Ministry of Local Government and Rural Development (MLGRD, 2008) do not set tariff levels which include capital maintenance costs. But the by-laws require that all Water and Sanitation Development Boards (WSDBs) operate three separate accounts: the operational account, the sanitation account (not less than 10% of net revenue after paying for all regular operations and maintenance) and the capital account (not less than 20% of net revenue). The capital account is to be used for major repairs, extensions and replacement of the water systems and not for routine operation and maintenance. It further states that the WSDBs responsible for service provision of small piped systems in Ghana should make monthly payments into the capital account amounting to not less than 20% of the net monthly revenue accrued from water sales after all regular operation and maintenance costs have been paid. The document further states that the Metropolitan, Municipal and District Assemblies (MMDAs) may allocate funds to the capital account annually through their regular budgetary allocation.

The tariff-setting guidelines of the Community Water and Sanitation Agency (CWSA) make provision for the replacement, rehabilitation and expansion of the water system, which is set at 25% of operational costs (CWSA, 2011). Operational costs are made up of water production, water distribution, routine maintenance, repair works, water quality monitoring and tariff collection expenses. In addition to operational expenses, the guidelines make provisions for replacement (20% of operational expenses), rehabilitation and expansion (5% of operational expenses), sanitation (8% of operational expenses) and contingencies (2% of operational expenses).

In practice, however, the District and Municipal Assemblies often do not make payments into the capital account even though the by-laws stipulate that they may allocate funds to the account annually through their regular budgetary allocation. In addition, revenues are not fully collected by the service providers, which affects the sustainability of WASH services. For example, a study on CapManEx practices in well performing small towns by Asante (forthcoming) shows that none of the systems ever received funds from the MMDAs into their capital accounts. Adank et al. (forthcoming) showed that fewer than 20% of all water committees in three districts had set tariffs based on projected operational and maintenance costs and none included provisions for capital maintenance. None of the Water and Sanitation Development Boards had tariff levels that would cover eventual capital maintenance costs. Nevertheless, 55% of water committees and 85% of the WSDBs have annual revenues higher than their required expenditure, indicating that tariff levels are above what is needed for OpEx, but it is not clear whether they are adequate for financing CapManEx.

To demonstrate the severity of the challenge, in Bekwai a legal battle ensued between the District Assembly and the WSDB when the latter attempted to ascertain from the MMDA whether the required amount was indeed in the capital account. To ward off the WSDB, the MMDA dissolved the entire Board. The WSDB challenged the decision of the District Assembly in the Kumasi High Court in 2008 and to date the court has not been able to settle the case (Braimah and Franceys, forthcoming).

The Community Water and Sanitation Agency guidelines for small towns[2] state that rehabilitation is the responsibility of the Water and Sanitation Development Boards while the MMDAs are responsible for system expansion (CWSA, 2010). The costs of capital maintenance and extension of small-town water schemes have been financed from the WSDBs' capital accounts, MMDAs, central government, external donors and pool funding.

When actual expenditure needs for capital maintenance are very high MMDAs, central government and/or donors can step in to fill the gap. There are examples of MMDAs paying for the capital maintenance of water systems and many examples of all the rehabilitation activities for water systems in a specific geographical area being clustered together as projects and funded by central government and donors. For example, the central government in Ghana used donor funds to rehabilitate six out of 12 small-town piped schemes ten years after construction (Asante, 2010), Five systems broke down within two to four years and the last one nine years after construction. Fortunately, however, there was a new project interested in rehabilitating the existing systems.

There is evidence that small-town water schemes that are doing well have been able to fund their capital maintenance from their capital accounts. Schemes that have not been able to finance their capital maintenance needs from their capital funds suffer unexpected and long breakdowns. The reasons why some schemes are not able to fund capital maintenance themselves are insufficient revenue, poorly managed systems and high capital maintenance needs, often where surface water is the only water resource.

These cases are illustrative of what happens in many countries. Tariffs may be set on the basis of detailed studies of projected costs for operation, maintenance and capital maintenance but service providers use their own discretion in considering which costs they will actually include in setting tariffs without securing funds from taxes or transfers (aid) to cover any remaining costs. If actual expenditure is higher, central or local government will eventually be asked to step in and help fill the gap. In the meantime consumers pay the price through poorer quality or limited service.

The role of economic regulators has rarely been extended to rural service providers in low-income countries. As Lockwood and Smits (2011) found, regulation of rural service providers is more of a plan than a reality in many countries and where it is present, may often be inappropriate to the rural context. In many cases entities that support the initial capital investment and establishment of service provision arrangements knowingly also support the establishment of tariffs that are inadequate to cover the costs of capital maintenance.

A case study by the NGO Water For People in **Honduras** showed that, despite significant emphasis on the sustainable provision of services, only 20% of the costs of the depreciation of the assets were factored into the tariff calculation, making a long-term shortfall in finance inevitable (Smits, 2011). Interviews with public officials in Honduras confirmed

2 Small towns refer to piped water schemes under community ownership and management in Ghana, serving a population of 2,000 to 50,000.

the same practice also in government-funded schemes. As one of the interviewees said, "We are happy if the tariff at least includes the costs of depreciation of a critical element like a pump, but including for example the depreciation costs of the distribution network into the tariff would not be realistic". This may be a realistic and appropriate first step towards funding capital maintenance, even though it does mean that at some point in future a capital maintenance gap will appear.

From these limited examples we can say that in rural water supply in low-income countries:

i. a majority of tariffs are insufficient to cover capital maintenance costs, with many barely covering operational and minor maintenance costs;
ii. tariff levels in a small proportion of cases are sufficient to cover operational and minor maintenance costs and also allow the service provider to establish a financial reserve. However, the financial reserve is not equivalent to the full depreciation of the asset base. This means that the service provider can operate effectively in the short and medium term, but over time will find it increasingly difficult to maintain specific service delivery standards, and eventually a third-party will need to co-finance capital maintenance; and
iii. in exceptional cases the service provider is able to raise funds that are adequate to cover operations and capital maintenance costs.

This is not unique to developing countries. Even in the **USA** today, only 51% of the costs for CapManEx and improvements are met from consumer tariffs (Pearson, 2007). Barraqué (2009) also notes that charging contributions to capital renewal did not start in Europe until everyone had a decent quality of service. Up to then the more limited requirements for early capital maintenance were funded through national or local taxes. It is common today to find urban service providers in Europe not yet charging adequately for capital maintenance.

Anticipating that tariffs will need to be complemented with funds made available through taxes, some countries have established other mechanisms for co-financing capital maintenance. These are elaborated in the following sections.

3.2 Local government co-financing capital maintenance

Moving one level up from communities, in some countries, local governments have structured budget allocations for what is effectively capital maintenance. One example is **Uganda,** where districts obtain a conditional grant from national government for water and sanitation. Part of this conditional grant, 8%, can be dedicated to CapManEx. However, it is uncommon to find district authorities having any type of asset management plan for rural water infrastructure. The 8% for rehabilitation is the main source of capital maintenance of point sources but this is rarely enough for all rehabilitation needs and large repairs in a district. For piped schemes, the Rural Growth Centre or Town Council can apply to the national ministry through the Water and Sanitation Development Facility. However, this process is long and the funds are limited. CapManEx is a challenge because, as the number of water systems increase, the 8% of the grant is even more inadequate. In addition, many piped schemes and boreholes built in the 1990s and early 2000s have reached the end of their life cycles and are due for major rehabilitation or replacement. NGOs sometimes help but struggle to raise funds to repair systems that are already in place, as opposed to constructing new schemes (Koestler and Jangeyanga, 2012).

In **South Africa**, municipalities can contract a support services agency (SSA), which can be a private company or an NGO, to support community-based service providers in their operational and (capital) maintenance tasks. Even though this is not the norm, the examples that exist provide important insights, particularly into the costs of capital maintenance. Gibson (2010) conducted an analysis of the actual costs incurred during a nine-year support programme, in which a private company, Maluti GSM Consulting Engineers, provided technical and institutional support to community-based organisations (CBOs) carrying out basic tasks at scheme level in two district municipalities in the Eastern Cape province (Alfred Nzo and Chris Hani District Municipalities). The project served a total of 429 villages comprising

67,437 rural households. Schemes included in the SSA programme varied in technology and population served, and ranged from large multi-village schemes supplied from dams and water treatment plants to handpump installations (Gibson, 2010). As an SSA, Maluti GSM Consulting Engineers were responsible for operation, maintenance and capital maintenance and providing direct support to the CBOs, including:

- supporting local operators in carrying out repairs and (capital) maintenance
- service and repair of mechanical and electrical equipment
- delivering diesel where required
- procuring and delivering material and spares
- preparing monthly reports
- providing technical engineering support
- facilitating the functioning of the CBOs
- training local operators

For this case a unique dataset exists with a tightly ring-fenced set of cost data related to operational effectiveness. The data shows that the total cost of the support was US$ 18.76 per person per year in the Chris Hani District Municipality and US$ 8 per person per year in the Alfred Nzo District Municipality. This includes expenditure on operation, capital maintenance and direct support. Gibson (2010) further suggests that the difference in costs between the two districts can be explained by factors such as technology (mechanical and electrical installations being more prone to failure than static infrastructure such as pipelines and reservoirs) and the distance of schemes from the main town. For this report, we re-categorised the data reported by Gibson (2010) according to the WASHCost life-cycle cost approach cost categories, the original paper did not use them. The breakdown of the relative contribution of different cost items to the total costs shows that approximately 79-83% of expenses refer to activities related to OpEx and CapManEx. Within these, the vast majority are actual OpEx, while CapManEx is around 19-27%, or US$ 1.52-5.06 per person per year, in Alfred Nzo and Chris Hani District Municipalities respectively. The figures for CapManEx do not necessarily indicate the long-term costs of capital maintenance, as the relatively new systems do not yet need re-investment in longer-life assets such as pipe networks. These costs are fully covered by local government, in line with South Africa's Free Basic Water policy.

In **Mozambique**, responsibilities for rural water supply are stipulated in the manual for rural water projects MIPAR *(Manual de Implementação de Projectos de Água Rural)* of the National Water Directorate in Mozambique (DNA, 2001). The main responsibilities can be summarised as follows:

- the national level retains responsibility for setting policies, developing strategies and regulating the sector;
- the provincial level is mostly a channel for investment funds, with procurement role to increase coverage;
- the district level bears responsibility for the decentralised provision of all O&M services in the water supply sector, and as such maintaining coverage and service levels; and
- the community level is responsible for collecting tariffs and conducting routine maintenance.

For rural water points communities are expected to contribute 2-10% for rehabilitation (CapManEx). These contributions can be non-monetary. In practice, the community contribution is an initial fixed capital contribution of around US$ 100 and is often allocated for OpEx. Operation and maintenance is the responsibility of communities and is defined to also include funds for pump replacements every ten years (i.e., CapManEx). Though this responsibility is clear on paper, in practice communities hardly ever accumulate sufficient savings for replacement and eventually request the district authorities for technical and financial support.

For small and medium town water systems, CapEx financing is the responsibility of the government and tariffs should cover all recurrent operation and maintenance (including replacement) costs. In reality, it is widely known that communities fail to have funds available for large interventions such as pump replacements and district authorities need to access decentralised funds for such repairs. These funds, though growing, are still very limited and are not specifically allocated to water. Donors and projects typically fill the gap by funding rehabilitation programmes. To improve the management situation a new institution has been established[3], which will be responsible for the asset management of small and medium town water systems.

In **India**, there is also no provision for CapManEx in allocations. While CapManEx is the responsibility of the Rural Water Supply and Sanitation Department, O&M is the responsibility of local bodies i.e.,, Panchayati Raj institutions. As no precautionary investments are made for capital maintenance, departments follow an ad hoc approach. Funds which have been allocated to OpEx are often used to fix major breakdowns. As a result, the OpEx account ends up having less than the actual allocations intended for it. The end result is the vicious circle of low OpEx, low CapManEx, declining lifespans, major breakdowns, increasing requirements for CapManEx, low reliable services and poor community contribution. In the event of major breakdowns resources are drawn from CapEx of other schemes, resulting in delayed implementation. In peri-urban areas a similar approach is followed, though full responsibility for CapManEx and OpEx lies with the department.

In general, where clear responsibilities for capital maintenance do not exist, communities tend to rely on relatively ad hoc arrangements to co-finance capital maintenance costs. Gasteyer (2011) reports how even in the **USA** communities appear to follow a 'pick and mix' approach from the various sources of soft loans and grants available from federal and state governments. In other countries, communities often wait for a major breakdown to occur, and then fall back on local government, the NGO which implemented the original project or donors to cover these much larger costs. In many of these cases, any savings that the community-based service providers may have generated in this way can be used as match funds.

3.3 Central government co-financing capital maintenance expenditure

In this approach, capital maintenance costs are shared between community-based service providers and central government on a structured basis.

An example is found in **Chile**, where regional utilities that provide water services to towns and cities are contracted by the central ministry to provide direct support to rural community-based service providers. This consists of technical assistance and advice, and supporting the identification of capital maintenance projects (Fuentealba, 2011). To that effect, the Ministry of Public Works establishes a contractual agreement with the regional utility, monitored through the regional divisions of the ministry. Twenty per cent of capital maintenance works are expected to be covered through tariffs raised by community-based service providers, the remainder coming from central government. Likewise, the government contributes to system expansion and enhancements of service levels. The overall volume has oscillated around an average of US$ 50 million per year over the past ten years, or US$ 33 per rural person per year. This is a combination of capital investment costs in new systems, extension and service-level enhancements and a major rehabilitation effort after the 2010 earthquake. Roughly a third of this, US$ 11 per person per year, has been for capital maintenance.

Even where central government steps in, the amounts invested may be too small. This is illustrated by the case of Namibia, where central government contributed to covering operational and (capital) maintenance costs but also undertook renewal works (unlike in Chile, where capital maintenance is sub-contracted). As part of the policy of community-based management of rural water supply, each water point has a Water Point Committee (WPC) responsible for day-to-day operation and the collection of tariffs to cover these costs. Technical support is provided by the local offices of the Directorate of Water Supply and Sanitation Coordination (DWSSC), which carries out major maintenance on request, though often not in a timely manner, as noted by Gibson and Matengu (2010) in an evaluation of this model in the Kavango and Caprivi regions. The same study noted that the budgets for direct support and for operation and maintenance were insufficient. The authors estimate that total costs for institutional

3 AIAS: *Administração de Infraestruturas de Abastecimento de Água e Saneamento:* Administration for Water and Sanitation Infrastructures.

and technical support would need to be US$ 12-24 per person per year, instead of the US$ 5-12 per person per year actually spent at the time. Using the original figures by Gibson and Mantengu (2010), we reclassified how much of this support would in fact be capital maintenance. A conservative estimate suggests that up to 20% of the budget would be for capital maintenance, the equivalent of about US$ 2-5 per person per year.

3.4 Capital maintenance: how much does it cost?

This section compares the expenditure data provided by the different examples in this section with the WASHCost capital maintenance benchmarks. Minimum benchmarks for capital maintenance expenditure for developing countries have been derived from the dataset from the four WASHCost countries by selecting water facilities providing a basic level of service[4]. Cost ranges in table 1 are based on interquartile values from the data.

Besides costs, many other social, institutional and political factors influence services, but there is evidence that if expenditures are much lower than these benchmarks, the services are below a basic level and are therefore not sustainable (Burr and Fonseca, 2013). These figures are not set in stone – there may be lower capital maintenance expenditures which provide decent levels of service (e.g., in highly densely populated areas with economies of scale) or higher capital maintenance expenditures with services below a basic standard (e.g., in remote areas).

The benchmark cost ranges provided for capital maintenance per person per year to provide a basic level of service do not seem to be very high. However, in some countries if we multiply these amounts by the population, the resulting amount might be higher than what is presently affordable for households and local and central governments.

It can be noted that the upper-bound cost for capital maintenance is the total cost of system replacement, a strategy that is common for rural handpumps but tends not to be captured in the statistics, as such investment might well be allocated to capital expenditure. Determining what such a cost may be per person per year depends upon the expected life of the asset and the number of people accessing water through it. Data on asset lives in practice, particularly for short life 'appropriate technology', is limited.

Table 1 **Cost ranges (min-max) for operational expenditure (OpEx) and capital maintenance expenditure (CapManEx) to provide a basic level of service, US$ (2011) per person, per year**

	Borehole and handpump	All piped schemes
OpEx	[0.5 - 1]	[0.5 - 5]
CapManEx	[1.5 - 2]	[1.5 - 7]

Source: Based on WASHCost, 2012.

Table 2 provides examples of existing actual expenditure on capital maintenance from a number of case studies from various countries around the globe. Note that these generally refer to case studies from certain regions in countries and not expenditure for the country as a whole. Moreover, these are actual expenditure figures, which do not imply the expenditure is sufficient to guarantee a service over 20 or 40 years.

Spending in countries like Mozambique, Burkina Faso and Ghana is below the benchmark, particularly for services dependent on handpump systems. This indicates a gap in capital maintenance and operational expenditure.

4 For water supply services, a basic level of service is achieved when all the following criteria have been realised by the majority of the population in the service area: People access a minimum of 20 litres per person per day, of acceptable quality (judged by user perception and country standards) from an improved source which functions at least 350 days a year without a serious breakdown, spending no more than 30 minutes per day per round trip (including waiting time) (Moriarty et al., 2011).

Countries with higher GDP and where rural services are predominantly piped systems with household connections have considerably higher operational and capital maintenance expenditure than those indicated by the benchmarks. This is probably partially because the service levels provided in these countries are higher and therefore also require higher levels of funding. However, these are also countries which can to some extent afford to cover these costs.

A simpler way of calculating capital maintenance expenditure needed in the future is now being considered by the governments of Mozambique and Ghana. In Mandlakaza district in Mozambique there are 210 boreholes (DNA, 2012), 33 of which are currently not working. Even if all 33 are rehabilitated, at least 10 more boreholes will need attention next year (based on 5% replacement per year). With the cost per rehabilitation known to be US$ 3,000 (Zita and Naafs, 2012), at least US$ 30,000 needs to be budgeted per year or coverage will go down. A district in Ghana typically has about 100 boreholes with handpumps and five small-town piped water schemes. For the handpump-based systems, at least five boreholes with handpump will have to be replaced every year (based on 5% replacement per year) at a total cost of US$ 5,000-7,500. For the piped schemes, at a current value of US$ 1.5 million, a design life of 25 years gives a conservative capital maintenance requirement of about US$ 60,000 per year.

Table 2 **Comparison of current expenditure on operational expenditure (OpEx) and capital maintenance expenditure (CapManEx) between various case study countries**

GDP (US$/person/ year) (International Monetary Fund, 2011) and country category (OECD-DAC, 2011)[5]	Country/case study and reference	Responsibility for financing capital maintenance	Predominant types of rural services	OpEx US$ person/ year	CapManEx US$ person/ year
12,344 Upper-middle income country	Chile (Naveas, forthcoming)	Co-financing by central government	Piped systems with household connections	25	11
10,439 Upper-middle income country	Integrated System for Rural Sanitation (SISAR) in Brazil (see also section 4.1) (Own calculation based on data from Meleg, 2011 and Smits et al., 2011)	Association of community-based service providers with ad hoc (state) government support	Piped systems with household connections	7-8	4-6
6,812 Upper-middle income country	Two districts in South Africa (calculations based on Gibson, 2010)	SSA carrying out capital maintenance work	Piped systems with standpipes	4.5-11	1.5-5
5,118 Upper-middle income country	Two regions in Namibia (calculations based on Gibson and Matengu, 2010)	Day-to-day CBM, with repairs and replacements by deconcentrated office of central government	Piped systems with standpipes; boreholes with hand pumps	5-12	2-5 (ideal)

5 OECD Development Assistance Committee, see: http://www.oecd.org/dac/aidstatistics/48858205.pdf

1.214 Lower-middle income country	India (Andhra Pradesh)	Rural water supply and sanitation department	Borehole and handpump	Negligible	Negligible
			Piped systems with household connections	0.2- 3.4	0-6.5
963 Lower-middle income country	Ghana	Water and sanitation development boards and district and municipal assemblies	Borehole and handpump	Negligible	No data
		Water and sanitation development boards	Piped systems w/ standpipes	1.4-4.1	0.4-1.5
476 Least developed country	Mozambique	Water Committees and District authorities responsible for technical and financial support	Borehole and handpump	0.1	No data
		Donors and projects fill the gap by funding rehabilitation programs.	Piped systems w/ standpipes	4.2	No data

NB: All figures adjusted to 2011 US$

3.5 Lack of funding for capital maintenance and impact on service delivery

Lack of capital maintenance can manifest itself in various ways, namely by loss of or reduced functionality, infrastructure lasting less than its design life, or service levels starting to decrease in terms of quantity, quality or reliability – a failure of serviceability. However, not all service shortfalls are caused by the lack of capital maintenance; there might be many other institutional and environmental causes. This section explores the extent to which capital maintenance contributes to service shortfall.

Loss of or reduced functionality. A common way of measuring whether capital maintenance has been adequate is to assess the functionality of infrastructure and its main components, where functionality refers to whether a piece of infrastructure works as it was designed to. Functionality (or the lack of it) may reflect the adequacy of operational and capital maintenance expenditures. Evidence shows high levels of non-functionality, with a widely-quoted figure of 30-40% of all boreholes in Sub-Saharan Africa not functioning at any given point in time (RWSN, 2010). In Andhra Pradesh, India, poor maintenance (CapManEx and OpEx) is the main cause of system failure and source failure due to hydrogeology (Reddy, Jaya Kumar, Venkataswamy and Mekala, 2011).

Functionality is closely related to payment for capital maintenance. A study in Ghana of 75 water point sources belonging to 31 communities in three districts showed that districts with the highest functionality were generally paying for water and spent more on the recurrent costs of service provision (Nyarko et al., 2012).

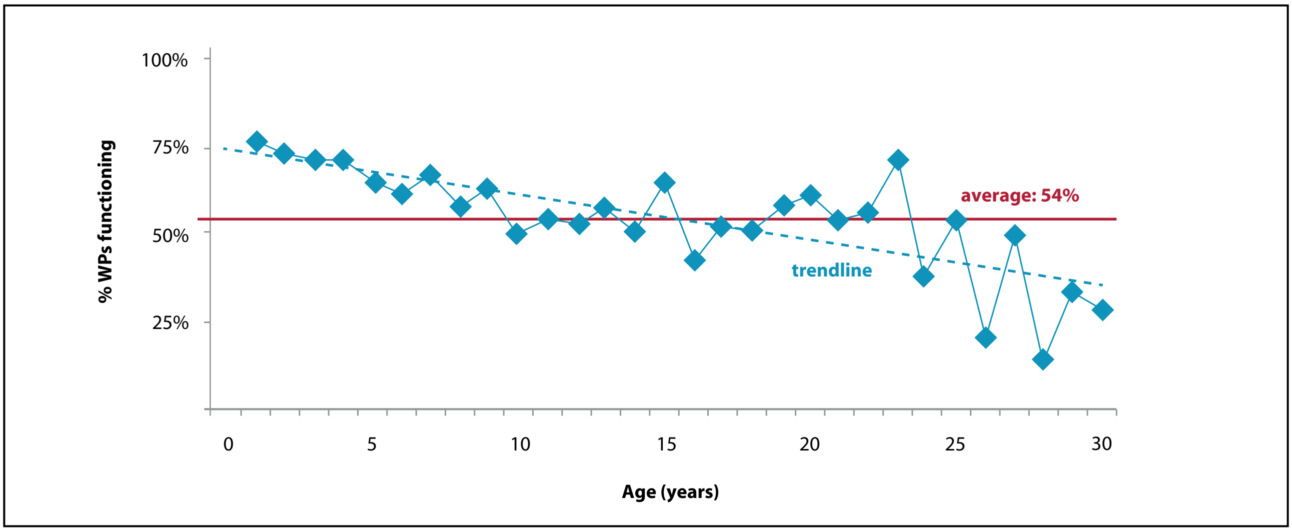
Piped schemes rarely fail completely, but a study in Colombia showed that 32% of a sample of 40 piped schemes were found to have non-functional components, including assets originally designed to improve water quality (water treatment plants or chlorination devices). In Honduras, where water systems are classified on a scale from A to D, at the latest count in 2009, 22% of systems were classified as D, indicating a need for investment, either for capital maintenance or to extend the service (SANAA, 2009).

Shorter lifespans of infrastructure compared with initial design plans. The speed and intensity of loss of functionality impacts on the expected lifespan of the infrastructure: a handpump on a borehole which is supposed to last for 20 years lasts, for example, for only five. Shortened lifespans can be a result of inadequate OpEx and CapManEx. For example, if mechanical parts are not greased frequently enough they will experience more wear and tear and need to be replaced earlier than expected (increasing the amount required for capital maintenance). Data on the real impact of lifespans is scarce though some case studies highlight that this is a particular problem around point sources (boreholes with handpumps).

In the case of Andhra Pradesh, India, Reddy, Jaya Kumar, Venkataswamy and Mekala (2011) estimated that the observed life of systems at state level is 8.2 years compared with the normative lifespan of 12.7 years. While the normative lifespan across the nine zones of the state does not vary much, the observed lifespan varies between 3.7 years in Godavari zone and 10.9 years in Krishna zone. Observed lifespan is lower due to systems breaking down frequently because of lack of maintenance or the geohydrology of the region (bore well failure).

A compilation of various water-point mapping exercises in Tanzania (figure 2) showed that 25% of all water points were already non-functional two years after they had been installed (WaterAid Tanzania, 2009). After ten years, which is considered a common life expectancy for handpumps (IDRC and IRC International Water and Sanitation Centre, 1988), only 50% were functional. Clearly, the pumps' lifespans were much shorter than they were designed for and those that make it to the age after which they start needing capital maintenance (about year 3 or 5) have a much steeper loss of functionality. Figure 2 shows that, in Tanzania, the percentage of water-point systems that are functioning decreases as the age of the system increases.

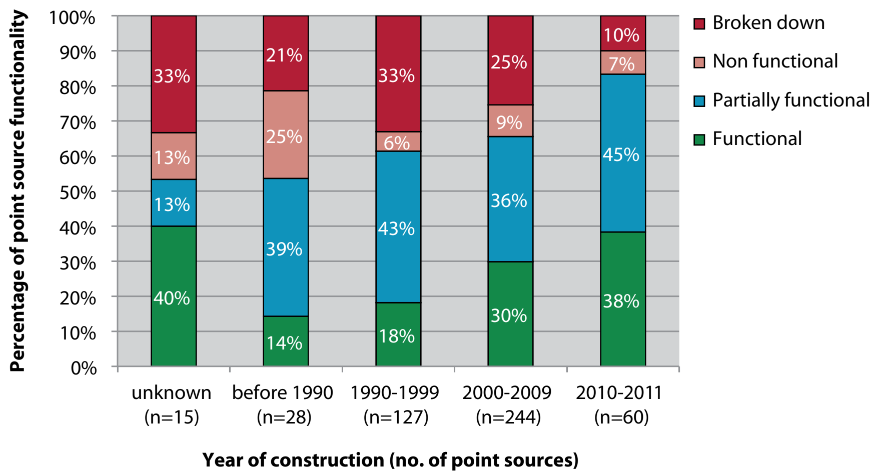
Figure 2 **Functionality of water points by age in Tanzania**



Source: WaterAid Tanzania, 2009.

Adank et al. (forthcoming) found similar data for Ghana (see figure 3), with 17% of point sources not functional just two years after completion. This sharp drop in functionality could represent very early major failures requiring capital maintenance before community-based service providers have had the time to build up sufficient funds to pay for it. However, it more probably points to other problems such as failed implementation or absence of operational expenditure.

Figure 3 **Functionality and year of construction of point sources in three districts in Ghana**

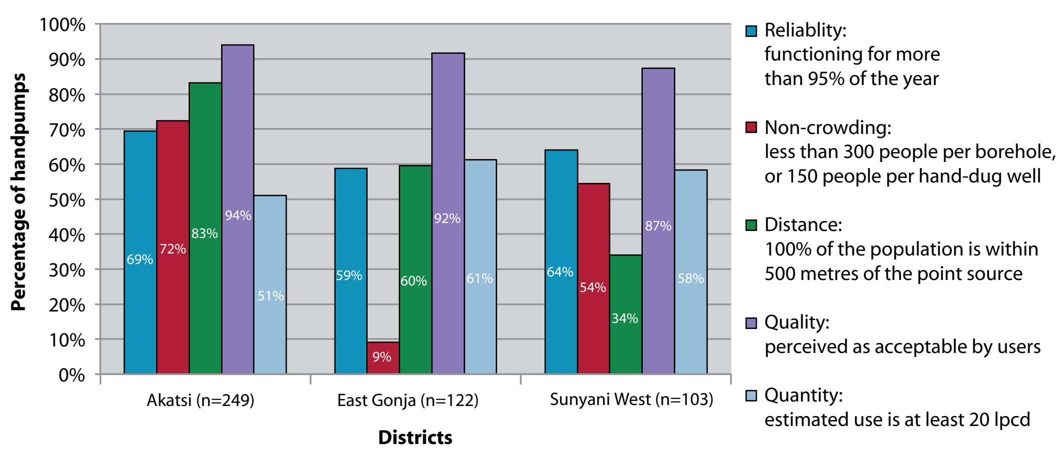


Source: Adank et al., forthcoming.

Reduction in the level of services. Apart from functionality, it is important to look at service levels. Many water systems, particularly gravity-fed schemes, often do not fail completely but experience gradual reductions in service levels. For example, a reduction in water quantity in a piped scheme may be due to a lack of CapManEx by the distribution network, resulting in high levels of leakages. But a reduction in water quality may occur because a water committee is no longer chlorinating the water it supplies, and is consequently spending too little on OpEx. If crowding increases due to more people using the same system, it may be due to the fact the investments in CapEx for system expansion are not keeping pace with population growth.

Although the baseline for service levels is only in its early stages, early evidence shows that levels are often below national norms and standards. A lack of capital maintenance is, however, only part of the problem. Figure 4 shows the scores for a service-level survey in three districts in Ghana. As can be seen only 50-60% of each of the aspects of service complied with national norms and standards. Distance and crowding are a characteristic of the number of water points in a specific area. Crowding may be a consequence of very few water points being developed or many being developed but not receiving sufficient capital maintenance, leading to reduced service levels.

Figure 4 **Service levels in three districts in Ghana**



Source: Adank et al., forthcoming.

Rural water supply suffers from many poor performance factors including low levels of functionality, services that are below national norms and standards and shorter lifespans than the systems were designed for. Lack of capital maintenance is one factor that contributes to this situation but others are a lack of operation and maintenance expenditure or poor initial implementation.

3.6 Reasons for under-resourcing of capital maintenance

As can be seen from the above, ignoring the need for capital maintenance is like postponing fixing a roof until it collapses. Not investing now to keep infrastructure functioning will mean larger expenditures later for total replacement. So, why does capital maintenance receive such little attention? There are various underlying reasons.

One of the main reasons, specifically in Sub-Saharan Africa, has been low levels of water coverage, so that ***providing new infrastructure has had a high priority*** to accelerate the provision of improved water to the millions left unserved. Water coverage has consistently increased over the years but the sector is now at a stage where growth in coverage levels could start to stagnate if maintenance and asset management are not systematically addressed (Smits and Moriarty, forthcoming).

There are several reasons why ***asset management is not taking place in rural water supply.*** One is that, unlike urban utilities which are clearly responsible for providing a service, the focus in rural water supply has been on developing infrastructure rather than on providing a service. Responsibilities for service provision are spread over several organisations with, typically, 'projects' implementing initial infrastructure, community-based organisations carrying out service-provision tasks, frequently with the assistance of local government or other support structures. There is thus not one single entity with the task of ensuring adequate asset management so that service delivery can be assured.

Realistic asset management requires continually updated information on assets. In most lower-income countries there are no recent inventories of how many rural water supply assets have been built and when or where. Only now that mobile phones and other information and communication technologies are becoming more commonplace in rural areas has the mapping of rural water assets become a feasible exercise, as witnessed by the recent boom in water-point mapping initiatives (Water and Sanitation Program (WSP), 2011; Hutchings et al., 2012). These initiatives mostly map the location of a water asset as well as some of its characteristics, including functionality; to our knowledge none track the costs of the water infrastructure and its components.

Furthermore, during the 1980s, the trend of disengaging government from capital maintenance in the rural water sector increased in the context of decentralisation and strengthening local organisations and community-based management of water systems (Briscoe and Ferranti, 1988). Unfortunately, ***the earlier failure of public allocations for maintenance was then transferred to rural communities.*** Fundamentally, the lack of capital maintenance shows the limitations of community-based management. Community-based management was promoted in response to the failure of centralised government agencies to provide and maintain rural water supply services. The discourse accompanying CBM emphasises concepts like self-reliance of communities and their full responsibility for providing and maintaining services. However, if operation and maintenance may be possible in communities of a few hundred people, there are many examples of management and maintenance challenges increasing as schemes increase in scale. This is not so much due to the increasing complexity of the technology but rather to the diminished individual and community responsibility which comes with a system which serves several communities. Community management is then confronted with 'tragedy of the commons' problems (Kleemeier, 2000).

A third reason is that ***capital maintenance appears to be expensive***, particularly to users, relative to often minimal operating cost requirements. As discussed in section 3.1, many communities cannot afford, or prefer not to afford, to include these costs in their tariffs. Table 2 shows that many low-income countries do not invest sufficiently in capital maintenance. Expenses on capital maintenance compete with all the other demands on public finances, and donors step in only to a certain extent.

An additional problem facing developing countries is the ***existing backlog of capital maintenance.*** "The problem facing public officials considering the adoption of asset management is that the damage of deferred maintenance has already occurred and needs to be addressed by a significant infusion of funding for rehabilitation or replacement that does not currently exist..."(Garvin, 2008). However, if money is short, maintaining existing, rather than building new, infrastructure is the right economic decision because rehabilitation will be even more expensive in the future.

A fourth underlying reason is that communities and governments alike seem to follow a strategy of ***dealing with large maintenance only when failure happens***. Anticipating capital maintenance implies saving funds for an expense that will happen in the future. Even though saving for the long term is a rational economic decision, people (and politicians) are often not well-inclined to do so, especially when faraway future needs compete with current ones. Also, as illustrated in the examples above, many service providers are often 'bailed out', i.e., when systems fail, an external project often covers the repair or replacement of infrastructure, further reducing the incentive to save funds for further future repairs. The 'moral hazard' of governments funding breakdown maintenance acts as a further disincentive for communities to take responsibility. It could equally be argued, however, that government, in its role of pooling society's common resources, is best suited to making resources available to replace the right assets at the right time.

The latest report from the UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) indicates that around 31% of all funds in the WASH sector go into the broad category of operation and maintenance (World Health Organization (WHO), 2012)[6], whereas estimates indicate this should be around 75% (Hutton and Bartram, 2008). Of all overseas development assistance (ODA), 7% was directed at replacing existing assets and another 36% at improving service levels in existing systems (WHO, 2012). Yet, in the WASHCost research countries, most external funds are allocated for rehabilitation and not for timely or preventive capital maintenance. If such external funds are not readily forthcoming, systems may be unable to deliver the desired services for long periods. Moreover, the financial efficiency of letting systems fail and then paying for rehabilitation should be questioned.

Another reason is that there is ***little incentive for users or for service providers to set funds aside before failure takes place.*** For users, it means that user charges would be higher and destined for an unknown future use. For service providers it would mean revising their business model and eventually raising tariffs or requesting more external funds – both of which are undesirable. Even if it is rational and more cost-efficient to save money to prevent future breakdowns, both users and service providers would rather use existing funds for immediate needs and deal with breakdown expenses in the future when they occur.

In urban water supply, this problem is partially overcome in some countries by economic regulation, which seeks to arbitrate between the interests of users (not paying too high tariffs and receiving good services) and service providers (who need to have adequate revenue to operate and maintain assets). As mentioned above, such arbitration in the form of regulation is, understandably, largely absent in rural water supply. There is thus no mechanism to ensure that community contributions or tariffs are in line with maintenance needs and that service providers are fully responsible for the services and assets they need to manage.

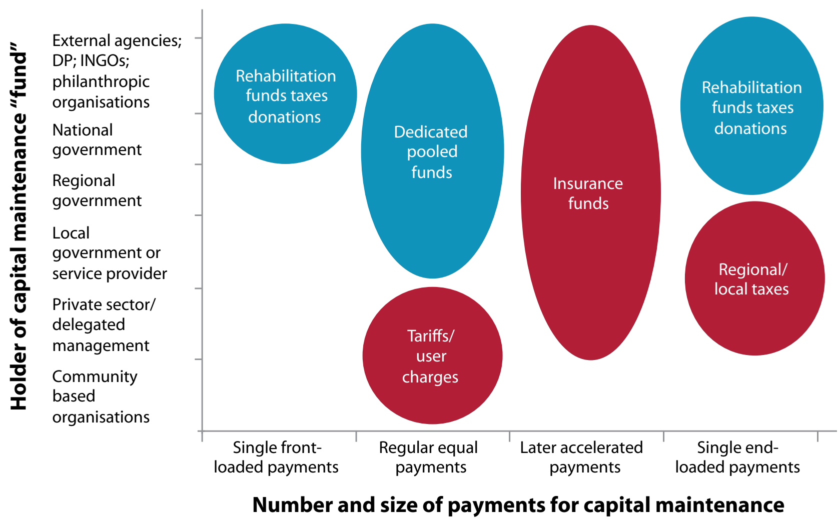
6 However, the data in the GLAAS report does not capture expenditure by households, which is known to be high.

4 Strengthening arrangements to finance capital maintenance

The need to address capital maintenance in a more structured manner is increasingly being recognised (Franceys and Pezon, 2010). Moreover, various countries have started experimenting with alternative approaches to funding and delivering capital maintenance, thereby not only hoping to raise the levels of funding but also providing mechanisms for doing so. This section introduces case studies on strengthening arrangements to finance capital maintenance as being currently tested and developed by a limited number of organisations and governments[7]. The strengths and weaknesses of each option are discussed, referring back to the fundamental problems highlighted in section 3.6.

It is possible to consider different modalities for funding capital maintenance depending on the main entity responsible for holding/disbursing capital maintenance funds and the number and size of expenditures required (figure 5). The blue circles represent modalities where there are some examples available, the red circles represent possible modalities where we could not find examples or which need to be tested. Any of these options can be sourced from either tariffs (or other user charges and household contributions), transfers (international) or taxes (national).

Figure 5 **Modalities for funding capital maintenance (existing and potential)**



Where affordability is limited, user charges paid by lower-income consumers can be supplemented by user-charge cross-subsidies, by direct support from taxes (local or national) or by external support, i.e., transfers from donors. To ensure affordability of capital maintenance charges can be 'end-loaded', whereby depreciation charges are designed to increase over time, to match economic growth over the lifetime of the assets. Alternatively, with regard to number and size of payments, donors may prefer to make their depreciation contributions as a single lump sum at the implementation stage so that if they are unlikely to be active in the area when the need for capital maintenance arises the funding will be available.

A community bank account delivers community ownership but is unlikely to be able to deliver the necessary funds several years into the future because of persistent more short-term urgent needs. Holding capital maintenance

7 There are certainly more options than those mentioned. We would welcome you sharing them with the authors for further documentation.

funds at local government level delivers greater protection against personal use but is equally vulnerable to early use. Holding funds at regional or national government level theoretically delivers the necessary protection against such early use. The next step in holding capital maintenance funds away from community/government control is outsourcing to trustee-protected international escrow accounts or private insurance companies. The following section describes case examples using variations of some of these options.

4.1 Regional pooled funds for capital maintenance

Pooled funds refer to mechanisms where community-based or district service providers put part of their savings into a joint account, possibly complemented by funds from an external entity (e.g., local or regional government). Members can use the money from the fund when needed, but according to certain rules. A key advantage of this mechanism is that it motivates members to set aside money for capital maintenance. Moreover, it reduces the perceived time lag between putting money into the fund and it being used, as funds can be requested at any time. The main disadvantage is that it may create perverse incentives against preventive maintenance, as a service provider may think that the pooled fund may act as a bail-out.

The Reserve Fund, Ghana

The three northern regions of Ghana offer an example of the use of pooled funding (sometimes also called mutualisation of funds) to address capital maintenance needs. The Association of Water and Sanitation Development Boards (AWSDB) was formed in 1995 when the Canadian International Development Agency (CIDA) supported an intervention to rehabilitate water systems for community management. CIDA requested the communities to make upfront payment of six months operations and maintenance as commitment fees. The funds were mobilised by the AWSDB and deposited in a reserve fund. In addition the AWSDB mobilised a 5% capital cost contribution from 22 communities which were benefiting from water systems being rehabilitated by the World Bank. The AWSDB advocated for the funds to be deposited in the reserve fund and invested it until completion of the rehabilitation works, when the funds were paid. The build-up of the reserve fund was supported through investment in short-term government treasury bills that yielded high returns as interest rates were high at the time (Agbenorheri and Fonseca, 2005). Other sources of funds for the reserve fund were donations received from individuals and external support agencies. From 1998 to 2003 the reserve fund was in the range of US$ 100,000 to 330,000 and the average interest rate 24%-39% (ibid). The board members were obliged to purchase shares (unit trusts) as well as annual subscription fees. The funds that accrue from this fund are issued as loans with moderate interest to members who apply to fix their water systems whenever the cost for repair/replacement is beyond what they can afford on their own. In the event of a breakdown, a formal request is made by writing to the association. Afterwards, a team from the association assesses the situation and makes a recommendation to the executive committee.

Initially, members were made to pay monthly contributions. However, over time, payments became irregular because some WSDBs are in remote areas where there are no rural banks to facilitate the payment of their contributions. As a result frequency of payment was changed to quarterly. Some WSDBs do not pay on a regular basis, with the consequence that requests for financial assistance by some members who are in dire need may not be honoured. A major challenge in administering the pooled funding is the high rate of defaults in payment due to the remote location of some of the water schemes, although the increase in the use of mobile phones for payment could help address this challenge. In addition the association has not been able to address all the needs of the WSDBs due to limited funds from the contributions and, most importantly, because the fund is mainly used after systems breakdowns and not for preventive maintenance.

After implementing the scheme for some time, the AWSDB now faces a number of financial challenges, making it difficult to achieve its original aim. An NGO is currently providing the AWSDB with financial support from which the executive secretary and the other staff members at the secretariat of the association draw their salaries. There are also claims that some members stopped paying their annual contributions because the fund managers failed to render proper accounts of the contributions.

SISAR, Brazil[8]

The Integrated System for Rural Sanitation (SISAR) is an organisational model for managing rural water and sanitation in the rural areas of three states in northeast Brazil (Bahia, Ceará and Piauí). The development of these SISARs started in 1996 as associations of community-based service providers, with a dedicated operational unit which provides technical and administrative support to its individual member communities and supports capital maintenance. In the State of Ceará, eight SISARs cover between 25 and 112 rural systems each, representing between 15,000 and 72,000 users (Meleg, 2011).

With respect to maintenance, a SISAR is responsible for jointly administering, maintaining and coordinating operations for its associates' water and sanitation systems, whereby tasks are shared between the local water-users group and the SISAR, and for setting and securing payment of realistic tariffs.

Each community has one operator for day-to-day operations and possibly more if a supply system has more than 300 connections. The operator receives a monthly payment from the SISAR, which is based on the payment rate by users (as an incentive to good performance). This model is financed through a user tariff, based on metered connections and collection of bills. The tariff is sufficient to fund:

- Operational and maintenance expenditure. There is some cross-subsidisation, managed by SISAR, from larger rural systems to smaller communities in rural areas. This financial ability to cover OpEx serves as a precondition and guarantor of independence and self-administration, freeing the utility from the inappropriate (political) pressures experienced by earlier organisations (Schiller and Schienle, 2004).
- Capital maintenance expenditure. This is managed centrally by SISAR (replacement of pumps, rehabilitation of wells and replacement of pipes) to ensure that services continue at the same level of performance that was first delivered. There have been occasional one-off investments by others. For example, Ceara Water and Sewage Treatment Company (CAGECE), the state utility in Ceará, has provided material for the refurbishment of old water meters and supported water quality analysis in specific cases). National or international funds would only be required for large extensions of the system, or rehabilitation of older systems developed prior to joining SISAR to bring them up to SISAR's technical standards. To meet the expenditures related to capital maintenance, business plans are developed at the level of the SISAR as the basis for calculating recovery of these costs through tariffs.
- Direct support costs. The initial costs of establishing the structure of SISAR were co-financed by the state, through CAGECE, the German development bank Kreditanstalt für Wiederaufbau (KfW) and the World Bank. The running costs of the model are covered by user tariffs.

Each SISAR specifies what proportion of tariffs collected by the service providers have to be forwarded to them to fund centralised regional activities.

4.2 Insurance for capital maintenance

Holding capital maintenance funds with private insurance companies might provide the necessary long-term ring-fenced protection that pooled regional funds may fail to offer. Conceptually, it is an interesting option but there are almost no known applications in the water sector.

Water For People has conducted a study on the potential of microinsurance to sustain water and sanitation services (Zeug, 2011). Most experiences with microinsurance as a risk-management mechanism for developing countries have

8 This text is largely drawn from Smits et al. (2011), based on Meleg (2011) and Water21 (2011).

been gained in the area of health, property and livestock, but it is still a learning field. Only two types of microinsurance linked to the water sector were found, and both were health products.

There are mainly two models which could be useful to the water sector: the community-based model and the provider model. In the community-based model, a committee of elected managers is responsible for negotiating the provision of products with external providers and collecting premiums, reviewing claims, managing the accounts, etc. The disadvantage of this system is that it requires extensive knowledge to deal with insurance companies (if they exist and are willing to insure communal water assets) and is essentially a voluntary system suffering from all the limitations of community-based models. In the provider model, the service provider offers a range of options to groups through insurance policies. Implementation is relatively simple with the payment of fixed amounts and clients being able to access the services when they are required (Zeug, 2011).

Mercy Corps is undertaking feasibility studies on the potential of insurance for increasing the sustainability of water and sanitation interventions in the Central African Republic. The results are not yet known. As part of the WASHCost research, the Community Water and Sanitation Agency (CWSA) in Ghana is also exploring options for the use of insurance in small towns.

Community Water and Sanitation Agency, Ghana

The idea of using insurance to address the needs of capital maintenance in small-town water schemes is very recent. The use of insurance seeks to address both emergency needs, such as when motors and pumps burn out due to high power fluctuations, and the need to replace components at the end of their useful lives. Insurance would thus ideally address the needs of both emergency and planned capital maintenance.

The idea of insurance for capital maintenance has not yet been implemented in Ghana. It has been discussed with stakeholders like the government facilitating agency: Community Water and Sanitation Agency (CWSA), community representatives through the Water and Sanitation Development Boards (WSDB) and some insurance companies. All parties are of the opinion that insurance will go a long way towards addressing the needs of capital maintenance and capital expenditure to enhance water schemes which have so far not received adequate attention and are adversely affecting sustainable water-service delivery. The insurance companies have suggested the use of both risk and deposit insurance for the water sector. The risk insurance will cover emergency needs like the untimely breakdown of electro-mechanical components, while the deposit insurance will cover the planned capital maintenance, such as rehabilitation of reservoirs, tanks, pipes, pumps, etc. The deposit insurance is in fact a type of savings that the WSDB can withdraw to address planned capital maintenance requirements as and when needed. However, the fund would not be dependent on elected officials as it is managed by a private company. Details on management and access to the deposit insurance are yet to be discussed.

The idea has not yet been tested but there is consensus on the principle of an outsourced depreciation or reserve fund holder which is more independent of local interests. The requirement of allocating some of the water revenue to a capital depreciation account for capital maintenance could in principle be used to finance the insurance mechanism.

4.3 Pooled (front-loaded) external contributions for capital maintenance

In addition to dedicated pooled or insurance funds for capital maintenance, there are two additional options which are more appropriate for external donors and NGOs in countries where the water sector is very dependent on external donors and there are limited options (lack of human resources or an institutional enabling environment) to implement the options described above.

'Front-loading' comes from practices used in conflict and emergency situations. We suggest adapting it to rural water supply deriving from the following observation: every NGO or government project wants its own water point to be sustainable for the next ten years, while knowing that they themselves will only be around for perhaps the first three. The other seven years it is assumed that the water committees will function properly, having received all due capacity building, having spare part provisions in place and thereby being able to ensure a functional service. However, around that same water point, there may be failing water points from other NGOs which were in the same community five years before.

An illustrative example: in a district with 80 boreholes, five of which are not working, NGO Water Forever plans to drill 20 additional boreholes but reserves 10% of the capital expenditure budget for maintenance of the existing 80 boreholes. Once the project is over, the total number of boreholes is 100 but two years later two of the original 20 are not working. A new NGO arrives and also allocates 10% of its existing budget to maintenance of existing infrastructure. The two malfunctioning boreholes provided by Water Forever will thus be repaired with funds from another project.

This is common practice in many areas, with NGOs or donor projects repairing previously built systems while constructing new ones. However, this is often done in an ad hoc manner. The main difference here lies in the fact that it is planned and budgeted for in a more structured manner. This does not have to be restricted to NGOs or water points. It can also apply to donors and town water systems. It does, however, mean that capital maintenance of existing infrastructure is accounted for in the budgets for new infrastructure projects. Front-loading might work in areas and countries where donor coordination is well established.

4.4 Pooled (end-loaded) external contributions for capital maintenance

With this option, donors/external NGOs are required to pay sufficient funds into an escrow account to pay for at least 10 or 20 years' worth of capital maintenance which can only be accessed after a number of years and through a board of trustees or some such entity. One organisation in the sector, Splash (formerly A Child's Right), has developed this concept further. Although it has not yet been implemented, we think it is worthwhile sharing Splash's preliminary findings.

Splash/A Child's Right (ACR) has been working in Cambodia since 2007. It currently works with 58 partners, representing a wide diversity of partner platforms throughout the country (orphanages, street shelters, schools, feeding centres, and two of the three largest paediatric hospitals in the country). In 2011, ACR began developing a savings model that seeks to ensure continuous safe drinking water for all partner sites for a bare minimum of 20 years. The result is known as the Sustainability Savings Fund (SSF). The SSF is a micro-savings approach that enables local partners to cover the expenses of years eleven through twenty by saving for them in years one through ten.

Simply put, the primary objective of implementing a micro-savings fund with partners is to make sure children have safe water and for a long time. The SSF attempts to create a mechanism and a supporting community that works together to see this as an achievable goal.

In 2012, ACR conducted a partner questionnaire, part of which was set aside to gauge thoughts on an SSF model. The model presented to partners required them to deposit US$ 8 into a savings account every month for ten years. They were asked if they would like to participate in this type of micro-savings model. Seventy-five per cent of current partners said they would prefer a micro-savings mechanism to no mechanism at all. Clearly, current partners want to have a long-term positive effect on their communities through safe drinking water and would prefer assistance in achieving this.

Several direct and indirect benefits have already been identified. Direct benefits include 20 years of uninterrupted access to safe drinking water, sites gain access to ACR's parts discounts and supply chain, and partners avoid the balloon payment needed at the end of the initial ten-year commitment. Indirect benefits are that the partner is clearly established in ownership role of the filtration system, if the system fails during the first ten years the partner is more likely to call on ACR for the repair if they are preparing for its long-term success, and it allows ACR to easily track the progress and buy-in of the partner and supports monitoring and evaluation (M&E) requirements.

There are risks involved in undertaking a new practice of this magnitude: partner enrolment or uptake may be lower than the estimated 70%. If partner interest is extremely low, ACR should consider the feasibility of maintaining a system that partners do not want to participate in. Low uptake may also be a sign that the model needs tweaking. Conversely, uptake and sustained enrolment may turn out to be higher than initially determined. This would require more staffing than anticipated, a risk that would be predominantly addressed by ACR headquarters' fundraising efforts.

5 Conclusions and recommendations

In terms of sustainability and service levels, investments in rural water supply in developing countries are under-performing. At any given point in time, around one third of handpumps are not functioning. Many stop functioning in the first few years after installation. Even those that function often provide services that fall below national norms. In piped systems, the situation is slightly better in the sense that they are less likely to fail altogether, but more usually service levels are below standard. This working paper has tried to explore the extent to which capital maintenance, or the lack of it, plays a role in this. It has done so by looking at the mechanisms for funding capital maintenance and the levels of funding dedicated to it. It has also identified alternative mechanisms in a range of countries in Asia, Sub-Saharan Africa and Latin America.

5.1 Current expenditure and funding for capital maintenance

Often rural service providers – including community-based organisations – do not raise sufficient funds to carry out these regular recurrent expenditures. On a positive note, there are ample examples of water committees and small private operators in middle-income countries which are able to raise tariffs to cover OpEx. However, this is rarely enough also to cover capital maintenance costs. In fact, many governments recognise that users should not be expected to save funds to cover the full depreciation costs of the assets, and governments and citizens therefore contribute to these costs through taxes.

In some countries, including Chile, Ghana and Uganda, central or local governments have set up accounts or introduced items on their recurrent budgets for capital maintenance, to carry out major rehabilitation and repair works themselves, or contract it out (as in Namibia and South Africa). Other governments fund capital maintenance in a more ad hoc manner, in the form of occasional rehabilitation programmes often funded by external donors. Where total investment in capital maintenance is too small or too irregular, we see cases of what can best be described as 'muddling through': a system functions for a few years but then starts experiencing a reduction in service levels or functionality. The water committee may scrape together funds from an external party to complement some of its own savings and a rehabilitation project will occur. The impact of this on services is obviously negative, though probably not as severe as total failure of relatively new systems.

Based on the data presented in this paper, the amount of OpEx for a basic level of rural water service is US$ 0.5-5 per person per year, and US$ 1.5-7 for CapManEx, which may constitute a significant percentage of the total costs of water services, particularly for handpumps and other rural point sources. Based on these figures it can be suggested tentatively that expenditure of less than US$ 2 per person per year (both OpEx and CapManEx) is insufficient to provide a basic level of service. This also correlates with the fact that countries where current expenditure on OpEx and CapManEx is below this threshold are in the least developed or low-income categories, where the capacity of users or local government to contribute to recurrent expenditures is lower. Countries where higher levels of service are provided also spend more on OpEx and CapManEx.

The overriding message from this analysis is that capital maintenance adds a substantial amount to the costs, which households cannot be expected to pay in full. Many governments and donors have started recognising this. However, the case studies indicate that there might be some scope for more organised co-financing of capital maintenance between users and government. Most likely, this will require a significant contribution from taxes or transfers. The challenge remains to access these public funds in a timely manner to ensure efficiency in the renewal process and, most importantly, to maintain service delivery.

5.2 Potential mechanisms for funding capital maintenance

If we accept the need for some kind of co-financing of capital maintenance between users and government, the question needs to be addressed as to what is the most efficient and effective way of doing this. There are currently various options:

- Ad hoc arrangements. The main risk of continuing the current ad hoc approach is that a certain number of systems will regularly experience periods of poor or no services, when a process for establishing arrangements to carry out capital maintenance activities fails. Besides, this approach is probably inefficient from a financial and economic perspective. Its advantage is that, unlike some of the other arrangements, it does not require the establishment of any external oversight or regulatory arrangements. At most, more structural front-loading could be promoted. This can only be recommended in cases where the capacity for a more articulated asset management approach is lacking and not likely to be developed in the near future.
- In many of the examples illustrated in this paper, government guidelines support the creation of capital maintenance funds, though in practice there are often insufficient funds to carry out preventive maintenance. Often funds are only accessible after major failures occur. One way of enforcing capital maintenance expenditures for infrastructure is to guarantee a steady flow of funds through a single annual allocation from the national budget (i.e., ring-fenced fund from the finance ministry) or regional budget, taking away the pressure to prioritise only new infrastructure. The dedicated fund could be replenished by resources from user charges, ensuring cross-subsidisation from better-off to less developed areas. This could in turn ensure that capital maintenance is contracted to the local private sector, which can be highly cost-effective and efficient in terms of, for example, the maintenance of roads, as it is administratively simpler to employ private contractors to perform maintenance tasks than to assign responsibility to a central government water department (Calvo, 1998).
- Other promising mechanisms are insurances and ring-fenced funds at donor/external level. None of these options have been implemented in the water sector and it is therefore too early to draw conclusions about their feasibility.

5.3 Recommendations and practical steps towards financing capital maintenance

The success of implementing any of the approaches outlined in this paper will depend on a number of enabling conditions. We have attempted to describe practical steps towards financing capital maintenance and implement asset management.

Making explicit who is responsible for capital maintenance

An essential first step for improving capital maintenance support is to identify who should undertake this role and the limits of their mandate. In other words, to define how financial responsibilities are shared. However, identifying who should be responsible is not enough; acknowledging the medium to long-term financial implications of building water infrastructure is essential to making progress. Without clearly defined mandates, there is no realistic possibility of holding stakeholders to account for their actions (or lack of them) and for the sustainability of services.

Promoting a more 'regulatory' approach that provides external oversight of rural water supply to strengthen accountability mechanisms for capital maintenance

At the moment it is not realistic to request a village or town with rotating elected officials to make provisions for the future replacement of assets in separate ring-fenced accounts and as such some form of regulation seems to be required. In the European Union (EU), maintenance works are often prompted by the need to comply with EU regulations. In urban areas, the responsibility for asset management tends to be with utilities. In rural areas, there are a large number of service providers, which complicate any more formalised asset management. An alternative could be to transfer the asset management responsibility of service providers to local government.

Understanding current and future capital maintenance needs – at scale

Current levels of funding for capital maintenance are not necessarily sufficient to deliver a basic level of service. Assessing the size of the gap is not a straightforward task but it can be done with relatively little effort. Ideally, for more accuracy this would require having an inventory of all assets in a specific service area, their age and expected lifespan and, based on the costs of implementation, assessing whether levels of capital maintenance expenditure are adequate and how much will be needed in the near future.

Such simple calculation of the costs of slippage or loss of infrastructure can help people understand the efficiency of CapManEx. This can support the shift from delivering new services to the unserved to maintaining services. Donors and governments should be able to be proud of (and be able to report on) maintaining coverage. For countries with more sophisticated data collection mechanisms, a more complex and structural approach is useful in understanding capital maintenance, similar to that used by utilities, based on inventories of existing assets.

The examples of good practices in capital maintenance show that, in order to plan and budget for CapManEx, a certain level of scale is needed. When these types of costs are incurred they tend to be "heavy and lumpy" (Barraqué, 2009), representing a peak in expenditure that many service providers simply cannot afford to meet in one go. By considering other units of scale, cost-levelling and cross-subsidy mechanisms, better financial planning can be conducted to manage assets more efficiently and effectively. This would mean that regulation of asset management or rural water supply would take place at the level of the service authority and not the service provider[9].

Implementing embryonic asset management planning supported by fixed asset accounting

Where local authorities and service providers continue to use a cash-accounting approach they have no easy record of their investment in fixed assets. 'Double entry book-keeping' based on fixed-asset accounting delivers an ongoing record of the value of the fixed assets held by the service provider. Recognition of that value, ideally updated by some form of rough and ready inflation indexing, forms the beginning of asset management planning (see also practical examples in section 3.4). The updated values of assets are complemented by some form of register of where the assets

9 **Service authority:** The body – often district local government or equivalent – with legal responsibility for guaranteeing a WASH service in a defined area, fulfilling functions such as planning, coordination and oversight. It may be the legal owner of assets but not necessarily so. In some cases, it may also have delegated functions of regulation. It may also be responsible for technical assistance, but can contract this out to an association of community-based providers, an NGO or private sector. **Service provider:** The organisation or operator that manages and delivers the service to a defined population in a defined service area, taking care of operation, maintenance and administration of the system.

are, when they were installed and what maintenance has been undertaken in the past. This information gives an indication of the likely funds needed and can be used in negotiations between service providers, service authorities and local and national governments.

Understanding current funding mechanisms for capital maintenance and improving modalities

It is not always clear how capital maintenance is supposed to be funded according to each country's specific guidelines. As described in section 3, it is often a combination of tariffs with government funding and ad-hoc funds from third parties. Capital maintenance often takes place after complete failure and is combined with rehabilitation and extension programmes.

Based on this, specific mechanisms and modalities need to be defined that are in line with the capacities of the country. This includes the capacity to develop and enforce regulations, to monitor financial investments in the sector, to establish financing mechanism agreements among different stakeholders, to establish asset inventories and to adopt an asset management approach.

Sufficiency of financial and other resources and realignment of priorities

Having identified who is going to provide what sort of contribution to capital maintenance, it is essential to assess the resource implications for the stakeholders, particularly what this means for tariffs and central and local government budgets. This starts with human and material capacity but ultimately ends with cash. Without a minimal level of funding, effective capital maintenance support from taxes cannot be provided. We recommend that further studies are done to identify the likely level of costs for capital maintenance in those countries where expenditure is currently clearly too low. Where it is not possible to obtain empirical data this may be done on the basis of modelling exercises.

A strong recommendation is that potential financiers of capital investment in rural water services ask themselves how the funding of capital maintenance is arranged and whether it is likely to be forthcoming. If the answer is no, they should accept that either 1) their investment is unlikely to be sustainable and will not provide the envisioned level of service for more than a couple of years or 2) a shift in priorities for financial allocation is required to ensure the investment is not completely lost.

References

Adank, M. et al. (forthcoming). *The Status of Rural Water Supply Services in Ghana: A Synthesis of Findings from Three Districts*. Accra: IRC International Water and Sanitation Centre.

Agbenorheri, M. and Fonseca, C., 2005. *Local Financing Mechanisms for Water Supply and Sanitation Investments*. Loughborough: WEDC-Water, Engineering and Development Centre, London: LSHTM-London School of Hygiene & Tropical Medicine, and Delft: IRC International Water and Sanitation Centre.

Asante, J. (forthcoming). *Capital Maintenance of Small Towns Piped Water Schemes in Ghana*. Accra: IRC International Water and Sanitation Centre.

Asante, J., 2010. *Quantifying the Cost of Sustainable Water Service Delivery in Selected Small Towns in Central Region, Ghana.* MSc thesis. Kumasi: Civil Engineering Department, Kwame Nkrumah Univeristy of Science and Technology.

Bakalian, A. and Wakeman, W., 2009. *Post-construction Support and Sustainability in Community-managed Rural Water Supply: Case Studies in Peru, Bolivia and Ghana*. Working Paper Report, Number 48731, 1 (1), Water Sector Board discussion paper series, no. 14. Washington, D.C.: Bank-Netherlands Water Partnership (BNWP) and World Bank.

Barraqué, B., 2009. The Development of Water Services in Europe: From Diversity to Convergence. In: Castro, J.E. and Heller, L., eds., 2009. *Water and Sanitation Services: Public Policy and Management*. London: Earthscan.

Braimah, C. and Franceys, R. (forthcoming). *Small Town Water Supply Management Models*. Ghana.

Brikke, F. and Rojas, J., 2001. *Key Factors for Sustainable Cost Recovery in the Context of Community Managed Water Supply*. (Occasional Paper Series 32) [pdf] The Hague: IRC International Water and Sanitation Centre. Available at: <www.irc.nl/content/download/2568/26552/file/op32e.pdf> [Accessed 29 August 2012].

Brikké, F., 2000. *Operation and Maintenance of Rural Water Supply and Sanitation Systems: A Training Package for Managers and Planners.* Geneva: Word Health Organization and Delft: IRC International Water and Sanitation Centre.

Briscoe, J. and Ferranti, D., 1988. *Water for Rural Communities: Helping People to Help Themselves*. Washington, D.C.: World Bank.

Burr, P. and Fonseca, C., 2013. *Applying a Life-cycle Costs Approach to Water: Costs and Service Levels in Andhra Pradesh (India), Burkina Faso, Ghana and Mozambique*. (WASHCost Working Paper 3) [pdf] The Hague: IRC International Water and Sanitation Centre. Available at: <http://www.washcost.info/page/2665> [Accessed 20 February 2013].

Calvo C., 1998. *Options for Managing and Financing Rural Transport Infrastructure*. (World Bank Technical Paper 411) [pdf] World Bank. Available at: <http://irispublic.worldbank.org/85257559006C22E9/All+Documents/85257559006C22E9852572600055A312/$File/twu025.pdf> [Accessed 18 February 2013].

Cardone, R. and Fonseca, C., 2004. *Financing and Cost Recovery*. (Thematic Overview Paper 7) [pdf] The Hague: IRC International Water and Sanitation Centre. Available at: <http://www.irc.nl/page/7582> [Accessed 29 August 2012].

CWSA-Community Water and Sanitation Agency, 2010.*Operations and Maintenance Guidelines for Small Towns*. Accra: Ministry of Water Resources, Works and Housing, Ghana.

CWSA-Community Water and Sanitation Agency, 2011. *Community Water and Sanitation Regulation*. Accra: Ministry of Water Resources, Works and Housing, Ghana.

Davis J. and Iyer P., 2002. *Taking Sustainable Rural Water Supply Services to Scale: A Discussion Paper.* Washington, D.C.: Bank-Netherlands Water Partnership – Water and Sanitation Program.

DNA-Direcção Nacional de Águas, 2001. *Manual de Implementação de Projectos de Água Rural*. Maputo: PRONASAR-Ministry of Public Works and Housing, National Water Directorate, Rural Water Department.

DNA-Direcção Nacional de Águas, 2012. *Estudo de base sobre a situação de abastecimento de água e saneamento rural-relátório sobre a capacidade institucional do Distrito de Mandlacaze.* Maputo: PRONASAR-Ministry of Public Works and Housing, National Water Directorate, Rural Water Department.

Fernández D., Jouravlev, A., Lentini, E. and Yurquina, A., 2009. *Contabilidad regulatoria, sustentabilidad financiera y gestión mancomunada: temas relevantes en servicios de agua y saneamiento*. [pdf] Santiago de Chile: Naciones Unidas. Available at: < http://www.eclac.org/publicaciones/xml/7/37447/lcl3098e.pdf> [Accessed 1 February 2013].

Ferro, G. and Lentini, E., 2009. *Network for Cooperation in Integrated Water Resource Management for Sustainable Development in Latin America and the Caribbean*. (ECLAC Circular 30). [pdf] United Nations Economic Commission for Latin America and the Caribbean. Available at: <http://www.eclac.org/drni/noticias/circulares/1/36321/Carta30in.pdf> [Accessed 17 November 2012].

Fonseca, C., Brikké, F. and Kouassi Komlan, E., 2005. *Planning for Sustainable Cost Recovery in Community-Based Water Supply Services.* Delft: IRC International Water and Sanitation Centre.

Fonseca, C., Franceys, R. and Perry, C., 2010. *Guidelines for User Fees and Cost Recovery for Rural, Non-networked, Water and Sanitation Delivery*. Water Partnership Programme of the African Development Bank. [pdf] Water Partnership Program and African Development Bank. Available at: <http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/2011_03%20Guidelines%20for%20User%20Fees%20Cost%20Recovery_Rural.pdf> [Accessed 17 November 2012].

Fonseca, C., Franceys, R., Batchelor, C., McIntyre, P., Klutse, A., Komnives, K., Moriarty, P., Naafs,, A., Nyarko, K., Pezon, C., Potter, A., Reddy, R. and Mekala, S., 2011. *Life-cycle costs approach: costing sustainable services.* (WASHCost Briefing Note 1a) [pdf] The Hague: IRC International Water and Sanitation Centre. Available at: <http://www.washcost.info/page/1557> [Accessed 17 December 2012].

Franceys, R. and Pezon, C., 2010. *Services are Forever: The Importance of Capital Maintenance (CapManEx) in Ensuring Sustainable WASH Services.* (WASHCost Briefing Note 1b) [pdf] The Hague: IRC International Water and Sanitation Centre. Available at <http://www.washcost.info/page/866> [Accessed 3 September 2012].

Fuentealba, R., 2011.Sostenibilidad en sistemas de agua potable rural en Chile. [ppt] In: IADB-Inter-American Development Bank, *Semana Sectorial del Agua del Banco Interamericano de Desarrollo,* Sanitago de Chile, Chile. Available at: <http://bidcomunidades.iadb.org/pg/file/read/120657/reinaldo-fuentealba-sostenibilidad-en-sistemas-de-agua-potable-rural-en-chile> [Accessed 10 November 2012].

Garvin M., 2008. *Does Bringing Infrastructure Onto the Balance Sheet Matter? An Overview of Public Water Enterprise Financial Reporting Practices.* In: Amekudzi, A. and McNeil, S., eds., 2008. Infrastructure Reporting and Asset Management: Best Practices and Opportunities. Virginia: ASCE Publications.

Gasteyer, S., 2011. *United States of America: Lessons for Rural Water Supply; Assessing Progress towards Sustainable Service Delivery*. [pdf] The Hague: IRC International Water and Sanitation Centre and Michigan: Michigan State University. Available at <http://www.waterservicesthatlast.org/Countries/USA-overview> [Accessed 20 January 2013].

Gibson, J. 2010. Operation and Maintenance Costs of Rural Water Supply Schemes in South Africa. In: IRC International Water and Sanitation Centre, *Pumps, Pipes and Promises – Costs, Finances, Accountability for Sustainable WASH Services.* The Hague: The Netherlands 16-18 November 2010. [pdf] The Hague: IRC International Water and Sanitation Centre. Available at <http://www.irc.nl/page/55846> [Accessed 10 February 2013].

Gibson, J. and Matengu, K., 2010. Challenges of Maintaining Rural Water Supply Scheme Kavango and Caprivi Regions (Republic of Namibia). In: Rural Water and Sanitation Network, *International Symposium on Rural Water Services, Providing Sustainable Water Services at Scale*. Kampala, Uganda 13-15 April 2010. [pdf] St.Gallen: RWSN. Available at <http://www.scalingup.watsan.net/> [Accessed 10 February 2013].

Gyamfi, P., Gutierrez L. and Yepes Boscán, G., 1992. *Infrastructure Maintenance in LAC: The Cost of Neglect and Options for Improvement*. Report 17. Vol.1. Latin American and Caribbean Technical Department, World Bank. World Bank.

Harvey, P.A. and Reed R.A., 2006. Community-managed Water Supplies in Africa: Sustainable or Dispensable? *Community Development Journal*, 42 (3), pp. 365-78.

Harvey, P.A., 2005, *Operation and Maintenance for Rural Water Services: Sustainable Solutions*. Background report for WELL Briefing Note 15. Loughborough: WEDC.

Hutchings, M.T., Dev, A., Palaniappan, M., Srinivasan, V., Ramanathan, N. and Taylor, J., 2012. *mWASH: Mobile Phone Applications for the Water, Sanitation, and Hygiene Sector*. [pdf] Oakland: Pacific Institute. Available at: <http://www.pacinst.org/reports/mwash/full_report.pdf> [20 February 2013].

Hutton G. and Bartram, J., 2008. Global Costs of Attaining the Millennium Development Goal for Water Supply and Sanitation, *Bulletin of the World Health Organization*, 86, pp. 13-9.

IDRC-International Development Research Centre and IRC International Water and Sanitation Centre, 1988. *Handpumps: Issues and Concepts in Rural Water Supply Programmes*. (Technical Paper 25) [pdf] The Hague: IRC International Water and Sanitation Centre. Available at: <http://www.washdoc.info/docsearch/title/109292> [Accessed 10 February 2013].

Kleemeier, E., 2000. The Impact of Participation on Sustainability: An Analysis of the Malawi Rural Piped Scheme Program. *World Development*, 28 (5), pp. 929-44.

Koestler, L. and Jangeyanga, P., 2012. *Information Scan on WASH Unit Costs and Financial Planning and Budgeting of the Water and Sanitation Sector in Uganda*. [pdf] The Hague: IRC International Water and Sanitation Centre and Kampala: Fontes Foundation. Available at: < http://www.washcost.info/page/2612> [Accessed 13 February 2013].

Lockwood, H. and Smits, S., 2011. *Supporting Rural Water Supply: Moving Towards a Service Delivery Approach*. [pdf] Rugby: Practical Action Publishing. Available at <http://www.source.irc.nl/page/67155> [Accessed 10 February 2013].

Meleg, A., 2011. *SISAR: An Innovative Sustainable Management Model for Small Decentralized Water and Wastewater Systems in Developing Countries*. Paper prepared for 6th International Rural Water Supply Network Forum 2011; *Rural Water Supply in the 21st Century: Myths of the Past, Visions for the Future*. Kampala, Uganda, [pdf]. Available at: <http://www.macsonline.de/ivs/fileadmin/macs_data/Media/SISAR_article_AM.pdf> [Accessed 10 February 2013].

MLGRD-Ministry of Local Government and Rural Development, 2008. *District Assemblies Model Bye-Law-Establishment and Operations of Water and Sanitation Development Boards*. Accra: Ministry of Local Government and Rural Development, Ghana.

Moriarty, P., Naafs, A., Pezon, C., Fonseca, C., Uandela, A., Potter, A., Batchelor, C., Reddy, R. and Mekala, S., 2010. *WASHCost's Theory of Change: Reforms in the Water Sector and What They Mean for the Use of Unit Costs*. (WASHCost Working Paper 1) [pdf] The Hague: IRC International Water and Sanitation Centre. Available at: <http://www.washcost.info/page/1034> [Accessed 18 April 2012].

National Asset Management Steering Group, 2006. *New Zealand Infrastructure Asset Valuation and Depreciation Guidelines*. [pdf] Thames: New Zealand National Asset Management Steering Group. Available at: <http://www.nams.org.nz/assets/file/Manuals%20&%20Order%20Forms/Val%20&%20Dep%20Guidelines%20Intro.pdf> [Accessed 10 February 2013].

Naveas, P., (forthcoming). *El agua potable rural en Chile: Estudio de caso*. Borrador: Banco Interamericano de Desarrollo.

Nyarko, K.B., Dwumfour-Asare, B., Moriarty, P., Appiah-Effah, E. and Obuobisa-Darko, A., 2012. *Life-Cycle Costs in Ghana: Functionality of Rural Water Systems in Ghana*. (WASHCost Ghana Briefing Note 6) [pdf] Accra: IRC International Water and Sanitation Centre. Available at: <http://www.washcost.info/page/2319> [Accessed 10 February 2013].

OECD-Organisation for Economic Co-operation and Development, 2009. *Managing Water for All: An OECD Perspective on Pricing and Financing Key Messages for Policy-makers*. [e-book] Paris: OECD. Abstract only. Available through the OECD website at: <http://www.oecd.org/env/biodiversitywaterandnaturalresourcemanagement/managingwaterforallanoecdperspectiveonpricingandfinancing.htm> [Accessed 29 August 2012]

Ofwat-The Water Services Regulation Authority, 2005. *Water and Sewerage Service Unit Costs and Relative Efficiency 2003–2004 report*. Birmingham: Ofwat. Available at: <http://www.ofwat.gov.uk/regulating/reporting/rpt_unc_2003-04.pdf> [Accessed 29 August 2012].

Ofwat-The Water Services Regulation Authority, 2007. *Guideline for the Analysis of Operating Costs and Assets 2006-7. Regulatory Accounting Guideline 4.03*. [pdf] Birmingham: Ofwat. Available at: <https://www.ofwat.gov.uk/regulating/gud_rag_4opcosts_403.pdf> [Accessed 29 August 2012].

Pearson, M., 2007. *US Infrastructure Finance Needs for Water and Waste-water*. Washington, D.C.: Rural Community Assistance Partnership. [pdf] Available at: <http://www.map-inc.org/finance> [Accessed 19 April 2010].

Reddy, V.R, Jaya Kumar, N., Venkataswamy, M. and Mekala, S., 2011. Cost of provision: how good are unconditional allocations? A study of water services delivery in rural Andhra Pradesh. (WASHCost-CESS Working Paper No. 15) [online] Hyderabad: WASHCost India and CESS. Available at: <http://www.washcost.info/page/1671> [Accessed 17 April 2012].

Rioja, F., 2003. The Penalties of Inefficient Infrastructure, *Review of Development Economics* 7(1), pp. 127-37. [e-journal]. Available at <http://www1.worldbank.org/publicsector/pe/pfma06/Rioja-penalties.pdf> [Accessed 3 February 2013].

RWSN-Rural Water Supply Network, 2010. *Myths of the Rural Water Supply Sector*. (Perspectives No. 4) [pdf] St Gallen: Rural Water Supply Network Executive Steering Committee. Available at: <http://www.rwsn.ch/documentation/skatdocumentation.2009-07-27.8158674790/file> [Accessed 3 February 2013].

SANAA-Servicio Autónomo Nacional de Acueductos y Alcantarillados, 2009. *Sistema de Información de Acueductos Rurales (SIAR) database*. Tegucigalpa: Servicio Autónomo Nacional de Acueductos y Alcantarillados.

Schiller, T. and Schienle, S., 2004. *Self-Administration by Users in the Delivery of Water and Wastewater Services – The Sistema Integrado de Saneamento Rural.* [pdf] Frankfurt: MACS Management and Consulting Services. Available at: <http://macsonline.de/downloads/MACS_User_Self_Administration_in_Water_and_Sanitation_paper.pdf> [Accessed 12 December 2012].

Schouten, T. and Moriarty, P., 2003. *Community Water, Community Management: From System to Service in Rural Areas*. Rugby: Practical Action.

Smits, S, Verhoeven, J., Moriarty, P., Fonseca, C. and Lockwood, H., 2011. *Arrangements and Cost of Providing Support to Rural Water Service Providers.* (WASHCost Working Paper 5) [pdf] The Hague: IRC International Water and Sanitation Centre. Available at: <http://www.washcost.info/page/1567> [Accessed 12 December 2012].

Smits, S. and Moriarty P., (forthcoming). *Into the Danger Zone*: *A Discussion Note.* The Hague: IRC International Water and Sanitation Centre.

Smits, S., 2011. *Cobertura total; ¿para siempre? Sistematización de la experiencia de Water For People en la municipalidad de Chinda, Honduras*. Tegucigalpa: Water For People and The Hague: IRC International Water and Sanitation Centre.

Smits, S., Tamayo, S.P., Ibarra, V., Rojas, J., Benavidez, A. and Bey, V., 2012. *Gobernanza y sostenibilidad de los sistemas de agua potable y saneamiento rurales en Colombia*. (Monografia No. IDB-MG-133) [pdf] Washington, D.C: Banco Interamericano de Desarrollo. Available at: < http://cinara.univalle.edu.co/archivos/pdf/142.pdf> [Accessed 3 February 2013].

Thames Water, 2001. The Water Cycle. [pdf] Available at: <http://www.thameswater.co.uk/cycles/pdf/WaterCyclePrint.pdf> [Accessed 7 February 2013].

WASHCost, 2012. *Providing a Basic Level of Water and Sanitation Services that Last: Cost Benchmarks.* (WASHCost Infosheet 1) [pdf] The Hague: IRC International Water and Sanitation Centre. Available at: < http://www.washcost.info/page/2386> [Accessed 7 February 2013].

WaterAid Tanzania, 2009. Management for Sustainability: *Practical Lessons from Three Studies on the Management of Rural Water Supply Schemes*. Dar Es Salaam: WaterAid.

WHO-World Health Organization, 2012. *UN-Water Global Annual Assessment of Sanitation and Drinking-water (GLAAS) 2012 report: The Challenge of Extending and Sustaining Services*. Geneva: World Health Organization.

Winpenny, J., 2003. *Financing Water for All: Report of the World Panel on Financing Water Infrastructure*, *World Water Council 3rd World Water Forum*. [pdf] Available at <http://www.financingwaterforall.org/fileadmin/wwc/Library/Publications_and_reports/CamdessusReport.pdf>
[Accessed 3 September 2012].

World Bank, 1994. *World Development Report 1992*. Washington, D.C.: World Bank Publications.
WSP-Water and Sanitation Programme, 2011. *Waterpoint Mapping in Liberia Using FLOW Technology.* [pdf] Washington, D.C.: Water Supply and Sanitation Programme. Available at: <http://www.wsp.org/wsp/sites/wsp.org/files/publications/WSP-FLOW-Liberia-Watermapping-Summary.pdf> [Accessed 3 September 2012].

Zeug, H., 2011. *Analysis: Potential of Microinsurance to Sustain Water and Sanitation Services*. Report for Water for People. Denver: Water for People.

Zita, J. and Naafs, A., 2012. *Custos das fontes dispersas em Moçambique: análise dos custos unitários dos contractos de 2011.* (WASHCost Folheto Informativo Moçambique C 03) [pdf] Maputo: WASHCost Mozambique. Available at: <http://www.washdoc.info/docsearch/title/178282> [Accessed 10 January 2013].