water for people

Private Sector Provision of Rural Water Services

A Desk Study for Water For People

Tim Foster

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Executive summary

Community-based management remains the dominant approach to rural water supplies in Africa, Asia and Latin America, though private sector provision is growing in importance

- In response to the low levels of sustainability achieved by community-based management, private sector involvement is now being promoted at a national policy level in more than a dozen African countries
- Formal policy endorsement of private sector management models for rural water supplies appears less explicit in India and Latin America
- While they remain the exception rather than the norm, rural water services managed by private individuals and enterprises span the full gamut of service levels, from traditional well ownership through to piped schemes

Self-supply offers a low-cost way to expand privately-managed supplies at a household level, though, with the notable exception of Zimbabwe, few formal initiatives have been scaled up beyond a pilot stage

- Zimbabwe's program has facilitated the upgrading of 120,000 wells at minimal subsidy (US$3-5 per capita)
- Recent pilot projects in Zambia, Ethiopia, Mali and Uganda have also yielded promising results at low-cost
- These pilots demonstrate traditional wells are most conducive to self-financed upgrading activities
- Four building blocks for scaling up self-supply: (1) technical advice for consumers; (2) access to micro-credit or savings mechanisms; (3) a well-developed private sector; and (4) policies which encourage individual initiatives

Despite being the most common mode of rural water supply, handpumps are rarely managed by the private sector

- Area pump mechanics are currently the most prominent private sector actors involved in handpump maintenance throughout Africa, Asia and Latin America, though the approach is plagued by several weaknesses
- Recent efforts to form professional pump mechanic associations and organised businesses appear to be yielding more promising results
- Contract-based arrangements have been mooted as possible alternatives for handpump O&M; however few of these have been tested in the field, and for those that have, the results have been disappointing
- Limited data suggests privately-managed water points are more sustainable than community-managed ones
- High costs associated with serving dispersed, hard-to-reach communities, combined with difficulties in collecting user payments, may limit the commercial viability of handpump O&M businesses, particularly in rural Africa
- Where commercial viability is questionable, bundling pump maintenance with piped scheme operation, as in Burkina Faso, would enable cross-subsidisation

Privately operated decentralised water treatment kiosks have emerged over the last decade (chiefly in India), though at this early stage have captured only a small share of the rural water market

- Though operated by a local entrepreneur, O&M responsibilities are retained centrally by the parent company, generating economies of scale, and a greater ability to manage supply chains
- With no distribution infrastructure, kiosks are cheaper to install than piped schemes, and tend to serve towns with populations between 1,500 and 5,000

Operation of piped schemes serving small towns is the most common modality of private sector involvement in rural water supplies

- Operators range from individual entrepreneurs through to multinational corporations
- Francophone African countries are particularly strident in their efforts - over a quarter of rural piped schemes are privately operated in Benin, Burkina Faso, Mali, Niger, Rwanda and Senegal
- Though far from conclusive, initial evidence indicates improvements across financial and operational indicators
- Privately-managed piped schemes appear less common in India and Latin America, though private operators are present in several countries including Peru, Paraguay, Colombia, Vietnam, Cambodia and Bangladesh

Full recovery of capital costs through user fees appears to be rare, particularly in rural Africa, thus widespread capital investment by private enterprises and entrepreneurs remains unlikely without external subsidies

- Self-supply is the exception, with households willing and able to invest a large proportion of the upfront costs
- Achieving full cost recovery for community handpumps is particularly problematic, though private investment and ownership of pumps has been documented in some settings, particularly Bangladesh and Vietnam
- In some rural piped schemes, private operators have financed network expansions without subsidies, but few examples of enterprises investing and recouping a high proportion of initial construction costs

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Report overview

The private sector offers a promising pathway to improve the provision of water services in rural areas. In light of the recognised deficiencies of community-based management, the potential for market-based solutions ought to be fully considered and tested. This review provides an overview of the different business models that have been deployed in the field, evaluates the prevalence of these approaches, and summarises the lessons learned. Documented approaches span the full technological and professional spectra from individuals investing in family wells through to piped schemes operated by multinational corporations. While they often represent isolated pockets rather than systematic approaches, the insights drawn from these initiatives can inform the design and testing of new market-based approaches and the creation of the conditions necessary for their success.

Though community-based management remains the principal service delivery model, policy-makers are increasingly looking to private individuals and enterprises to deliver rural water supplies. This is true across all four modalities analysed in this study: small piped schemes, decentralised water treatment services, dispersed water points, and household self-supply. Notwithstanding this shifting policy emphasis, in reality the current role of the private sector in rural water provision remains limited. There is little doubt that, despite its failings, community-based management remains the dominant approach across Africa, Asia and Latin America.

Along the water service ladder, small piped schemes are the most common modality for private sector involvement in rural areas. Numerous governments have turned to private operators to manage piped schemes in small rural towns, particularly in Francophone Africa. For example, over a quarter of rural piped schemes are privately operated in Benin, Burkina Faso, Mali, Niger, Rwanda and Senegal.

At the other end of the technology spectrum, self-supply has caught the attention of cash-strapped governments looking to harness people's willingness to invest in basic household-level supplies. In recent years, ministries in Zimbabwe, Zambia, Mali, Ethiopia and Uganda have supported initiatives that have yielded promising results. While the global prominence of government-supported self-supply remains muted, as more lessons and insights from pilot projects emerge, awareness and appreciation of this option will increase amongst planners and practitioners.

Entrepreneurs and enterprises figure less prominently in the management of dispersed water points. Though market-based approaches to handpump maintenance are beginning to be promoted by water ministries, these policy objectives have yet to be translated into significant action on the ground. Individual pump mechanics are active in numerous countries, though this maintenance service approach is plagued by a number of weaknesses, and augments community-based management rather than supplants it. Many contract-based arrangements have been mooted as possible alternatives for water point management; however few of these have been tested in the field, and for those that have, the results have been disappointing. As the most common yet least reliable of all water supply technologies, the importance of testing new handpump management models cannot be understated.

Without some external assistance, the opportunities to harness market forces to expand coverage in rural areas still appear restricted. Though private actors are often contracted to construct and install facilities, this is usually funded by government, NGOs or donors. In order to invest their own funds, private sector actors must be confident of recouping full capital costs via user fees, and this literature review failed to uncover more than a few isolated cases of this occurring.

The exceptions to this are decentralised water treatment services and household self-supply, where users are often willing and able to cover a large proportion of the capital costs involved. Though even with self-supply initiatives, the widespread expectation of donor- and NGO-funded water investments

has proven difficult to dislodge. In some instances, private sector expansion of piped schemes has occurred in small rural towns, with the costs recouped through service tariffs and connection fees. In most cases however, tariffs are constrained to covering operation and maintenance (O&M) costs, meaning expansion and rehabilitation is generally reliant on external support. Capital cost recovery for community water points is virtually non-existent, and most policies dictate a community contribution of only 2-5%. This is perhaps unsurprising given the ongoing struggle to collect revenue to cover even basic maintenance costs. This should not preclude private sector investments incorporating both 'build' and 'operate' components – indeed, there is a strong argument that bundling the two would achieve the most sustainable services for both piped and point source systems. Rather, it means in many cases enticing this kind of private investment will require some form of subsidy, perhaps best delivered via a 'least subsidy' or 'output-based aid' approach.

It is in the area of sustainable operation that the private sector has most to contribute. The profit motives of entrepreneurs and small enterprises can undoubtedly be aligned with the objectives of sustainable service provision. The concept of user fees covering O&M costs is now widely accepted, and in many instances water enterprises can be incentivised to ensure the continued functionality of systems, without the need for subsidies. Yet, despite this potential, there remains limited evidence on the performance of private operators from either financial or operational perspectives, and questions remain about the viability of rural water businesses.

Piped schemes and decentralised treatment services are the most commercially attractive propositions. Several examples demonstrate that enterprises can concurrently meet the dual objectives of providing a more reliable service and generating an adequate financial return.

Dispersed water points appear to be more problematic, particularly hand-operated pumps. In many regions, maintenance providers will be confronted by high unit costs associated with serving sparse populations; low availability of spare parts; high risks associated with many discrete assets of unknown condition; and poorly maintained roads. At the same time, the commensurate willingness to pay is often disproportionately low. Nonetheless, if adequate mechanisms for monitoring and regulation can be established, performance-based contracts and 'pay-as-you-fetch' approaches may prove effective ways to align commercial incentives with water point sustainability objectives.

It appears the strong sense of ownership associated with self-supply leads to high rates of ongoing functionality for household water supplies. The demand stimulated in pilot initiatives illustrates the appetite amongst owners to engage suitably skilled service providers for the ongoing improvement and maintenance of their supplies.

Finally, if a vibrant rural water services market can be established, it is no substitute for government institutions. Though the public sector might relinquish direct responsibility for ownership, operation or maintenance activities, they in turn must assume new duties. Government efforts to establish a favourable policy environment, design and administer subsidies, manage contracts, monitor and regulate service providers, and facilitate the development of businesses are all vital if private enterprise is to contribute to the improvement of rural water service delivery. These efforts will be crucial to stimulate the market-based solutions that can rise to the rural water challenge.

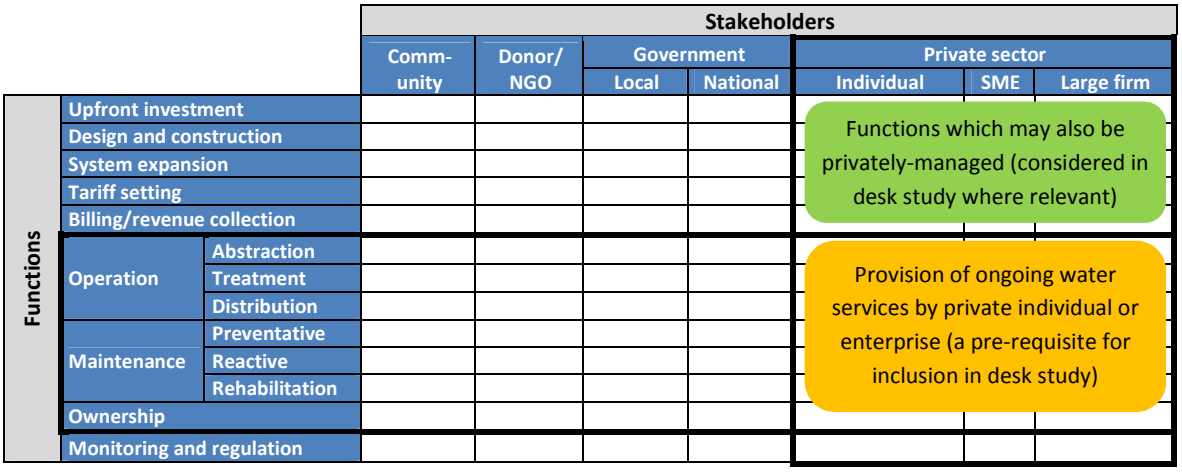
Desk study approach

This desk study provides a broad overview of how the private sector currently engages with rural water services in Africa, Asia and Latin America. A review of publicly available literature has been undertaken to identify examples of a private entity (whether individual, small enterprise or large firm) providing water services in a rural setting. The review seeks to assess the prevalence of private sector management models and their potential to improve both the coverage and sustainability of rural water supplies. It also considers the conditions under which these approaches might succeed, and the associated equity and resource implications.

Provision of operation and maintenance services was considered a pre-requisite for inclusion in the review, though additional privately-managed functions are discussed where linked with ongoing service provision, including upfront financing, construction and system expansion. Based on the case studies, this review assesses both the prominence and potential of private sector participation across four categories: (a) household self-supply; (b) dispersed community water points; (c) decentralised water treatment services; and (d) small piped schemes.

Though acknowledging the complex urban-rural distinction, this study considered the rural water market to encompass small towns, villages and dispersed households. Definitions vary as to what distinguishes a rural town from an urban or peri-urban settlement, though this study considered schemes that serve settlements with less than 5,000 inhabitants.

A range of sources have been drawn upon, including reports, literature reviews, policy documents, conference papers, journal articles, and discussions with practitioners. The desk review by Kleemeier (2010a) was a particularly rich source of information. Supporting data used throughout was obtained from the WHO/UNICEF JMP database, Afrobarometer surveys, Demographic and Health Surveys, and water point inventories from Uganda, Liberia and Kenya. Reflecting the geographical skew of rural water literature, the majority of case studies focus on sub-Saharan Africa.



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1 Introduction

1.1 The rural water supply challenge

The rural water sector in the developing world faces twin challenges. Efforts are urgently needed to increase access to safe water supplies, as well as improve the sustainability of those services. Significant investments over the last two decades have seen coverage of improved water sources in the developing world rise from 58% of rural dwellers in 1990 to 79% in 2010 (WHO/UNICEF 2012). Yet globally the number of people in rural areas without a safe water supply remains a staggering 663 million (Figure 1). Indeed, in the 20 years since 1990 the number of rural Africans lacking access to a safe water source has actually increased from 238 million to 276 million. At the same time, best estimates suggest 25% to 40% of handpumps, mechanised pumps and small piped schemes in rural Africa are non-functional (RWSN 2009, Kleemeier 2010a). Likewise, the Government of India (2011) reports that 490,000 handpumps and 12,900 small piped schemes have fallen into disrepair. Clearly such low levels of sustainability undermine efforts to expand coverage. In Africa alone, Baumann (2009) calculates the wasted investment over the last two decades to be in the order of US$1.2-1.5 billion.

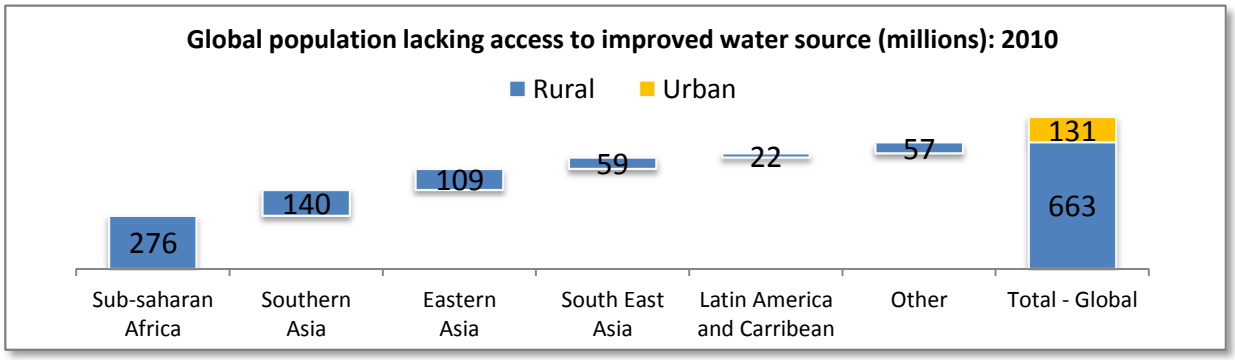

Figure 1 – Global population lacking access to an improved water source (WHO/UNICEF 2012)

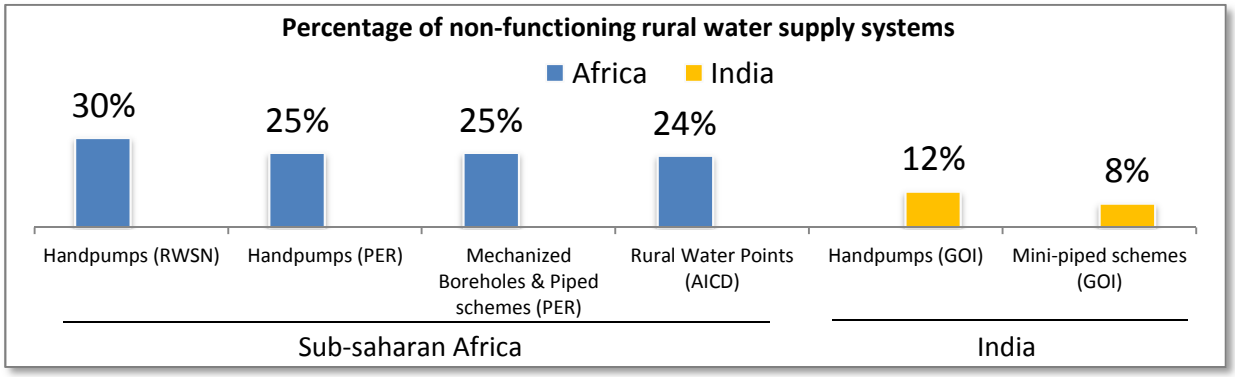

Figure 2 - Rural water scheme functionality in Africa and India (Kleemeier 2010a, Government of India 2011)

Given the limited public resources available to tackle this daunting challenge, self-sustaining solutions need a high degree of financial autonomy. In Africa alone the annual water and sanitation funding gap is in the order of US$12b, or 1.8% of the continent's GDP (Bannerjee and Morella 2011). Donor and public sector financing is clearly inadequate to meet future rural water supply requirements. In light of this shortfall, sustainability improvements and acceleration of safe water coverage will only be yielded if management approaches can leverage user payments to cover a greater proportion of both upfront and ongoing water service costs.

In response to these dilemmas, there is a growing consensus that the dominant community-based management paradigm needs to be reconsidered. For over two decades, community-based management has been embraced by governments, donors and NGOs. Under this approach, rural communities have been responsible for tariff setting, revenue collection, maintenance and repairs, and purchasing of spare parts. However a growing body of literature, combined with unacceptable water system failure rates, provides strong evidence of the flaws in this approach.[1] Harnessing the private sector offers a promising but still unproven alternative. Efforts to design, trial and evaluate new market-based management models are therefore needed, a call recently echoed by the Rural Water Supply Network (2010).[2]

1.2 A shift to private sector involvement and cost recovery

Though community-based management remains the most dominant approach to rural water supplies, many within the sector are now considering the potential of private sector solutions to address the dual challenges of sustainability and expanding access. Private management of piped schemes, water points and self-financed household-level supplies has the blessing of policy-makers across a growing number of jurisdictions (Table 1). Private sector involvement in rural water services is now promoted at a national policy level in more than a dozen African countries. The formal policy and regulatory environment is less conducive in India – as WSP (2011) observes, "there is no prescription against private sector provision nor is it encouraged in the rural water sector". This is in contrast to more explicit policy pronouncements promoting private sector service provision in neighbouring Bangladesh and Sri Lanka. The push for greater private sector participation is less apparent in Latin America and the Caribbean, though a number of countries have formally recognised the role of rural water businesses, including Peru, Colombia, Paraguay and Haiti.

Country	Cost recovery		Policy recognition of private sector		
	O&M	Capex	Piped	Water points	Self-supply
Benin	100%	-	Yes	Yes	
Botswana	0-100%[3]	0%			
Burkina Faso	100%	5-20%	Yes	Yes	
Ethiopia	100%	5%	No		Yes
Ghana	100%	5%	Yes	Yes	Yes
Kenya	100%	25-100%	Yes		
Madagascar			Yes		
Mali	100%	5%	Yes	Yes	
Mauritania			Yes		
Mozambique	100%	2%	Yes	Yes	
Niger			Yes		
Nigeria	100%	5%	Yes		
Rwanda			Yes	Yes	
Senegal	100%	3%	Yes		
South Africa			Yes		
Tanzania			Yes		

[1] For a good overview, see Harvey and Reed (2007).
[2] The RWSN (2010) recently declared, "given that communities are clearly not always capable of managing their facilities on their own, we argue…. [for] full consideration and testing of alternatives to community management, such as household owned systems or private operator managed systems."
[3] 33-100% HH connections, 0% for public standpipes.

Uganda	100%	2-5%	Yes	Yes	Yes
Zambia	5-100%[4]			Yes	Yes
Zimbabwe	100%	10-70%[5]			Yes

Table 1 - Policy positions on cost recovery and private sector involvement in the rural water sector[6]

Importantly, preceding this increased recognition of private sector management models is a widely held consensus that cost recovery is essential to the sustainable operation of rural water systems. Around 70% of African countries are now adopting policies promoting cost recovery in the rural water sector (Bannerjee and Morella 2011). Nonetheless, payment for water in rural areas remains the exception rather than the norm. Data from recent Afrobarometer surveys suggest only 32% of Africans pay for water in rural areas, compared to 75% in urban settings (Figure 3). As expected, payment is most common where water is piped into the home (69%), and least common where the source is outside the compound (29%). However these numbers conceal a more complex reality where user fees, even when collected, are often insufficient to cover basic operation and maintenance costs, and even less so rehabilitation and replacement costs. For example, Whittington et al. (2009) found only half of water user committees studied in Ghana and Peru collected enough money to cover operating costs, and less than a third collected enough to cover major repairs (Figure 3). Carter et al. (2010) therefore call for a change of mindset "in which payment of a realistic tariff for a reliable service, and commitment to provide that service – in other words a customer orientation – become the norm."

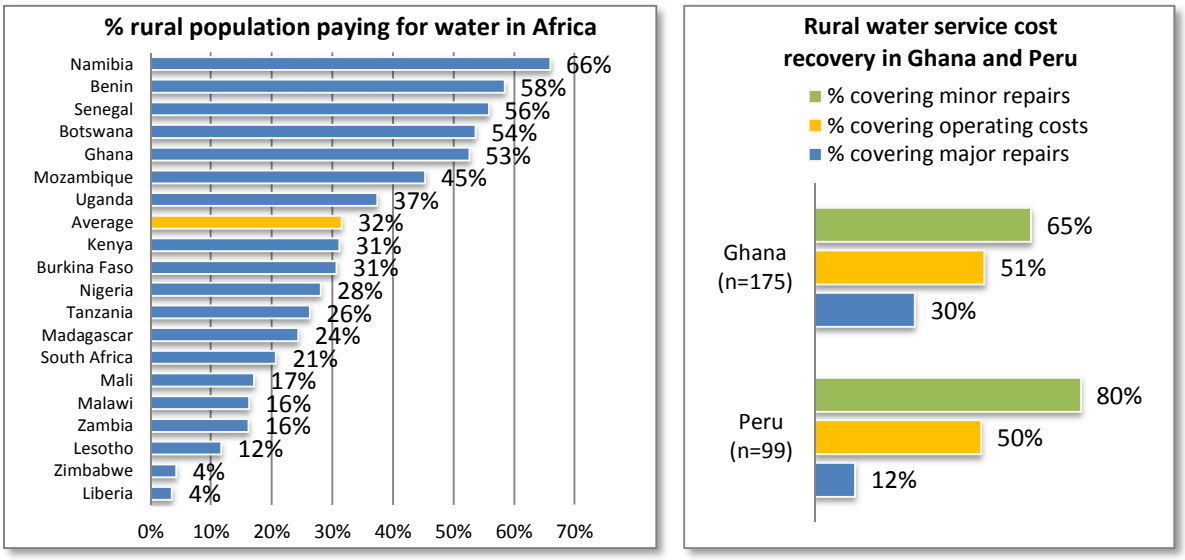

Figure 3 – Payment and cost recovery for rural water services (Afrobarometer survey data, Whittington et al. 2008)

This change of mindset is crucial if the private sector is to play a greater role in delivering rural water services. In the absence of subsidies, user payments must cover the cost of delivering the service, and an additional profit margin lucrative enough to attract commercially-oriented operators.[7] Willingness to pay for a reliable water supply is therefore crucial – importantly this is influenced by many factors within the control of a service provider including perceived advantages of an improved service, confidence in revenue collection systems, and reliability of the service (AfDB 2010). Rural water entrepreneurs and

[4] 5% for major repairs, 100% for minor repairs.
[5] 70% capital cost contribution applies to family wells.
[6] Information collated from a range of sources including AfDB (2010) and Lockwood and Smits (2011).
[7] It should however be kept in mind that an inability to pay the required amount does not necessarily preclude private sector involvement, so long as subsidies can be targeted to make up for the tariff shortfall.

enterprises will therefore need to offer a suitable combination of product, price and promotion to ensure their services are demanded by consumers.

In recent times, a number of influential institutions have offered upbeat prognoses about the prospects of private sector solutions for the rural water sector (e.g. ICF and WSP 2011). Proponents of private sector involvement point to a multitude of potential benefits. These include improved professionalism; enabling government to concentrate on the roles they are best equipped to perform; redirecting service subsidies to expand coverage to the unserved; extending the reach of public funds by leveraging commercial financing; provision of service levels that better respond to the needs and priorities of rural water users; and the ability to align commercial incentives with sustainable service provision. Despite the well documented controversies, the experience of private sector providers in urban water service delivery is instructive. With the right checks and balances in place, privately managed water supply schemes appear to have led to service improvements and expanded coverage in urban Africa. For example, though constituting only 9% of the urban water service market, private sector operators account for 20% of the increase in household connections seen in recent times in African cities (Bannerjee and Morella 2011).

Rural water businesses and social marketing

The emergence of rural water businesses has triggered new approaches to marketing the benefits of a safe, convenient water source. Combining educational messages for behaviour change and product promotion enables a powerful alignment of commercial incentives (water sales) and human development outcomes (health benefits, time savings). The commercial imperative means entrepreneurs and enterprises will tailor their products and branding to the needs and priorities of their rural water customer base. For example, WaterHealth International brands its product with "Dr Water". The Bob rainwater bag in Uganda emphasises the convenience and time savings associated with a household level water supply. Salter (2003) describes the marketing strategy employed by the highly successful pump program in Central Vietnam as one which "tapped into the emotions and aspirations of the consumer base… It did not promote hand pumps or wells. It promoted dreams."

1.3 The rural water market

According to Hammond et al. (2007) the size of the bottom-of-pyramid water market is in excess of US$20 billion. In response to this opportunity, small-scale private operators within the rural water sector are beginning to emerge. Mirroring the heterogeneity of potential water service levels and associated management responsibilities, private enterprises touch upon every dimension of rural water provision. Private sector involvement varies dramatically by level of formality, professionalization, scale of supply, and service technology - from traditional well maintenance and jerry can delivery services through to the supply of treated water via piped connections.

Yet despite the growing recognition of private sector participation in rural areas, very few examples have been rigorously reviewed or evaluated. This paucity of information makes it difficult to confidently ascertain the true prevalence and potential of private sector management models. It is unclear whether

these gaps in understanding remain because entrepreneurs and enterprises still figure very little in the rural water landscape, or that their involvement is often informal in nature and has therefore escaped the attention of researchers and practitioners.

It is nonetheless clear that the private sector is less active in the rural water sector than in urban and peri-urban areas. This has much to do with the less favourable economics which prevail in rural settlements that are sparsely populated, difficult to reach and subject to low/irregular incomes. Indeed, community management remains the predominant approach across rural regions. In rural Uganda (which by virtue of its dense rural population and favourable policy framework is better positioned to usher in market-based approaches than most), around 74% of water schemes are community-managed, compared to 11% by private individuals and 2% by private operators (MWE 2011). Likewise, a WaterAid study across several districts in Tanzania found privately managed water schemes tally to just 3% of the total, compared to 89% overseen by a village water committee (WaterAid Tanzania 2009). Market-based approaches are even rarer in Liberia where just 1.2% of rural water points have been installed by private individuals (MPW & LISGIS 2011).

However, there are some instances where privately owned and/or operated rural water supplies are the norm. This is particularly so for small piped schemes, as detailed in section 5. Even for off-grid water points there are outliers. A recent mapping exercise in drought-prone Kyuso District in Kenya found 42% of water supply systems were funded and owned by a private individual. A report by WSP (2000b) estimated 65% of tubewell handpumps in rural Bangladesh were owned by individuals, with private funding totalling to an amount equivalent to 50% of public sector expenditure, and five to six times more than that spent by the NGO sector. Similarly, Salter (2003) details a market development initiative in Central Vietnam that saw 64,000 handpumps sold to private individuals in the space of six years.

The prevalence and nature of private sector activities vary considerably across water supply scales and technologies. For the purposes of this study, private sector involvement in rural water services has been categorised into four simplified modalities: household self-supply, dispersed water points, decentralised water treatment services, and small piped schemes. These distinctions are in turn correlated with settlement size and population density. While acknowledging these service-level delineations conceal varying levels of complexity and sophistication (e.g. hand-operated pumps versus mechanised pumps; standpipes versus household connections), holding all things equal these basic modalities are accompanied by different life-cycle costs and levels of willingness-to-pay, which in turn define their potential for market-based approaches (Figure 4). These four categories therefore provide a useful framework for segmenting potential customers, and are examined in detail in Sections 2 to 5.

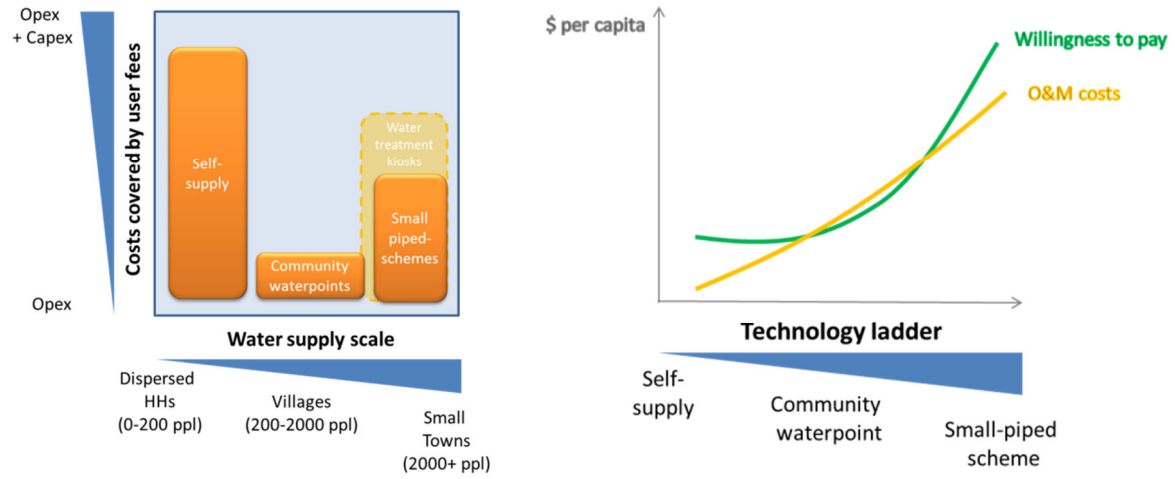

Figure 4 – Simplified schematic of water supply modalities and illustrative cost recovery levels

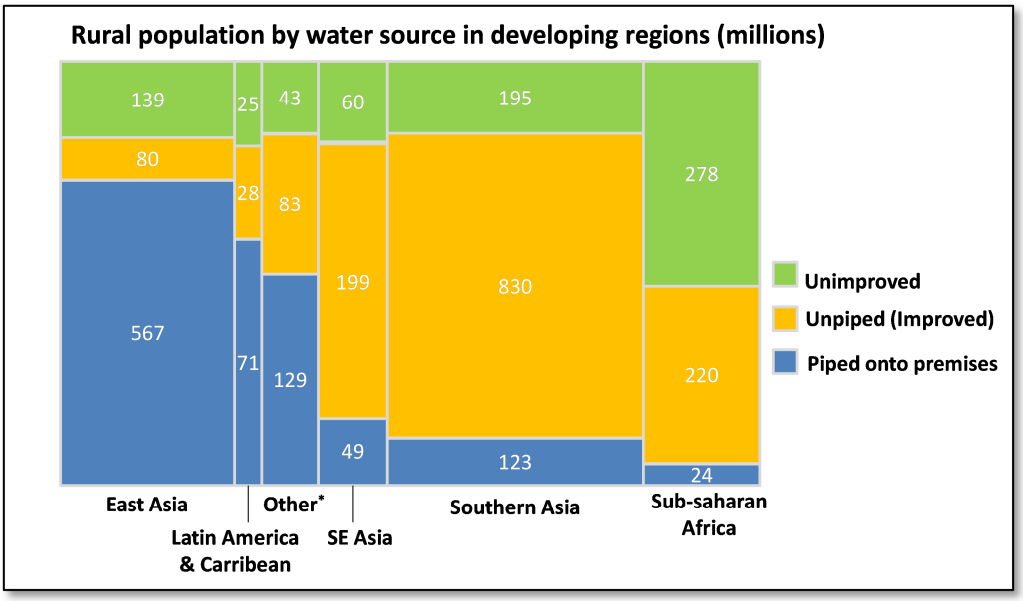

Figure 5 - Rural population by water source across developing regions

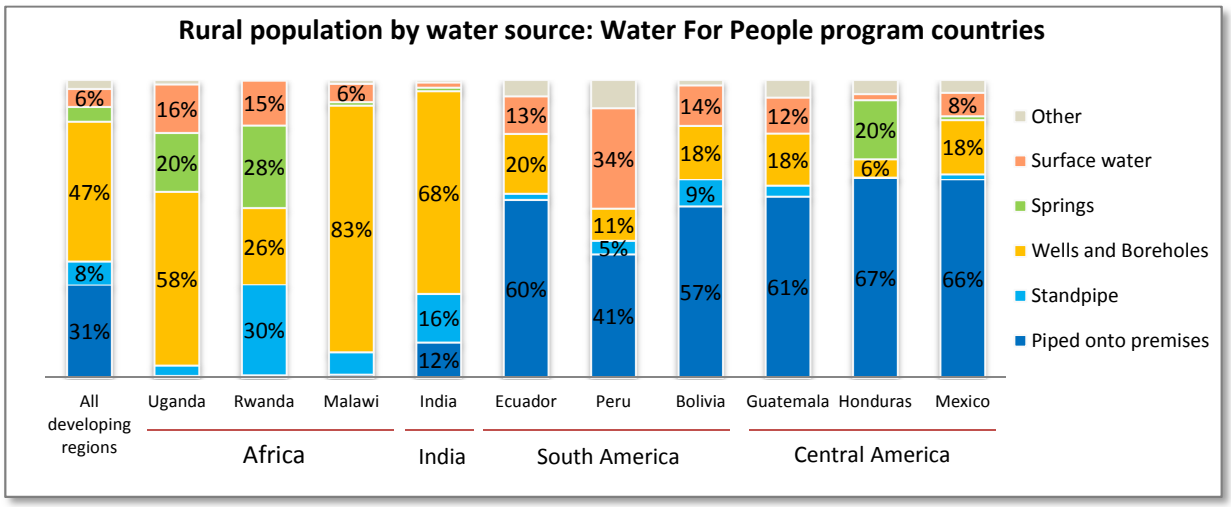

Figure 6 - Rural population by water source in Water For People program countries

At the lowest end of the technological spectrum is privately-managed household self-supply. Owned and maintained at a household level, self-supply water sources have been the focus of several pilot studies over the last decade. These initiatives have generated promising results with minimal levels of external funding. The degree to which self-supply activities is undertaken in an unsupported and informal fashion is unknown. However, with 210 million rural Africans and Indians still drawing water from unprotected wells, the gains to be made from scaling-up self-supply approaches could be substantial.[8] For example, in five of the countries in which Water for People conduct programs, improved water coverage in rural areas could increase by 10 to 20 percentage points with universal well upgrading.

At the other end of the spectrum are small piped schemes, which are clearly the most common modality of private sector involvement in the rural water sector. Through a mix of household connections and public taps, private operation of such schemes has led to performance improvements in a number of cases. It should be noted however that in Africa piped schemes still serve a tiny minority of rural dwellers – four percent of households have a piped connection and eight percent access standpipes – figures which have hardly changed in twenty years. This figure is higher in rural India, where a little over a quarter of people are served with piped water.[9] Piped systems reach a much greater proportion of rural residents in South and Central America, with more than two thirds accessing standpipes or private connections.[10]

Dispersed water points (most of which are fitted with hand-operated pumps) remain the dominant approach to supplying water for rural populations in the developing world, yet they are theprogram least likely to be privately managed. Approximately 47% of rural dwellers across the developing world draw drinking water from wells and boreholes. Around 135 million rural Africans and 463 million rural Indians access protected groundwater sources, more than double the number using piped water systems through household connections or standpipes. However this water supply modality appears to be the least amenable to market-based solutions. When compared to traditional wells, community handpump supplies are accompanied by a significant rise in ongoing expenditure to ensure continued operation; unfortunately, a commensurate leap in willingness-to-pay is often absent. Whether the promise of a more reliable and trust-worthy private-sector led service can catalyse such a leap is therefore a critical question.[11]

Privately-run decentralised water treatment services have also sprouted up in the last decade, chiefly in rural Indian towns. These services do not fit neatly on the traditional water technology ladder, though could be considered akin to public standpipe services. They involve higher capital and recurrent costs than manually-operated water points, though are cheaper to install than piped schemes as they avoid the need for a fixed distribution network. Many of these enterprises are still in their infancy, so the overall market share commanded by these systems remains small. The major players serve a total of one million users, and Hystra (2011) predicts these services could reach up to 10 million rural water users.

[8] The opportunity in Latin America is less clear due to data collection limitations. Unlike with Africa and India, Demographic and Health Surveys in Latin America tend not to differentiate between protected and unprotected wells.
[9] Around 12 percent have a household connection, and a further 16 percent collect water from standpipes.
[10] In the Latin American countries in which Water For People operate, between 40 percent and 70 percent of rural residents are served with piped water.
[11] A basic service level that lies between a piped-scheme and hand-operated water point is also included in this category. A typical configuration might include a borehole, motorized pump, a small storage tank and no more than a handful of public taps. A system like this has the advantage of a lower cost base compared to piped-schemes, yet the operational inputs are self-evident (eg fuel for the pump), which is likely to boost people's willingness-to-pay well beyond that associated with a hand-operated water point. The prominence of entrepreneurs informally establishing similar schemes in peri-urban areas suggests full cost recovery tariffs might be a realistic aim for this service level.

Finally, an essential ingredient for market-based approaches is the existence of enterprises and entrepreneurs who possess the business and technical skills to provide the services demanded by consumers. The literature suggests this supply-side challenge is ubiquitous across the water technology ladder, whether it be artisans for hand dug well maintenance, individual pump mechanics or operators of complex piped schemes. Promisingly there are numerous case studies which demonstrate how targeted interventions and strategies can overcome these initial shortfalls in technical capabilities and business acumen.

2 Household self-supply

2.1 Overview

Self-supply refers to a situation where individual households finance the improvement and maintenance of their own water supply. The approach is premised on incremental improvements which are easily replicable and affordable. Self-supply sources are often shared with neighbouring households, usually at no charge, in effect fulfilling the role of a privately-managed community source. Self-supply is a pragmatic approach that is particularly applicable to sparsely populated or socially discordant communities (Sutton 2004b, Sutton 2007a, Sutton 2009c).

> ***Self-supply defined[1] (Sutton 2007a)***
> *"Self-supply is the improvement to household or community water supply through user investment in water treatment, supply, construction and upgrading, and rainwater harvesting. It is based on incremental improvements in steps which are easily replicable, with technologies affordable to users. This self-help approach is complementary to conventional communal supply, which is generally Government funded and which forms the backbone of rural water supply. However the latter is not equally sustainable everywhere, and is inadequately funded to reach MDG target coverage in sub-Saharan Africa."*

Self-supply approaches have been recognised by governments in a handful of countries, though few formally supported initiatives have been scaled up beyond a pilot stage. Zimbabwe's iconic family well program stands out as the most successful example of a government-backed self-supply initiative, having facilitated the upgrading of 120,000 family wells, serving more than 1.5 million people (WSP 2002, Sutton 2007a). Recent pilot projects in Zambia, Ethiopia, Mali and Uganda have also yielded promising results at low-cost, and demonstrate that many households are able and willing to invest in making improvements to their own water supplies (Sutton 2010a, Sutton 2010b, Sutton 2010c, Carter et al. 2008). These small-scale initiatives have successfully encouraged households to invest between 40 and 100 percent of upgrading costs. Traditional wells appear to be the water supply technology most conducive to a self-investment approach. Importantly, the evidence suggests significant water quality improvements can be achieved through the use of simple technologies and locally-available skills and materials. Ugandan experience also suggests community springs are susceptible to low-cost, self-financed upgrading (Tillett 2007, Carter et al. 2008). The advocated potential for rainwater harvesting has been demonstrated on a reasonable scale in Thailand (Juntopas and Naruchaikusol 2011), and fledgling initiatives are also underway in Uganda.[13] Given the technical and financial hurdles, gravity flow schemes and boreholes have been deemed unsuitable for self-supply, though the Bolivian program detailed by MacCarthy et al. (2011) seems to challenge this view for certain socio-economic and hydrogeological settings.

Water source technology[12]	Suitability for self-supply
Shallow hand-dug well	Very High
HH water treatment	Very High
Rainwater harvesting	High
Point-source springs	Medium-Low
Boreholes	Low
Gravity-flow schemes	Very Low

[12] Adapted from Carter et al. (2008).
[13] In Uganda, Danert and Sutton (2010) refer to a programme involving 20 NGOs, where rainwater harvesting is being promoted through training of artisans and women's groups. This may be the same initiative as that described by Baziwe (2011). Danert and Sutton (2010) also note that of the 15,000 rainwater tanks of 6m^3 or above in Uganda, 28% have been privately financed.

2.2 Prominence of approach

Notwithstanding the growing recognition of self-supply, the bulk of initiatives remain fragmented and localised. Most documented examples of supported self-supply strategies have only surfaced in the last decade, and concern government-backed and NGO-supported projects in Zimbabwe, Ethiopia, Uganda, Mali and Zambia. Sutton (2004) also refers to initiatives in Liberia, Sierra Leone, Mozambique and Benin, though this study failed to uncover any detailed information regarding these. Outside of Africa, self-help programs have been noted in Bolivia (MacCarthy et al. 2011), Vietnam (Salter 2003) and Thailand (Juntopas and Naruchaikusol 2011). The approach has also received the formal backing of governments In India, Honduras and Colombia (Lockwood and Smits 2011). Informal and unsupported self-financed improvements undoubtedly take place across the globe – particularly in regions with shallow groundwater – though a lack of documentation means the prevalence of such activities remains unknown.

Country	Scale	Technology promoted	External support	Owner contribution	Output
Bolivia[14]	Unknown	Rainwater harvesting Wells with pump	NGO training of local technicians Dissemination of training videos	Up to 100% of costs	MacCarthy et al. (2011) found small businesses are successfully implementing manually-drilled borehole systems fitted with pumps. - 78 out of 79 inspected handpumps were operational
Ethiopia[15]	Two regions	Upgraded wells Rope pumps	Local Government undertook advocacy and promotion activities, and trained: - 220 ppl in monitoring and supervision - 1,500 trainers - 6,000 development agents - 30,000 groups of five households - Metal workshop enterprises in rope pump construction	Unknown	Between 2004-6 - 85,940 family wells; - 9,500 community wells; - 10,500 springs on spot
Mali[16]	13 communes, 9 districts	Upgraded wells	Ministry of Health - Over 45 masons trained at commune or village level	40-100% of capital cost	- Over 300 wells upgraded in 18 months at 40% cost recovery; - 75 wells upgraded with 100% cost recovery
	Six health districts in 3 regions	Upgraded wells	Ministry of Health, supported by UNICEF - Training for masons - Provision of cement	US$20-50 per water point plus material	- 50 well upgrades subsidised - 15 wells upgraded with no subsidy
Uganda[17]	1 district	Springs	UMURDA (NGO) - Contribution to direct costs (e.g. cement, pipes, skilled-labour, transport) - Overhead and software costs	51% of capital costs	22 water sources upgraded
	1 district	Upgraded wells and springs	WEDA (NGO) - Direct, software and overhead costs	59% of capital cost	19 water sources upgraded
	4 districts	Rainwater harvesting	Relief International initially subsidised purchase of Bob bags - Study underway to determine appropriate subsidies	Household initially paid US$13 per bag (29% of cost) Bags now retail in hardware stores for US$50	167 Bob bags sold in first 8 months

[14] MacCarthy et al. (2011).
[15] Oromia Regional State Water Resources Bureau (2006), Sutton (2010c).
[16] Sutton (2009a), Sutton (2010a), Jones (2011).
[17] Tillett (2007), Mpalanyi (2008), Baziwe (2011), Nakato and Bavuma (2011), Carter et al. (2008).

	6 districts	Rainwater harvesting	URWA - Training in construction, operation and maintenance of tanks WaterAid and SNV - Funded training District government - Provided technical assistance and funding	Some funds plus locally available material	Rakai district: - 4 tanks constructed Koboko district: - 2 water jars and ferro-cement tank Mpigi & Gomba districts: - 50 tanks in 6 months
	1 district	Rainwater harvesting	Start-up funding from donor	100% of construction via revolving fund	Between 2004-2011 - 181 rainwater tanks
Zambia[18]	1 district	Upgraded wells	WateAid (NGO) - Training, supervision, monitoring and establishing revolving funds - 16 mason artisans trained	100% of capital cost	Half the traditional well-owners had made at least one improvement
	2 districts	Upgraded wells	DAPP (NGO) - Training and equipping four artisans per ward in well protection, ring making, basic metal work and brick laying	100% of capital cost	- 95% of 516 well owners made at least one improvement - 60 wellheads in 15 villages improved with local materials
Zimbabwe[19]	Nation-wide	Upgraded wells	Govt/donor subsidies amounting to US$3-5 per head - Subsidies included cement, tin lid, and windlass - By 1995, 1000 well builders had been trained	60%-80% of capital cost	Between 1991 and 2006 - 120,000 family wells upgraded, serving 1.5m people
Thailand[20]	Nation-wide	Rainwater harvesting	Govt/NGO support	Unknown	Rainwater harvesting as a domestic water source went from 24% in the late 1980s to 37% in 2005
Vietnam[21]	3 provinces	Low-cost pumps	International Development Enterprises (NGO) - Developed private sector capacity for handpump installations and after-sales services - Market development constituted 80% of total program budget	100% of capital cost of pumps and installation	By 2001 - 64,000 pumps had been installed - Providing safe water to 320,000 people - End-user investments totalled US$2.3m

Table 2 - Overview of formal self-supply initiatives

2.2.1 Case Study 1: Zimbabwe[22]

Inspired by a strong tradition of self-financed family-owned wells, Government and donors have supported the upgrading of shallow wells in rural Zimbabwe since the early 1990s. The Ministry of Health initially offered subsidies and technical advice on basic protection measures. In most cases, the capital contribution by households amounted to over 60 percent of the total improvement cost. By the end of 1991, 2,500 wells had been built. Over the ensuing nine years, the Mvuramanzi Trust promoted the upgrading of a further 34,000 family wells. Over 120,000 family wells had been upgraded by 2006, serving 1.5 million rural Zimbabweans with an external subsidy of just US$3-5 per capita.

2.2.2 Case Study 2: Uganda[23]

Pilot projects in Uganda between 2006 and 2008 were overseen by two NGOs, UMURDA (Uganda Muslim Rural Development Association) and WEDA (Wera Development Association). In the target communities, households were encouraged to improve their own water supplies with minimal subsidies. UMURDA targeted communal sources, with a particular emphasis on springs, whilst WEDA focused more on privately owned supplies, particularly shallow wells. The communities and individuals either carried out

[18] Sutton (2010b), Sutton (2009c).
[19] WSP (2002), Sutton (2007a).
[20] Juntopas and Naruchaikusol (2011).
[21] Salter et al. (2003).
[22] WSP (2002), Sutton (2007a).
[23] Tillett (2007), Mpalanyi (2008), Carter et al. (2008).

the work themselves or contracted artisans to do it for them. As a result of the project, 41 sources (26 springs and 15 wells) were improved, at a cost of ~US$1,000 per source. Users contributed ~55% of the total capital expenditure. When factoring in overheads and software components, these contributions amounted to ~27% of the total implementation cost. A two stage plan for scaling-up the program was subsequently proposed, culminating in a nationwide implementation. However it is unclear to what extent these plans have since been pursued.

2.2.3 Case Study 3: Central Vietnam[24]

In 1995, International Development Enterprises (IDE) began an initiative to build the capacity of the private sector to install handpumps, and provide after-sales maintenance services throughout three provinces in Central Vietnam. Around 80% of IDE's budget was directed at market development, which included building the capabilities of 150 manufacturing, wholesaling and well-drilling enterprises. The competitiveness of these businesses drove down the cost of pump installation from US$100 to US$30. According to Salter (2003) social marketing was used to "tap into the emotions and aspirations" of the customer base. Within six years, end-users had self-financed the installation of 64,000 pumps at a total cost of US$2.3 million.

2.3 Evidence of benefits

Due to a lack of systematic monitoring and rigorous evaluation, a degree of uncertainty surrounds the outcomes and impacts from the self-supply pilot projects. Nonetheless, emerging evidence relating to the anticipated benefits is presented in Table 3.

Potential benefits	Examples from pilot projects
Strong ownership and low maintenance costs mean self-financed wells are more reliable than community systems	- In Zimbabwe, non-functionality rate for family wells was 12% in 2004, while for boreholes with pumps it was 30% (Sutton 2007a) - In Kaoma, Zambia, 94% of unprotected wells were functional versus 80% of handpumps (Sutton 2004b) - Study in Ethiopia found 72% of handpumps were operational vs 87% of traditional family wells (Mamo et al. 2011)
Simple upgrading measure can dramatically improve water quality	- Spring improvements in Uganda saw a 10-20 fold improvement in water quality in most cases (Tillet 2007) - In Zambia, 95% of wells improved with low-cost protection had less than 10 fecal coliforms per 100ml, compared to 34% before the intervention (Sutton 2004) - In Mali, only one well in 35 was found to be contaminated after upgrading (Sutton 2011) - In Ethiopia, 42% of unprotected wells had >100 TTC/100ml vs 19% semi-protected wells (Mamo et al. 2011)
Self-supply sources are essentially privately-managed sources that are freely shared with other community members	- 90% of household well owners in Mali shared water with neighbours (Sutton et al. 2006) - 90% of household well owners in Zambia shared water with neighbours (Munkonge and Harvey 2009) - 75% of household well owners in Uganda shared water with neighbours (Carter et al. 2005)
Self-supply sources are generally closer to the household, reducing water collection times	- 91% of traditional well users in Mali are within 100m of water supply versus 40% of communal well users (Sutton 2009c) o Those more than 500m from water source use 40% less water than those within 100m - 90% of traditional sources in Luapula Province (Zambia) are within 25m versus 75% of alternative sources which were over 100m away (Munkonge and Harvey 2009)

Table 3 - Evidence of impacts from self-supply studies

2.4 Future considerations

Looking forward, supported self-supply approaches to water source improvement present a significant opportunity. Almost 106 million rural Africans still rely on unprotected wells for drinking water - if all of these wells were to be upgraded, the proportion of the rural population with access to an improved

[24] Salter (2003).

water source would increase from 47% to 65%. On the face of it, the approach also has great potential in rural India, where 104 million people continue to draw drinking water from unprotected wells (i.e. 78 percent of those who lack safe drinking water). Data limitations prevent similar estimates for Latin America, though the opportunity may be just as substantial if figures from Bolivia are any indication (Figure 7).

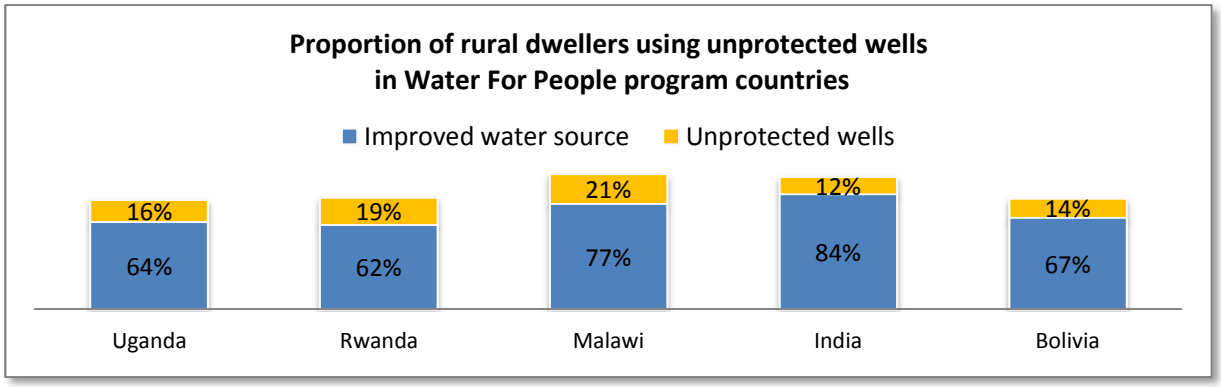

Figure 7 - Potential for well upgrading to increase improved water coverage in Water for People program countries[25]

Government, donors, NGOs, private sector actors and users all have an important role to play in supporting self-supply initiatives (Sutton 2011)**.**[26] External support for both demand and supply sides can take many forms, including business development training, technical assistance and advice, marketing, enabling access to credit, and providing well-targeted subsidies. Based on the experience of pilot projects, four building blocks for scaling up self-supply have been identified by Sutton (2007a):

a) technical advice for consumers;
b) access to micro-credit or savings mechanisms;
c) a well-developed private sector; and
d) policies which encourage individual initiatives.

In many cases, the supply side of the market will need stimulation if artisans have limited technical and business skills, and lack the appropriate equipment, sufficient capital and/or access to credit. The size, nature and target of any subsidies are also important considerations in order to avoid stifling or distorting the market, or demotivating users from financing their own improvements. Levels of subsidies offered in the pilots ranged from 0% through to 60% of the capital costs. Unfortunately, due to the lack of systematic evaluation and the different approaches adopted in the pilots, the optimal subsidy design remains unclear. Additional characteristics which are likely to improve self-supply prospects include the availability of high quality shallow groundwater, a tradition of digging family wells, and a keen interest shown by influential personnel (Sutton 2011).

The pilots also clearly highlighted some imposing barriers to success. Obstacles to overcome include the negative perceptions of low-cost options among decision makers; fears of poor water quality; a reluctance to support individual households rather than communities; a lack of loan mechanisms that allow households to access credit; difficulties in administering subsidy schemes; low capacity of the private sector; user expectation that NGOs/donor would finance a more technologically-sophisticated option; and a lack of guidelines on cost reduction for family-level investment and incremental improvement (Sutton 2011, Carter et al 2008).

[25] Data sourced from the most recent Demographic and Health Surveys (see http://www.measuredhs.com)
[26] Sutton (2011) provides an overview of the roles and responsibilities undertaken by the relevant parties in several pilot projects.

3 Dispersed community water points

3.1 Overview

Given the lack of documented large-scale examples, it is difficult to gauge the potential of privately-managed rural water points. Handpumps, in particular, have become the principal technology for supplying water in rural Africa and India – more than 5 million pumps have been installed across these two regions. The vast majority of these water points are community-managed, and private sector involvement is usually limited to standalone construction activities or provision of spare parts. However, of all the challenges in the rural water sector, the sustainability of handpump supplies is perhaps the most important to resolve.

Despite the fact around a third of community-managed water points are non-functional, market-based models remain conspicuously elusive. The DFID-commissioned report by Harvey and Reed (2004), invigorated new debate when it concluded that private sector approaches should be explored and mooted a number of potential models. In theory, market-based approaches to water point management could generate a number of potential benefits, such as:

a) enabling alignment of commercial incentives with sustainability objectives;
b) removing the need for communities to store funds in advance of breakdown;
c) allowing for a clustering of water points, unlocking economies of scale and pooling risk across many communities; and
d) eliminating the need for spare part supply chains to remain viable all the way down to an individual community level

3.2 Prominence of approaches

With the ever present prospect of public sector subsidies, private investment in, and ownership of, water points is rare. This is perhaps unsurprising – as RWSN (2010) questions, "how many local drilling companies can sell a borehole to a community if the cost is as high as US$6000?" Bangladesh is a notable exception, where it is thought that two thirds of the country's four million rural handpumps are owned by private individuals (WSP 2000b). This has been made possible by the shallow aquifers, the availability of low-cost suction pumps, and high population densities. Estimates from the late 1990s indicated private buyers constituted five to ten percent of the handpump market in Afghanistan and Pakistan (WSP 2000a). A recent water point mapping exercise in Kyuso District in Kenya found 27% of handpumps were owned and managed by individuals, most of whom sell water on a 'per jerrycan' basis.[27] Larger African data sets paint a very different picture however. The nationwide water point inventory conducted in Liberia revealed just 1.2% of handpumps were privately installed.[28] Of the almost 45,000 handpumps in Uganda, only 2.9% were privately funded, while 2.4% are privately managed.[29] Unfortunately this review failed to uncover similar water point datasets that shed light on the situation in Latin America. Note however, with the exception of Kyuso District, it is unclear whether the abovementioned private owners sell water to others on a commercial basis - if not, they would be better considered examples of household self-supply.

Aside from outright ownership, a range of commercially-oriented models for water point management have been proposed in the literature. Unfortunately, few of the hypothetical approaches outlined have been tested and evaluated at a meaningful scale. Indeed, the recent global review by Kleemeier (2010a)

[27] Unpublished data.
[28] Data can be found at http://wash-liberia.org/Waterpoint_Mapping.html
[29] 0.6% of handpumps are managed by a private operator and 1.8% by a private individual.

identified only a handful of practical examples of handpumps being managed by a private operator. Other studies have come to similar conclusions, such as a report by Water Management Consultants Ltd (2005), which conceded "there appears to be no example from rural Africa of a truly viable business of handpump maintenance". Some remain optimistic however, such as Valfrey-Visser (2008), who asserts that "it is quite likely that in a decade or so, cheap handpumps will represent a profitable market".

Of all the approaches reviewed here, individual pump mechanics are the most widespread, though their services are generally limited to reactive maintenance. Parry-Jones et al. (2001) note that private sector pump mechanics are more active in Latin America and Asia than in Africa, due to higher population densities and longer traditions of water lifting devices. Handpump service contracts that encourage preventative maintenance remain the exception rather than the norm, though recent reforms in Burkina Faso and Benin may lead to more committed attempts to engage the private sector in this way. The insights drawn from these West African experiences will hopefully shed much needed light on a topic that currently presents more questions than answers. Based on examples uncovered in the literature, Table 4 outlines the ways in which private individuals and enterprises can provide water point O&M services.[30]

Approach	Description	Examples	Impact
Independent area pump mechanics	- Mechanics respond to community requests for repairs when needed - Mechanics often have other means of income - Zones of responsibility often cover between 10-50 handpumps in Africa; and sometimes in excess of 100 in India	- Operate throughout Africa, Asia and Latin America (existing literature covers examples from Ghana, Kenya, Uganda, Malawi, Zambia, Mali, Burkina Faso, South Sudan, Chad, Bangladesh and India)[31] - Inter Aide in Malawi have set up a well-known system in five districts, involving 149 area mechanics (Hystra 2011)	- Though a widespread approach, only snippets of evidence that approach can lead to improved levels of sustainability - A review of the Jalabandhu program by Water for People (2010) found a reduction in downtime from 10-15 days to less than one day - Between 2002 and 2010, Hystra (2011) estimates Inter Aide's Malawi program has lifted functionality rates from 65% to 85%
Professional pump mechanics associations[32]	- Professional mechanic association formed at district level - Tools, training, transport provided to mechanics - Prices are standardised and disseminated to communities - Mechanics replaced when they move away or lose interest - Associations bid for contracts for rehabilitation	- Between 2008-2010, SNV facilitated formation of 5 district based associations	Wandera at al. (2011) report that since the introduction of associations, some districts have realised up to 96% handpump functionality (though the true impact is difficult to ascertain given the absence of a baseline for comparison)
Professional pump mechanic business	- Communities notify a master mechanic of a faulty pump, who then delegates the maintenance task to the most appropriate mechanic - Mechanics are equipped with tools and transport - Mechanics keeps a percentage of the repair fee	- According to Rosenberg (2011), WaterAid financed the establishment of four mechanical workshops in Mahoba District, Uttar Pradesh (cost of US$40k)	- In 14 months, mechanics repaired more than 1,100 pumps, 93% within 24 hours of first phone call (Rosenberg 2011) - In second year of operation, workshops were on the verge of meeting profitability goals
'Informal' entrepreneurs privately managing water points	- Individuals attend community water points and collect money on a 'pay-as-you-fetch' basis - Responsible for ongoing operation, payment for O&M costs, and possibly asset improvements - Not contingent on contract with community, though in theory	- A number of Tanzanian examples were highlighted by WaterAid Tanzania (2009) - Sutton (2006) refers to a local entrepreneur in rural Niger who assumed management of four boreholes and installed mechanical pumps and generated sufficient	- WaterAid Tanzania (2009) found "water points run by small scale private operators achieved very high functionality rates even with older schemes", largely due to their ability to collect and store funds in advance of breakdown

[30] It is acknowledged that a number of these approaches exhibit similar characteristics, and could be consolidated into a simpler categorisation of approaches.
[31] Parry Jones et al. (2001), Harvey et al. (2002), Harvey et al. (2003), Harvey (2003), de Saint Meloir (2009), Hystra (2011), Lindsay (2011), Harvey and Skinner (2002), Ligthart (1998), Rahan (2011), Water for People (2010).
[32] Wandera et al. (2011), Water Integrity Network (2011), Nekesa (2011), Mommen and Nekesa (2010).

	commercially incentivised to keep pump operational	revenue to cover costs and provide some return on investment. - SNV are planning a pilot project based around this concept in Lake Victoria region, Kenya in 2012	
Individual ownership	- Individuals self-finance construction of shallow well/borehole and procure handpump - Water sold to surrounding households on fixed or volumetric basis	- In Bangladesh, it is estimated 65% of handumps are privately owned (WSP 2000b) - In Kyuso district (Kenya), 27% of handpumps are privately owned - In Uganda, 2.9% of handpumps are privately owned/installed - In Pakistan and Afghanistan, it was estimated that 5% to 10% of handpump sales were for private entities (WSP 2000a) - NB. With the exception of Kyuso, it is unclear whether these private owners sell water on a commercial basis – if not, they would be better considered self-supply	- In Bangladesh, a WSP (200b) study found average handpump downtime for privately owned pumps was 1.8 days per month, compared to 5.5 days per month for government-managed pumps - In Kyuso, Kenya, 7% of privately owned handpumps were non-functional, compared to 23% of community-managed pumps - In Uganda , privately installed handpumps have a non-functional rate of 19% compared to 24% of those pumps installed by government and NGOs (MWE 2011)
Exclusive maintenance contract	- The community signs a maintenance agreement with a private individual or firm to handle preventative maintenance and repairs on all the handpumps within a given area	- An AFD-funded pilot is underway in 13 provinces in Burkina Faso - An approach similar to this will be piloted across 100 water points in a district in Kenya in 2012 (managed by a local engineering firm)	- According to Lockwood and Smits (2011), the delegated contract approach in Burkina Faso "has met with some success, especially in achieving greater economies of scale"
Basic and Total Warranty Scheme[33]	- Partnership between a pump manufacturer, local after-sales private enterprises, local governments and users - Manufacturer supports and trains local enterprises, and supplies spare parts - Users pay an annual fee to a local business which provides a guaranteed maintenance service that is regulated by a local authority	- Total Warranty Concept first piloted by Vergnet for 75 water points in Mauritania. - Expanded to other countries in West Africa (incl. Niger, Benin, Burkina Faso) offering two levels of warranty: one covering just labour (basic), the other including both spare parts and labour (total)	- Two years into pilot project, 60% of the villages had paid the enterprise, and 20% had paid half - The number of WUAs interested in renewing contracts dropped significantly after two years - Both services levels were undermined by difficulties in collecting payments from water committees
Water Assurance Scheme[34]	- Communities pay a monthly fee to a private company, which is regulated by local government - In return, the company provides a maintenance and water monitoring service - Similar to a warranty scheme, but instead of a manufacturer providing a warranty on equipment, the service provider guarantees a water service irrespective of the equipment used	- Harvey and Reed (2004) referred to an opt-in "membership scheme" being trialled in Kenya by Rural Water Development - According to their website, a rural water insurance product will soon be trialled by MSABI, a Tanzanian NGO - Plans were underway to implement pilot studies to assess the wider potential of WAS in sub-Saharan Africa, though this study failed to uncover any further examples in the literature	
Grundfos LIFELINK	- Grundfos installs solar-powered pump and water dispensing unit on a pre-drilled borehole - Installation linked to a multi-year service contract - Users pay for water on a 'pay-as-you fetch' basis via mobile phone - User fees (US$1.5/$m^3$) purportedly cover O&M costs, though capital costs reliant on donor funding	- Systems installed in 17 peri-urban and rural sites in Kenya, though this number is expected to grow substantially over the coming years	- On average, each installation dispenses 3.2m^3 per day[35] - Limitations to scaling up may include (a) proprietary nature of technology; (b) high installation cost (~US$40k); and (c) high O&M tariff
Handpump Lease Concept[36]	- A local enterprise offers maintenance contracts for existing handpumps and lease contracts for new / replacement	- A small town water utility in Lubango, Angola, adopts this approach for handpumps in 20	- No information is available on the levels of sustainability achieved - In 2003, the Lubango example

[33] Harvey and Reed (2004), SDC (2008), Desille (2004), Ligthart (1998), Kleemeier (2010a).
[34] Harvey and Reed (2004).
[35] Calculated using data from http://www.grundfoslifelink.com
[36] Van Beers (2001), Kleemeier (2010a).

	handpumps - Tariffs set at the beginning of the contract - Caretaker is responsible fee collection and routine maintenance - Water company is responsible for major repairs	communities - The concept was tested in Kenya through a Catholic Dioceses program aided by several donors	reported was in a strong financial position with annual revenue per handpump of $240 versus annual costs of $150 for salary, spare parts, repairs, and future investment (Van Beers 2001) - A World Bank-funded visit found this approach had not been successfully replicated elsewhere in Angola (Kleemeier 2010a) - The Kenyan project failed, though it is unclear why
Professionalised Rural Service Areas (PRSA)/FRUGAL[37]	- A private business receives a long-term contract to design, build or rehabilitate, operate and/or maintain water supplies within a geographical zone - Aggregated service area would include both small towns and remote villages. - A contract for a rural piped scheme would include O&M responsibilities for handpumps within the service zone	- In Burkina Faso, Vergnet Hydro (in partnership with its subsidiary Faso Hydro) is responsible for O&M of 37 handpumps in the service areas of 7 piped scheme they operate - The Côte d'Ivoire utility company, SODECI, had a contract from 1972 to 1986 to 13,000 rural water points, though the company did a poor job and found the activity unprofitable (Tremolet et al. 2002)	- In first 20 months of Vergnet operations in Burkina Faso, handpump sales accounted for 1.9% of total revenue, and up to 4.4% in one of the seven towns (Barbotte 2011) - Due to difficulties in enforcing the handpump tariff policy, Vergnet has closed handpumps within 500 meters of standposts (Barbotte 2011, Kleemeier 2010)

Table 4 - Private sector approaches to water point management

3.2.1 Case Study 1 – Area Pump Mechanics

Working as private individuals, area pump mechanics undertake handpump maintenance and repairs in numerous countries across Africa, South Asia and Latin America. Mechanics are responsible for anywhere between 10 and 100 handpumps (though this can rise to above 100 water points where population densities are high). However pump maintenance is usually only a part time job and mechanics supplement income through other means (e.g. motorbike/bicycle repairs). Mechanics rarely conduct preventative maintenance, and normally only undertake repairs when called out by a community (there are exceptions however – see 3.2.1.2). NGO, donor or government support is usually necessary to equip mechanics with tools, technical skills and means of transport.

The individual pump mechanic approach has achieved only mixed results due to several systemic issues. First, non-payment by communities is a chronic and universal problem. Communities are often unwilling to pay for repairs, particularly for tasks that they themselves have been trained to conduct. In most cases recognition and elevated status are more powerful motivations than commercial benefit (see e.g. Lindsay 2011). At the same time, service charges have proven difficult to standardise and regulate, thus mechanics have been known to exploit communities by charging exorbitant fees and undertaking poor quality repairs. Hence a scepticism of pricing and the quality of repair work often prevails.

An inherent weakness of the pump mechanic model is the lack of commercial incentives to ensure both preventative maintenance and reactive repairs are conducted. As a review of Water For People's Jalabandhu program noted, "sustained health of the water source conflicts with [the pump mechanics'] prospects for earning" (Water For People 2010). A related policy challenge that has reared itself in some contexts is the need to strike a balance between allocating exclusive service zones to improve commercial viability and the need to regulate what becomes a monopoly service provider.

[37] Kleemeier (2010a), Hoang Gia et al. (2011), Barbotte (2011), Tremolet et al. (2002).

Though pump mechanic programs have generally met with limited success, four initiatives appear to have generated more positive results:

3.2.1.1 Water For People's Jalabandhu Program, West Bengal[38]

Water For People's Jalabandhu initiative in West Bengal is one of the better examples of up-skilling individual mechanics to provide ongoing maintenance support on a commercial basis**.** Aimed at easing the burden shouldered by the local Panchayat, this pilot initiative trained and equipped 22 local villagers to undertake both preventative and reactive maintenance. Each mechanic was assigned 40-45 tubewells, and standardised prices were set. A review conducted two years after the pilot's commencement observed several positive developments. A number of mechanics had expanded their business beyond their assigned water sources, and half a dozen continued to build their skill base and stock of spare parts. It was concluded that handpump downtime was reduced to less than one day for minor faults. A range of familiar obstacles however endured, including communities' reluctance to pay for simple repairs, the low community demand for preventative maintenance, and the limited incentives for mechanics to undertake work that would reduce the risk of subsequent breakdown.

3.2.1.2 Inter Aide's Area Mechanic Program, Malawi[39]

Inter Aide Malawi and local NGO Baseda support an integrated commercially-oriented maintenance approach across five districts. Around 149 area mechanics provide maintenance and repair services for 8,500 handpumps. With the aid of external grants, mechanics are equipped with technical skills, bicycles, tools and official ID cards to build trust among communities. Though predominantly a part time role, pump mechanics earn an average of US$13.50 per month from conducting both reactive and preventative maintenance (with around 2 to 3 interventions per month). Preventative maintenance agreements have been made with 15% of communities, at an annual fee of between US$5.35 and US$8. The average cost per repair is $6.65. Inter Aide also acts as an intermediary between the importers and local retailers of handpump spare parts, thereby boosting the viability of supply chains. Donors provide ongoing subsidies equivalent to 60% of the total operational costs. There were plans to scale up the program to 11 districts during 2011.

		WFP's Jalabandhu Program, West Bengal	Inter Aide's Area Mechanic Program, Malawi
Commenced		2009	2002
No. of mechanics		22	149
Ave. WPs per mechanic		68	57
Total water points		1,506	8,500
Monthly earnings (US$)		16.7	13.5
Prevent. maint. contract (US$/WP/yr)		2.40 (plus 1.3-2.9 honorarium)	5.35-8.00
Job status		77% Part-time, 23% Full-time	Part-time
Mechanics mark-up spare parts		✓	×
External support	**Training**	✓	✓
	Tools	✓	✓
	Transport	×	✓
	Spares	✓	×
	Honorarium	✓	×

Table 5 - Comparison of pump mechanic programs supported by Water For People and Inter Aide[40]

[38] Water For People (2010).
[39] Hystra (2011).
[40] Data collated from Water for People (2010) and Hystra (2011)

3.2.1.3 *Professional mechanic associations, Uganda*[41]

One promising solution to the issues that plague individual mechanics is the formation of business-oriented mechanic associations. This strategy is being pursued by the Ministry of Water and Environment in Uganda, following recent district-level pilots overseen by WaterAid and SNV. Under this approach, mechanics pay an annual membership fee, and in return receive a range of support services. The association standardises prices for maintenance and repair activities, and disseminates information through various media channels to make customers aware of prices and complaint mechanisms. The association also takes measures to improve access to spare parts and tools, provides refresher training, and ensures mechanics are replaced when they lose interest or move away. Though anecdotal in nature, emerging results from trials suggest more transparent and standardised pricing can lead to greater trust and willingness to pay amongst communities. Wandera at al. (2011) report that since the introduction of associations some districts have realised up to 96% handpump functionality, though the true impact is difficult to ascertain given the absence of a baseline for comparison. Koestler (2008) also observed that associations led to "a drastic increase in functionality" and handpump downtimes became "incredibly short." There are however some downsides to this form of professionalization, such as application of taxation and administrative requirements, which may further undermine the commercial attractiveness of this line of work.

3.2.1.4 *WaterAid 's professional maintenance business, Uttar Pradesh*[42]

A WaterAid initiative in Mahoba District in Uttar Pradesh (India) provides an example of how pump mechanics can band together to operate as a commercially-oriented maintenance and repair business. At a cost of US$40,000, WaterAid funded the establishment of four workshops, headed by a master mechanic. Upon being notified of a fault, the master mechanic delegates the repair work to an equipped and trained mechanic. Repairs usually cost between US$2 and US$6, with the mechanic retaining 70 to 90 percent of the payment. The government manages a fund which village councils can tap should they need major repairs. Having repaired more than 1,100 pumps (93% within 24 hours), the business was on the verge of achieving profitability targets after 14 months.

3.2.2 Case Study 2 – Grundfos LIFELINK, Kenya[43]

Perhaps the most innovative water point business model is LIFELINK, a high-tech off-grid scheme developed by Danish pump manufacturer Grundfos. Replete with solar-powered pump and water dispensing units, these point source systems cost around US$40,000 each, and have been installed across 17 sites in rural and peri-urban Kenya.[44] By incorporating both mobile money systems and smart metering technology into a water point abstraction and dispensing scheme, Grundfos has enabled a cashless pre-paid system which is remotely monitored, transparent and absent the risk of price mark-ups. The key to the LIFELINK model is the 'pay-as-you-fetch' approach to revenue collection. A user cannot receive water without money in their mobile wallet, thereby overcoming the revenue collection challenge usually associated with a communal water point. Each installation supplies an average of 3.2 cubic meters of water a day, all of which is paid for via mobile phone. Every installation is coupled with a multi-year service contract, which includes remote surveillance capabilities and an annual inspection. Despite the relatively high tariffs (currently US$1.50/$m^3$, having been reduced from US$2.50/$m^3$ during 2010) and the upfront cost of the RFID 'water key' (US$1.15), initial evidence indicates this system is generating a myriad of business expansion, agricultural and health benefits (Plyler et al. 2010).

[41] Wandera et al. (2011), Koestler (2008), Water Integrity Network (2011), Nekesa (2011), Mommen and Nekesa (2010).
[42] Rosenberg (2011).
[43] Plyler et al. (2010), Haas and Nagarajan (2011), http:// www. grundfoslifelink.com
[44] The number of installations is expected to rise considerably over the coming years.

The LIFELINK model however has two key limitations. First, the proprietary nature of the technology means the system is likely to be dependent on Grundfos' continued interest. Second, the cost of setting up and maintaining the system is significantly higher than simpler alternatives, such as a hand-operated pump. Thus the system may only be suitable where groundwater is deep (i.e. beyond the capacity of a hand-operated pump), and where arid conditions prevent a lack of cheaper alternative sources. Notwithstanding these caveats, this innovative system demonstrates the potential for information communications technologies to open up new private sector business models for rural water points.

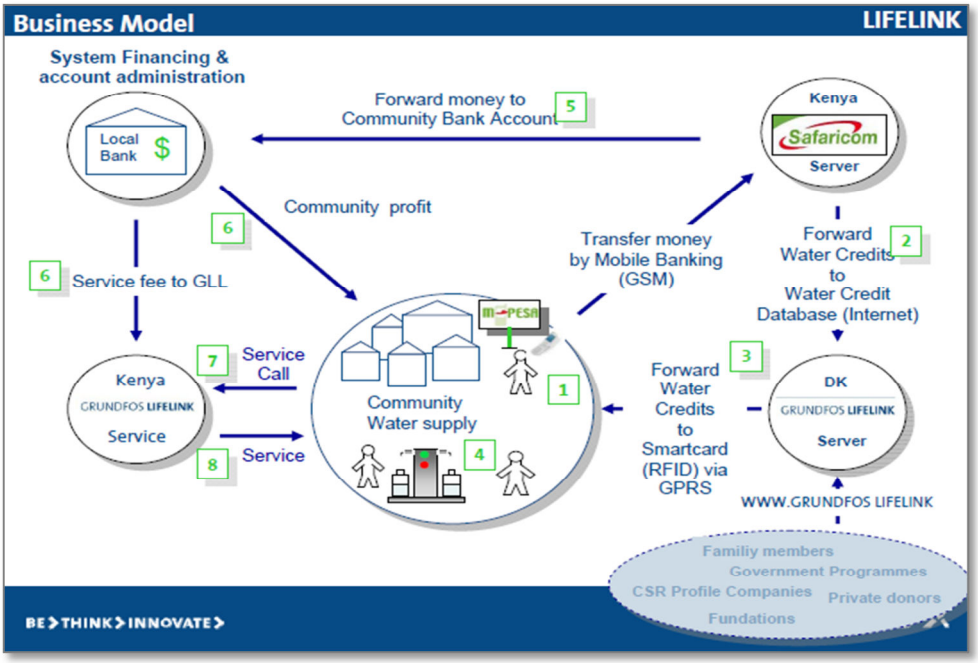

Figure 8 – Grundfos LIFELINK business model

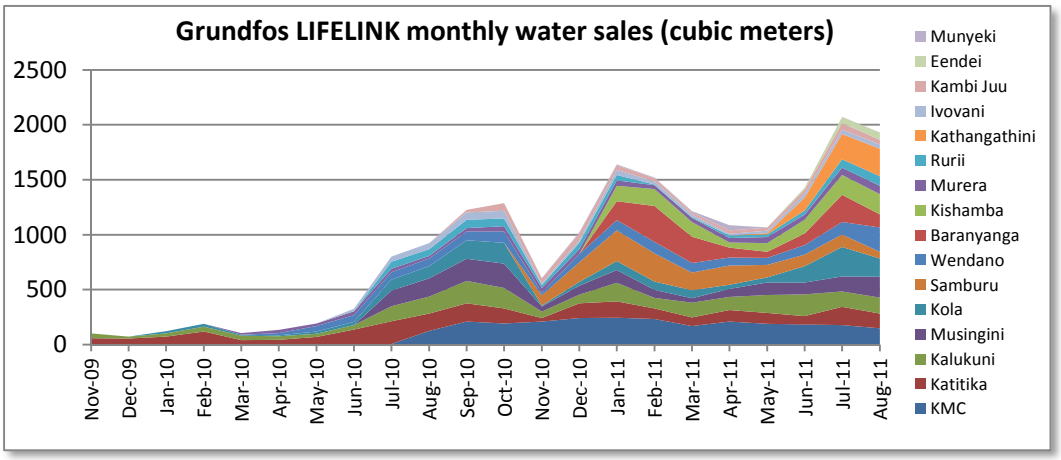

Figure 9 - Monthly water sales at Grundfos LIFELINK installations in Kenya: Nov 2009 - Aug 2011[45]

3.2.3 Case study 3 – Bundling handpumps with piped schemes, Burkina Faso[46]

Incorporating handpump maintenance responsibilities into a contract for piped scheme operation could be an effective way of attracting private sector parties where handpumps alone are of limited commercial interest. By doing so, revenue generated through piped water sales can cross-subsidise the operation and maintenance of off-grid water points. A good example of this can be found in Burkina Faso, where Vergnet Hydro, a French firm, in partnership with its local affiliate Faso Hydro, operates

[45] Data sourced from http:// www. grundfoslifelink.com
[46] Barbotte (2011), Kleemeier (2010a).

seven rural piped schemes in settlements ranging from 3,000 to 15,000 people. In the first 20 months of operation, five schemes had a positive operating cash balance, and three maintained a surplus after setting aside funds for future provisions (Figure 10). Handpump sales accounted for 1.9% of total revenue, and up to 4.4% of revenue for one of the seven towns. According to the original plan, water from handpumps was to be sold for the same price as standpipe services. However, the operator could not find a reliable method to enforce payment, thus all handpumps within 500 meters of standpipes were closed.

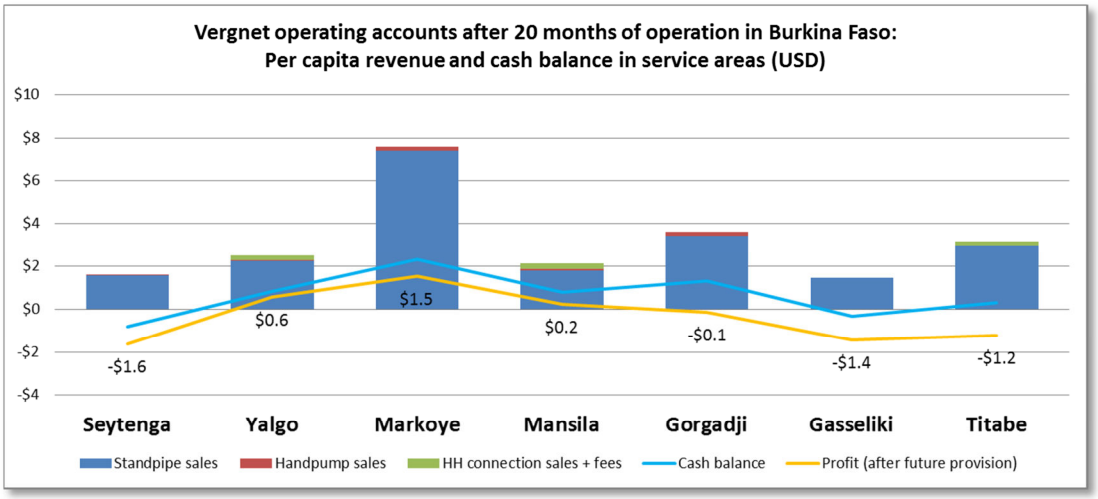

Figure 10 - Revenue and cash balance for mixed-schemes managed by Vergnet Hydro in Burkina Faso[47]

3.2.4 Case study 4 – Vergnet Basic and Total Warranty Scheme, West Africa[48]

Under the warranty scheme a community pays a fixed fee to an enterprise in return for a guaranteed maintenance and repair service. The concept was piloted in Mauritania by Vergnet, a French pump manufacturer, who formed partnerships with local after-sales enterprises, local governments and communities. Committees for 75 water points paid an annual fee to the local businesses, who in turn undertook to maintain and repair their pumps. After two years, 60% of the villages had paid the enterprise the full amount, and 20% had paid half – at this two year milestone, there was also a marked decline in the number of communities wishing to sign up to the scheme. Notwithstanding these mixed results, Vergnet expanded the concept to other West African countries, this time offering two levels of warranty – one covering just labour (basic warranty), the other including both spare parts and labour (total warranty). The maintenance activities were again performed by small businesses, who maintained a contractual association with Vergnet. This expansion failed to meet expectations however. According to Vergnet, the difficulties in collecting payments from the water committees undermined the viability of both service levels. A study by Ligthart (1998) also found that the Burkina Faso operations were hindered by the limited financial management capabilities of the local enterprises.

3.2.5 Case study 5 – Management Reform Project, Burkina Faso[49]

In 2000, the water ministry in Burkina Faso developed a new strategy whereby firms are awarded handpump maintenance contracts. Smaller enterprises are awarded contracts for one or two communes, and larger businesses can compete for installation and maintenance contracts for several communes. The commune signs an agreement with a private individual or firm to carry out preventative maintenance and repairs on all the handpumps within the specified area. Service providers are contractually obliged to pay inspection visits to all handpumps on a regular basis, and to undertake repairs based on a predetermined

[47] Data sourced from Barbotte (2011).
[48] SDC (2008), Desille (2004), Ligthart (1998), Kleemeier (2010a).
[49] SDC (2008), Kleemeier (2010a), Lockwood and Smits (2011).

price list set out in the contract. Repairs are paid for by a Water Users Association (WUA), which also pays an annual fee to the commune to cover the cost of the inspection visits. The WUA hires a local handpump caretaker to collect user fees to pay for maintenance and eventual handpump replacement. The commune sets a water tariff that is supposed to cover maintenance, monitoring, pump attendant salary, and handpump replacement costs. The ministry recommends an annual tariff that will generate at least US$150 per handpump, or US$5 per household. Aided by AFD funding, it appear this approach has been rolled out to 13 provinces.

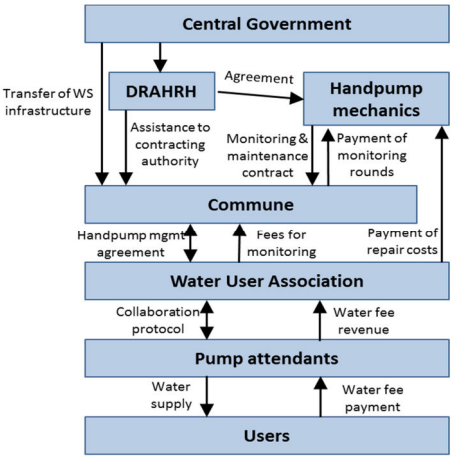

Figure 11 - Handpump maintenance model in Burkina Faso (SDC 2008)

3.3 Evidence of benefits

Despite the array of proposed business models, rigorous evaluations of the performance of privately-managed water points are non-existent. Some of the more favourable findings include:

- According to Lockwood and Smits (2011), the delegated contract approach in Burkina Faso "has met with some success, especially in achieving greater economies of scale"
- Water For People (2010) found the Jalabandhu pump mechanic initiative in West Bengal had reduced pump downtime from 10-15 days to less than 24 hours.
- A randomised field experiment by Kremer et al. (2008) found that paying contractors to maintain springs in western Kenya led to an improvement in maintenance quality by 50% of one standard deviation compared to community-managed springs.
- Though it is uncertain how many people have gained access to an improved water source as a result, the Grundfos LIFELINK systems are producing an average of 3.2 cubic meters per day across each of their 17 installations – this is enough to provide the basic needs for 2,720 people.
- Across three districts in Tanzania, WaterAid (2009) found "water points run by small scale private operators achieved very high functionality rates even with older schemes", and concluded that "autonomy helped ensure that funds are available when needed for repairs by improving revenue collection and reducing mismanagement."
- Water point surveys suggest privately owned and/or managed handpumps have higher levels of functionality compared to community-managed ones.
    - In Bangladesh, a WSP study found average handpump downtime for privately owned pumps was 1.8 days per month, compared to 5.5 days per month for government-managed pumps (WSP 2000b)
    - In Kyuso, Kenya, 7% of privately owned handpumps were non-functional, compared to 23% of community-managed pumps
    - In Uganda, privately-managed handpumps have a non-functional rate of 22% compared to 24% for community-managed water points (MWE 2011)

3.4 Future considerations

Though large-scale examples of privately-managed water points are few in number, the case studies highlight two salient issues: (1) performance incentives, and (2) commercial risk. The design and application of new business models will require careful consideration of both these dimensions. Proven delegated management models for water kiosks in peri-urban areas may provide a useful blueprint to help overcome these obstacles (see e.g. Norman and Parker 2011).

Private sector management models for dispersed water points need to structure incentives so that profit motives and sustainable operation are aligned. An obvious starting point is a business model where revenue generation is contingent on the continued operation of the service. That is, if the handpump is working, then the operator continues to receive payments for water sales. If the pump breaks, then the lack of income will incentivise the operator to repair the faults. This model brings with it an obvious simplicity but also major risks. Cost of pump repairs vary greatly, and at the scale of a single (or a handful of) water point(s) it is difficult to plan for major unforeseen repairs. Should borehole rehabilitation or pump replacement be required, there is a danger that a small-scale operator might lack sufficient cash flow, and prefer to walk away in order to avoid the hefty cost. Potential measures to manage this risk include a cost sharing agreement with a relevant authority or an insurance scheme that offers a 'major breakdown/rehabilitation/replacement' product for private operators. Such measures would be particularly important for entrepreneurs and micro-enterprises that lack the ability to spread their risk across many water points. This will also enable a private operator to levy an 'average' O&M tariff with a degree of confidence as to its adequacy, and would encourage operators to take on the management responsibilities for existing pumps even where their condition and installation quality are unknown.

A potential model for privately-managed handpumps

- *An enterprise/entrepreneur pays a licence fee to local government for the exclusive rights to manage a cluster of handpumps*
- *Licence fees are pooled to finance an insurance scheme that covers major handpump repairs and rehabilitation*
- *The enterprise employs a full time caretaker at each waterpoint who charges and collects user fees on a 'pay-as-you-fetch' basis*
- *A meter is affixed to the handpump to keep the caretaker accountable*
- *Output-based aid could assist the operator to install new water points in unserved areas, and an exclusive service provision licence might act as collateral for the residual loan.*

An alternative (or perhaps concurrent) approach is to structure management contracts based on agreed service levels, as is the norm for piped schemes. Building in bonuses for over-performance and penalties for under-performance would further strengthen incentives. This performance-based contract approach however requires fundamental pillars to be in place. First, the capacity of local governments to manage such contracts and monitor compliance would need to be built. Designing and managing contracts for rural water points remains uncharted territory – little is known about what duration and scale is needed for commercial viability; which service level metrics are the right ones and how they can be measured and monitored; who bears the risks regarding non-payment and major faults; and what is the appropriate size and nature of incentives and penalties. Given the increased complexity and inevitable transaction costs involved, contractual approaches may best be suited to entities managing many water points across large geographical regions. In order to ensure water users are not exploited by private operators, mechanisms for monitoring and regulating will be crucial. In light of this requirement, it is important to note that the coverage of mobile networks now makes remote monitoring and benchmarking of water point performance a more realistic goal, whether crowd-sourced or automated in nature (see box below). Institutional reforms might also be needed given the virtual absence of rural water regulating bodies.

Those pursuing contract-based approaches to water point management would be also well advised to review the lessons from piped schemes. Outcome improving measures could include clustering water points to enhance commercial viability and build economies of scale, linking service contracts with installation to minimise life-cycle costs, bundling spare parts provision with maintenance services, and supporting entrepreneurs and enterprises with bid preparation and business development skills.

The largest risk involved in all water point case studies reviewed is the difficulty in collecting user payments. In a piped scheme, operators can ring-fence and disconnect customers who do not pay. Controlling access to communal point sources is however more problematic. In order to succeed, private sector approaches to water point management will need to address this conundrum. An operator will need to decide between a regular (e.g. monthly) communal payment versus 'pay-as-you-fetch' collection from individual users. The former option will require a degree of self-organisation within a community – the inherent risks involved in this approach continue to undermine community-based management, and appears to have led to the downfall of Vergnet's Total Warranty Scheme in West Africa. On the other hand, the pay-as-you fetch alternative will lead to higher operating costs, as it will require a full time attendant (with accountability measures in place).[50] If these additional costs can be absorbed within an O&M tariff, the risk of non-payment will however be significantly reduced. Encouragingly, there are existing examples that demonstrate hand-operated water points can generate a substantial return even where the majority of costs are directed to a permanent caretaker's salary (see Figure 12), though the replicability of this is likely to be contingent on a minimum volume of water sold (in turn a function of the population served). It must also be stressed that a 'pay-as-you-fetch' model remains uncommon in some rural area – for example, the recent inventory of rural water points in Liberia failed to identify a single handpump operating on a pay-as-you-fetch basis.[51] The social acceptability of this payment model for rural water points may therefore require careful navigation.

Harnessing mobile technology to monitor and regulate the private sector

As with the urban sector, oversight and regulation will be needed to hold private operators to account and ensure compliance with agreed performance levels. However monitoring thousands of dispersed water points across remote and sparsely populated regions presents a daunting challenge. Though mapping innovations are increasing transparency levels and providing much needed coverage and functionality snapshots, the high cost of updating the data makes them ill-equipped to fulfil a day-to-day monitoring function. Harnessing the rapid growth in mobile technology presents a potential solution however. In response to this opportunity, several mobile-based monitoring initiatives are underway:

- ***Manobi** provides an SMS mobile-to-web based monitoring and reporting platform for more than 100 rural water operators in Senegal and Mali. This service uses a dedicated mobile phone with an application – mWater – which allows a water scheme manager to forward weekly financial and operational information from a mobile phone (WSP 2010a).*
- ***Crowd-sourcing SMS monitoring** approaches for water point fault reporting have been piloted by Triple-S (Uganda), Daraja (Tanzania) and H2.0 (Zanzibar). The latter two initiatives have however reported disappointingly low adoption levels.*
- ***Automated water point monitoring** has been pioneered by Grundfos LIFELINK for their submersible pump installations, while a team from Oxford University is testing a device for automated monitoring of handpumps via SMS in rural Kenya*
- ***Remote monitoring** of decentralised water treatment facilities is the key to the O&M business models for both*

[50] Grundfos LIFELINK circumvents this problem by employing advanced metering technology – an option that is less feasible for a hand-operated pump.

[51] Of the 7,176 rural water points fitted with a manual pump, 53% had no revenue collection system in place, 29% had a reactive payment arrangement, 17% paid on a monthly basis, and 1% on an annual basis.

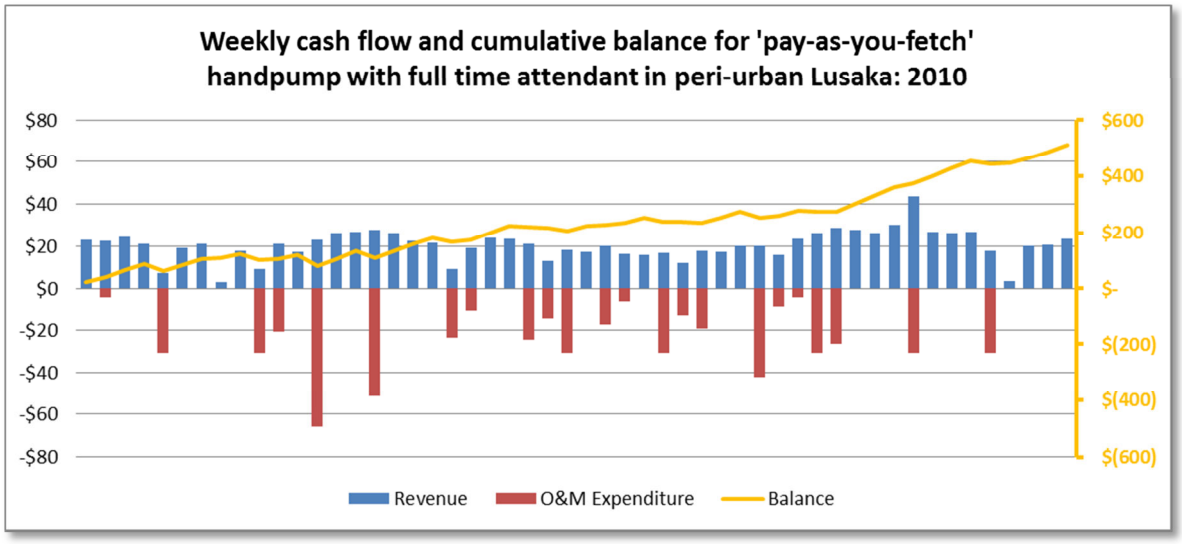

Figure 12 - Cash flow for a permanently staffed handpump in peri-urban Lusaka, Zambia

Finally, whichever pathway is followed, an essential building block for both local governments and rural water businesses is a good understanding of the life-cycle cost of water points, and the associated risk profile. Though data remains limited (see Table 6), reliable cost information will be vital for private entities to evaluate the commercial opportunity, and for local government to set or regulate realistic cost recovery tariffs. Importantly, outputs from the ongoing WASHCost project are now beginning to rectify this information deficit.

Handpump type (s)	Location(s)	Est. annual O&M cost, USD [range]		Source
		Per water point	Per household	
Afridev	Mozambique	[50-65]	0.60	Obiols & Baumann (1998)
-	-	[12-60]		Brikke (2000)
India Mk II	India	[59-107]		WSP (2001)
-	Angola	30		Van Beers (2001)
India Mk II	Ghana	35	0.70	Harvey (2007)
-	Zambia	117		JICA and MLGH (2007)
Afridev	Tanzania	58		WaterAid (2009)
Nira	Tanzania	26		WaterAid (2009)
-	Ghana		0.65	IRC (2010)
-	Ghana	40 [0-102]		Nyarko et al. (2011)
Vergnet	Chad	30 [10-115]		Barbotte and Leger (2011)
Afridev	Malawi	[10-40]		Hystra (2011)
Afridev, India Mk II, Nira	Kenya, Zambia, Uganda	36 [0-270]	0.62	Author's data (2011)
Average		**44**	**0.64**	

Table 6 – Crude handpump O&M cost estimates, excluding major rehabilitation/replacement

4 Decentralised community water treatment

4.1 Overview

Privately operated water treatment kiosks have emerged over the last decade, chiefly in India. Generally adopting off-the-shelf treatment technologies, these systems tend to serve rural towns with populations around 1,500-5,000 people, and are particularly suited to areas where water sources are highly polluted.

The facilities are operated by local entrepreneurs, while O&M responsibilities are retained centrally by the parent organisation. This business model generates economies of scale, and a greater ability to manage supply chains and ensure adequate technical capabilities.

Though portrayed as a 'bottom-of-pyramid' solution, tariffs are around US$3-US$6 per cubic meter. This price point is considerably higher than water delivered via piped systems, and is comparable to the price of water supplied by vendors and tankers in urban areas. On one hand these tariffs might call into question whether these systems truly serve the poorest of the poor. On the other it is likely that the high price is offset by the small volume of treated water that households purchase for drinking purposes. For example, a study from Ghana suggested households purchased just 3 litres per person per day from the local WaterHealth International facility (IRC 2010). Similarly, Hystra (2011) estimates Sarvajal and Naandi customers consume 4 litres per person per day. Thus the overall cost to a household will remain low where purified water is augmented with lower cost and low quality water for non-drinking purposes.[52]

Crucially, the upfront capital costs of decentralised facilities are comparatively low, as no distribution infrastructure is required. This means in some situations communities or franchisees can shoulder a higher proportion of the initial investment. The models use a mix of financing sources, including community funds, commercial debt, franchisee payments and donor funds. In response, Kumar and Davies (2010) have suggested that these models "may ultimately prove to offer one of the most capital efficient means for accelerating access".

Unique to these services is the health-oriented social marketing which is used to promote the health benefits and monetary savings which arise from consumption of purified water. This social marketing and demand stimulation is central to a business model which depends on people's willingness to pay a high price for treated drinking water.

4.2 Prominence of approach

As decentralised water treatment services are only a recent phenomenon, the scale of operations remains relatively small. Concentrated mainly in India, the top three companies sell water from over 1,000 facilities to more than 1 million people. Of these, WaterHealth International has the largest operations, and has a growing footprint in West Africa. Available data suggests some service providers have achieved penetration rates of 30-50% in their towns of operation. Overall Hystra (2011) predicts decentralised water treatment kiosks could potentially serve up to 10 million rural dwellers, mainly in Asia.

[52] Hystra (2011) estimates customers spend 2-3% of household income on water from Naandi kiosks and 1-10% from Sarvajal units.

Name	Scale of operations	Tariff	Approach
WaterHealth International[53]	- 480 systems serving 500,000 people - Each system serves 2,500-5,000 people - Operations mostly in India - Also expanding into Ghana, Liberia, Nigeria, Philippines and Bangladesh	US$3-4 per cubic meter	- Community provides land and access to local water source - Community makes upfront payment of 60-100% (depending on size of community and availability of local financing) - Local Banks finance remainder of capital costs with a long term loan - WHI responsible for O&M under a service contract for up to 10 years - Revenue from water sales covers O&M costs - In theory sales should cover rehabilitation and replacement, though IRC and Aguaconsult (2011) suggested in Ghana this "is not well defined"
Sarvajal[54]	- 133 rural franchises serving 73,283 people - Operations in four Indian states - Town populations around 5,000 people - Each unit serves ~110 households	~US$6 per cubic meter	- Local entrepreneurs are recruited operate the systems - Total capital cost of ~US$3,000 (franchisees pays 32%, Sarvajal pays 68%) - Water revenues are shared 60:40 between the franchisee and Sarvajal - Sarvajal are responsible for all filtration unit maintenance and repairs - Franchisees expected to break even after 6-12 months
Naandi "Community Safe Drinking Water System"[55]	- 400+ Kiosks in rural India, serving ~600,000 people - Operations in five Indian states - 50% penetration in towns of operation	US$2-4 per cubic meter	- Facility is operated locally by entrepreneur, with maintenance and repairs managed centrally - Upfront cost of facility is US$10k-20k - Community contributes 20% of the capital cost; 80% financed through commercial debt and/or donor support - Sometimes follows a BOT model, where facility financed by public authority
WaterLife India[56]	- Systems in more than 1,500 villages, in six Indian states - Plans to expand to Indonesia and Bangladesh	~US$5 per cubic meter	- WaterLife installs the facility and operates and maintains system for 5 to 6 years
Aquasure Chlorination Plants[57]	Unknown number of systems deployed in Senegal and Madagascar	~US$6.50 per cubic meter	-Upfront cost of facility is US$7k -When serving 230 families, system expected to break even within two years -Local operator retains profit margin of 43%
1001 fontaines pour demain[58]	By 2008, systems installed in 8 villages in Cambodia, serving 10,000 people. Plans to install further 200 systems between 2011 and 2015	~US$13.25 per cubic meter	- Upfront cost of facility is US$15k - Local operator earns US$50-60 a month - NGO provides initial support, including: o Training the operator and paying their salary during the initial period o Assisting the operator with quality control, spare parts provision, and management support o After a year, the operator signs a contract which stipulates a portion of the revenues is directed to the local NGO in return for ongoing external support

Table 7 - Privately-managed decentralised water treatment services

4.3 Evidence of benefits

There has yet to be any formal, objective assessment of the impacts generated by decentralised water treatment facilities.

4.4 Future considerations

The low capital costs make decentralised water treatment services an attractive proposition for small towns where people are often accustomed to paying high prices for vended water. They offer a scalable, financially secure alternative to piped systems whose business models are undermined by high water losses and under-collection of post-paid water bills. However, decentralised treatment facilities

[53] WHI (2010), IFC and WSP (2011), IRC and Aguaconsult (2011), http://www.waterhealth.com
[54] Hystra (2011),Planete d'Entrepreneurs (2010), http://www.sarvajal.com
[55] Hystra (2011), Vousvouras and Heirli (2010), http://www.naandi.org
[56] Talukdar (2010), http://www.waterlifeindia.com
[57] Vousvouras and Heirli (2010)
[58] http://www.1001fontaines.com

tend to serve small towns with a population exceeding 2,000 people and a reliable power supply, thus they are unlikely to provide a feasible solution for the largest segment of rural water users who live in smaller, more sparsely populated communities.

Hystra (2011) identifies several challenges and pathways for scaling up decentralised water treatment kiosks. Key threats include the proliferation of low-quality competitors who might damage the brand of kiosk operators; the ability to control and retain competent franchisees as networks grow; and business model restrictions that prevent operators from sourcing the cheapest and most appropriate technologies. On the flipside, critical success factors cited by Hystra (2011) include obtaining operating permits from the local community or public authority; quality control of local operators to ensure the integrity of the brand; promotion and social marketing techniques that drive high penetration within communities; and mobilization of financing for capital expenditure requirements.

Figure 13 - Water treatment facilities for WHI (left) and Sarvajal (middle and right)

5 Small piped schemes

5.1 Overview

Operation of small piped schemes is the most common way in which entrepreneurs and enterprises deliver rural water services. With the rapid population growth in small towns and rural trading centres, privately-operated piped schemes are becoming an increasingly viable option. Schemes vary greatly in terms of size and division of management responsibilities, and operators range from individual entrepreneurs and village elders through to multinational corporations. The spectrum of contract options is similarly broad, and includes service contracts, management contracts, leasing arrangements, concession contracts, and build-own-operate-transfer agreements. The case studies reviewed below also possess a diverse mix of endpoints, with no dominant ratio of standpipes to household connections.

Documented reviews of privately operated rural piped schemes are generally favourable in their assessments. Compared to dispersed community water points, piped schemes have a number of commercial advantages. In particular, operators have more potent sticks to enforce payment (e.g. disconnection) and they benefit from economies of scale that accompany network expansions and metered water sales.

While some models of delegated management also involve a design and/or build component, the degree to which capital costs are recovered in rural piped schemes still remains low. Mauritania provides a good example of how private operators can finance the extension of piped networks through user fees. Likewise, the K-Rep bank microfinance pilot in Kenya demonstrates how user payments can cover up to 60% of capital costs (Advani 2010).

Population size and density appear to be crucial factors in establishing the commercial viability of a piped scheme. In rural Africa, Barbotte and Leger (2011) believe piped schemes are only feasible for settlement sizes above 2000 people. Similarly, the findings by Nkrumah et al. (2011) from Ghana emphasise the central role population density plays in the per capita cost (and thus cost-recovery potential) of setting up piped-schemes.

The 'social water point' in rural Madagascar

In their review of privately operated piped schemes in Madagascar, Annis and Razafinjato (2011) identified the establishment of 'social water points' (SWPs) as a key success factor. Shared by five to 15 self-selecting households, the cost of installing an SWP is lower than a household connection, as are the volumetric tariffs. The SWPs are conveniently located, and all contributing households have 24 hours access. This service level option thus responds to the demands of customers who cannot afford a household connection, but are unsatisfied with distant public water points that have limited hours of operation. As the SWPs are metered, operators also benefit from an increase in water sales. It has been observed that many households have subsequently moved to private connections after 1 to 2 years of sharing a SWP.

5.2 Prominence of approach

Privately operated rural piped schemes are becoming increasingly common in Africa, particularly Francophone countries (see Figure 14). By the end of 2008, over a quarter of rural piped schemes were privately operated in Benin, Burkina Faso, Mali, Niger, Rwanda and Senegal (WSP 2010b). Having been one of the first countries to introduce rural public-private partnerships, Mauritania leads the way with almost 100 per cent of rural piped schemes under private management. Uganda is another notable example of a country that has embraced this management option for small town water provision. Despite the increasing prevalence of privately-operated services, piped schemes generally reach a small minority

of rural Africans. Only 4.5 percent have individual connections and 8 percent access standpipes – figures which have barely changed since 1990. It is uncertain how many more people live in settlements with densities that make such schemes viable. WSP (2010b) estimates 15% to 20% of rural Africans reside within the service area of small piped schemes (3 to 8 percentage points higher than the proportion who currently access piped water). Thus, while they could be considered 'low hanging fruit' from a commercial perspective, improved performance of piped schemes achieved through private sector management will only be of benefit to a small fraction of the rural African population.

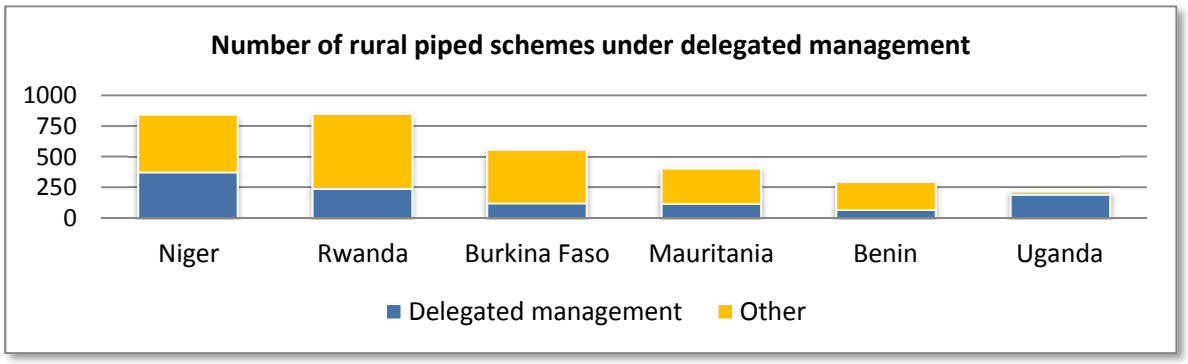

Figure 14 - Delegated management of rural piped schemes in select African countries (WSP 2010b)

The extent of private sector engagement in rural India and Latin America is less clear. In contrast to rural Africa, more than half of rural dwellers possess individual piped connections in Latin America, suggesting there is a potentially large market opportunity. Peru and Colombia are two countries with an emerging cohort of commercially-oriented rural water operators. With its high population densities, there is also scope to usher in private sector participation in India, where there are around 160,000 'mini' piped schemes in operation (GOI 2011). However, while WSP (2011) reports an increase in private sector participation for urban water services in India, the rural sector has yet to follow suit.

Country	Scale	Operators	Contractual arrangements	Cost Recovery
Bangladesh[59]	- 21 schemes completed	- NGOs and private individuals	- Design-build-operate contracts - Operation for 15 years - Operator signs service agreement with each customer with individual connection	- Initially, operators expected to invest 50% of capital cost, collect 10% from communities, and receive 40% subsidy if targets achieved - Operators unable to raise financing, so revised down to 20% investment - One scheme made a loss in first year
Benin[60]	- 130 PPPs - Settlement sizes: 2,000 to 25,000	- 80 operators (74% national firms, 26% private individuals, associations and enterprises)	Policy foreshadows use of lease contracts for three modes of delegation, involving (a) a private operator; (b) three-way agreement between commune, water user association (WUA) and private operator; or (c) production by a private operator and distribution by WUA	- Operator not directly responsible for financing replacement of major assets - Portion of revenue is directed into a fund to pay for capital maintenance and system expansions - Record keeping insufficient to ascertain the financial viability of the schemes
Burkina Faso[61]	- 125 PPPs - Piloting new approach for 12 new and 3 rehabilitated schemes	- 7 schemes operated by Vergnet (French firm) in partnership with local	- Communes request competitive bids from private firms for affermage or management contracts - WUA monitors operator performance, and represents consumer interests	- Under affermage contracts, the operators are responsible for replacing assets with a design life of <15 years - For the Vergnet-managed operations, the total cash balance after 20

[59] Kleemeier (2010a).
[60] Le Gouais (2011), Lockwood and Smits (2011).
[61] Kleemeier (2010a).

		affiliate Faso Hydro	- Commune sets maximum water price	months was ~US$32,000 (~$750 after deducting "future provisions")[62]
Cambodia[63]	- Plans for 23 schemes; only 11 constructed	- Local private operators	- Design, build and lease contracts	- Private operators invested funds in construction - Tariffs cover O&M costs only
Colombia[64]	- One scheme (2,500 ppl)	- Local private operator	- Build and operate contracts - Operators expected to finance expansion and improvement	- Scheme operates at slight deficit - Operator receives subsidies from central government
Cote d'Ivoire[65]	- In 2000, SODECI operated 174 rural systems - Systems serve 257settlements with populations <10,000	- SODECI, the national operator, is a subsidiary of multinational SAUR	- SODECI has an affermage contract to provide water services throughout the country, including rural centres down to 3,000 inhabitants	- Almost all small rural systems are unprofitable - Abidjan and other urban centres cross-subsidize rural water supply via uniform national tariffs set as part of SODECI's contract
Gabon[66]	- 32 rural areas	- Veolia has a controlling interest in SEEG, the national water provider	- In 1997, SEEG took over responsibility for providing piped services to 32 rural areas, some with populations of just over 1,000	
Kenya[67]	- As at June 2011, 18 projects , benefitting over 40,000 people - 350-600 connections per scheme - Plans to scale up to 50 projects	- Local firms	- K-Rep requires new loan recipients to engage a private operator on a management contract until the loan has been repaid - Operator is contracted competitively and paid a fixed monthly fee plus a share of the net operating revenue - Fee is reduced if certain performance benchmarks not achieved	- Financing arrangements are 40% subsidy, 40% loan, and 20% equity from community - According to Advani (2011), communities struggle to pay a private operator fee in addition to debt service and operating expenses
Madagascar[68]	- 20 piped schemes serving 120,000 people - Settlement sizes >5,000 people	- Locally registered private companies	- Contracts for operation, management and maintenance 10-25 years in length	- Operators contribute 5% - 40% of upfront system cost - In one scheme serving 7,000 people, operator contributed US$65,000
Mauritania[69]	- 350 PPPs[+] - Settlement sizes: 500-2000	- >320 private operators - 100% individuals	- Government-funded association (ANEPA) signs one year management contracts with private operators - Operator pays ANEPA a fee (based on water volume sold) to carry out major repairs and maintenance	- Although not stipulated in the contract, expansion of the schemes often financed by charging users the full cost of new connections - Government subsidies still needed to cover two-thirds of ANEPA's costs
Morocco[70]	- Pilot in Sidi Kacem serving 130,000 people across many settlements		- 10 year affermage style management contract	- 74% of connection costs subsidised by National Water Supply Company (ONEP) via output-based aid
Niger[71]	- 298 PPPs[+]	- 50% individuals, 45% local enterprises or NGOs	- Central ministry solicits bids on behalf of WUAs for private operators to manage schemes - Winning operators then sign a contract for each scheme with WUA	- Kleemeier (2010a) notes an evaluation of some schemes had found them to be "inherently unprofitable"
Paraguay[72]	- 4 schemes serving a total of 9,600 people - 1,940	-	- 10 year build and operate concession contract - Contracts stipulate tariffs and connection fees	- Operators invested 50% of upfront costs, 40% of which was recouped via output-based aid - Subsidies of $200-250 per connection

[62] Assumes US$1=490 CFA
[63] Kleemeier (2010a).
[64] Kleemeier (2010a).
[65] Kleemeier (2010a), Tremolet (2002), Tremolet et al. (2002).
[66] Kleemeier (2010a) and Tremolet (2002).
[67] Advani (2010), Advani (2011).
[68] Annis and Razafinjato (2011).
[69] WSP (2010a), Kleemeier (2010a).
[70] de Beauchêne (2009).
[71] WSP (2010a), Kleemeier (2010a).
[72] Kleemeier (2010a), Triche et al. (2006).

	connections in total			- Tariffs cover O&M costs but not expansion
Peru[73]	- 9 schemes, 6 with private operator, 3 with private operators in partnership with municipality - Settlement sizes: 6,000 to 25,000	- Of the 6 private operators, 5 were regional companies, 1 national	- Relationship governed by management contract, ordinance of provision of services, ordinance of charging and pricing, and development plan - Contract 7 to 10 years in length - Operator assumes O&M, commercial, and minor investment risk (but not upgrade/expansion) - Municipality sets price and service quality	- Tariffs set to cover operation and maintenance costs - Municipality funds expansion/replacement/upgrade
Rwanda[74]	- 235 PPPs[++] - 31% of a total 847 rural systems - Systems serve 1 million people[++] - 95% served by public standpipes - Average of 5,000 ppl per town - Schemes average 12 standpipes and 35 HH connections	- 65 operators - Half are self-employed entrepreneurs - Each manages an average of 3-4 schemes - Few operators had prior experience managing water services, though more competent operators now emerging	- Contracts signed with the District Government - Initial contracts were part management part lease contracts - Lack of data and the uncertainty relating to demand and willingness to pay forced short contract lengths - NB – 30% of contracts were terminated prematurely	- According to Lazarte et al. (2011), despite the short contract durations, some operators have invested up to US$10,000 in extensions and network maintenance
Senegal[75]	- 20 PPPs[+] - Covering 80 boreholes, servicing 240,000 ppl	- Nearly 50% are self-employed entrepreneurs	- User association hires a private operator to manage a scheme - A national firm carries out repair and preventative maintenance	
Uganda[76]	- 72 PPPs - Covering 8.5% of national total - Settlement sizes: 5,000 to 40,000	- 14 private operators - Many operating schemes in five to six towns - Local 'regionally-oriented' firms	- Local authorities enter into a management contract with a private operator - Usually a three-year rolling contract - Operator responsibilities include revenue collection, maintenance and repairs and minor extensions - Local authority is responsible for replacing and extending the assets	- After five years, O&M cost coverage had lifted from 50% to 84% (WSP 2010b)
Vietnam[77]	- 80 out of 415 small schemes privately owned in Tien Giang	- Local entrepreneurs		- Consumers help finance construction by paying upfront connection fee of US$60-100

Table 8 – Private operation of rural piped schemes

[+] As at 2009; [++] As at 2010

5.2.1 Case Study 1 – Mauritania[78]

In Mauritania some 350 rural piped schemes are operated by 320 entrepreneurs. Operators are awarded contracts by the Agence Nationale d'Eau Potable et d'Assainissement (ANEPA), a government-funded association. ANEPA is responsible for major repairs and maintenance, in exchange for a fee paid by operators based on volume of water sold. Management agreements are for one year, and are renewable at the discretion of the government. Less than 10% of the contracts are terminated after one year, and the average duration is four to five years. Many of the operators finance major repairs and new

[73] WSP (2008).
[74] Lazarte et al. (2011), Prevost et al. (2010).
[75] Fall (undated), Kleemeier and Narkevic (2010).
[76] WSP (2010b), IFC and WSP (2011), Triche et al. (2006).
[77] Kleemeier (2010a).
[78] Kleemeier (2010a), WSP (2010a).

connections through collection of user fees (though they are not contractually obliged to do so). Between 1994 and 2004, operators installed an estimated 35,000 household connections without any external subsidies. This success has been aided by flexible construction standards that have helped minimise costs.

5.2.2 Case Study 2 – Uganda[79]

Since 2000, a delegated management model has been adopted for water services for small towns (population 5,000-40,000) throughout Uganda. Operators are typically local firms, and are responsible for up to 5 or 6 schemes each. Each tender typically attracts 2 to 3 bids. The contracts, which are signed and supervised by local governments, were initially for three years, though this is now shifting to five years. Operators are generally not expected to invest in capital improvements or system expansions. In 2005, an Output-based Aid component was introduced to make the contracting conditions more attractive to local firms. Now more than 72 systems are privately operated. According to WSP (2010b), in the first five years the reform had led to an increase in billing from 50% to above 95%; collection efficiency had been bolstered from 40% to 85%; water losses had declined from 50% to 21%; O&M cost coverage had risen from below 50% to 84%; and revenue had increased more than three fold.

5.2.3 Case study 3 – Kenya K-Rep Bank 'Maji ni Maisha' Scheme[80]

Under a pilot phase of the 'Maji ni Maisha' program in 2006, US$1m was lent to 10 communities in rural and peri-urban Kenya to finance piped water infrastructure improvements. The financing was based on 20% equity from the community and 80% debt from K-Rep Bank, a commercial bank specialising in microfinance lending. The loans have a one year grace period to take account of the construction period, and will be paid back over a five year period (at market rates) with revenue generated through water sales. Upon completion an output-based subsidy equivalent to 40% of the project cost is awarded.

In some cases, the community opted to bring in a private operator. The operators were contracted competitively and are paid a fixed monthly fee plus a proportion of the net operating revenue. The fee is reduced if certain performance benchmarks are not achieved. Advani (2011) subsequently noted that "where a private operator has been employed to manage a project, the financial and operational performances of the project have been significantly better than those managed by communities." The program will now be scaled up to around 50 communities and 165,000 beneficiaries, with a new condition that loan recipients must engage a private operator on a management contract until the loan has been repaid. It has been noted however that communities struggle to pay a private operator fee in addition to debt service and operating expenses. The program architects also recommended that future projects should be amalgamated to enhance their commercial attractiveness, and operators should be encouraged to take on design-build-operate contracts.

5.3 Evidence of benefits

While literature is generally favourable, no studies have rigorously ascertained the long-term financial and operational sustainability of privately-managed rural piped schemes. Similarly, information on the levels of capital costs recovered through user fees remains sketchy – this is perhaps understandable given the nascent stage of private sector participation in many countries. Various references to impact and viability include:

- Five years after the private sector reforms in Uganda, billing had increased from 50% to above 95%; collection efficiency had risen from 40% to 85%; water losses had declined from 50% to

[79] WSP (2010b), IFC and WSP (2011), Triche et al. (2006).
[80] Advani (2010), Advani (2011).

21%; O&M cost coverage had lifted from below 50% to 84%; and revenue had increased more than threefold (WSP 2010b)

- Tremolet (2002) notes that almost all small rural piped schemes operated by SODECI in Cote D'Ivoire are unprofitable
- Kleemeier (2010a) reports that the first scheme completed in the Bangladesh Water Supply Program Project made a loss in the first year of operation – revenue was less than US$214 per month, and operational expenditure was US$382 per month.
- For the seven Vergnet-managed schemes in Burkina Faso, the cash balance after 20 months was ~US$32,000,[81] most of which was set aside for "future provisions" (Barbotte 2011)
- Network expansions financed through levying of user fees had been observed in schemes in Ghana, Gabon, Mauritania, Rwanda, Mozambique and Madagascar
    - In Mauritania, around 35,000 household connections have been installed by rural operators between 1994 and 2004 without any external subsidies (WSP 2010a, Kleemeier 2010a)
    - For one scheme in Madagascar, in the first two years of operation there was a 22% increase in household connections and 71% increase in social water points (Annis and Razafinjato 2011)
    - One entrepreneur in Nyamasheke District in Rwanda has installed 460 new connections (Lazarte et al. 2011)
    - In three privately operated schemes in Mozambique, household connections had increased by 333% in three years (WSP 2010b)
    - In the first 20 months of operations, seven Vergnet schemes in Burkina Faso had added just 10 new connections (Barbotte 2011)
- In the first year of operation of the Vergnet schemes, per capita water consumption increased from 5 litres to 8 litres (Kleemeier 2010a)
- Kleemeier (2010a) notes that several older initiatives – Niger, Senegal and Rwanda – provide evidence that private operators have managed schemes better than was the case with community management
- An assessment by WSP in 2009 found the majority of customers in Rwanda were satisfied with the service provided and quality of water distributed in privately operated rural schemes (Lazarte et al. 2011)
- When reviewing the K-Rep Bank financed schemes, Advani (2011) noted that "where a private operator has been employed to manage a project, the financial and operational performances of the project have been significantly better than those managed by communities."
- In Senegal, Fall (undated) asserts that private operation of rural schemes in one region has led to 98% functionality (versus 80% for rest of the country) and an average repair time of 2 days (versus 4 days for the rest of the country)

5.4 Future considerations

There is a growing body of literature detailing the key challenges and success factors associated with ushering in private sector participation for rural piped schemes (see e.g. WSP 2010a, WSP 2010b, Kleemeier 2010a, Triche et al. 2006). Hence only brief mention of some salient issues will be made here.

[81] Two of the seven scheme had a negative cash balance over this time. Assumes US$1=490 CFA.

A consistent theme throughout the literature is the difficulty faced in attracting high quality operators (Kleemeier 2010a). Based on the documented case studies, a number of measures have been proposed to overcome this problem, including:

- Training and support in bid preparation for firms and entrepreneurs
- Grouping schemes into profitable clusters to spread costs and revenues across schemes, and create economies of scale
- Opting for design, build and operate contracts to ensure quality of construction, save time and reduce disputes regarding the technical status of schemes
- Initially offering short contracts to minimise commercial risks, but subsequently lengthening contract durations so operators have sufficient time to recoup investments
- Establishing knowledge sharing forums, umbrella organisations/associations and/or business development services to support operators with capacity building, management oversight and technical backstopping

Another important consideration is the institutional arrangements needed to oversee the process. In the case studies reviewed, there was no dominant institutional configuration. As Kleemeier (2010a) points out, Benin, Burkina Faso, Mali, and Rwanda have all introduced rural private operator initiatives in which local governments are parties to the contracts. In contrast, Niger, Senegal, and Mauritania have maintained more centralised approaches where a Ministry, or central agency, has taken the lead. Whatever the permutation, strong institutions that monitor and regulate private sector participation are paramount.[82]

[82] Similarly, contractual arrangements have varied, and there is no consensus as to the optimal approach. Lessons can however be learnt from the experience of private sector involvement in urban Africa. Management contracts have tended to lead to improvements in revenue collection and service continuity, while lease contracts have additionally accelerated coverage of household connections and driven operational efficiencies (Bannerjee and Morella 2011).

6 Broader implications

6.1 Equity implications

An important consideration arising out of private sector participation in rural water service provision is the impact it may have on low-income households. In the absence of subsidies, the private sector will need to take a more disciplined approach to collecting cost recovery tariffs. If affordable, this should be seen as a positive shift, as it is likely to lead to more sustainable services. It should therefore be noted that most research indicates willingness to pay is more important than ability to pay (Harvey 2009). Nonetheless, any shift towards private sector involvement should be accompanied by targeted pro-poor measures that have proven effective in urban settings.

Without robust data on what *is* a cost recovery tariff in rural settings, it remains difficult to gauge the effect private sector provision will have on the rural poor. With few published cost recovery tariff estimates for rural services, any affordability analysis is unavoidably crude, and it does little justice to the widely varying conditions which influence life-cycle costs and a household's ability to pay at any given time. Data presented in Bannerjee and Morella (2011) suggests an average of 1.9% of household income is spent by rural dwellers on water services in Africa, which is below the commonly cited 3%-5% affordability guideline. However, this figure masks great variation in water supply technologies and service levels, and in any event the relevant tariffs may well be below long-term cost recovery levels. Moreover, affordability assessments using fixed sector benchmarks are overly simplistic. With these limitations in mind, 'back of the envelope' analysis is presented here to provide indicative 'order of magnitude' estimates.

6.1.1 Community water points

As the dominant mode of rural water provision in India and Africa, the following analysis is for handpump supplies. Estimates calculated by Harvey (2007), Baumann (2006), WaterAid (2009), and Bannerjee and Morella (2011) suggest the following for a handpump serving 50 households:[83]

- Annual maintenance costs lie at around US$0.50-0.70 per household.
- Incorporating replacement and rehabilitation costs, this rises to $3-$5 per household per year.
- Including initial drilling, construction and institutional support costs, estimates rise to around US$15 – US$30 per household per year

The degree of cost recovery expected will evidently dictate the affordability implications for poor households. For a family earning an average of US$1.25 a day, a simple maintenance tariff would account for less than 0.2% of family income. Incorporating major repairs and replacement costs, this figure rises to 1%-2%. This suggests that if a private operator can provide a financial buffer between regular community member payments and the lumpy cost profile of a water point, then replacement and rehabilitation costs are affordable with room to manoeuvre on overheads and profit margins. Finally, when initial construction costs and institutional support is factored in, households earning US$1.25 a day might will need to spend beyond 5% of family income on water, a figure which might push the bounds of affordability. Hence in the short term, it is perhaps unrealistic to expect full cost recovery to become the norm, a conclusion shared by Harvey (2007). Least subsidy and/or output-based aid approaches might be the best way to strike the ideal balance between full cost recovery via user fees and provision of external subsidies.

[83] Note these estimates are based on a range of crude assumptions relating to replacement/rehabilitation intervals, cost components and pump types.

It must be stressed that the averages applied here conceal great temporal variability and unpredictability in both rural incomes and water point maintenance and replacement costs. To ensure affordability for the poor year-round, variable pricing regimes may need to account for periods of no cash income, which could be offset by higher prices during and after harvest. Though this might pose cash flow challenges for the operator, appropriate financing mechanisms could keep small-scale operators afloat if the earnings from water sales are insufficient for major repairs at a particular point in time.

6.1.2 Piped schemes

Given the great variation in scale and complexity of rural piped schemes, affordability analysis is similarly crude. The recent Africa Infrastructure Country Diagnostic report pegs an indicative figure for O&M cost recovery for urban piped schemes at around US$1 per cubic meter. This accords well with the K-Rep financed schemes in rural Kenya, where tariffs lie between US$0.50 and US$1 per cubic meter, and the Vergnet operated schemes in Burkina Faso which sell water for US$0.90 per cubic meter (including private operator fee). While data from 65 rural towns in Kenya reveal an average production cost of just US$0.24 per cubic meter of water billed, many of these schemes are likely to be gravity-fed, as is the case with privately managed schemes in Madagascar which charge between US$0.25-US$0.50. At US$1 per cubic meter, the annual expenditure for a rural household of five people (consuming 20 litres per person per day) would amount to a lofty 8% of income if earning US$1.25 a day.

An even bigger financial challenge however is the cost of recouping household connection costs without subsidies. In urban Africa an average household connection costs US$159, and in some nations exceeds the GNI per capita (AICD 2011, Bannerjee and Morella 2011). References to connection charges in the rural sector are less forthcoming. Lazarte et al. (2011) suggest the average connection cost for privately operated schemes in rural Rwanda is US$170. Though referring to initial capital expenditure rather than connection fees, Nkrumah et al. (2011) estimate the cost of rural piped scheme installation in parts of Ghana to be between US$30 and US$95 per capita, which for a household of five people equates to $150 to $475.[84] Vergnet in rural Burkina Faso charges a lofty fee of US$385 for a private connection, a figure which may explain why there were only ten new connections added in the first 20 months of operation (Barbotte 2011). An even higher figure is quoted by de Beauchêne (2009) from rural Morocco, where connection fees were priced at US$577. Such prohibitive charges will limit the commercial success of a water service business model, given maximisation of water sales is contingent on expanding the customer base. Hence if governments are seeking to lure enterprises and entrepreneurs into the rural sector, flexible construction standards and output-based subsidies that reduce connection charges will be needed.

6.1.3 Private operator profit margin

Drawing together the above analyses, crude estimates of cost recovery tariffs as a proportion of household income are illustrated in Figure 15. These figures are intended to be indicative only and cannot take into account the full range of factors which influence water service costs (e.g. settlement size, population density, hydrogeology, unit input costs etc.).[85] It should be noted that this cost analysis applies equally to community-managed water services where subsidies are absent. The issue that remains unclear is the size of an additional operator profit margin that is high enough to attract entrepreneurs and enterprises. This may be a limiting factor in some cases, as evidenced by the Kenyan examples referred to by Advani (2011) when he observed "communities struggle to pay a private operator fee in addition to debt service and operating expenses." It is worth pointing out however that a

[84] Network length and mode of water abstraction (i.e. pump vs gravity-fed) the two key cost drivers.
[85] More robust figures and frameworks for calculating lifecycle costs are now emerging thanks to IRC's WASHCost initiative.

more professional approach to service provision may well create efficiencies and economies of scale that more than offset the cut taken by a private operator.

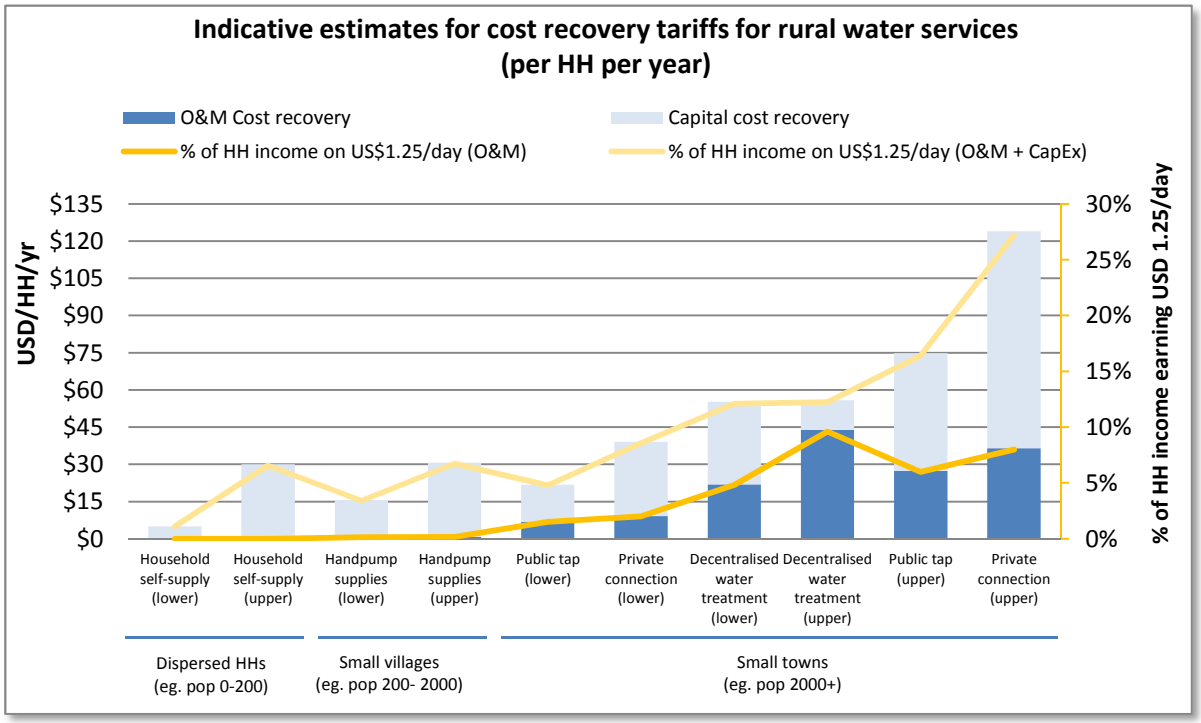

Figure 15 – 'Back of envelope' estimates for cost recovery tariffs for rural water services[86]

There is also the thorny issue of enterprises exploiting their monopoly status by levying exorbitant charges above and beyond the needs of cost recovery and reasonable profit margins. In the urban sector, this risk is often managed by an independent regulator who sets and monitors the water tariffs charged by commercial providers. With the exception of small town piped schemes,[87] there is currently an absence of rural water regulation. If many small enterprises are managing a multitude of water points across a range of hydrological and socio-economic conditions, it is unclear whether a centralised approach to tariff setting and regulation is a feasible option. Instead it may be that local authorities or communities themselves are better placed to regulate providers (e.g. through annual agreements that set prices), so long as clear lines of communication can be maintained with an authority that provides light touch oversight and resolves disputes when needed.

Finally, private sector suppliers of rural O&M services may naturally tend toward lower-risk, wealthier communities, where the ability and willingness to pay is highest and input costs of service delivery are lowest. Such cherry-picking could be avoided through clustering approaches that would enable cross-subsidisation to support the less commercially viable systems. Even if private investors and operators do migrate towards easier to reach, wealthier communities, this will at least mean government subsidies can be redirected to those communities that are most in need of them.

[86] All estimates assume a household of five people. Piped schemes assume consumption levels of 20 l/p/d, and decentralised water treatment kiosks assume consumption of 4 l/p/d. Capital costs are crudely spread across a 10 year period, and the cost of debt servicing and indirect support is excluded.

[87] See the recent Impact Report 4, published by WASREB (2011), which includes performance metrics for 31 rural water service providers delivering piped water to 65 small towns.

6.2 Resource implications

The resource implications of greater private sector involvement will depend on local hydrological conditions specific to a region. There was no suggestion in any of the case studies that a market-based approach to domestic water supplies had compromised a region's water security. However, the profit motive driving rural water businesses will undoubtedly incentivise efforts to increase water volumes sold, which in turn could drive up abstraction levels. This is exemplified by Vergnet in Burkina Faso, which has managed to increase per capita consumption within their service zones by 60% (Barbotte 2011). Expanding piped water coverage could particularly increase water stress in arid localities where water is used for irrigation purposes. However, understanding these implications will require case-by-case bottom-up analysis that takes into account local hydrological and socio-economic factors.

It should be noted that the commercial imperative may lead to better conservation efforts that drive down unaccounted for water, as has been the case in urban Africa.[88] High levels of water losses plague many rural providers, as exemplified by the fact rural piped schemes in Kenya lose 61% of abstracted water through leakages and illegal connections (WASREB 2011). Hence in some cases profit-driven rural operators may be incentivised to abstract less water overall, instead selling and collecting revenue for a much higher proportion of the volume produced.

The resource base is likely to have greater implications for the viability of private sector approaches to rural water provision than the reciprocal. A lack of alternative sources is a strong driver of willingness-to-pay. Often, the more water stressed a region is, the greater the willingness to pay, and hence the more likely a private sector approach is to succeed. Conversely, an abundance of free, though unprotected, sources is likely to undermine water sales. For the Grundfos LIFELINK installations, water sales during the six wettest months are 65% lower than in the driest six months. Likewise, Vergnet-managed water sales in Burkina Faso declined by 28% during the wetter half of the year (see Figure 16). The review of Water For People's Jalabandhu pilot noted a similar depression in demand for handpump maintenance services during the wettest months (Water For People 2010).

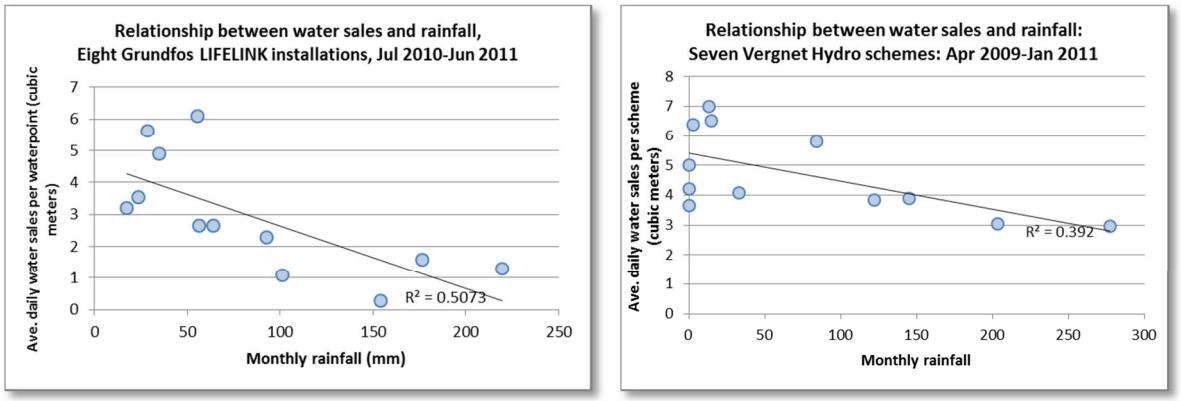

Figure 16 - Average daily water sales for LIFELINK installations in Kenya and Vergnet piped schemes in Burkina Faso[89]

[88] Non-revenue water levels in African cities generally hover between 30% and 50% of all water produced.
[89] Data sourced from Barbotte (2011), www.grundfoslifelink.com

7 Conclusion

The private sector offers a promising pathway to improve the sustainability of rural water supplies and reduce dependence on limited government and donor financing. Notwithstanding this potential, outside of delegated management for small piped schemes there are few large-scale examples of private sector provision of rural water services. Even scarcer are instances of private investment in rural water scheme installation where upfront costs are recouped through user fees. The case studies reviewed do however provide important lessons and insights that can inform the design and implementation of commercially-oriented approaches. They also provide cautionary tales for planners and practitioners that new business models will need to carefully structure incentives, manage risks, provide targeted support and build the capabilities of entrepreneurs and enterprises. With the growing policy and professional appetite to explore this alternative, the time is now ripe to innovate and test new private sector management models. To remedy the current information deficit on the effectiveness of private sector approaches, it is hoped that future implementers will rigorously review and candidly share what works, what doesn't, why and how approaches can be tailored to accelerate coverage and ensure water services continue long into the future.

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