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SMALL-SCALE WATER PROVIDERS IN KENYA: PIONEERS OR PREDATORS?



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Resilient nations.*

Small-Scale Water Providers in Kenya: Pioneers or Predators?

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LIST OF ACRONYMS AND ABBREVIATIONS

AWSB	Athi Water Services Board
CBO	Community-based organisation
CDF	Kenyan government's Community Development Fund
CESR	Center for Economic and Social Rights
GoK	Government of Kenya
GPOBA	Global Partnership on Output-Based Aid
ICEFI	Central American Institute for Fiscal Studies
ISD	Informal Settlements Department
JMP	WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation
KENSUP	Kenya Slum Upgrading Programme
Kshs	Kenyan Shillings
KWTP	Kinoo Water Trust Project
MWI	Kenyan Ministry of Water and Irrigation
NCWCS	Nairobi City Water and Sewerage Company
NGO	Non-governmental organisation
OBA	Output-based aid
PPIP	Pro-Poor Implementation Plan
UfW	Unaccounted-for-water
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
UN OHCHR	Office of the United Nations High Commissioner for Human Rights
WASREB	Water Services Regulatory Board
WHO	World Health Organization
WSBs	Water Services Boards
WSP	World Bank's Water and Sanitation Program
WSPs	Water Service Providers
W&S	Water and Sanitation
WSTF	Water Services Trust Fund



EXECUTIVE SUMMARY

There are two main schools of thought about the role of small-scale private water providers. Proponents view them as pioneers and gap-fillers, supplying water where utilities are not providing it adequately. Sceptics argue that they are predators who charge high prices and supply poor quality water. This study examines which argument holds true in the urban and peri-urban areas of Kenya. The study is based on household and provider surveys, as well as topical interviews with government officials and stakeholders. We find that small-scale providers increase water supply coverage and reduce time poverty.

As predicted by the “poverty penalty” concept, however, low-income households pay high prices for water of questionable quality. For two-thirds of households, expenditure on water is above the affordability threshold. And 57 percent of households consume below the water poverty line. Water is also exposed to contamination by external toxic residuals, mainly during transportation and as a result of pipe leakages. Given their inability to store water, low-income households suffer disproportionately in times of scarcity and rationing.

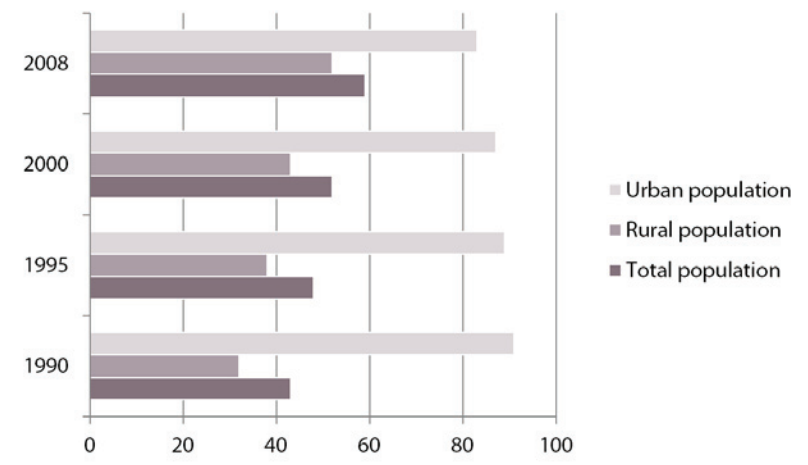
As regards policy intervention, piped water connections on premises remain the most affordable and safe system of water provision. In the meantime, supporting fixed-point water suppliers such as public taps and water kiosks represents a second-best solution. Strengthening capacity within regulatory institutions is required to ensure affordability and quality of the water provided.



1. INTRODUCTION

Kenya faces challenges in realizing its “2030 Vision” for the water and sanitation sector “to ensure that improved water and sanitation are available and accessible to all” (GoK, 2007, p. 18). The 2010 constitution made access to water and sanitation the right of citizens.¹ This is in line with the United Nations stipulation of access to water and sanitation as a human right that requires member states to take “deliberate, concrete and targeted steps” to ensure the progressive realisation of this right (UN OHCHR, 1990).² Despite these ambitious objectives, the proportion of people with access to an improved water source remains low (MWI, 2007). As shown in Figure 1, in 2008 only 59 percent of Kenyans had access to safe drinking water, although the share had increased from 44 percent in 1990. In urban areas the figure is 83 percent, down from 91 percent in 1990. This gradual deterioration in urban water access is mainly due to rapid population growth, especially in the informal settlements.

Figure 1: Improved water source (% of population with access), Kenya 1990–2008



Source: World Bank (2011).

Kenya is undergoing rapid urbanisation. It is estimated that more than half of the population will be living in cities by 2020, compared to only a third in 2000 (UN HABITAT, 2003b). Nairobi’s population alone is projected to grow by 3.9 percent between 2006 and 2020 (City Mayors Statistics, 2011).³ In addition, natural population

1 The right to water falls under the category of economic, social and cultural rights. The principle of “progressive realisation” follows from the recognition that the full realisation of such rights generally may not be possible in a short time period. Rather, it is contingent on the availability of resources. The obligation thus differs significantly from that contained in article 2 of the International Covenant on Civil and Political Rights, which embodies an immediate obligation to respect and ensure all of the relevant rights (UN OHCHR, 1990).

2 The right to water is protected by articles 11 and 12 of the International Covenant on Economic, Social and Cultural Rights (UN CESCR, 1966). The “Guidelines for the Realization of the Right to Drinking Water Supply and Sanitation” of the UN Sub-Commission on the Promotion and Protection of Human Rights also recognizes these essential services as rights.

3 This development is partly the result of mechanical population growth caused by rural-urban migration.



growth in the city's current 200 informal settlements surpasses that of planned urbanised areas (UN HABITAT, 2010). In 2003, some 71 percent of Kenya's urban population, or 7.6 million people, lived in informal urban settlements (UN HABITAT, 2003a). These settlements are often associated with high levels of poverty and inadequate provision of basic services.

The growth of informal settlements poses serious challenges to the provision of water. On the supply side, since residents do not hold formal land titles, there is a constant risk of eviction. According to the public utility, the Nairobi City Water and Sewerage Company (NCWSC), the perceived risk of—and sometimes actual—removal of dwellings in urban informal settlements hinders investments in water infrastructure. For instance, pipe laying requires negotiations with community members over the possible removal of structures to make way for construction. In the Waruku settlement, the removal of dwellings by the Nairobi City Council involved the demolition of a community water and sanitation block. The block had a formal piped water connection to the utility provider and had been inaugurated by the Minister of Water and Irrigation in 2008. This did not prevent its demolition. In addition, the perceived and real threats facing metre readers who seek to enter informal settlements are also seen as impediments to revenue collection, making service delivery to settlements appear unprofitable.

On the demand side, even if the utility company is willing to extend its network to cover informal settlements, the cost of a connection alone—40,000 Kenyan shillings (Kshs)—is unaffordable for most households.⁴ This is exacerbated by the fact that the NCWSC, unlike the Kenya Power and Lighting Company (KPLC), offers no gradual repayment schemes. Only recently has NCWSC adopted a billing system similar to KPLC's PayBill service, which enables metered users to submit their bill payments via the mobile money transfer system M-Pesa. Unmetered customers, who account for about 12 percent of NCWSC connections, still have to settle their bills directly at one of the company's payment locations across Nairobi.⁵ Here, people often wait in long queues, especially at peak times. In addition, only a minority of households can meet the requirements to obtain an individual metered connection, namely an applicant's plot number, a landlord's certification of residence, and a certificate of employment. (NCWSC, 2011).

The abovementioned demand and supply-side factors have exacerbated inequalities in access to water and have left gaps in public service provision. Small-scale water providers have entered the market to fill the gaps. Small-scale provision takes various forms, including independent small piped systems; fixed-point resale businesses such as borehole water vendors, tap water vendors and water kiosks; and mobile delivery services offered by pushcart vendors and tanker trucks.⁶

According to Kariuki and Schwarz (2005, p. 6) small-scale providers "play an important role in service provision, compensating for—or supplementing—the limited financial and human resources of the public

4 The cost of connections covers NCWSC fees as well as the cost of construction material.

5 In 2008, the number of NCWSC bill-payment locations increased significantly. In addition to existing NCWSC business centres and regional offices, banks and post offices country-wide now offer NCWSC bill-payment services (NCWSC, 2008).

6 In October 2009, NCWSC launched the Informal Settlements Department (ISD) with a mandate to deal with water and sanitation supply in informal settlements. According to ISD, sabotage of NCWSC infrastructure is common, both by small-scale water vendors, who see NCWSC as a competitor to their lucrative business, and by land owners, whose land has been grabbed by the slum dwellers and who thus consider the installation of public water supply infrastructure a "formalisation" of the status quo, benefitting what they consider to be land grabbers.



sector". These providers play three basic roles. First, in acting as "gap fillers" they help ensure high coverage levels, albeit at a lower quality. Second, they are "pioneers" extending water access to areas where there is no infrastructure and no system of delivery. Third, small-scale providers act as "sub-concessionaires" buying from the utility and reselling to customers. Schaub-Jones (2008, pp. 271–273) adds that these providers are:

"outperforming larger formal providers in meeting demand for household connections, usually without any external subsidies. This achievement relies on their ability to innovate, using appropriate standards to lower the costs of delivery. Investment and operational risks are passed through to the user and the local relationships built to provide security."

Sceptics, however, argue that small-scale provision is associated with higher prices, in the range of five to twenty times higher than prices charged by utilities (Sansom, 2006). Since services are usually unregulated, quality and labour standards are not maintained (Kjellén and McGranahan, 2006). There have been reports of water vendors illegally extracting water from the piped system for resale, deliberately creating a shortage and thereby raising demand for private water supply. Water cartels, through collusive price setting, are increasingly prevalent in poor communities (WSP, 2009). These are the negative aspects of unregulated private provision, challenging the benign view of small-scale providers.

This paper looks at whether small-scale providers in Kenya are innovative gap fillers, as proponents claim, or predators, as the sceptics argue. The findings are that the water utility (NCWSC) is unable to extend adequate water-supply services to the majority of urban and peri-urban communities, resulting in small-scale private providers filling the service gap. This study examines what role these providers play in ensuring affordable, safe and reliable water supply. The main findings are outlined below.

First, there is a significant incidence of water deprivation: 57 percent of the low-income households surveyed consume less than the water poverty line of 20 litres per capita per day. About 63 percent of households spend well above the affordability threshold on water. Mobile vendors, such as those using pushcarts and tanker trucks, charge the highest unit prices for water.

Second, about 53 percent of the water provided by small-scale providers comes from "other improved sources". The ability of mobile vendors, such as pushcarts and tanker trucks, to obtain water from a variety of sources allows them to supply water in times of shortage. This, however, also introduces an information gap regarding the quality of water sold, as end users have little means of verifying the safety of the water they purchase. Inferior quality pipes used by illegal connections break easily, and initially safe water can thus be contaminated by garbage, other toxic residuals, and impure external water flows.

Third, water supply is unreliable, mainly because of extensive rationing by the utility company. Rationing, in turn, is partly the result of high unaccounted-for water use. All communities surveyed suffer from unreliable water provision on the part of the utility provider. In the short run, water rationing leads to expectations of future water shortages, and households respond by storing water. This pushes up the demand for water beyond immediate consumption levels, further exacerbating water shortages.

As regards policy interventions, key water-sector institutions need capacity strengthening for several reasons. The first is to ensure the safety of water. A recent report by the Water Services Regulatory Board (2010) identifies institutional weaknesses in the quality assurance system. Government officials, for example, inspect



boreholes only once at the time of granting licenses. The second reason is to expand connections to fixed-point water suppliers such as public taps and water kiosks. This would allow more households to shift from a reliance on mobile water vendors to buying water from fixed-point water sources that are safer and more affordable. And the third reason is to tackle water rationing by repairing decaying infrastructure to reduce leaks, and by investing in the expansion of catchment capacity to increase supply.

The study is organised as follows: Section 2 locates the paper within the conceptual framework of the “poverty penalty” literature. Section 3 outlines the methodology and the data used in the analysis. Section 4 describes the water distribution and supply chain. Section 5 presents the findings on the demand for and consumption of water. Section 6 explores the extent to which the regulatory framework adequately addresses the challenges to ensuring affordable, safe and reliable water supply in informal settlements. Section 7 concludes with policy recommendations.



2. CONCEPTUAL FRAMEWORK: THE POVERTY PENALTY IN THE URBAN MARKET FOR WATER

The concept of the poverty penalty refers to “the relatively higher cost shouldered by the poor, when compared to the non-poor, in their participation in certain markets” (Mendoza, 2008, p. 2). This may apply to low-income households as consumers and as producers.⁷ Depending on the specific context, the poverty penalty can take at least four possible forms.

First, the poor may be disadvantaged and marginalised in markets by a quality-related poverty penalty. Examples of commodities offered to the poor that have a quality-related poverty penalty include expired medicines, spoiled or contaminated foodstuffs, faulty electrical and mechanical devices and products, and water from unimproved sources. In some cases, poorer quality products may be offered at the same price as better quality products.

Second, a price-related poverty penalty exists in markets where lack of competition often results in higher prices. In this type of market, poor customers pay a higher price per unit of a specific product.⁸ This type of poverty penalty can be measured quantitatively, for example by calculating the ratio of the price paid by the poor relative to the non-poor. This is called “the poverty premium”.⁹

Third, stronger forms of price-related market exclusion also lead to catastrophic expenditure burdens. Catastrophic spending refers to a situation in which the spending burden of a particular commodity or service forces a household to “reduce its basic expenditure over a period of time” (Xu et al., 2003, pp. 111–112). Such a scenario is likely when non-consumption of the commodity or service is not an option for the household. Examples include spending on energy, health and water. Researchers have identified a “catastrophic spending threshold” of 10 percent of household income to best approximate the level, which implies giving up other basic needs, disposing of productive assets, incurring debt or becoming (more) impoverished (Van Doorslaer et al., 2007; Xu et al., 2003).

Finally, non-usage refers to a situation in which demand-related factors cause the poor to opt out of the market, even though they can afford the commodity or service in question. Reasons for non-usage can include the provider’s insensitivity to cultural beliefs and practices, and a lack of adequate awareness among users (Houweling et al., 2007).¹⁰ A study by Fotso et al. (2008) found that even where quality health services were

7 This paper adopts a focus on the poor as consumers. The poverty penalty facing the poor as producers refers, for example, to lower wages paid to poor labourers. One reason is that the poor disproportionately tend to find employment in the informal sector.

8 The law of one price predicts that a homogenous good trades at one price no matter who buys it or which firm sells it. Market failures, however, distort the assumptions underpinning this law.

9 Mendoza (2008) proposes calculating this “poverty premium” as the ratio of the highest price offered to the poor by informal lenders (credit), small-scale private providers (water) etc., and the price offered by large-scale providers, such as formal financial institutions, utilities etc., minus 1.

10 While low income is the root cause of the poverty penalty, other reasons relate to the broader market environment. First, the poor tend to live either in remote and geographically dispersed areas or in informal urban environments. Investments in infrastructure and supplying services in these areas and settlements tend to be costly. Second, regressive price structures may be the result of store and size effects. The store effect refers to differences in pricing between large and small stores for the same size and quality item. The size effect, on the other hand, refers to differences in prices per unit of measure for various sizes offered for a particular product within any given store (Mendoza, 2008). A third source is that of market failures that includes imperfect information and high transaction costs.



made available to poor populations in urban informal settlements, usage only improved when affordability and physical accessibility were combined with health education. This shows the importance of enhancing non-users' awareness, skills and knowledge of health-related consequences of their decisions. A similar seeming paradox of non-usage of professional health services has been reported in Guatemala. Efforts to reduce maternal mortality among indigenous women, in particular, have been compromised by the cultural inappropriateness of reproductive health services. The women report derogatory treatment and disregard for their language and cultural traditions, such as a preference for vertical childbirth (CESR and ICEFI, 2009).

While the poor in general shoulder a poverty penalty in markets for water, health, credit and telecommunications, there is evidence to suggest that the urban poor suffer an additional *urban* penalty. The urban penalty is related to the fact that "cities concentrate poor people and expose them to unhealthy physical and social environments" (Freudenberg et al., 2005, p. 2). UN HABITAT's (2006) flagship publication, *State of the World's Cities Report*, reveals that outcomes in the areas of health, education, employment and other key development indicators are significantly below average in urban informal settlements. Among the main reasons are substandard housing and inadequate or non-existent essential services in informal settlements.

In water markets, the poverty penalties discussed above are applicable to low-income households in urban informal settlements. First, there is a combined quality- and price-related poverty penalty when the poor are not connected to the utility's piped network. This leaves households dependent on various forms of formal and informal small-scale private provision. Households have little means of verifying the quality of water supplied by mobile vendors. Sometimes, even fixed-point vendors may be offering water that has been diverted illegally from the piped network via substandard pipes.¹¹ But the price charged by these small-scale providers is much higher than that charged by the utility. The price-related poverty penalty is exacerbated by the fact that slum dwellers lack space to store large quantities of water, and thus tend to purchase water in smaller units (20-litre jerry cans). Furthermore, the expense of bulk water storage tanks makes them unaffordable to the poor, and the tenure insecurity of semi-permanent dwellings discourages the installation of infrastructure such as large water tanks.

Since water is essential to sustaining life, non-usage of available water supply is generally unlikely. This is what economists call *perfectly inelastic demand*. The poor's disadvantaged position in the market for water, therefore, is likely to expose them to catastrophic expenditure burdens. When the cost burden becomes too great, however, households may have little choice but to opt out of the market. They may choose instead to rely on unprotected water sources at no monetary cost. But, this carries severe health risks. Where households access water by means of illegal feeds off the water mains, leaks may jeopardize the safety of the piped water supply.

¹¹ Leakages due to low-quality plastic piping and improper fittings expose the water to contamination.



3. THE DATA AND METHODOLOGY

Primary data for this study was collected through a representative household survey as well as structured and topical interviews. Structured interviews with small-scale providers consisted of open-response questionnaires to gather information on the water supply chain and the business model of small-scale water vending. To understand the constraints in the water sector, as well as regulatory issues, we conducted topical interviews with government officials and other key stakeholders. We also interviewed operators of tanker trucks at Dagoretti Corner, a central convening point for privately owned water tankers operating in the Nairobi city area.

The surveys were conducted in September 2010 in peri-urban and urban areas within Nairobi city. The sample consists of 576 households and about 159 small-scale water providers interviewed in Dam, Kangemi Village, Kaptagat, Kiambiu, Kinoo, Olepolos, Soweto East (Kibera) and Waruku.¹² For each location, the representative sample for the household survey was decided on the basis of the approximate size of the population residing in the community. The size of the sampling area, covered by a single enumerator, therefore varies with population density. Less populated communities were divided into larger sampling area units, while highly populated ones were subdivided into smaller area units.

Household randomisation was applied by distributing the enumerators across these non-overlapping sampling area units that spanned the entire community. Because dwellings are located in a disorderly fashion inside the informal settlements, no further systematic randomisation was possible beyond the geographical sub-delineations. During the household data collection, a separate group of enumerators covered larger pre-specified geographical areas, often spanning a couple or more household sampling area units.¹³

12 The two OBA communities in our sample (Kinoo and Olepolos) were chosen according to the following criteria: (i) characterised as urban or peri-urban locations (not rural); (ii) had participated in an OBA financing scheme; and (iii) had completed at least one output assessment after project implementation. The other communities were chosen on the basis of their not having received OBA and having similar demand for water to the OBA communities, proxied by population size and similar demographic characteristics. As expected, OBA recipient communities have a relatively lower number of private providers. This is because the water projects themselves offer in-dwelling piped connections as well as water kiosk services to a large population.

13 This methodology holds a potential bias leading to a higher proportion of fixed-point vendors, relative to mobile vendors, in our sample, than is the case in reality.



4. WATER SUPPLY AND DISTRIBUTION

4.1 Small-Scale Water Providers

As shown in Table 1, the fixed-point water suppliers (tap water vendors and water kiosks) make up 62 percent of the small-scale water providers in our sample. The mobile suppliers (pushcart vendors and tanker trucks), make up 20 percent of providers. These are followed by borehole water vendors, which make up 18 percent.

Table 1: Types of small-scale water providers

Type of providers	Sample: number of providers	Share (%)
Tap water vendors	62	39
Water kiosks (including CBOs) ^a	37	23
Borehole water vendors	28	18
Pushcart vendors	17	11
Tanker trucks	15	9
Total	159	100

Source: authors' survey.

^a CBO = community-based organisation.

Fixed-point vendors (tap water vendors and water kiosks): The services offered by the tap water vendors and water kiosks are very similar. Tap water vendors are private entrepreneurs relying on a single piped connection, usually selling water from their dwellings or from a separate legal connection in a strategic location within the community. Households that engage in water reselling are another type of tap water vendor. These vendors are unregulated and consist mainly of landlords supplying tenants, sometimes through a small piped network.

Water kiosks tend to be formally licensed providers and are distinguished by their better infrastructure (a cabin or small office). They are distributed across the community and offer services in official opening hours. On average, vendors operate at least six days a week. Kiosks can usually serve more than one customer at a time from two or more taps, thus speeding up the service rate. All these attributes contribute to the ability of water kiosks to sell significantly more water than tap water vendors. While tap vendors in our sample sell on average 94 20-litre jerry cans of water a day, the kiosks, on average, sell 238 jerry cans. Customers walk to the vending points to fill their own containers for a fixed rate per unit.¹⁴

The typical tap water vendor or operator of a water kiosk is a woman. Water is a profitable business compared to selling vegetables, cooking or cleaning. For both types of vendor, the average monthly per capita income at the household level is Kshs 6,046.5 (US\$2.43) per day.¹⁵

¹⁴ About 69.2 percent of the tap and kiosk vendors reveal that a typical customer purchases water from them on a daily basis, or on all days when the water vendor operates, since some vendors do not open seven days a week.

¹⁵ Conversion rate as of December 2010; US\$1.00 = Kshs 80.5.



For both tap water vendors and water kiosks, the coverage area is localised: 87 percent of respondents report selling water to residents within a few streets of the water point. Some vendors even have overlapping geographic markets, implying high coverage levels for fixed-point vendors. These findings further indicate that the distance between the household and the water source is relatively short, suggesting low levels of time poverty.

In our sample, about 62 percent of fixed-point vendors declared that they have a legal connection to the water utility network. About 35 percent seem to be reselling water from illegal connections: 24 percent are illegally connected to someone else's formal piped connection, and 11 percent declared "another piped connection" that we assume consists chiefly of illegal connections to the main water grid, given the exclusion of other legal alternatives presented in the survey questionnaire. Two percent sell water from a borehole and one percent of vendors did not reveal the water source.

Most fixed vendors depend on the reliability of supply from the utility. They complain of supply disruptions caused by rationing by the utility company. Water kiosk operators also complain of weak water pressure and its negative impact on the service rate and the time spent in line by consumers.

Most fixed-point vendors operate between 12 and 15.5 hours a day, six or seven days a week. This schedule is interrupted when pipes run dry as a result of rationing by the utility company. Where lighting is absent because of the unavailability of electricity, business hours are further restricted due to security concerns.

CBO-run water projects (kiosks): Water and sanitation services are also provided by community-based organisations (CBOs) or "Usafi Groups".¹⁶ These are groups of residents who together manage, operate and maintain a number of sanitation blocks and associated water kiosks. CBO-managed water projects are usually funded by the government's Community Development Fund (CDF) or by non-governmental organisations (NGOs). CBOs rely on a formal connection to the utility's (NCWSC) piped network, paying a subsidised water tariff of Kshs 15 (US\$0.19) per m³. This rate is lower than the company's commercial and residential rates. The price charged per jerry can of water by the CBO is set by the utility at a uniform rate of Kshs 2 per 20-litre jerry can.¹⁷

The group of residents running the water and sanitation blocks are called "members". They hold frequent meetings that serve as forums for elections and decision making on all matters related to block operation and the general welfare of community members.¹⁸ Having discounted the monthly operational and bulk water costs, the profit is reinvested or saved. Dividends are shared periodically among the members according to a set formula. CBO-managed projects are good examples of participatory management and community empowerment.

¹⁶ "Usafi" means "sanitation" in Kiswahili.

¹⁷ In all the settlements surveyed, CBO-managed sanitation blocks operate according to similar mechanisms, offering water resale from a water kiosk as well as latrine and shower services at "social fees". The sanitation blocks operate according to a pay-as-you go scheme, with some CBOs offering monthly pre-paid family cards for unlimited use of latrine and shower services.

¹⁸ Most water and sanitation blocks have an office within the block structure, where they archive the bookkeeping files. In some cases, this office has also been used for the instalment of electricity metres associated with individual electricity connections to the power utility, for which a group of households has applied collectively.



Borehole water vendors: The typical borehole vendor operates as a family business. Initially, the borehole may have been constructed to serve the household and possibly a cluster of tenants. However, in the face of mounting community demands, it has been transformed into a water vending business. A number of privately owned boreholes, in the vicinity of Dagoretti Corner in Nairobi, supply a fleet of tanker trucks. Boreholes comprise an essential water source for households not connected to the utility's network.¹⁹

Borehole construction is expensive and involves sunk costs associated with digging and construction, as well as the purchase of pumps and storage tanks. Some vendors are able to finance construction through revolving fund schemes.²⁰ Before construction can begin, an official authorisation is required. This may explain why boreholes are found only in the formalised settlements of Kangemi Village, Kinoo and Olepolos. Concerns over water quality and quantity are decisive factors in the regulator's decisions to authorise borehole construction. But quality testing is carried out only at the time of licensing, with no subsequent monitoring. This, as we shall see later, has serious implications for the quality of the water distributed.

In contrast to the fixed-point vendors discussed above, who are dependent on a reliable supply provided by the utility company's piped network, borehole vendors are better positioned to take advantage of negative water supply shocks in the network. Our interviews indicate that these vendors violate their tariff obligations by inflating prices during dry spells. Borehole supply, however, also suffers from supply disruptions, caused by power outages.²¹

Pushcart vendors: Operators of manual and donkey-pulled pushcarts obtain water mostly from boreholes, water kiosks or through an illegal connection to the piped network. They resell water to end users in 20-litre jerry cans. Less than half of the providers surveyed said that they were subject to regulation.

A typical pushcart water vendor is a man in his mid-thirties with two family dependants, earning an average monthly per capita household income of Kshs 9,948 (US\$4.12 per day). This amount is well above the US\$2.43 per day income received by fixed-source water providers, who supply quality water because they are directly connected to the utility's network. Pushcart vendors deliver water to households in urban informal settlements by manual pushcarts or by donkey-pulled carts in peri-urban areas. The initial investment cost consists of buying 15 to 30 jerry can containers at Kshs 200 per unit, and acquiring the pushcart (about Kshs 5,000) or renting it. Operating costs include cart maintenance as well as animal feed and care.

Our survey indicates that the competitive advantage of mobile vendors lies primarily in their ability to reduce the time cost for households associated with obtaining water by offering door-to-door vending. These vendors also play a larger role where kiosks and tap vendors either are absent or are too few to provide an adequate supply of water. About 64 percent of pushcart vendors serve households located far from any fixed-point water source. They may either walk house to house offering services or, more efficiently, deliver in response

¹⁹ A large borehole has been built on the main highway (Embulbul) to service an apartment building that is under construction, but it now serves a mix of private households, pushcart vendors and tanker trucks. Another borehole, initially constructed to provide water supply to a church facility, now supplies the community and mobile vendors at a price that is competitive compared to that offered by water kiosks in the area.

²⁰ Also known as "merry-go-round".

²¹ For instance, the Kinoo Water Project's network is supplied in part by water from two boreholes. The central transformer supplying the community with electricity has been vandalised. Since then, the project's water kiosks have been closed.



to mobile phone orders. Some vendors also have a number of regular customers, who receive a daily supply and therefore may qualify for a lower rate. A single mobile vendor serves, on average, 16 customers per day.

Tanker trucks: Privately operated tanker trucks supply water in bulk to end users who can afford storage tanks. Tanker trucks obtain water either from private boreholes or directly from the utility company. Borehole water vendors supply water to mobile vendors for resale, but also sell water directly to end users. A fleet of tanker trucks and exhaustor vehicles gathers daily at Dagoretti Corner, a location on the outskirts of Nairobi city that has strategic access to a number of borehole water vendors.²² Exhaustor vehicles service households that are not connected to a sewer line and empty pit latrines when they are full. Tanker trucks deliver water to private homes or firms, where they replenish storage tanks. They do so in response to mobile phone calls, covering all of Nairobi. Some tanker trucks operate 24 hours a day.

The average truck operator is a male in his mid-thirties. The business is typically operated as a family business, passed from father to son. Some vendors purchase their own truck, while others rent a vehicle from the Nairobi City Council (NCC). All tanker truck operators require a business permit, issued by NCC for a fee. Truck operators incur recurrent costs associated with truck maintenance, parking fees, and operational equipment such as gloves, piping and pumps.

Some government officials allege that the truck operators at Dagoretti Corner are sometimes involved in disrupting the piped supply network in order to boost demand. There are also stories of exhaustor vehicles being refurbished into water tankers in response to soaring demand at the peak of the 2009 drought.

CBOs receiving output-based aid: Kinoo and Olepolos are two peri-urban areas in Nairobi city that qualified for output-based aid (OBA) funding in the pilot phase of the Global Partnership on Output-Based Aid (GPOBA).²³ OBA is an aid modality based on ex-post grant disbursements that partially cover the original costs of an investment project.²⁴ Aid is granted to the recipient project via debt cancellation upon successful achievement of pre-determined output targets. These projects have been licensed to finance, build, own and operate their own small piped water systems.²⁵ OBA-funded projects have thus replaced the municipal utility company as primary water providers.

The OBA funding scheme has two financing components. First, the water project must qualify for a bank loan with the financial partner, K-Rep Bank. Within a year of the loan's disbursement, the project has to meet the targets set out in the loan agreement in order to release a World Bank subsidy worth 40 percent of total project costs towards repayment of the bank loan.²⁶ The remaining 60 percent of the project costs are to be covered partly by a 20 percent community contribution.

22 Some borehole owners have their own tanker truck.

23 Because the governance structure of the water sector in Kenya is organised according to catchment areas, Kinoo and Olepolos — while being part of Nairobi City — fall under the authority of the Tanathi Water Services Board rather than Athi Water Services Board, which covers downtown Nairobi.

24 Most of the funding comes from the World Bank.

25 See K-Rep Bank (2010).

26 Five annual targets are usually set for the years following the end of the project, but the first is decisive as to whether the water project will receive the entire 40 percent subsidy of the full project cost.



The project in Olepolos serves about 600 households through individual piped connections and two water kiosks. The network is supplied by two boreholes, from which water is pumped into a single tank and then distributed by gravity flow to individual households. The OBA loan agreement specifies two project outputs: (i) increased coverage (minimum 50 individual connections annually over the five-year implementation period); and (ii) higher revenue by increasing the metering ratio and the number of connections (average Kshs 600,000 per month).²⁷ Coverage increased from 557 to 619 individual household connections between March 2009 and September 2010.²⁸ Infrastructure improvements have reduced the average unaccounted-for water rate from 42 percent to 23 percent.

The project mobilised the required 20 percent down payment (Kshs 2 million) by charging Kshs 3,000 (about US\$37.27) per connected household. In addition to the cost of the water consumed, households paid a one-time membership fee of Kshs 30,000 (US\$373) to join the household distribution system plus an additional Kshs 5,000–10,000 (US\$62 to US\$124) to finance the cost of the pipe extension to the household. Households were responsible for purchasing their own metre. Given its satisfactory compliance with the achievement targets, the Olepolos Water Project has been deemed eligible to receive the full OBA amount equivalent to 40 percent of the investment.

Despite the successful increase in connections, and the construction of a second water kiosk in 2007, the Olepolos water project currently meets only 60 percent of water demand. At the time of this study, households still received water for only a couple of days a week, in line with a set rota involving seven distribution zones. Households therefore continue to depend on large water tanks of 6,500-litre storage capacity. The remaining service gap is filled by other small-scale providers.²⁹

The Kinoo Water Trust Project (KWTP) started in 1974 when about 50 community members got together to dig a borehole on a self-help basis. Today, the project operates a piped distribution system serving 389 individual households and two water kiosks.³⁰ Water is extracted from a spring and then pumped into a central storage tank from which it is redistributed via the gravity-flow piped distribution network.³¹ Households are required to pay a membership fee of Kshs 100 per month towards the purchase of pumps. The initial connection/registration fee is Kshs 1,000 and the project charges a flat rate of Kshs 350 (US\$4.35) per month, irrespective of the level of consumption.³²

In 2006/2007 the KWTP was deemed eligible to participate in a five-year OBA scheme to finance the construction of a second water catchment source (a spring); the installation of metres in all existing connections; the building of three water kiosks; and a new pump and tanks for the existing borehole. At a

27 See Tertiary Engineers Consulting Ltd. (2009).

28 See PricewaterhouseCoopers (2010b).

29 The project managers argue that the community needs another borehole in order to increase water supply. Boreholes, however, cannot be financed through an OBA scheme because borehole construction is a risky investment (the water could be of poor quality or the borehole could dry out).

30 See PricewaterhouseCoopers (2010a).

31 There are currently seven supply lines, or “distributional zones”, in operation - one of them still accepting new connections.

32 In the 1990s, developers built a large number of houses, increasing the village’s population by about 10,000. The new houses applied for connections to the Kinoo Community Water Project but applications were rejected due to the project’s limited water-supply capacity. Instead, developers were given licenses to dig boreholes.



cost of Kshs 4.8 million (US\$59,627), the project's expansion led to an increase in water-supply frequency from once a week to approximately twice a week.

At the time of the Output Verification Report, which was produced by the independent auditing company, PricewaterhouseCoopers, the project had increased the number of household connections from 350 to 500 and had completed the construction of one kiosk. But KWTP failed to meet the household metering targets for the first year.³³ Consequently, the community received only 35 percent of the loan repayment from the donor.³⁴

Figure 2 captures the water-supply system in Nairobi city. It shows the utility as the main provider, supplying individual households as well as fixed-point formal vendors such as water kiosks and tap water vendors via piped connections. It also shows the many types of informal water provision and the many transactions that some water goes through before reaching the end user. For example, a pushcart vendor may be selling water by the jerry can, having obtained the water from a kiosk supplied by NCWSC's piped network.

4.2 Water Pricing

The price-setting behaviour of small-scale providers indicates substantial levels of extraction in response to excess demand. Among the small-scale providers surveyed for this study, the majority of water kiosks (59.5 percent), pushcart vendors (47.1 percent) and tap water vendors (36.1 percent) set water prices on the basis of the price charged by competitors (see Table 2). About a third of tap water vendors and pushcart vendors declared that they set prices on the basis of a cost mark-up. Another indication of the significant extraction levels is the relatively high share of tap water vendors (23 percent) and borehole water vendors (22 percent) who set prices on the basis of what they believe the customer is able to pay.

Kiosk, tap and borehole operators also admitted to pushing up prices in times of limited supply and excess demand. Still, kiosks, on average, offer the lowest price with the lowest variance (see Table 3). One explanation for their lower price may be the higher degree of official tariff compliance by fixed-point vendors, and especially by licensed kiosks buying water at the subsidised bulk water rate from the utility company. The presence of water kiosks generally seems to be putting downward pressure on the prices charged by individual tap water vendors, the competitor most similar to water kiosks. The declared price setting strategy of tanker trucks could be taken to suggest a high degree of market competition, with prices being based mainly on the cost of provision (operational and bulk water costs) and distance (transport costs). With tanker trucks operating from a single gathering point in the city, however, price collusion can easily occur.³⁵

33 Within the first year of OBA funding, the Kinoo Water Project had installed only 150 of the output target of 170 metres. The project managers argue that the budget was exhausted before they could install all the required metres because of unexpected expenses associated with a land dispute at the location of the water spring.

34 After the metres were installed, the project needed to improve the distribution system further, but lack of funds impeded this improvement.

35 The formally licensed kiosks, linked to the utility, charge water at a fixed rate of Kshs 2 per jerry can. The same applies to CBO-managed kiosks supplied via a piped connection to the utility network. As for kiosks supplied by OBA financed water projects, they also operate under a transparent tariff scheme. Tariffs are listed on a board affixed to the kiosk structure. However, while NCWSC-provided kiosks operate under the utility's annual tariff agreement with the regulator, OBA kiosks are bound under the loan agreement to contribute to revenue generation. Thus, in the case of Kinoo for instance, prices were recently increased following a rise in the cost of electricity, an essential input for running the borehole pumps.



Figure 2: The water supply chain in Nairobi city

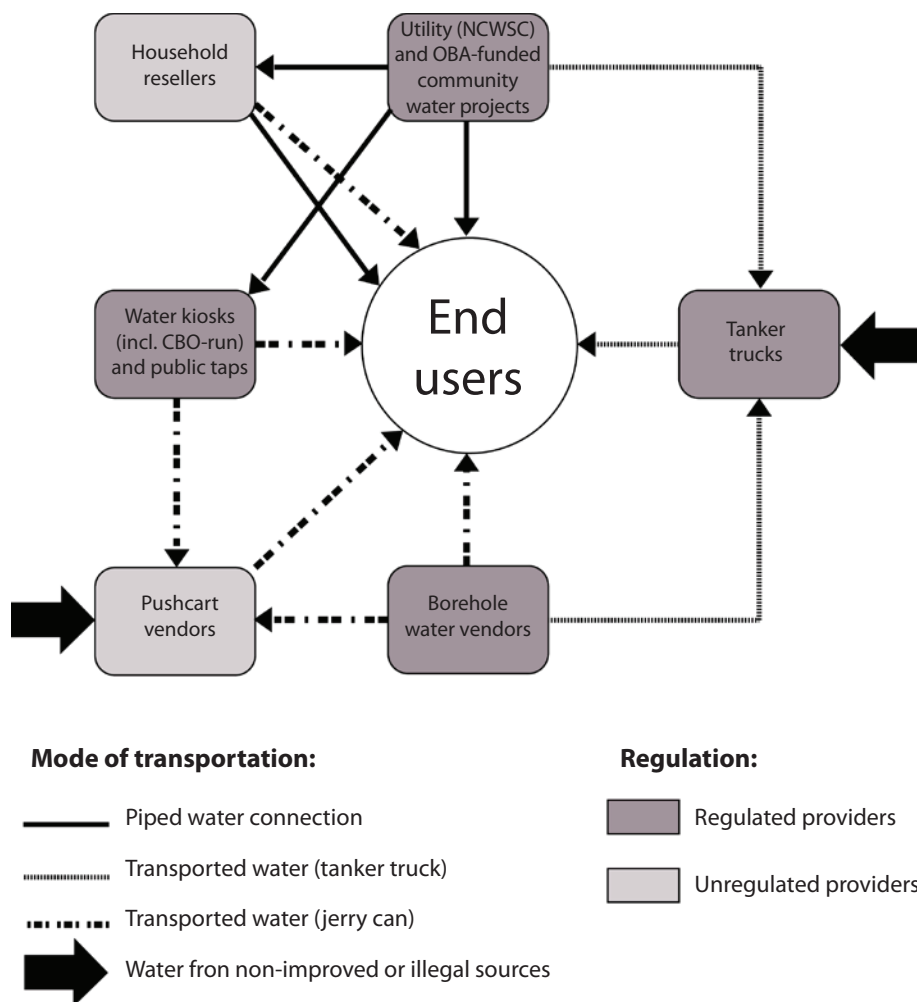


Table 2: Price determination across different private providers

How do you decide what to charge?	Tap water vendor (%)	Water kiosk (%)	Borehole water vendor (%)	Pushcart vendor (%)	Tanker truck (%)
Cost of service provision	34.4	27.0	66.7	35.3	53.3
Your income needs	6.6	5.4	11.1	-	-
Prices charged by competitors	36.1	59.5	-	47.1	6.7
What you think the customer can pay	23.0	8.1	22.2	5.9	6.7
Distance from the water source	-	-	-	11.7	33.3
Total observations	61	37	9	17	15

Source: authors' survey.

Note: the survey asked providers to list all responses that apply.



Table 3: Price of water across vendors in Kshs (20 litres, jerry can unit)

Type of provision	Mean	Standard deviation	Minimum	Maximum	Mean price in US\$	Poverty premium (mean) ^a	Poverty premium (max)
Pushcart vendor	12.15	5.73	3.00	21.00	0.15	30.28	51.5
Tanker truck	7.90	5.47	3.00	22.50	0.10	18.75	55.25
Borehole	6.11	3.50	2.00	15.00	0.07	14.28	36.50
Tap water vendor	3.18	1.68	2.00	15.00	0.04	6.95	36.50
Water kiosk	2.81	0.98	1.00	5.00	0.03	6.03	11.50
Average	6.43	3.47	2.20	15.70	0.08	15.26	38.25
Official NCWSC water kiosk rate	2.00	0.00	2.00	2.00	0.02	4.00	4.00

Source: authors' survey.

Note: conversion rate: US\$1 = Kshs 80.5.

^a This is calculated using the poverty premium formula proposed by Mendoza (2008): $\frac{P_{SSPP}}{P_{NCWSC}} - 1$

Pushcart vendors and tanker trucks charge the highest average unit prices for water, at Kshs 12.15 and Kshs 7.90 per 20-litre jerry can, respectively (see Table 3). Service providers in these categories also present the highest degree of price differentiation among vendors. The larger price variance may be a result of the discretion with which mobile vendors are able to set prices. Mobile vendors also rely on several different water sources. This allows them to take advantage of excess demand during dry spells, when the piped supply suffers severe interruptions. Tariff regulation can more easily be exercised over fixed-point vendors, mainly because they are licensed and registered with the utility. Mobile vendors, on the other hand, largely remain unregulated in terms of the price and safety of water.

The poverty premium on water in Nairobi is calculated by comparing prices charged by small-scale providers with the official rate of Kshs 0.40 per 20 litres charged by the utility for water provided by individual piped connection.³⁶ For instance, our survey found that the mean price charged by pushcart vendors is Kshs 12.15 per 20 litres of water. This price level translates into a poverty premium of 30.28 (see Table 3). In other words, low-income households who obtain water from pushcart vendors are paying 30.28 times the price charged by the utility through a piped connection. Our data also shows that some households are paying as much as 51.5 times the price charged by the utility. This is the maximum premium indicated in the last column of Table 3. For all small-scale providers we find that low-income households pay, on average, about 15 times the price charged by the utility.

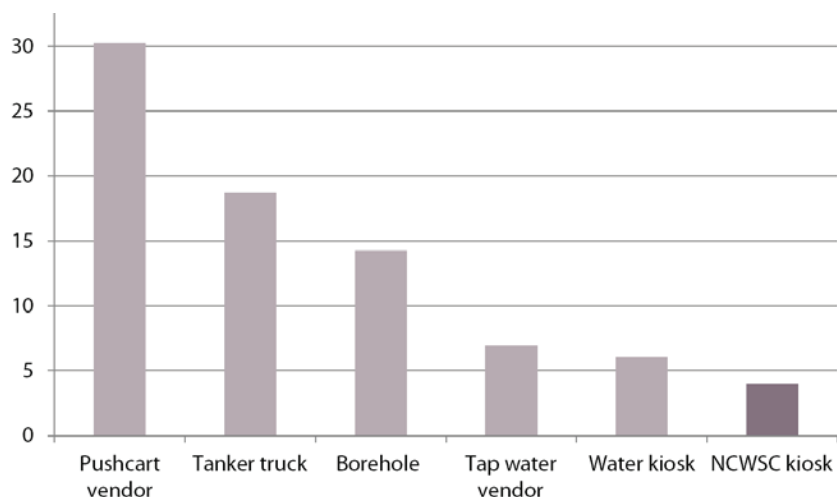
We further illustrate the findings in Table 3 using the simple graphical presentation in Figure 3. The highest poverty premium is related to water provided by pushcart vendors, followed by tanker trucks and boreholes. It is interesting to note that the poverty premiums associated with fixed-point water vendors — the tap water vendors and water kiosks — are the lowest. Short of extending piped connections to all households, therefore,

³⁶ Following Mendoza (2008), we calculate the poverty premium associated with private water provision as: $\frac{P_{SSPP}}{P_{NCWSC}} - 1$. We use the official NCWSC rate of Kshs 0.40 per 20 litres, charged for consumption of a maximum of 10m³ per month, as our baseline (see Annex 3). This is the equivalent of 333 litres per household per day, or 95 litres per person per day, assuming an average household size of 3.5 persons (the figure for our sample is 3.3).



the poverty premium on water could be reduced significantly by increasing coverage of the utility-operated water kiosks and enforcing the official kiosk tariff of Kshs 2 per 20-litre jerry can.

Figure 3: Average poverty premium on water across vendors



Source: authors' survey.

Note: the poverty premium is calculated against a baseline of Kshs 0.40 per 20 litres. This is the rate charged by NCWSC for customers with piped connections who consume less than 10m³ per month.

The higher prices charged by mobile vendors are consistent with the reason for entering the business. Unemployment was the leading reason given by pushcart and tanker truck operators for starting water-vending businesses. About 30 percent of vendors reported the profitability of operations as the main reason for entering the business. In contrast, tap water vendors, borehole water vendors and operators of water kiosks identified community needs as their main motivation for starting operations (see Table 4). By implication, any intervention in the water market that seeks to eliminate mobile water vending is likely to push these vendors back into unemployment. Assuming that men are the main breadwinners, risk of unemployment undermines the livelihoods of already poor families. A true pro-poor intervention must therefore involve considerations of the poor as both consumers and providers.

Table 4: Reasons for entering the water-vending business

How did you first get involved in water selling?	Tap water vendor (%)	Water kiosk (%)	Borehole water vendor (%)	Push-cart vendor (%)	Tanker truck (%)
Jobless/needed income	15.5	27.0	10.0	50.0	40.0
Profitable business	36.2	27.0	30.0	31.3	40.0
Community need/neighbour needed	37.9	43.2	40.0	12.5	20.0
Inherited business/parents were involved	10.3	2.7	20.0	6.3	-
Total observations	58	37	10	16	15

Source: authors' survey.



5. DEMAND FOR WATER AND CONSUMPTION

Living conditions of households: The mean size of households is 3.3 members, and 74.3 percent of households have between three and five members. Across the nine communities, female-headed households account for 15–40 percent of all households. The literacy rate among household heads is high: more than 95 percent of household heads report that they can either read, write or do both (see Table 5). The average educational level of household heads varies little across communities: household heads have studied up to secondary level, although most have not completed secondary schooling. Despite similar levels of education, however, per capita income varies significantly across communities. Households in Kaptagat and Kiambiu are the poorest. On average, Olepolos, Kinoo and Kangemi Village have higher-income households. These are also the only three communities in the survey in which owners of structures hold formal titles to the land.³⁷

Table 5: Average living standard of households in selected urban communities in Kenya

Community	Years living in the community	HH size	Female-headed (%)	HH head is literate (%)	HH head's age	HH head's educ. level	Income per capita per day (US\$)
Dam	8.9	3.0	15.4	96	35.2	4.5	1.61
Kangemi Village	9.3	3.3	30.7	97	32.5	4.2	3.33
Kaptagat	9.7	3.2	16.7	100	39.0	4.6	1.13
Kiambiu	7.3	3.6	40.3	97	33.2	4.0	1.00
Kinoo	9.4	3.1	22.4	98	33.1	5.0	2.82
Olepolos	10.4	3.3	20.2	95	34.6	4.5	3.00
Soweto East	9.1	3.0	33.0	98	31.5	4.3	1.30
Waruku	8.8	3.7	22.8	99	30.6	4.5	1.46
All communities	9.2	3.3	26.4	97	33.0	4.5	2.04

Source: authors' survey.

Note: educational level was recorded as a categorical variable with the following values: 1—never in school; 2—primary incomplete; 3—primary complete; 4—secondary incomplete; 5—secondary complete; 6—tertiary incomplete; and 7—tertiary complete. The community in Dam village neither received OBA nor had CBO-operated water provision. Residents rely entirely on water reselling by small-scale providers. In Kangemi Village, where owners hold formal titles to the land, residents are extensively involved in water reselling from individual piped connections and privately owned boreholes.

Access to water: World Health Organization (WHO) recommends a daily per capita consumption level of 20 litres for drinking, cooking and hygiene purposes as the minimum quantity of water needed to sustain a livelihood. Among the households surveyed, about 57 percent fall below this water-poverty threshold (see Figure 4). The Waruku community, which has recently suffered extensive demolition of dwellings, has

³⁷ Many of the residents surveyed did not own the structure in which they lived. Rather, it was sublet from a wealthier landlord or "structure owner". Structure owners themselves may or may not live in the communities where they own structures.

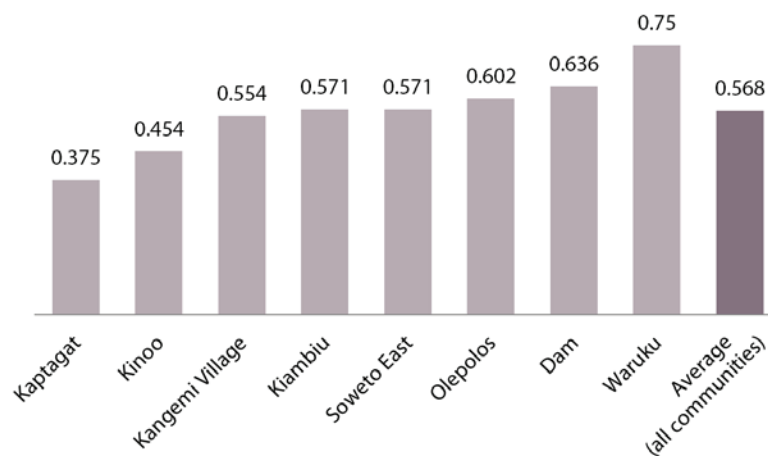


the highest incidence of water deprivation: 75 percent of households report consuming below the water poverty line. At more than 63 percent, the Dam community, which is serviced by neither a CBO nor an OBA scheme, also has a high incidence of water deprivation among households. It is worth noting that the two OBA communities (Kinoo and Olepolos) still suffer high incidences of water deprivation. Despite running independent water distribution systems and having recently expanded infrastructure, insufficient water production capacity curtails reliable water supply.

For households, fetching water on any typical day involves a busy queue of women and children waiting at a standpipe or a water kiosk to fill 20-litre jerry cans. Women carry the 20-litre loads on their heads or backs, rarely assisted by animals or carts. Children carry as much as they can. The trips between the dwelling and the water source are repeated many times a day, several days a week.

Figure 4: Incidence of water deprivation by community

(Threshold = household per capita availability of 20 litres of water per day)



Source: authors' survey.

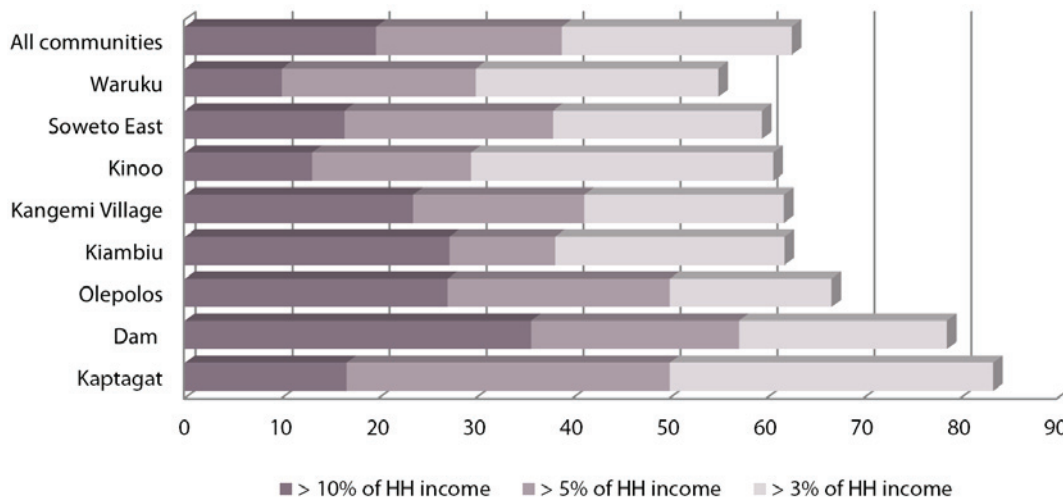
Affordability: The commonly used affordability threshold proposes that no household should spend more than 3 percent of total household income on water (UNDP, 2006). The household income and expenditure reported in our survey reveals that 63 percent of households in the communities surveyed spend above the affordability threshold (see Figure 5). On average, households spend 11 percent of their income on water. This is above the “catastrophic spending threshold” of 10 percent identified in the poverty-penalty literature. In Dam, for instance, 36 percent of households spend above this threshold. This level of spending entails giving up other basic needs, disposing of productive assets, incurring debt or becoming (more) impoverished. Overall, 20 percent of households reported that their expenditure on water was above the catastrophic spending threshold.

In fact, 12 percent of households pointed to official tariffs as being “too expensive” and gave this as the main reason for their not being connected to the utility provider. When asked why they did not have an individual connection to the utility company’s piped network, 47 percent of households found it too expensive to pay for the connection fee. Six percent of households did not connect to the utility because they “do not want to



be billed on a monthly basis” (see below for a discussion of alternative, flexible billing systems).³⁸ Twenty-two percent of households declared that they did not have a water connection to the utility because “the piped network is not available”.

Figure 5: Household water expenditure as a share of household income by community (%)



Source: authors' survey.

Affordability problems have two origins: high prices of services and low household income. As we noted above, the mean prices of water supplied by small-scale providers vary between Kshs 2.81 and Kshs 12.15 per jerry can (20-litre unit). The average price paid by households with a piped connection (either in a dwelling or on a plot) varies between Kshs 2.51 to 5.35 per jerry can. At Kshs 3.56 per 20 litres of water, piped water is on average slightly cheaper than water obtained from alternative sources (other improved), which costs Kshs 3.91 per jerry can.³⁹

³⁸ The connection fee to set up a water and sanitation block is about Kshs 32,000, payable in cash only. The fee includes expenses for an account opening (Kshs 10,000) and purchase of the water metre (Kshs 21,000 to 47,000) from the utility company. Improved sewerage depends on the availability of a sewer line in the community. The CBO in Kaptagat has paid Kshs 20,000 to connect to the main sewer line that was extended to the community given the demand of a newly constructed factory of veterinary medicine in the neighbourhood. The cost included Kshs 10,000 for the connection fee and Kshs 10,000 for labour expenses. The community remarks that if the company had not demanded an extension of the sewer line to that region, Kaptagat still would not have a sewage connection. The price for the exhaustion of a pit latrine, the solution used when the community was not connected to the sewer line, is about Kshs 15,000 per service visit.

³⁹ The water kiosks of water and sanitation (W&S) blocks are, for the purposes of our study, classified as “other improved” sources. Communities such as Kiambiu and Soweto East have several W&S blocks as main water providers. The blocks resell water from the utility company, provided at a subsidised rate that is lower than the regular residential rate. This has been deemed necessary to prevent the progressive block tariff structure from having regressive effects where more than one household rely on a single connection. The subsidised rate offered to water kiosks by NCWSC is Kshs 15/m³ — cheaper than the average rate charged by individual users for consumption below 10m³ (see Annex 3). It is interesting to note the effect of the presence of W&S blocks within communities on the price of water. We observe that water in Kiambiu and Soweto East, on average, is provided at a significantly lower unit price — about Kshs 1.6 difference per jerry can — than other piped water sources available to residents in these areas.



Surprisingly, respondents noted a large variance in prices among piped water connections (see high standard deviations in column 4 of Table 6). Since the utility company sells water at a standard rate, the prices of piped water should not differ much, except for a slight variation due to the utility's rising block tariff structure (see Annex 3). The observed variation can be explained by the fact that few households are paying according to a water metre. Rather, they either pay a flat rate for indefinite consumption or are illegally connected and thus have no water-related expenses. Another possible source of variation could be a prevalent system whereby landlords extend small pipe schemes from a single formal water connection in order to supply a number of tenants, charging them more than the utility company's rate.⁴⁰ Households whose water use is incorporated into the rent may also report zero expenditure on water, while in fact their landlord is selling water at a profit.

The general perception of small-scale water providers among the households surveyed is that vendors are organised into cartels, fixing prices at a higher rate than would be the case under full competition. Half of the households surveyed (51.9 percent) agree that water vendors fix prices between them. The other half state that vendors are charging too much. These communities, however, also recognise the importance of small-scale water providers: 71.4 percent believe that they provide "an essential service to the community".

Securing access to water in the event of household income distress is an important aspect of water security and the maintenance of an individual's minimum basic needs. When negative income shocks occur, the most frequent coping strategy adopted by 61 percent of households is to reduce the amount of water consumed. About 19 percent of households ask a neighbour for water and 10 percent of them reduce consumption of other goods in order to buy water. About 5 percent borrow money to buy water.

A formal system for borrowing money for water-specific purposes is not available. Small-scale providers, however, operate according to a flexible pay-as-you-go system. This makes it easier for low-income households to manage expenses than would be the case if they faced monthly bills associated with the threat of immediate service disruption or, at best, if fees accrued to them in the event of late payment. One of the main reasons for the successful spread of small-scale suppliers in the market is precisely the greater flexibility offered by a pay-as-you-go billing system, complemented by short-term credit. This means that, in the event of a household suffering temporary income distress, it is allowed to continue to consume water.

Credit is disbursed in the form of informal arrangements allowing for delayed payments at no interest. Private water vendors have a closer and more personal contact with their customers than does the utility company, allowing them to offer credit at a lower risk than the utility. All of the interviewed CBO-managed water kiosks reported offering credit to their customers. None had experienced households defaulting on their debt. CBO-managed sanitation blocks and water kiosks have strict bookkeeping systems that keep records of late payers.⁴¹ Some even provide free use of sanitation facilities to the elderly, the sick and children under the age of five.

40 In Kangemi Village, land is private and households have formal title to the land. All plots have connections to the water and electricity utility companies (the Nairobi City Water and Sewerage Company and the Kenya Power and Lighting Company). Owners have divided plots into small units that are rented out. It is common for landlords to bar tenants from having their own utility metres, such that plots are leased as rent-utilities combos: the rent payment includes water and electricity provision charged at a flat rate. By providing these utility services themselves, landlords extract profit from reselling water and electricity at higher rates.

41 For those connected to the water utility, billing is monthly (although, because of the NCWSC's weak billing and revenue-collection capacity, in reality this may be even quarterly). A payment default or a delay in payment of more than seven days leads to prompt water disconnection. Customers who wish to be reconnected after disconnection for non-payment are charged a fee of Kshs 500 (AWSB, 2011).



Table 6: Price of water paid by household across communities (Kshs/20-litre jerry can)

Community	Type of provision	Mean price	Std. dev.	Observations	Is the difference "piped vs. other" statistically significant?
Dam ^a	Piped water	5.00	5.00	3	No
	Other improved	4.30	1.98	17	
Kangemi Village	Piped water	5.35	6.97	23	No
	Other improved	6.53	15.43	25	
Kaptagat	Piped water	3.00	1.41	10	No
	Other improved	3.62	0.96	13	
Kiambiu	Piped water	4.40	2.58	9	Yes
	Other improved	2.82	1.11	30	(1% s.l.)
Kinoo	Piped water	3.57	1.64	15	Yes
	Other improved	4.19	1.62	47	(10% s.l.)
Olepolos	Piped water	3.63	3.70	24	No
	Other improved	5.58	11.2	24	
Soweto East	Piped water	4.44	8.19	12	Yes
	Other improved	2.81	1.23	67	(10% s.l.)
Waruku	Piped water	1.62 ^b	1.70	31	Yes
	Other improved	3.05	1.81	19	(1% s.l.)
All communities	Piped water	3.56	4.53	127	No
	Other improved	3.91	6.24	242	

Source: authors' survey.

Notes (prices as of 13–19 September 2010): (a) the Dam community has no formal grid connecting the community to the water utility company. This explains why only two households reported using a piped connection (most likely a plastic pipe connection extending over a long distance); (b) average price among all households in Waruku (including those who pay nothing for the water). The mean price of piped water among only those who pay for water is Kshs 2.51 per jerry can.

Water quality and safety: According to the Joint Monitoring Programme of WHO and the United Nations Children's Fund (UNICEF), access to water is classified into: (i) improved source (piped water inside the dwelling, plot or yard); (ii) other improved sources (public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs or rainwater collection); and (iii) unimproved water sources (unprotected dug well, unprotected spring, cart with small tank/drum, surface water river, dam, lake, ponds and so on) (see JMP, 2010, p. 13).



Table 7: Main source of drinking water in selected peri-urban and informal settlements in Kenya

Mode of water provision	Number of HHs	Share (%)	Water source classification
Piped into dwelling with water metre	108	19	Improved
Piped into dwelling without water metre	10	1.8	Improved
Piped into plot/yard with water metre	117	20.5	Improved
Piped into plot/yard without water metre	34	6.0	Improved
Piped into neighbour's yard	34	6.0	Other improved
Public tap/standpipe	177	31.0	Other improved
Tanker truck/vendor kiosk	36	6.3	Other improved
Protected tube well/dug well/borehole	50	8.8	Other improved
Rain water collection/protected spring	2	0.4	Other improved
Bottled/sachet water	1	0.2	Unimproved
Unprotected tube well/dug well/borehole	1	0.2	Unimproved

Source: authors' survey.

As shown in Table 7, about 47 percent of the water is classified as “improved”. But the bulk of the water, 52.5 percent, comes from “other improved sources”. These numbers indicate general conditions of safe access to water. In fact, when the households’ perception of water quality (taste, cleanness and safety) is assessed on a scale from 1 (very poor quality) to 4 (excellent), 83.24 percent of households classified drinking water quality as either “excellent” or “acceptable”.

Despite the generally positive perceptions of water quality, in 3.7 percent of the surveyed households that declared the quality to be good or excellent, at least one family member had suffered from diarrhoea at some point in the previous week. It is important to note that the typology of water sources according to safety does not take into account the effect of weak regulation of water delivery services. Hence sources categorised as “improved” or “other improved” may suffer contamination during transportation and transfer. This is particularly the case when water is stored and transported using several containers, substandard plastic pipes and tanker trucks before reaching the final user (WHO, 2004).⁴² These findings underline the need to identify integrated water and sanitation solutions, since the recorded incidence of disease might also be a symptom of unsanitary water treatment at the household level.

Consumers have reported that some small-scale providers intercept the utility’s formal water supply, using low-quality plastic pipes to redirect the flow of drinking water. These pipes break easily and leaks are common. Initially safe potable water can become contaminated by externally running water, garbage residuals, faeces and other toxic waste. The poor drainage systems typical of most informal settlements lead

⁴² In addition, standing water is at a relatively higher risk of developing microorganisms, and is more likely to breed mosquitoes and thus contribute to the proliferation of disease vectors, threatening health in the community (WHO, 2004).



to the free circulation of waste water. Contamination is visually imperceptible, since the water still looks clean when it reaches the tap. One consequence of inadequate monitoring of borehole water quality is the high incidence in the adult population of dental fluorosis — a discolouration of the teeth caused by excess fluoride concentration in the drinking water.

Water provision by pushcart vendors and tanker trucks introduces additional risks of contamination. First, consumers who rely on mobile vendors have few means of ensuring that the source of provision is safe. Water from unprotected sources and illicit connections is at a higher risk of being contaminated. Second, even when water is obtained from an “improved” or “other improved” source, transporting and storing it increases the risk of contamination. The quality can be tested at any of the three stages of the delivery chain: source, delivery and consumption. Quality testing at the point of consumption can include purification, such as by filtering and boiling. Filtering, however, is time consuming, and boiling water is an expensive practice that is unaffordable for most low-income households who have limited fuel supplies. Testing at the source is associated with the lowest transaction cost, while avoiding passing the burden of quality control onto consumers.

Reliability of delivery: Water supply in informal settlements is highly unreliable, forcing households to seek alternative forms of provision. The unreliability is a direct result of rationing by the public utility. This is because small-scale providers are also supplied by the utility, directly or indirectly. In times of rationing, their water supply capability depends on the capacity of storage tanks (for fixed-point vendors with a piped connection) and on the availability of non-piped sources such as boreholes (in the case of mobile providers). This also applies to the licensed CBO-managed water and sanitation blocks that are unable to provide water seven days a week.⁴³ In the case of the OBA-funded water projects, boreholes are a major water source. For these types of water-distribution systems, unreliability of supply is primarily associated with low production capacity and an unreliable electricity supply (most boreholes are electricity-pump operated).

Our survey found that 18 percent of households rely on two or more different sources for their drinking water. In times of shortages, for households using piped water as their main source of drinking water, the preferred alternative sources are tap water vendors (chosen by 40.3 percent of households) or water kiosks and tanker trucks (chosen by 29 percent of households that rely on a second source). Among households that rely on all other sources but piped water as the primary mode of provision, the most frequent secondary water sources are rainwater harvesting, protected springs and water kiosks. In some communities, households also turn to mobile vendors.

A general problem with rationing goods and services is overstocking and the creation of a parallel market. Although a parallel market for water at times of water rationing does not seem to emerge, we are informed of increases in the prices charged by borehole water vendors and mobile vendors. Wealthier households simply store water in tanks for consumption during periods of rationing. When households expect water shortages, they tend to over-demand water during days of supply in order to smooth out water consumption. Overstocking exacerbates shortages and their regressive effects. Since low-income households are unable to store water or to pay higher prices during scarcity, they suffer disproportionately from rationing.

⁴³ Nairobi’s piped water infrastructure dates back to the 1960s. It is a loop supply system subdivided into three delivery zones. The utility company can therefore carry out targeted rations, affecting only one zone at a time.



Long-term storage of water is also not recommended for health reasons, since water may develop microorganisms or become contaminated by dirty containers. Moreover, storage tanks are expensive and occupy a large amount of space. Long-term disruptions in water supply also affect sanitation, a circumstance that has negative health externalities for the entire community. In times of prolonged rationing, some sanitation blocks become unprofitable and must close until the water supply is restored. Sanitation blocks connected to the official sewerage network cannot operate without water. Residents then resort to the widespread practice of “flying toilets”.⁴⁴

In Nairobi, the unreliability of water supply could be reduced dramatically by controlling the high rates of unaccounted-for-water (UfW). In 2009, 40 percent of the water that entered NCWSC’s network was recorded as “non-revenue water” (WASREB, 2010). This figure measures not only water lost through leaks caused by the decay of infrastructure, but also water diverted through illegal connections, inaccurate metering of water use, and inefficient revenue collection due to low metering ratios and weak billing capacities. Illegal connections, therefore, are both a cause and effect of water rationing: because supply is unreliable, underserved households turn to the market for small-scale water provision. These types of providers, in turn, rely on a variety of sources, including illegal connections. The illegal diversion of water increases UfW rates, leading to further rationing. Inefficient billing and revenue collection similarly contribute to exacerbating UfW rates. Lost revenues entail downward pressure on investment capital to carry out critical maintenance work on a decaying water-supply infrastructure.

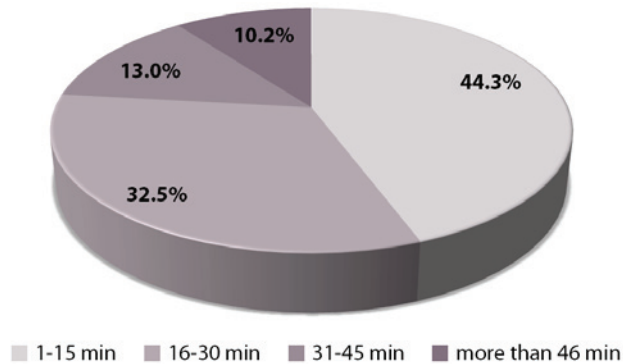
Conversely, the unintended corollary of rationing is greater water conservation *at the household level*. In the communities surveyed, there is a very strong culture of saving every drop. For example, when women fill their jerry cans, all attention is paid to shifting containers quickly under the taps and controlling the water flow so that not a single drop is wasted. As expected from the market mechanism, scarcity reminds individuals of the value of water and of the importance of using it wisely. The clear market inefficiency that this study reveals, therefore, is that individuals who value a unit of water the most are the ones with inadequate access to it.

Proximity to water sources: Overall, small-scale providers improve access proximity to water services. The high density of tap water vendors and water kiosks in settlements shortens the walking distance between the home and the vending point. Mobile vendors entirely eliminate the distance between the vending point and the point of consumption. Residents in the communities surveyed, however, are also eager

⁴⁴ “Flying toilets” refers to a practice common in informal settlements in sub-Saharan Africa that have inadequate provision of sanitation services. Lacking any alternative, individuals defecate into a plastic bag and then fling the bag onto a rooftop or into an alley. In Kangemi Village, 60 percent of the water is provided by the Nairobi City Water and Sewerage Company. Although nearby regions receive water throughout the entire week, water supply in Kangemi Village is nonetheless limited to two days a week. Rainwater harvesting is not an option in Kangemi village, according to residents, because the air pollution in Nairobi city contaminates the water. Faecal remnants on rooftops from the occasional resort to “flying toilets” are another reason why traditional water harvesting is not an option. The community water project in Olepolos also rations water. Despite recent expansion-related investments financed by an OBA subsidy, the amount of water produced daily is not sufficient to fully meet the residential demand. The piped system is divided into seven zones and each zone receives water twice a week for half a day (day or night). The rationing scheme provides water to two zones at a time, according to the following schedule: Wednesday and Saturday; Tuesday and Friday; Monday and Thursday. Zone 7 receives water only once a week on Sundays. Sixty percent of households have water tanks, usually of 6,500 litres capacity. The tanks allow rainwater collection in the rainy seasons and water storage for between-supply days. In Kiambu, water rationing by the utility company is a major problem for running the W&S blocks: toilets cannot operate without water for more than two days. Then, the services are suspended because toilets would otherwise break down.



Figure 6: Time required per single roundtrip to collect water
(for drinking and cooking purposes, excluding time waiting in line)



Source: authors' survey.

to experience an improvement in the *quality* of water provision. Forty percent of households identified access to water as the most desirable improvement in living conditions, compared to 28.5 percent who declared a better job as the most desired change.

Nonetheless, in densely populated places such as urban informal settlements, a time-use criterion seems to be a more reasonable measure of access than the standard accepted distance of one kilometre from the water source in urban settings (UNDP, 2006). The rationale is that, despite the presence of water points close to the dwelling, demand for water in overcrowded spaces may entail a longer waiting line to fill containers. What is important to consider is the opportunity cost or “social cost” of waiting in line, particularly in locations with a high poverty incidence.

On average, household members make 12 trips a week to collect water. There is, however, significant variation across households in the weekly number of trips. Households say that members make between 7 and 28 trips to the water source. Households spend on average 19 minutes per roundtrip to the source, excluding waiting time. Although the largest share of households, 44.3 percent, declared spending less than 15 minutes a day on each roundtrip to the water source, almost a third, about 32.5 percent, spend between 16 and 30 minutes on each trip to and from the source (see Figure 6). The remaining quarter of households spend more than half an hour on a roundtrip. Such a short timeframe for collecting water seems to indicate that there are significant numbers of small-scale providers, such as door-to-door services by pushcart vendors. But if we take into account the time spent waiting in line multiplied by the numerous daily trips that a household makes, the total time per household spent on fetching water is significantly higher.

The workload of fetching water is not equally shared among household members. Women and girls, on average, spend more time. In 51.5 percent of non-single-member households, only women are responsible for fetching water (see Figure 7). In 66 percent of households, either women or children are responsible for collecting water. Only 15.7 percent of households balance the workload between men and women (no children). We also note that children participate in water collection in about 19.5 percent of all households.

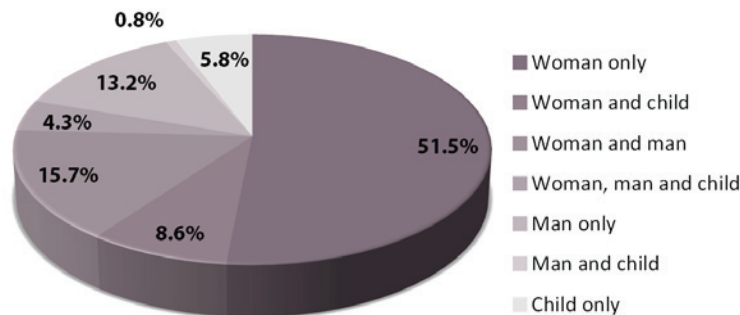


This not only places physical strain on the children, but also could keep them out of school. Men engage in water collection in few households, and often they do so only where there are no women in the household.

The gender imbalance suggests room for female empowerment through policies geared to improving access to water. Making water more accessible may trigger positive economic externalities. Better access to water frees up time that can be used in education and more productive, perhaps even remunerative, activities. By reducing time poverty, therefore, improved access to water could help increase women’s intra-household bargaining power (see Costa et al., 2009).

Figure 7: Intra-household division of labour

(proportion of households, classified by the member(s) responsible for fetching water)





6. THE REGULATORY FRAMEWORK: ENSURING AFFORDABILITY, SAFETY AND RELIABILITY

The government of Kenya has pledged to “ensure that improved water and sanitation are available and accessible to all” by 2030 (GoK, 2007, p. 18).⁴⁵ In line with this objective, the 2002 Water Act introduced a new institutional structure that separates the responsibilities for policy formulation, regulation and service provision in the water sector. Responsibility for overseeing regulation lies with the Water Services Regulatory Board (WASREB). The board sets national standards for water pricing and quality, and issues licenses for water service providers. The two main categories of formally licensed providers are: (i) the utility, the NCWSC;⁴⁶ and (ii) small-scale providers that supply more than 20 households or more than 25 m³ per day for domestic purposes.

Within the government, pragmatism seems to dominate water sector officials’ views of small-scale providers. This is evident in the statement by one such official that “what we care about is that people get water — and less about how they get it”.⁴⁷ The government is also aware, however, that small-scale providers, given their current form of organisation and the present state of the regulatory framework, are unable to secure the governing principles for providing affordable and safe water. The government’s position is that informal service providers should be linked to the formal system so as to ensure their compliance with official tariffs and quality standards (MWI, 2008).

The Ministry of Water and Irrigation has issued the Implementation Plan for the National Water Services Strategy (MWI, 2008), which includes a special Pro-Poor-Oriented Implementation Plan (PPIP). The PPIP recognises the need to regulate all providers in order to ensure that service provision is “formalised” and “complies with human rights standards” (MWI, 2008). It proposes tariff adjustment for the benefit of the poor, for example through cross-subsidisation, and recommends the collection of comprehensive baseline data for all settlements in Kenya. The Water Services Trust Fund (WSTF) is developing a database, “Maji Data”, which merges local-level socioeconomic data with information on the current state of water supply.⁴⁸ Maji Data is intended to serve as a guidance tool for the pro-poor planning of water service provision.⁴⁹

45 To achieve this, the GoK has led a sophisticated process of institutional transformation in the water sector. In 1999, the government published Sessional Paper No. 1 on “National Policy on Water Resources Management and Development”. The National Water Policy proposes a framework for comprehensive water-resources management and development with the private sector and community participation as the prime movers in a geared to sustainability in the water sector.

46 NCWSC is publicly owned and operates according to commercial principles to provide water directly through piped connections.

47 MWI, interview on 17 September 2010.

48 “Maji” means “water” in Kiswahili.

49 At the level of service provision, Athi Water Services Board (AWSB), the government body responsible for asset development and water services in Nairobi, has issued Strategic Guidelines for Improving Water and Sanitation Services in Nairobi’s Informal Settlements. These guidelines are intended to direct the utility’s operations in the informal settlements. A first step in this direction has been taken with the establishment of a special Informal Settlements Department within NCWSC. Since informal settlements fall outside the government’s formal planning framework, however, the Kenya Slum Upgrading Program (KENSUP) has been established with the institutional mandate for slum upgrading. AWSB’s guidelines also propose a set of specific technical options for improving water supply in informal settlements that are considered feasible under the current conditions of informality (see AWSB, 2009).



Despite the existence of pro-poor principles and strategies, the regulatory framework falls short of ensuring *reliable, safe and affordable* water supply to low-income households. The problem originates in two interrelated issues.

First, the utility does not have the full financial and human-resource capacity to monitor the compliance of licensed small-scale providers with their service agreement. In order to tackle the problems of high unaccounted-for water rates and of maintaining regular supply, frequent inspections are essential. There are widespread concerns that the utility's historical inefficiencies have simply been carried over into the new structure. Fears seem to have been substantiated with the launch of an investigation into the company by Kenya's Anti-Corruption Commission in August 2010. It was initiated in response to widespread complaints of irregularities in the accounting procedures and in metering, billing and procurement systems. Allegations that company officials demanded bribes are also being investigated. Large amounts of revenue (an estimated Kshs 900 million) are unaccounted for. The investigation led to the dismissal of the company's board for non-performance (Jamah, 2010).

The second issue that applies more directly to our assessment of the effective regulation of small-scale providers, is that the regulatory framework does not apply to water providers who supply fewer than 20 households or less than 25 m³ of water per day for domestic use. This category of unlicensed providers mainly includes mobile vendors who obtain water from a variety of sources, protected and unprotected, licit and illicit. Because of the high transaction costs associated with regulating pushcart vendors, in particular, they are currently left outside the regulated tariff structure and system of regular quality inspections.

As regards **pricing**, our survey shows that mobile water providers are those that least adhere to the formal tariff structure; they set prices almost entirely at their own discretion, considering factors of supply and demand. There are signs of collusion on prices. Our survey results indicate that mobile pushcart vendors charge on average Kshs 9.15 more for a unit of water (20-litre jerry can) than fixed-point sources (public taps and kiosks). The result is that consumers not connected to the public utility — usually low-income households — face higher prices per unit of water. The pushcart business model involves purchasing water from formal (and sometimes informal) sources and selling it to end users at a mark-up. These many transactions add several layers of profit, pushing the price well beyond the source price.

Under the current regulatory framework, there are at least two means of regulating the prices charged by unlicensed small-scale providers. First, since tariff enforcement carries a lower transaction cost for fixed-point sources, the establishment of more public taps and water kiosks would lead to lower prices for end users. An important challenge in this regard is to overcome the perception held by the utility that water and sanitation services are unprofitable in informal settlements. By establishing more public taps and water kiosks connected to the utility network, the utility can catalyse a shift in the market for small-scale water provision from illicit and collusive mobile vending towards a licit market of licensed "sub-concessionaire" water kiosks. This would have the added benefit of increasing the utility's revenue collection efficiency, which is currently at only 80 percent (WASREB, 2010).

Second, the pro-poor component of the existing tariff scheme that sells water to kiosks and public taps at a subsidised rate, should be complemented by additional tariff components better suited to the budget cycle of poor households. For instance, the main obstacle identified by households surveyed in our study was the



The Regulatory Framework: Ensuring Affordability, Safety and Reliability

large down payment needed to obtain a connection. One possible change to the existing tariff structure could therefore be the introduction of progressive connection fees based on geographical location. The WSTF's "Maji Data" could serve as an effective guidance tool for this kind of pro-poor planning of water service provision. Alternatively, a credit system or gradual repayment scheme could be offered to allow households to pay the connection fee incrementally over time. Respondents identified the Kenya Power and Lighting Company's (KPLC) gradual payment scheme as a possible solution. Finally, innovative telecom-based billing systems should be expanded and developed further.

The **safety** problem is also associated mainly with small-scale unlicensed providers. In Soweto East, for instance, within Nairobi's largest informal settlement, Kibera, an extended spaghetti network runs through a large landfill. Because most illegal connections are created without the use of proper fittings and with inferior quality pipes, they not only increase unaccounted-for water rates but, as explained above, they pose a health hazard because leaks can be significant sources of contamination.

Most fixed-point vendors hold formal licences, which in principle makes them subject to official standards for quality and pricing. This seems to imply that the regulatory standards for water quality and pricing would be met. The current lack of monitoring, however, allows for a number of deviations. For instance, the quality of borehole water is tested only at the time of licensing.⁵⁰ There are widespread reports of unsafe salinity levels in borehole water.⁵¹ While the ability of mobile vendors to obtain water from a variety of sources allows them to improve water supply in terms of access proximity and reliability, this also introduces an information asymmetry, whereby end users have little means of verifying the safety of the water they purchase. This is confirmed by our survey results that indicate a divergence between respondents' perception of water quality and household disease history. Because of the high transaction costs associated with regulating small-scale mobile providers, a cost-benefit analysis of systems for quality monitoring of mobile vendors may favour greater investment in fixed-point water sources. This increases the availability of "improved" sources to any remaining mobile vendors.

WASREB already publishes the results of its monitoring assessments in an annual "Impact Report". The most recent report (2010) identifies institutional weaknesses in the quality assurance system.⁵² These assessments could be carried out more regularly and extended to apply to small-scale providers. The current system relies extensively on self-reporting. It could be improved by a "system of independent surveillance", tasked with verifying that service providers deliver water to meet health-based targets, as recommended by the World Health Organization (WHO, 2004).

⁵⁰ The cost of opening a borehole in Olepolos, for instance, is Kshs 20,000 for a site survey and Kshs 20,000 for the permit. The license to operate a spring is Kshs 17,000, plus 50 cents/m³ for the water extracted.

⁵¹ Chronic high-level exposure to fluoride can lead to skeletal fluorosis. Early symptoms of skeletal fluorosis include stiffness and pain in the joints. In severe cases, however, the bone structure may change and ligaments may calcify, resulting in pain and muscle impairment. Acute high-level exposure to fluoride causes immediate effects of abdominal pain, excessive saliva, nausea and vomiting (WHO, 2008).

⁵² While not legally binding, WASREB's Water and Effluent Quality Guidelines identify three criteria for determining the frequency of sampling: (i) the number of water sources; (ii) the amount of water produced; and (iii) the nature of the distribution system. The guidelines further propose four types of water quality monitoring: self-monitoring; scheduled monitoring; unscheduled monitoring; and demand monitoring. Apart from self-monitoring, responsibility for monitoring falls to the WASREB and the relevant Water Services Board. The combination of weak capacity and the immense challenges facing water companies in achieving other important benchmarks makes it sensible to have independent monitoring units working closely with each of Kenya's seven WSBs.



Ultimately, piped water connections on premises represent a more cost-effective system of quality water provision. The second-best solution remains connections to fixed-point water suppliers such as public taps and water kiosks. Increased density of water taps and kiosks would allow more households to shift from a reliance on mobile water vendors to buying water from fixed-point water sources that are safe and more affordable.

The unsatisfactory **reliability** of the public utility's supply of water is related partly to insufficient production of drinking water. In 2009, supply fell short of demand by 150,000 m³. This supply shortage is related to the utility's challenges in curtailing unaccounted-for water use. The resulting rationing has serious implications for both the safety and affordability of water supply for low-income households. During temporary interruptions in the piped supply, small-scale water resellers resort to other, sometimes unprotected water sources. Providers were also reported to be taking advantage of service interruptions by charging higher prices.

There is an urgent need for substantial investments to fix the leaks in decaying pipes, so as to reduce unaccounted-for water. The amount of water lost as a result of illegal connections could be reduced by increasing the number of water points from which end users and small-scale providers can obtain safe water legally, at an affordable rate. Considering the current supply shortfall, a long-term solution to the problem of water rationing will require heavy investments in the expansion of catchment capacity, water treatment, and re-use.



7. CONCLUSION AND POLICY IMPLICATIONS

The main findings of this study can be summarised as follows. First, there is a significant incidence of water deprivation: 57 percent of the low-income households surveyed consume less than the water poverty line of 20 litres per capita per day. Sixty-three percent of households spend well above the affordability threshold on water. In about 20 percent of households, expenditure on water exceeds the catastrophic spending threshold. Mobile vendors, such as pushcarts and tanker trucks, charge the highest unit prices for water.

Second, about 53 percent of the water provided by small-scale providers comes from “other improved sources”. The ability of mobile vendors, such as pushcarts and tanker trucks, to obtain water from a variety of sources allows them to supply water in times of shortage. This, however, also introduces an information gap, since end users have little means of verifying the safety of the water they purchase. Each transaction in the multilayered supply chain exposes water to contamination. The inferior-quality pipes used by illegal connections break easily. This means that initially safe water can be contaminated by externally running water, garbage and other toxic residuals.

Third, water supply is extremely unreliable, mainly because of extensive rationing by the utility company. In the short run, water rationing leads to expectations of future water shortages, and households respond by storing water. This pushes up the demand for water beyond immediate consumption levels, which helps further exacerbate water shortages. Since low-income households do not have storage capacity, they suffer disproportionately from water scarcity.

Finally, and in favour of the view that small-scale providers serve an important role as gap fillers, we find that in some cases such providers reduce the distance between the water source and the point of consumption. Seventy-three percent of households spend less than 30 minutes per trip to the water source. Small-scale providers also offer a system of flexible payment and credit, which is better suited to the budget cycle of low-income households.

As predicted by the poverty penalty literature, therefore, low-income households in Nairobi’s informal settlements are facing both quality and price-related poverty penalties. Building on the findings in this paper, policy interventions need to:

1. Ensure the safety of water. A recent report by the Water Services Regulatory Board identifies institutional weaknesses in the quality assurance system. For instance, boreholes could be inspected regularly.
2. Expand connections to fixed-point water suppliers such as public taps and water kiosks. This would allow more households to shift from a reliance on mobile vendors to fixed-point sources that are safer and more affordable. Credit, tax and subsidy incentives could encourage fixed-point suppliers to enter the market.
3. Tackle water rationing by repairing decaying infrastructure to reduce leaks, and by investing in the expansion of catchment capacity to increase supply.⁵³ Rationing has economic consequences such as interruptions in the production of goods and services, a worsening of hygiene standards, and the proliferation of diseases due to water storage and use of alternative unsafe sources.

⁵³ According to water sector officials, the two dams supplying Nairobi (Ndakaine Dam and Susumua Dam) are unable to catch enough water to meet the Nairobi area’s water demand. This is partly a result of deforestation.



4. Formalise settlements to improve water delivery. Stronger collaboration between the Ministry of Water and Irrigation and the Ministry of Lands could address barriers to land-titling.⁵⁴ The formal application requirements (applicant's plot number, landlord's certification of residence, and a certificate of employment) bar many potential customers from submitting an application.
5. Extend regulation to apply to small-scale providers. Enforcement will be effective only where the transaction costs of regulation are reasonable. This would involve formalising the interaction between small-scale providers and the water utility company, for example by means of a sub-concessionaire model.
6. Strengthen the synergies between utilities, mainly between the water and electricity sector. A reliable electricity supply allows water and sanitation facilities to operate for longer hours and improves safety. For instance, the Kinoo Water Trust Project relied entirely on water from two electricity-operated boreholes. At the time of primary data collection, the project's water distribution system was completely dry because of vandalism of the community's central transformer.

Taken together, these six interventions can improve access to safe water that, in turn, has synergetic effects on a range of other development outcomes. Progress on the target for water under Millennium Development Goal (MDG) 7 can be expected to accelerate progress on other MDGs.

⁵⁴ Our survey indicates that the utility is already allowing connections in informal settlements on an ad-hoc basis. To ensure equity and reduce the risk of mismanagement, a transparent system of installing piped connections to informal settlements should be put in place.



ANNEX 1. PROFILES OF THE COMMUNITIES SURVEYED

Dam is an informal settlement in Kitusuru, Westland's Division, about 10 km northwest of Nairobi city centre. Its semi-permanent houses are squeezed between a main road to downtown Nairobi and a water dam. The community was set up in 1974 during a road construction. During the 1990s, the Provincial Administration settled families from other informal settlements into the Dam community, though no one was issued with land titles. About 600 families live in the community's 275 residential units. Most residents are self-employed, working in local trade (such as vegetable selling). Less than 1 percent of the population is formally employed. There are only three (private) water points in the entire community and no water and sanitation blocks. Privately owned public pit latrines are available, but the community is not connected to a sewer line.

Kangemi Village is historically a residential suburb of Nairobi, in Westland's Division, located about 10 km northwest of the Nairobi downtown area. All land is privately owned and most residential units are permanent-structure houses. About 20 percent of the plots are in dispute (among family members) because of inheritance issues. The economy is based on small businesses and land tenancy. The residents mostly work in casual jobs in Nairobi city (watchmen, housemaids and so on). Most plots have an individual water connection to the utility company, but no sewer line is available in Kangemi Village. Owners rent out parcels of their plots, providing tenants with water and electricity. They charge a rate typically higher than that charged by the utility, and measure consumption using a single metre for the entire plot.

Kaptagat is an informal settlement of semi-permanent houses located on privately owned land in Kitusuru Location, near Kangemi Village. It is about 1.5 hours walking distance to Nairobi city centre. The population live in about 400 households. Most men are casual labourers in the city. Women work within the community in a range of small kiosk businesses, their trade being restricted to the community. The village was connected to the water supply network in 1978, but few people have individual connections. A CBO in Kaptagat was established in 2003 and two water and sanitation (W&S) blocks were built with support from a local NGO. Before the construction of the W&S blocks, water was supplied to the community by a single water pipe free of charge. A cholera outbreak led the community to close it. The W&S blocks have had a tangible impact on household income by bringing down the price for water. Water supply, however, is still insufficient and highly unreliable. Rainwater harvesting is not an option because the rooftops are dirty, mainly as a result of the continued practice of "flying toilets" (see note 46).

Waruku is an informal settlement of semi-permanent houses located 6km northwest of Nairobi city centre, adjacent to the wealthy neighbourhood of Lovington. It was established in 1966 by former workers of colonial offices, and about 100 families currently live in the village. About 60 percent of residents are casual labourers in the city or work in small businesses within the community. Resale of products acquired in the nearby Kangemi market is common. Waruku has suffered several attempts at demolition (1970s and 1990s) and was partially removed by the Nairobi City Council in August 2009 and early 2010. The second demolition involved the partial destruction of the community's W&S block. The community now relies on a few private water points for its water supply. Sanitation services for the entire community are limited to nine latrines, which are not connected to a sewer line.



Soweto East is one of more than 10 communities within Kenya's largest informal settlement, Kibera. The semi-permanent housing units of the approximately 9,600 families in Soweto East are spread along a railway and cover about 15 acres. Residents do not hold titles to the land. The community is very densely populated and, as in other informal settlements, the residents are mainly employed as casual workers and in small businesses inside the community. Infrastructure is very precarious. The manually dug drainage system is often clogged with garbage. There are only about 50 privately operated water points in the community and a few privately owned public latrines. Illegal water connections make up an elaborate spaghetti network, and cracks in the plastic piping contaminate the drinking water that supplies the community. The practice of "flying toilets" is decreasing but people still resort to it, especially at night, because of a lack of public lighting and associated street insecurity. CBOs have been constructing W&S blocks in Kibera for more than a decade. The community has also qualified for the Kenya Slum Upgrading Programme (KENSUP). Key expected results include improvements in access to safe water, sanitation, drainage and solid-waste management.

Kiambiu is an informal settlement in the Eastland's part of Nairobi, located in a narrow 15–20 acre strip between an air force base and the Nairobi River. Like Soweto East, Kiambiu consists mainly of semi-permanent houses, but it is smaller and more organised. It comprises about 2,400 households, although fewer than 200 of these own the structures in which they live. Less than 20 percent of household heads are formally employed. The residents' remunerative activities include casual labour in the industrial district and the city centre, domestic work, and small-scale business. Less than 40 percent of housing units have sanitation facilities. W&S blocks have been set up by CBOs in the community over the past decade with the support of a local NGO.

Kinoo is located 15 km from downtown Nairobi, close to Kangemi Village, in the Kikuyu Division, Kiambu District. Given its proximity to the city and the availability of larger land units, Kinoo has undergone rapid transformation in recent years, from a rural village to a suburb of Nairobi city. Kinoo runs an independent, community-managed water project that supplies water to a population of 5,845 households, covering 88.4 percent of Kinoo. The community water project was established in 1974, when community members came together to dig a borehole on a self-help basis. In 2006/07 the project qualified for a pilot output-based aid (OBA) financing scheme managed by the World Bank to expand the water distribution system.

Olepolos is a growing peri-urban suburb of Nairobi city in Ngong Division, Kajiado District, located 25 km south of downtown Nairobi. Daily commuting to the city is easy via the Ngong Road highway that traverses the village. The majority of the population work in the city or rely on income from the selling of fruits and vegetables harvested in their large plots. The community-managed water project supplies 99.6 percent of the Olepolos area and has set a target of supplying 5,788 households with clean water. The subsidy paid by the World Bank under its OBA financing scheme has supported a significant expansion of the water supply system. Water rationing, however, is still necessary. At the entrance to the village, an enclave of large middle-class houses has been constructed, increasing the demand for water.



ANNEX 2. KEY WATER SECTOR INSTITUTIONS

The Ministry of Water and Irrigation (MWI)

The ministry is responsible for policy formulation and overall sector coordination.

Water Services Boards (WSBs)

Kenya's seven WSBs are responsible for "the efficient and economical provision of water services" but "may arrange for the exercise and performance of all or any of [their] powers and functions under the license by one or more agents, to be known as water service providers". In addition, boards "may purchase, lease or otherwise acquire ... premises, plant, equipment and facilities" (GoK, 2002).

Water Service Providers (WSPs)

The main WSPs are municipal utilities or water companies. They are state-owned entities but have been commercialised to improve performance and to operate like private businesses according to certain standards of efficiency; operational and financial autonomy; accountability; and strategic but minor investments.

The Water Services Regulatory Board (WASREB)

WASREB is a statutory body in charge of setting and enforcing standards within the sector. It is the institution responsible for issuing licenses to WSPs; advising WSPs on procedures for dealing with consumer complaints; developing guidelines for tariff setting; and developing performance agreements between service providers and WSBs.



ANNEX 3. RISING BLOCK TARIFF SCHEME, NCWSC

Table 1A: Price of water across vendors in Kshs (20 litres, jerry can unit)

Water consumption	Rate Kshs/m ³	Rate US\$/m ³	Rate Kshs/20 litres
0–10 m ³	Kshs 200 flat rate	US\$2.48 flat rate	0.40
11–20 m ³	25	0.31	0.50
21–50 m ³	30	0.37	0.60
51–100 m ³	45	0.56	0.90
101–300 m ³	75	0.93	1.50
300+ m ³	100	1.24	2.00
Water kiosk (subsidised rate)	15	0.19	0.03
Water kiosk (vending price)			2.00

Source: AWSB (2011).

Note: water rates for residential connections at 15 September 2010. Conversion rate 1 US\$= Kshs 80.5.



REFERENCES

- AWSB (2009). 'Strategic Guidelines for Improving Water and Sanitation in Nairobi's Informal Settlements'. Nairobi, Athi Water Services Board. Mimeographed document.
- AWSB (2011). 'Water Tariff Structures', Athi Water Services Board website, www.awsboard.go.ke/page.php?id=18 (accessed 21 February 2011).
- CESR and ICEFI (2009). *Rights or Privileges: Fiscal Commitment to the Rights to Health, Education and Food in Guatemala*. Executive Summary. Madrid and Guatemala City, Center for Economic and Social Rights and Central American Institute for Fiscal Studies.
- City Mayors Statistics (2011). 'The World's Fastest Growing Cities and Urban Areas from 2006 to 2020', City Mayors website, www.citymayors.com/statistics/urban_growth1.html (accessed 15 February 2011).
- Costa, J., D. Hailu, E. Silva and R. Tsukada (2009). 'The Implications of Water and Electricity Supply to Time Allocation of Women in Rural Ghana', *Working Paper 59*. Brasilia, International Policy Centre for Inclusive Growth.
- Fotso, J. C., A. Ezeh and R. Oronje (2008). 'Provision and Use of Maternal Health Services among Urban Poor Women in Kenya: What Do We Know and What Can We Do?' *Journal of Urban Health: Bulletin of the New York Academy of Medicine* 85 (3), 428–442.
- Freudenberg, N., S. Galea and D. Vlahov (2005). 'Beyond Urban Penalty and Urban Sprawl: Back to Living Conditions as the Focus of Urban Health', *Journal of Community Health* 30 (1), 1–11.
- GoK (2002). 'The Water Act, 2002'. *Kenya Gazette Supplement* 107 (Acts No. 9). Nairobi, Government Printer.
- GoK (2007). 'Kenya Vision 2030: The Popular Version', National Economic and Social Council website, www.nesc.go.ke/Meetings/publications/2008june10_Vision2030_PopularVersionFinal.pdf (accessed 15 February 2011).
- Houweling, T. A. J., C. Ronsmans, O. M. R. Campbell and A. E. Kunsta (2007). 'Huge Poor-Rich Inequalities in Maternity Care: An International Comparative Study of Maternity and Child Care in Developing Countries', *Bulletin of the World Health Organization* 85 (10), 745–754.
- Jamah A. (2010). 'KACC Moves to Probe Nairobi Water Over Graft' *The Standard*, 23 August. *The Standard* website, www.standardmedia.co.ke/InsidePage.php?id=2000016658&catid=159&a=1 (accessed 10 March 2011).
- JMP (2010). *Progress on Sanitation and Drinking-Water: 2010 Update*. Geneva, WHO and UNICEF.
- K-Rep Bank (2010). 'Microfinance for Community Water Projects in Kenya: Financing a Community Water Project Under a Build Own Operate Transfer (BOOT) Arrangement. Concept Note'. Mimeographed document
- Kariuki, M. and J. Schwarz (2005). 'Small-Scale Private Service Providers of Water Supply and Electricity: A Review of Incidence, Structure, Pricing and Operating Characteristics', *World Bank Policy Research Working Paper 3727*. Washington, DC, World Bank.
- Kjellén, M. and G. McGranahan (2006). 'Informal Water Vendors and the Urban Poor', *Human Settlements Discussion Paper Series: Water 3*. London, International Institute for Environment and Development.



- Mendoza, R. U. (2008). 'Why do the Poor Pay More? Exploring the Poverty Penalty Concept', *Journal of International Development* 23 (1), 1–28.
- MWI (2007). 'The Pro-Poor Implementation Plan for Water Supply and Sanitation (PPIP-WSS)'. Nairobi, Ministry of Water and Irrigation.
- MWI (2008). 'Implementation Plan for the National Water Services Strategy (PPIP-WSS/Pro-Poor Implementation Plan)'. Nairobi, Ministry of Water and Irrigation.
- NCWSC (2008). 'City Residents to Benefit from Alternative Water Sources Initiative', *Nairobi Water News* 14, 1–2, November. Nairobi, Nairobi City Water and Sewerage Company.
- NCWSC (2011). 'Customer Water Supply Contract. Nairobi City Water and Sewerage Company', Athi Water Services Board website, www.awsboard.go.ke/documents/water_application_forms_NWSC.pdf (accessed 9 March 2011).
- PricewaterhouseCoopers (2010a). 'Kenya—Microfinance for Community Managed Water Projects: Output Verification Report for Kinoo Water Project'. September. Mimeographed document.
- PricewaterhouseCoopers (2010b). 'Kenya—Microfinance for Community Managed Water Projects: Output Verification Report for Olepolos Water Project. September. Mimeographed document.
- Sansom, K. (2006). 'Supporting Non State Providers of Water Services'. Paper for DFID Policy Division, Loughborough University website, www.lboro.ac.uk/well/resources/well-studies/full-reports-pdf/task2765ii.pdf (accessed 15 February 2011).
- Schaub-Jones, David (2008). 'Harnessing Entrepreneurship in the Water Sector: Expanding Water Services through Independent Network Operators', *Waterlines* 27 (4), 270–288.
- Tertiary Consulting Engineers Ltd. (2009). 'Kenya—Microfinance for Community Managed Water Projects: Baseline Assessment Report for Olepolos Water Project. March. Mimeographed document.
- UN CESCR (1966). 'International Covenant on Economic, Social and Cultural Rights'. Geneva, United Nations Committee on Economic, Social and Cultural Rights, United Nations.
- UN HABITAT (2003a). 'Slums of the World: The Face of Urban Poverty in the New Millennium?' *Working Paper*. Nairobi, United Nations Human Settlements Programme.
- UN HABITAT (2003b). *The Challenge of Slums: Global Report on Human Settlements*. Nairobi, United Nations Human Settlements Programme.
- UN HABITAT (2006). *State of the World's Cities: The Millennium Development Goals and Urban Sustainability: 30 Years of Shaping the Habitat Agenda*. London, Earthscan and United Nations Human Settlements Programme.
- UN HABITAT (2010). *State of the World's Cities 2010/2011—Cities for All: Bridging the Urban Divide*. UN Habitat website, www.unhabitat.org/pmss/getElectronicVersion.aspx?nr=2917&alt=1 (accessed 18 January 2011).
- UNDP (2006). *Human Development Report. Beyond Scarcity: Power, Poverty and the Global Water Crisis*. New York, Palgrave Macmillan and United Nations Development Programme.
- UN OHCHR (1990). 'The Nature of States Parties Obligations (Art. 2, par. 1): CESCR General Comment 3'. United Nations Office of the High Commissioner for Human Rights.



- Van Doorslaer, E., O. O'Donnell, R. P. Rannan-Eliya, A. Somanathan, S. R. Adhikari, C. C. Garg, D. Harbianto, A. N. Herrin, M. N. Huq, S. Ibragimove, A. Karan, T.-J. Lee, G. M. Leung, J.-F. R. Lu, C. W. Ng, B. R. Pande, R. Racelis, S. Tao, K. Tin, K. Tisayaticom, L. Trisnantoro, C. Vasavid and Y. Zhao (2007). 'Paying Out-Of Pocket for Health Care in Asia: Catastrophic and Poverty Impact', *Health Economics* 16 (11), 1159–1184.
- WASREB (2010). 'Impact: A Performance Report of Kenya's Water Services Sub-Sector', Issue 3. Nairobi, Water Services Regulatory Board.
- WHO (2004). *Guidelines for Drinking-water Quality*, Volume 1, Recommendations, Third Edition. Geneva, World Health Organization.
- WHO (2008). *Guidelines for Drinking-water Quality*, Third Edition Incorporating the First and Second Addenda, Volume 1—Recommendations. Geneva, World Health Organization.
- World Bank (2011). *World Development Indicators*. Washington, DC, World Bank.
- WSP (2009). *Guidance Notes on Services for the Urban Poor: A Practical Guide for Improving Water Supply and Sanitation Services*. Water and Sanitation Program website, www.wsp.org/UserFiles/file/Main_Global_Guidance_Note.pdf (accessed 8 July 2010).
- Xu, K., D. Evans, K. Kawabata, R. Zeremandi, J. Klavus and C. Murray (2003). 'Household Catastrophic Health Expenditure: A Multicountry Analysis', *The Lancet* 362, 111–117.



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