WATER GLOBAL PRACTICE • REPORT

Performance of Water Utilities in Africa

Caroline van den Berg and Alexander Danilenko

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Foreword

The Sustainable Development Goals (SDGs) aim to achieve universal and equitable access to safe and affordable drinking water and sanitation for all by 2030. The SDGs are also calling on more sustainable use of water resources through, amongst others, improving water quality by reducing pollution by halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse. These goals and targets are very ambitious, especially since the region was not able to meet either the water or the sanitation Millennium Development Goals.

Between 2000 and 2015, access to piped water in Africa increased, but the urban population grew even faster. This resulted in the decline of piped water on premises as a primary source of water supply from 40 percent in 2000 to 33 percent in 2015. One of the reasons for the decline in piped water access is that many utilities are not able to cover their basic operation and maintenance (O&M) costs. This results in insufficient funds to keep up the service levels for existing consumers, let alone for new consumers. Government funds in such environments often have to pay not only for the expansion of access, but also to cover part of the O&M costs, which crowds out investments to connect new customers.

This report tries to look into how African utilities are performing. The study used a panel data of 120 utilities throughout low- and lower-middle income countries in Africa utilizing the Bank supported IBNET toolkit and database. The study also includes a set of case studies of the best performing utilities in the continent. The report also investigates the drivers of utility performance. This will help governments in the design and implementation of water projects and sector reforms in urban environments as achieving the SDGs in the fast growing cities of Sub-Saharan Africa will require a massive effort to ensure that more people get access to sustainable and affordable services.

The key findings of the report were shared with the ministers of Finance of Africa during the Joint Bank-Fund Annual Meetings in October 2016. These key findings included that utilities in SSA show overall weak performance, especially with regard to customer performance. The case studies, however, show that there are well performing utilities. At the same time, using larger datasets, it is clear that sector reforms in combination with changes in the economic environment in which utilities are operating (referring to for instance civil service reform, energy policies, and land use planning, improvements in public investment planning) can help to improve the efficiency of water utilities in Africa. But as there is large gap in service coverage, especially with regard to wastewater collection and treatment (as few utilities in the sample provided these services), the region would need to invest significantly in the sector if the SDGs are to be met.

We hope that this publication will add information to the debate on how to most efficiently and effectively increase access to affordable water and sanitation services in the cities of Sub-Saharan Africa, and provide the reader with an informed view on the workings of the water utility sector to synergize international efforts in the region.

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Abbreviations

CPIA	Country Policy and Institutional Assessment
DEA	data envelopment analysis
DHS	Demographic and Health Survey
GNI	gross national income
GoS	government of Senegal
IBNET	International Benchmarking Network for Water and Sanitation Utilities
IDAMC	internally delegated management contract
JMP	UNICEF–WHO Joint Monitoring Programme
lcd	liter per capita per day
MICS	multiple indicator cluster survey
NRW	nonrevenue water
NCWSC	Nairobi City Water and Sewerage Company (Kenya)
NWSC	National Water and Sewerage Corporation (Uganda)
OCCR	operating cost coverage ratio
O&M	operation and maintenance
ONAS	Office National de l'Assainissement du Sénégal
ONEA	Office National de l'Eau et de l'Assainissement (Burkina Faso)
PPP	public-private partnership
SDE	Sénégalaise des Eaux (Senegal)
SODECI	Société de Distribution d'Eau de la Côte d'Ivoire
SONES	Société Nationale des Eaux du Sénégal
TTL	task team leader
WASREB	Water Services Regulatory Board (Kenya)
WSB	water services board
WSP	water service provider

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Overview

Africa's urban population is growing rapidly. Between 2000 and 2015, the urban population increased by more than 80 percent to 373 million people. Although access to piped water increased (from 82 million urban dwellers with piped water in 2000 to 124 million in 2015), African utilities were not able to keep up with the rapid urbanization as reflected in the decline of piped water on the premises as a primary source of water supply in percentage terms. The urban population served with piped water on the premises declined from 40 percent in 2000 to 33 percent in 2015.[1] The total population with improved services increased, but most of that increase came from an increase in the access to piped water off premises and self-supply. Government funds often have to pay not only for expansion of access, but also to cover part of the operation and maintenance (O&M) costs, which crowds out expansion investments. These government transfers also provide utilities with few incentives to improve their financial performance.

This report looks into how African utilities are doing using a data panel of about 120 utilities in low- and middle-income countries in Africa, which represent about 53 percent of the urban population served by piped network services and covered 14 countries in different parts of Africa. The most notable exceptions in the analysis were Ethiopia and Nigeria—which had only one or two years of data available at the time of analysis.

Utility performance in Africa is in general weak, although there are well-performing utilities. The performance of African utilities in the data panel has shown some improvements between 2010 and 2013. Utilities in the sample were able to slowly improve water coverage, but overall coverage stood at only 60 percent. Access to sewerage services is in its infancy in

Africa with very few utilities providing such services. The O&M costs are highly variable in Africa—ranging from less than US$0.23 per cubic meter of water sold to US$2.07. The variance of utilities' performance within and between countries is very large. This is, for the most part, because water and wastewater services are affected by local factors. These factors can vary widely between utilities and include factors such as the distance to the water source and the effect on the cost to store and transport water, the quality of the water source and the need for treatment, and design standards, among others. Yet, more general policies in the country (for example, energy subsidies and labor policies) also affect the cost of O&M. As virtually everywhere water tariffs are set on the basis of the O&M cost of water, controlling costs is a major element in making the service more affordable.

A data envelopment analysis (DEA) showed that although there are some relatively efficient utilities in Africa, they make up a small minority of utilities. The majority of utilities register an efficiency of 0.30 (which is far below the highest score of 1), showing significant options for improvement. As the fixed cost component in water (and wastewater) service provision is very large, the design (but also environmental, water quality, public health, and other) standards under which water infrastructure is constructed will determine the cost of the services for decades to come. Hence, it is important to undertake a proper least-cost analysis when investment decisions are made to ensure that the benefits and costs of such investments are properly analyzed because the financial, organizational, and social implications of such investment decisions will be felt for many decades. DEA tests also show that governance may be a significant driver of water utility performance in Africa and that attention to improving governance may be key to improving performance in water utilities.

The increase in O&M costs of water services between 2010 and 2013 has been accompanied by an increase in the affordability of water services. This suggests that in many utilities, even in Sub-Saharan Africa, there is some scope for balancing the goals of revenue sufficiency and affordability more in favor of the former as government subsidies will otherwise need to increase rapidly in some countries. This is especially important because in 2013 a little less than half the utilities in the sample were not able to cover their O&M costs with their revenues. The high dependence on subsidies has major consequences. It crowds out investments in the sector, but it also results in serious equity concerns as those with piped water services tend to be more likely to be households with higher incomes. The case studies undertaken show that there are relatively well-performing utilities, but that even those that are performing well with regard to operational and financial performance show weaknesses in providing customers with high-quality services (as measured in type of service level, reliability, and water consumption levels), especially when compared with global benchmarks.

The context in which utilities operate matters. Collecting data on the institutional and socioeconomic context in which utilities operate matters. Regulation is often seen as a tool to ensure better governance in the sector.[2] In low-income countries a regulator results in better customer performance, but does not extend to other forms of performance, such as operational performance or water coverage. This may be expected, because the objective of a regulator is to provide "customer protection" to existing customers (and hence the focus is on providing minimum levels of customer service) but does not necessarily focus on improvements in financial and operational sustainability or improvements in coverage compared with utilities without a regulator.[3] Service provision at the local level will increase accountability and improve utility performance. Yet, the financial and operational performance of utilities is not statistically different from the performance of other forms of service delivery. As for customer performance, there are statistically significant differences: district- or municipal-based service delivery shows better results. Yet, coverage lags behind in municipal- or district-based service delivery compared with other levels of service delivery. This may be partially explained by the impact of economic development on a utility's performance. If customers have access to more piped water to consume, the benefits of piped water are more apparent compared with other water supply sources.[4] This focus on improving the infrastructure will require, in the short term, more investments in the sector to improve water coverage and a level of water consumption that sets piped water apart from alternative water sources.

The organization of water services affects utility performance. Economies of scale and scope matter. Analysis of the large data sample shows that size matters, but that being too big has a negative impact on performance. Economies of scope are evident. Utilities that provide water and wastewater services in low-income countries tend to show slightly higher levels of water coverage (as can be expected as sewerage coverage is provided sequentially after a certain level of water coverage has been achieved). But customer performance (or service quality), operational performance, and financial performance are also higher when sewerage services are provided in tandem with water services.

Using large utility performance datasets to explain the drivers of utility performance shows that the various aspects of what is considered good utility performance are very much interrelated with feedback. The different aspects of performance affect one another. Higher customer service quality has a positive impact on water coverage, whereas financial performance may affect operational performance and water coverage, suggesting that funding is necessary to improve access and measures to improve operations in the utility. In the case of improving water access, the level of economic development matters, but also the quality of economic management, especially for smaller utilities that may depend more than the large ones on external funding to increase access, and hence enhance their revenue base. The most interesting findings are that water coverage is directly influenced by customer performance (that is, service quality). Better economic management and higher gross national income (GNI) growth have a positive impact. In most cases there is no link between a utility's financial performance and water coverage—with the exception of large utilities in low-income countries (although the effect is small). This suggests that most utilities are not able to improve access through improved financial performance but depend on external funds to do so. This finding was confirmed by the case study utilities as most of these utilities needed some external funding to make progress in improving access. Finally, as many of the performance indicators are composite indexes, using a single indicator, the most important may be the O&M cost per cubic meter sold. We found that tariffs essentially are driven by the O&M costs and to a lesser extent by the collection efficiency. Hence, minimizing the cost of services and improving the efficiency with which utilities collect their revenues will explain how well they are able to manage their financial performance.

Another interesting finding is the impact of operational performance and customer performance on financial performance. Better operational performance tends to have a positive impact on financial performance; but the opposite is true for customer performance. The better the customer performance, the lower the financial performance. This may link to the cost associated with improvements in the different aspects of performance. Financial performance has a positive impact on operational performance too, although the effect seems weaker than the other way around.

There is evidence that unobserved utility-specific heterogeneity explains a large portion of the total variance, which would call for the large-scale collection of additional utility-specific variables, for example, information on local conditions (topography, distance to the raw water source, whether the utility gets water primarily from groundwater or surface water, quality of the raw source, age of the infrastructure, access to alternative water source, and so on) and organizational and institutional data.[5] Hence, much more and detailed information on utility operations and the context in which the utilities operate is required to explain with more clarity what drives individual utility performance. However, such data collection comes at a price with regard to the cost of collection and the willingness of utilities, regulators, and other stakeholders to provide such information; there is a trade-off to be made between data to be collected and analyzed and the cost of doing so.

Notes

1. The United Nations Children's Fund (UNICEF) and World Health Organization (WHO) Joint Monitoring Programme has served with piped water a total population of 153.4 million in 2015 (compared with 74.5 million in 1990), as there is also a small part of the rural population being served with piped water. The rural population with piped water increased in absolute numbers from 15 million to 29 million between 1990 and 2015, and piped water coverage remained more or less constant over the 1990 to 2015 period, at around 15 percent.

2. Countries that have a regulatory agency in place show higher indexes for public sector management and institutions (as measured by the Country Policy and Institutional Assessment [CPIA]) as there is reference in the definitions of CPIA to the existence and functioning of regulatory agencies in the quality of public administration definition (part of the public sector management and institutions overall index).

3. It is unclear whether this is the result of the higher service levels, higher labor costs (as labor efficiencies coincide with higher staff cost per employee), the existence of higher transaction costs for the utility operators, or a multitude of other factors.

4. In places where there are abundant alternative water resources, demand for piped water will always have to compete with these alternatives. Hence, when planning investments in piped water, this should be considered and a detailed demand analysis should be undertaken to investigate the demand for piped water in such environments.

5. The IBNET Toolkit includes organizational data, but in this round of data collection in Africa, this information was not consistently collected by the task teams, and such information was not available in many of the regulatory reports. Hence, this information is not included in the analysis.

Chapter 1 Objective of the Study

Africa's urban population is growing rapidly. Between 2000 and 2015, the urban population increased by more than 80 percent from 206 million to 373 million people. Although access to piped water increased over the period (from 82 million urban dwellers with piped water in 2000 to 124 million in 2015), African utilities were not able to keep up with the rapid urbanization as reflected in the decline of piped water as a primary source of water supply in percentage terms. The urban population served with piped water on the premises declined from 40 percent in 2000 to 33 percent in 2015. The total population with improved services increased, but most of that increase came from an increase in the access to piped water off premises and self-supply. This means that the performance of water utilities has been seriously lagging behind as there seems to be no lack of demand for improved water supplies. One of the reasons for the decline in piped water access is that many utilities are not able to cover their basic operation and maintenance (O&M) costs and hence are not able to generate sufficient funds to expand access. Government funds often have to pay not only for expansion of access, but also to cover part of the O&M costs, which crowds out expansion investments. This dependence on government transfers at the same time does not provide utilities with many incentives to improve their financial performance.

The overall decline in performance has not been investigated in much detail. As a result, the drivers of success in utility performance are still rather elusive for two major reasons. The first is a lack of agreement on what constitutes good performance. Utilities are supposed to provide services that are efficient, affordable, and sustainable. Yet, to simultaneously be able to provide affordable and sustainable water services has proven to be difficult as these different goals often result in conflicts and trade-offs. Having financially sustainable water services that cannot be afforded by the majority of the population and as such are only accessible to the most well-off may not be desirable for a service that has important public health benefits. Yet, a service that is affordable but not financially sustainable tends to set utilities on a path of inadequate maintenance that results rather rapidly in low service quality for which consumers are not willing to pay and hence will stall the willingness of potential customers to connect and the willingness of existing customers to pay for piped water services. Hence, different emphasis on different aspects of what constitutes good performance may result in widely varying performance assessments.

Second, because of lack of empirical work, there is little clarity on what drives performance in utilities. Water utilities in Africa are diverse. Utilities differ in their institutional setup (ranging from national utilities to decentralized companies working at municipal levels), organization, and reporting requirements. In view of the large number of utilities all over the world, the wide variety in geographic, hydrological, economic, social, institutional, political, and cultural differences, and changes over time and space, this lack of empirical work often means that sector professionals apply results from one utility or one country (often utilities in developed countries) to utilities in other countries with, often, very different institutional, political, and economic environments.

The objective of this assessment is to inform Bank and government policies and projects on the drivers of utility performance by

- assessing the performance of a sample of African utilities and benchmarking their performance against one another;
- investigating the drivers of utility performance and determining how this affects the way that the government and Bank staff design and implement water and wastewater projects and policies; and
- helping to increase the monitoring and evaluation capacity in utilities using the data available and benchmarks for performance in Africa as a baseline for water utility performance in Africa.

The report describes the main outcomes and lessons learned from the assessment that identified and analyzed the main features of water utility performance in Africa. The report includes the following chapters. Following this introduction, chapter 2 describes the methodology used in the study, including details on the data collection process. In chapter 3, the study team undertook a trend analysis of utility performance of the sector. The team had to weigh the advantages of providing shorter time series that cover larger groups of utilities or longer time series with a limited number of utilities. Chapter 4 examines the efficiency of utilities using a DEA while also using an absolute performance approach. Chapter 5 investigates the effect of institutional factors on utility performance. This is followed in chapter 6 by an econometric analysis of the drivers of utility performance, using various definitions of utility performance. The results from the econometric models are then triangulated with a set of case studies of five utilities

(Burkina Faso's *l'Office National de l'Eau et de l'Assainissement* [ONEA], Côte d'Ivoire's la Société de Distribution d'Eau de la Côte d'Ivoire [SODECI], Kenya's Nairobi City Water and Sewerage Company [NCWSC], Senegal's Sénégalaise des Eaux [SDE], and Uganda's National Water and Sewerage Corporation [NWSC]), similar to those that the Electricity Study Team undertook, which are presented in chapter 7. The report concludes in chapter 8 with the lessons learned from the assessment.

Chapter 2 Scope and Methodology

When looking into the performance of water utilities in Africa, one has to bear in mind that Africa is a large continent with significant differences in institutional setup of water sectors, access to and quality of water resources, and levels of economic development across and within countries. Much of that variation will be lost in aggregating information. Yet, taking into account all these utility-specific differences will result in a set of case studies that make it hard to compile any of the findings into more general lessons learned. This study is part of a larger study that also looks into the performance of electricity utilities. The electricity study used a case study approach and together with this water assessment will allow for a better understanding of the advantages and disadvantages of the different study approaches.

A well-performing utility is a *utility that is able to provide high-quality water and/or wastewater services to its customers in a sustainable manner*. This definition of a well-performing utility includes elements of good financial and operational performance, but also universal access to water and wastewater services that are affordable to all. The analysis will look at three elements to define a well-performing utility: financial performance, customer performance (an index that covers the quality of access to water services), and operational performance. Water coverage is looked at separately because in many cases investments to support an increase in access to water and wastewater services are mostly funded by government and hence not fully under the control of the utility.

Another point to consider is that water coverage has increased rapidly over time in Africa. Between 1990 and 2015, Africa's population grew from 510 million to 989 million—an increase of 94 percent. Population growth in urban areas was even higher—increasing by more than

169 percent between 1990 and 2015. Even though the proportion of access to improved services increased from 48 percent in 1990 to 68 percent in 2015, access to piped water barely changed and still stood at 15 percent in 2015 according to the UNICEF-WHO Joint Monitoring Programme (JMP). This means that access to piped water services on the premises in urban areas decreased from 43 percent in 1990 to 33 percent in 2015. At the same time, the absolute number of people with access to piped water services on the premises increased from 74 million to 153 million between 1990 and 2015 in Sub-Saharan Africa.[1] Simultaneously, the number of utilities in Africa has increased significantly as more and smaller towns established utilities and a larger number of these smaller towns were included in the International Benchmarking Network for Water and Sanitation Utilities (IBNET) sample.

The team combined a desk study using existing data from IBNET with fieldwork undertaken by task team leaders (TTLs) in Africa to collect additional operational and financial utility data. This ensured a sufficiently large panel to undertake analysis to determine (a) the drivers of good utility performance and (b) the scope of efficiency improvements in these utilities that could be achieved.

The data collection by the TTLs was most effective in western Africa where data was collected for the period 2010 to 2013 for Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Niger, and Senegal. In addition, data for the same time period was collected for the Democratic Republic of Congo, Kenya, Malawi, Mozambique, Tanzania, Uganda, and Zambia mostly by mining reports and databases from regulators, the IBNET team data collection efforts, and, in the case of Mozambique, through TTL project reporting. Data from Ethiopia and Nigeria were collected previously by the IBNET team managed by the Water and Sanitation Program; but data collection efforts have just started in these countries and hence only include one or two years of observations. The team used the IBNET Toolkit to ensure that the data collected was comparable. By the end of the data collection period, the team had access to 306 utilities from 41 countries covering a period of up to 20 years of observations. However, the data panel is unbalanced, with some utilities represented in the database with only one year of observations and others with up to 20 years. Some utilities provide very detailed information while others provide much less information. The data was provided voluntarily by the utilities and this—in combination with differences in the quality of the data collected—results in variations in what data is being submitted and can actually be used by the study team. The data was collected by TTLs from the utilities with a first quality check from the TTLs and a second quality check from the IBNET team. The quality assurance methods are discussed in appendix C.

For the analysis, the team used a balanced panel (that is, a set of utilities that remains unchanged over the period under review). The team used datasets that included a subset of the dataset covering a shorter period (2010 to 2013). This balanced panel will, however, exclude large parts of Africa (especially utilities in countries like Ethiopia and Nigeria where data collection has just started and where there are only one or two years of data available). The analysis also excluded utilities from Namibia and South Africa[2] as these are upper-middle-income countries whose utilities perform at a different level than most, if not all, other utilities in the region. Where possible, and as far as data availability allowed, the team also analyzed institutional factors. Despite the exclusion of many countries, the panel data sample represents a large part of the African population served with piped water; partially because access to piped water in countries like Ethiopia and Nigeria is still rather low. The JMP estimated that 149 million people in Sub-Saharan Africa had access to piped water in 2013; when excluding upper-middle-income countries like Botswana, Mauritius, Namibia, and South Africa, the population with access to piped water on the premises drops to 108 million. The database between 2010 and 2013, excluding the upper-middle-income countries, covers a total population served with piped water of 58 million (equivalent to 55 percent of the people served by piped water according to the JMP), of which 41 million use piped water through house connections (including sharing of these house connections). Hence, the people covered in the database cover a very large part of the total population in Africa with access to piped water. Table 2.1 below describes the sample of utilities in detail.

Performance Analysis

The analysis starts with a sector status report looking at the performance of the balanced panel of 119 utilities in Africa. The sector status report provides data on how these 119 utilities have been performing between 2010 and 2013 on different elements of performance. The team undertook a performance analysis by defining three different indicators: operational performance, financial performance, and customer performance.

Operational performance was defined as the unweighted average of three indicators: metering, nonrevenue water (NRW, as measured in cubic meters per connection per day), and staff efficiency (which measures how much revenues are collected for each U.S. dollar spent on staff costs). Table 2.2 shows the benchmarks that were used to calculate how far utilities

TABLE 2.1. Characteristics of the Sample of Utilities

Indicators	Total sample	Subsample 2010–13 (without UMIC) in 2013
Number of people served with piped water (million)	88	58
Number of people served with wastewater services (million)	24	5
Number of people in service area of utilities (million)	134	103
Number of towns served with piped water	1,754	1,574
Number of towns served with wastewater	347	183
Annual utility turnover (US$, billion)	3.7	1.1
Annual volume of water sold (billion m^3)	3.0	1.3
Total staff employed in utilities	39,392	28,560

Note: UMIC = upper-middle-income country.

TABLE 2.2. Operational Performance (Unweighted Average)

Indicator	Africa benchmark (best 25 percent of sample)	Global benchmark (best 25 percent of sample)
Metering (%)	100	100
NRW per connection per day (in m^3)	0.205	0.121
Staff efficiency	4.21	4.27

Note: Staff efficiency = Total revenue per employee/Total (labor) cost per employee.

deviate from those benchmarks set at the best 25 percent of the sample being used. Scores are between 0 and 1. If the utility is achieving the benchmark value, a value of 1 is assigned; in case the utility achieves below the benchmark the utility achieves a score of below 1—the further away from the benchmark, the lower the value. A global benchmark was also calculated using the data analysis from the second IBNET Blue Book (Danilenko et al. 2014) using the best 25 percent of a sample covering 2006–11.

For financial performance, the operating cost coverage ratio (OCCR) was used. The African benchmark of the best performing (25 percent) utilities was 1.19; whereas the global benchmark stands at 1.38.

Customer performance was defined as the unweighted average of three indicators: population per connection, reliability, and affordability. The population per connection is looked at as a proxy for service levels. When utilities provide only household connections, the population per connection tends to be relatively low (slightly above the average household size). Yet, sharing of connections is common in Africa through the provision of standposts, the use of water kiosks, and sharing of house connections with several households. Table 2.3 shows the benchmarks that were used to calculate how far utilities deviate from those benchmarks set at the best 25 percent of the sample being used. The same methodology is used as described above in the operational performance measurement.

Finally, a water coverage performance indicator that measures how the utilities are performing in providing access to water services was included. Although there are utilities in the sample that provide wastewater, the number of utilities that provide wastewater services is limited and moreover, those that provide wastewater services provide services to only a very small population. Hence, this service has not been included. Yet, if it had been included, the performance would have lagged significantly behind global benchmarks. Even without taking wastewater coverage into consideration, Africa's top utilities provide water to 77 percent or more of the population in its service area, compared with a global benchmark of 100 percent.

In addition, a data envelopment analysis (DEA) was undertaken to measure the relative efficiency of utilities. The DEA creates a performance index from indicators—referred to as inputs and outputs in the DEA literature—that can be related to other factors that drive performance. Under basic DEA, a water utility is regarded as a relatively efficient utility if its observed inputs can be scaled to yield outputs that equal or exceed any combination or

TABLE 2.3. Customer Performance (Unweighted Average)

Indicator	Africa benchmark (best 25 percent of sample)	Global benchmark (best 25 percent of sample)
Population per connection (proxy for service level)	8.3	3.0
Reliability (hours of supply)	21.6	24
Affordability (%)	1.22	0.5

scaling of what other utilities' observed inputs yield. Productive efficiency was assessed through DEA. Water billed was considered as the major output while number of staff and number of connections are considered as inputs.

Institutional Performance Analysis

The institutional assessment used the data panel for 2010 and 2013 because institutional performance is a variable that does not vary too widely over time. Collecting organizational data from utilities turned out to be difficult (that is, the response rate was very low). So a set of more general institutional data was used, such as type of service delivery (national, regional, or municipal service delivery), the presence of an (independent) regulatory agency, and the scope of services (that is, utility provides only water or provides multiple services). A simple t-test analysis was used to test several institutional factors of the utilities' institutional context and their effect on a number of performance indicators.

Drivers of Utility Performance Analysis

The focus in this analysis is on three indicators of performance: the first one assesses utilities' financial performance and is defined as a binary variable. More precisely, a utility is considered to be financially well-performing if its OCCR is equal to, or greater than, 1.19.[3] The second indicator measures the quality of service. The so-called customer performance indicator is the average of three indicators as laid out above: population per connection (as proxy for service level with a level of less than 8.3 set as the African benchmark), reliability as measured by hours of water supplied (African benchmark of 21.6 hours per day or more), and affordability (with water costing consumers less than 1.22 percent of GNI). The customer performance index is measured on a 0–1 scale, with a higher value of the indicator indicating better performance. The third indicator, assessing utilities' operational performance, is calculated as the average over three indicators: staff efficiency (takes the value 1 if equal to or higher than 4.21), metering (takes the value 1 if equal to 100 percent), and NRW (takes the value 1 if equal to or lower than 0.205 m^3 per connection per day). Finally, the team used water coverage where a top-performing utility has a coverage of 77 percent or higher. The team found that the correlations between the four indicators are positive but very small. The lack of, or rather small, correlation between the four indexes indicates, for instance, that being financially a good performer does not necessarily correlate with the fact, or imply, that the utility provides a good service to its customers. The performance indicators thus have to be analyzed separately because the drivers of utility performance are not closely correlated; hence, improvements in financial performance do not automatically translate to improvements in customer performance and vice versa. The team then tried to estimate the drivers of performance using econometric techniques.

Case Studies

In chapter 3, the team analyzed five case studies to determine whether the findings in the econometric analysis could be validated by the individual case studies. To ensure some similarity in case studies, the team was asked to undertake the same case studies as those undertaken by a similar study conducted by the Electricity Team—looking into the drivers of performance of electricity utilities in Africa. The case studies were those of Burkina Faso, Côte d'Ivoire, Kenya (Nairobi), Senegal, and Uganda. The selection of the case studies was not at random, and hence there are certain characteristics that differ from the sample as used in the econometric analysis. All these utilities are large, and serve more than 1 million people (compared with the typical utility in the econometric database of about 115,000). The five utilities are all—with the exception of Nairobi—national utilities. National utilities are not very common in Africa and they tend to be mostly located in western Africa. Yet, all five case studies refer to large utilities. Because all these utilities provide services to the capital city, they tend to have a longer history than the typical utility in Africa. The case studies show how these five utilities are doing in terms of providing services to clients (to make the results comparable with those of the Electricity Study), while also triangulating the results from the econometric models presented in chapter 6.

Notes

1. The increase in access to improved water sources (which includes not only piped water, but also other forms of improved water services such as access to protected wells and springs, rainwater) as defined by UNICEF-WHO Joint Monitoring Programme saw a much sharper increase from 242 million in 1990 to 669 million in 2015.
2. Including Namibia and South Africa may skew the performance to such levels that are not necessarily realistic measures of good performance for utilities in other parts of Africa.
3. To avoid possible errors due to misreporting and the presence of outliers, we removed from the sample observations below the 2.5 percentile and above the 97.5 percentile in the OCCR distribution.

Reference

Danilenko, Alexander, Caroline van den Berg, Berta Macheve, and L. Joe Moffitt. 2014. *The IBNET Water Supply and Sanitation Blue Book 2014: The International Benchmarking Network for Water and Sanitation Utilities Databook*. Washington, DC: World Bank.

Chapter 3 Performance of Utilities in Africa: Trend Analysis

The team undertook the analysis for the panel with the shorter time series but larger number of utilities. The trend analysis excludes utilities from Namibia and South Africa as these are upper-middle-income countries whose utilities perform at a different level than most, if not all, other utilities in Africa.

When analyzing the data, three dimensions of performance will be examined: operational, financial, and customer performance. Operational performance will look into how well the utility manages its operations. The financial performance is measured in terms of how effective the utility is in generating revenues from its operations, and using these revenues to cover its operation and maintenance (O&M) costs. Finally, customer performance is assessed. The objective of a utility is to provide customers with high-quality water services and (to a much lesser extent) wastewater services. The quality of its water services is measured by its ability to provide access to water users, but also the level of services it can provide to its customers.

Operational Performance

NRW. Operational performance of utilities is often measured using nonrevenue water (NRW). As can be seen in figure 3.1, NRW as a percentage of water production has declined between 2010 and 2013. Nevertheless, the NRW stands high compared with global benchmarks. but the figure shows the variation between utilities in keeping NRW under control. The NRW as

FIGURE 3.1. NRW as Percentage of Water Production

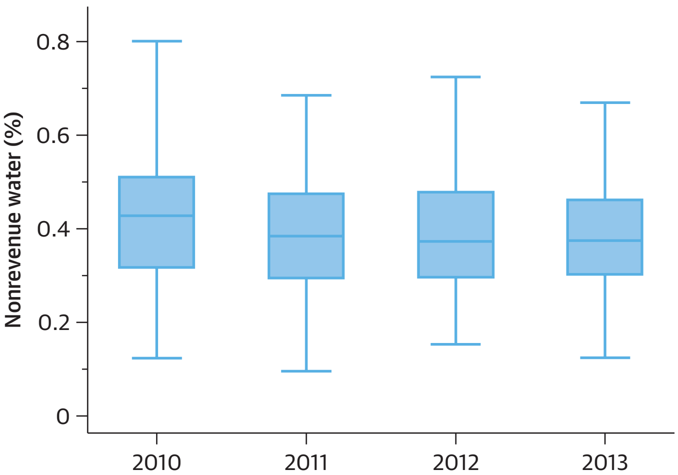
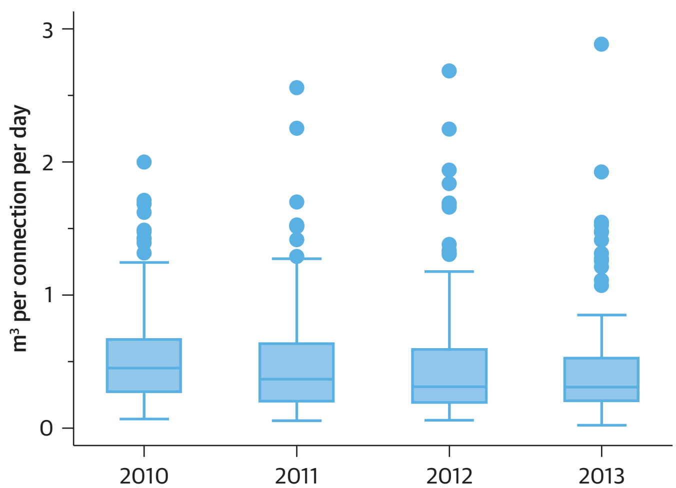


FIGURE 3.2. NRW, by Connection



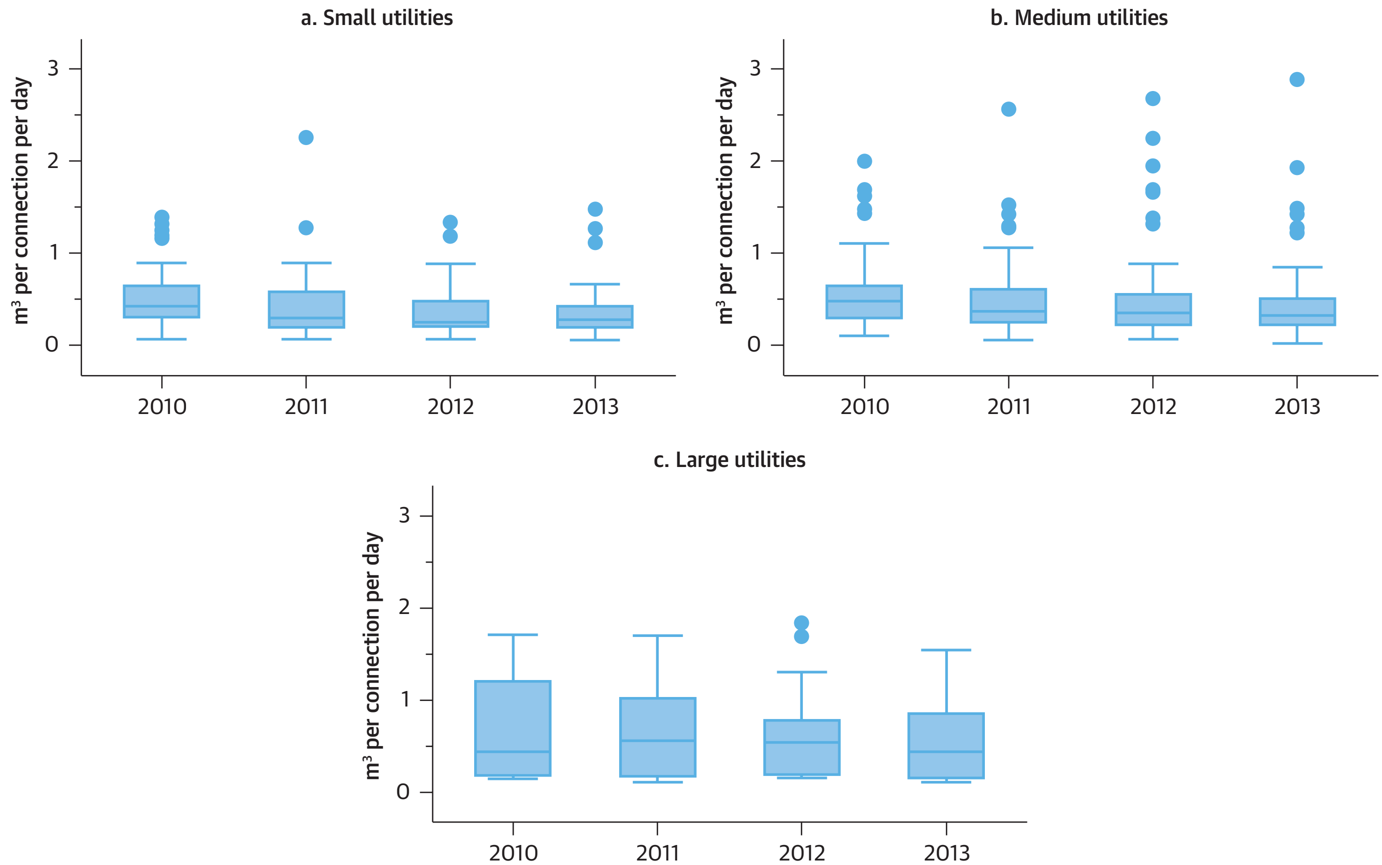
a percentage of water production indicator has its drawbacks (Alegre 2006), so looking at another NRW indicator may be useful. This indicator measures NRW per connection per day; the typical utility experienced a similar decline that was mostly registered between 2010 and 2011 (see figure 3.2).

Reducing NRW tends to be difficult (van den Berg 2015), partially because of the distinct cost structure of water services. In the water sector, on average, production costs tend to be low, while the costs of distribution are relatively high. Whittington et al. (2009) estimate that about 70 percent of the total costs of water supply are related to the cost of distributing the water. Hence, every cubic meter not lost in the distribution system often has a relatively low opportunity cost; which may explain the stubbornness of high levels of NRW in many utilities. Based on this finding, it is to be expected that utilities with high operating costs or high water scarcity will be more likely to have incentives to decrease NRW than those that do not. And indeed, utilities that have high operating costs per cubic meter of water sold have statistically significantly lower levels of NRW per connection per day than those that do not.

In general, larger utilities tend to have higher NRW losses than smaller utilities. Utilities serving more than 500,000 people showed an average NRW per connection of 0.49 m^3 per day, compared with 0.31 m^3 per day for the smallest utilities (see figure 3.3). This may reflect the age of the network system; utilities started to develop in the capital cities and then moved into secondary cities, hence the larger utilities tend to have been in existence longer and have more aged infrastructure. Using the dataset, it was found that in general utilities with 100 percent metering tend to have lower levels of NRW per connection per day. Equally important is the effect of continuous supply: 24 hours of supply tends to be associated with significantly lower levels of NRW per connection per day.

Staff productivity (measured as number of staff per 1,000 connections) is low in Africa, although it is improving. In 2010, the typical utility registered 11 staff per 1,000 connections, which dropped to 8.7 in 2013. The staff productivity is especially low in the smallest utilities, with a median of almost 13 staff per 1,000 connections in 2013 compared with 6.4 in the largest utilities. However, because many utilities in Africa provide low levels of service

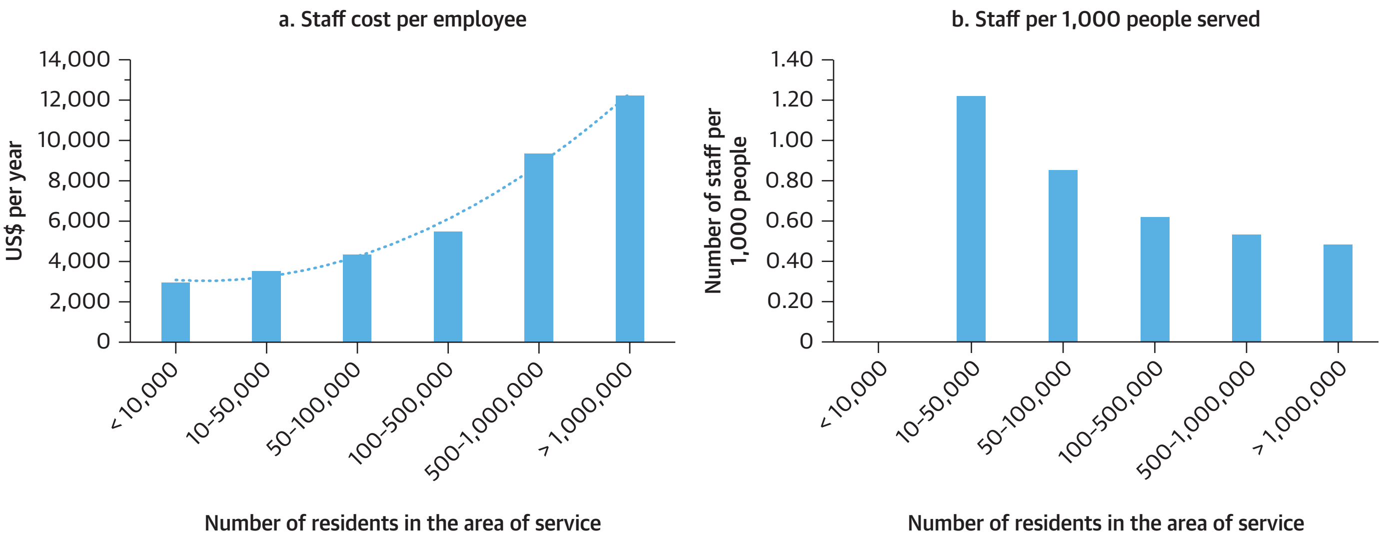
FIGURE 3.3. **NRW, by Size of Utility, 2010–13**



and the number of people served per connection is very high, we also used staff productivity measured as number of staff per 1,000 people served so that utilities which provide different levels of service were not disadvantaged. The median staff per 1,000 people served stood[1] at 0.72 in 2013, inching up from 2010 (when the ratio was 0.68). This is better than the global benchmark of 1.04 in 2010 (Danilenko et al. 2014). At the same time, the median annual staff costs are increasing. The data show the rapid increase in annual staff cost per employee from US$4,246 in 2010 to US$5,865 in 2013. In 2013 year, the bottom 10 percent of the sample spent US$2,305 or less per employee, but in the top 10 percent of the sample, utilities spent more than US$14,438 per employee. As a result, the share of labor in the total cost structure of the utilities is increasing. Figure 3.4 summarizes labor efficiency and annual staff cost by size of utility.

Staff efficiency is measuring how much every U.S. dollar of staff costs translates into utility revenues generated. In 2010, the typical utility generated revenues at a ratio of 3.47. In 2013, the ratio had dropped to 3.04.

FIGURE 3.4. Labor Efficiency and Annual Staff Cost, by Size of Utility, 2010–13



Financial Performance

O&M Cost per Cubic Meter Sold. The median O&M costs per cubic meter sold increased from US$0.76 in 2010 to US$0.86 in 2013. This rapid increase seems to be mainly the result of higher labor costs, resulting from both a decline in staff productivity and an increase in staff cost per employee. The O&M cost per cubic meter sold is significantly higher in low-income countries in the sample, which may be the result of the smaller sample of reporting utilities in middle-income countries and/or the result of economies of scale in utilities in low-income countries (figure 3.5).

When looking at the size of the utility and O&M cost, some evidence of economies of scale was found. The smallest utilities have the highest O&M cost per cubic meter sold. In the period between 2010 and 2013, the typical small utility had an O&M cost of US$0.96 per cubic meter, compared with US$0.71 for medium-size utilities and US$0.79 for large utilities (figure 3.6).

Average Revenues per Cubic Meter of Water Sold. The increase in O&M cost per cubic meter of water sold is coinciding with rising average revenues per cubic meter sold from US$0.71 in 2010 to US$0.85 in 2013. Hence, utilities charge more when the O&M costs increase but not necessarily the full increase in O&M costs—hence, passing costs to consumers is not standard practice in Africa.

Average revenues per cubic meter sold (proxy for tariff) is strongly correlated with O&M cost per cubic meter sold. Yet, average revenues per cubic meter sold is highest in small utilities, but the trend over the last four years also shows that the typical utility saw minor

FIGURE 3.5. Median O&M Cost per m³ Sold, by Income Status, 2010–13

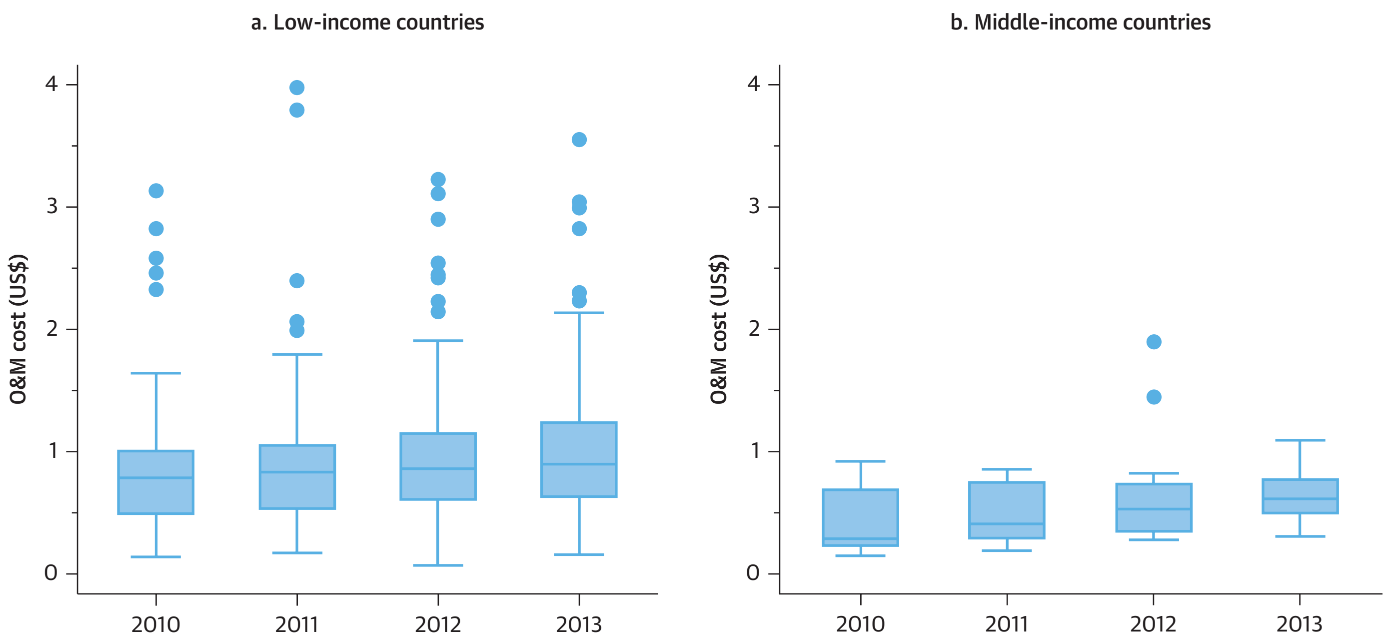
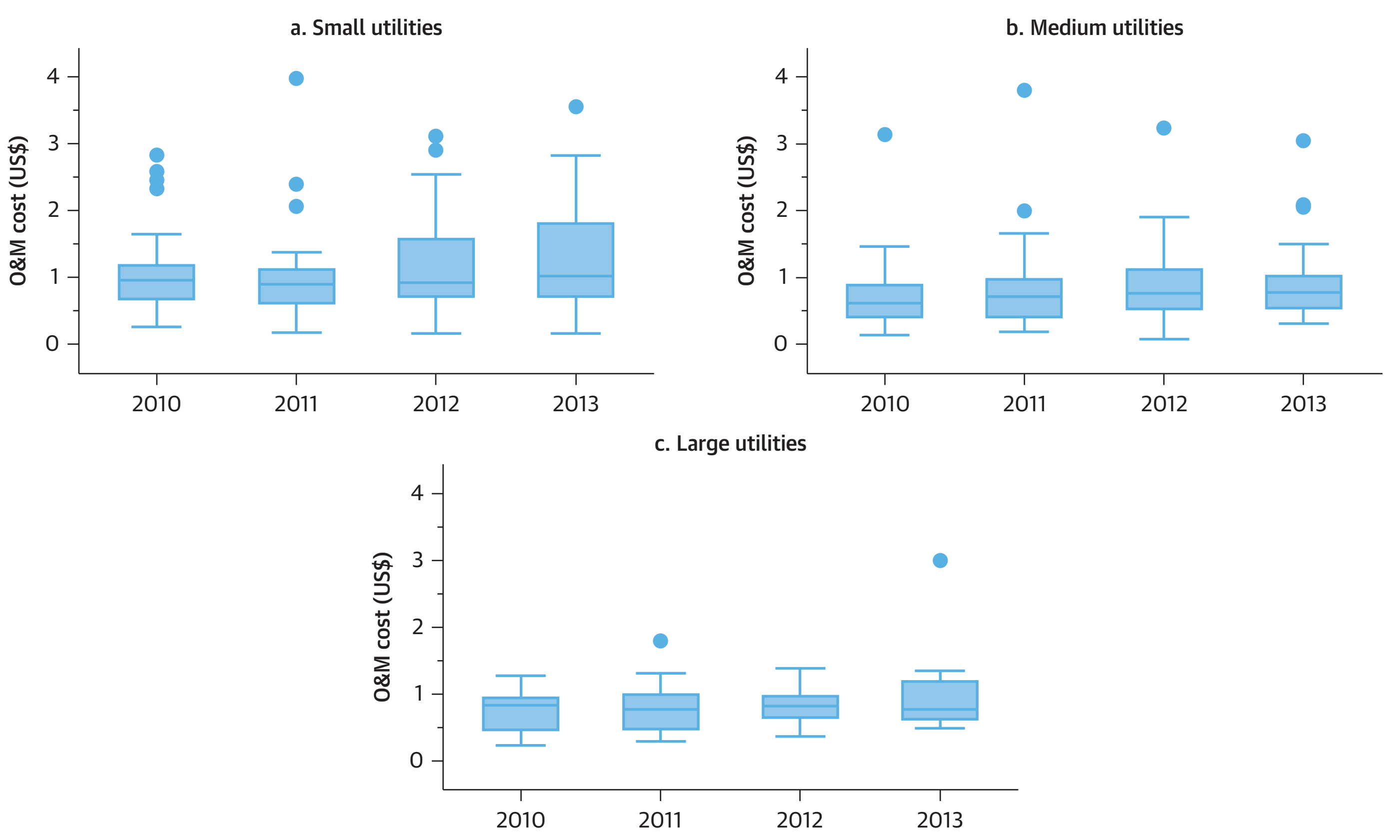


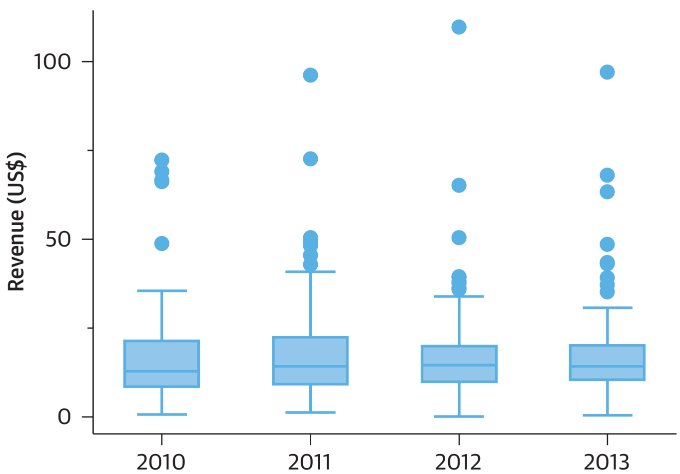
FIGURE 3.6. Median O&M Cost per m³ Sold, by Size of Utility, 2010–13



changes in the average revenues per cubic meter. Although the tariffs in the typical medium and large utilities have increased more significantly, they are below the tariff levels that the smallest utilities charge their customers.

Although tariffs can be high, the effect of high tariffs can be partially mitigated by lower levels of consumption (and collection). In addition, most utilities use cross-subsidies—sometimes quite high levels of cross-subsidies—where nonresidential water users usually have a more price elastic demand for water and pay significantly higher tariffs than residential water consumers. Hence, to understand how well the utility is capable of generating revenues, the annual revenues generated per person served were examined. As can be seen from figure 3.7, the average annual revenues per capita are less than US$15. This is a very small revenue base for a utility. Figure 3.8 show a significant variation in the revenue per connection in low-income countries due to structure of connections, when up to 200 people can be served from one connection.

FIGURE 3.7. Median Annual Revenues per Capita, 2010–13



OCCR. The typical utility in the sample is able to cover its O&M costs with its operating revenues. Yet, the "cash flow" operating cost coverage ratio (OCCR) (defined here as the difference between collected revenue and O&M cost) is significantly lower because utilities can only collect part of their

FIGURE 3.8. Median Annual Revenues per Connection, by Income Status, 2010–13

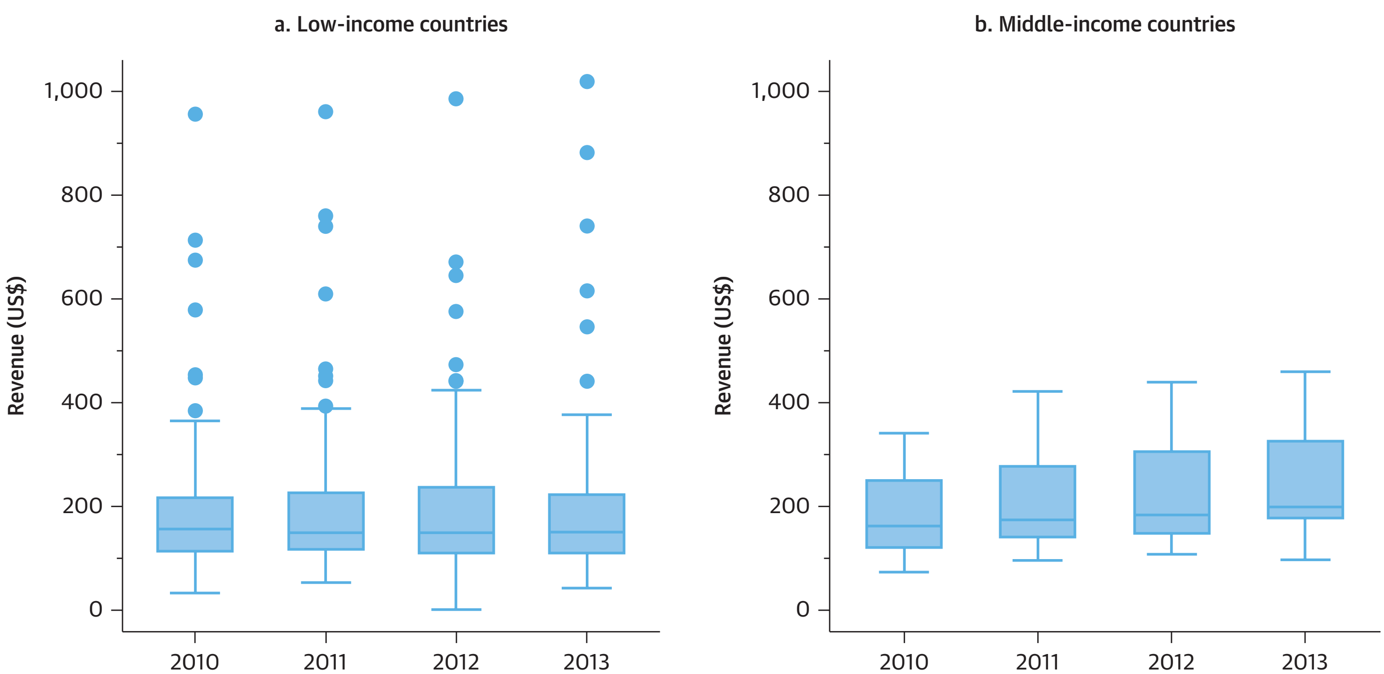
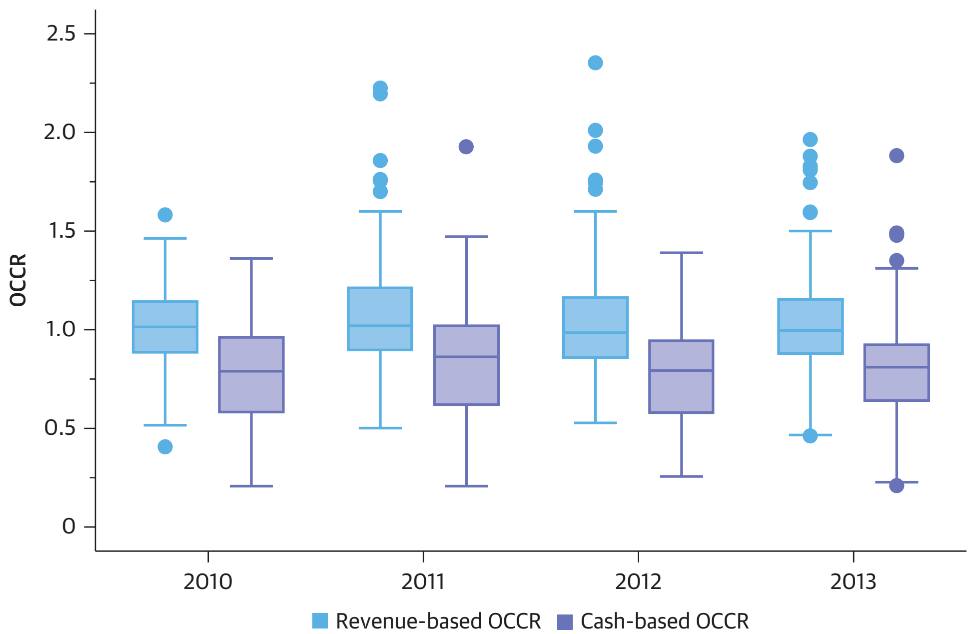


FIGURE 3.9. Operating Cost Recovery versus Cash Flow Operating Cost Recovery, 2010–13



revenues, as can be seen in figure 3.9. Operating (O&M) cost recovery and cash flow operating cost recovery are more complicated in smaller utilities than in larger utilities. Smaller utilities typically charge higher water rates than larger utilities, and water in such utilities tends to be much less affordable than in larger utilities. The actual financial problems are, hence, rather serious as collection efficiencies were around 80 percent of total revenues, meaning that the utilities' cash inflow is negative and hence the utility has to (a) decrease service levels; (b) postpone maintenance; (c) postpone payments to suppliers; and/or (d) if available, increase its dependence on government subsidies. The figure 3.10 presents that information for countries by income status.

FIGURE 3.10. Operating Cost Recovery versus Cash Flow Operating Cost Recovery, by Income Status, 2010–13

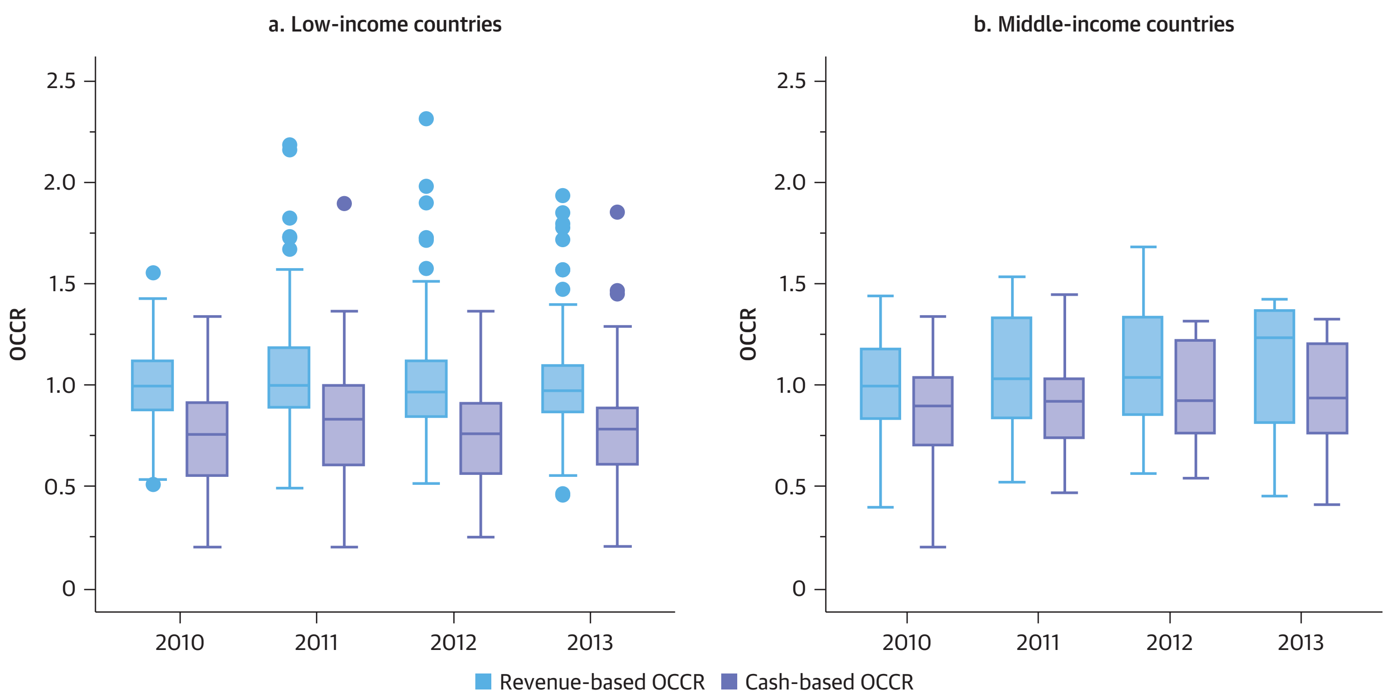


TABLE 3.1. Cost Recovery among Bottom- and Top-Performing Utilities

Variable	Bottom 10 percent	Bottom 25 percent	Median	Top 25 percent	Top 10 percent
Operating cost recovery (billed revenues as % of O&M costs)					
Low income	0.73	0.88	1.00	1.15	1.36
Middle income	0.79	0.83	1.05	1.36	1.44
Cash-flow-based operating cost recovery (collected revenues as % of O&M costs)					
Low income	0.42	0.59	0.79	0.95	1.102
Middle income	0.60	0.76	0.92	1.13	1.33

Table 3.1 shows how the bottom and top performers among utilities are doing. There are two important observations. The first is that operating cost recovery rates do not really change when income levels increase. Even the best-performing utilities do not cover more than about 140 percent of total O&M costs. This is standard around the world—whether analyzing utilities in developing or developed countries. The Blue Book 2014 confirmed this trend of more or less stagnant levels of cost recovery also at the global level. This means that most utilities cover only basic O&M costs plus a little extra.

The second observation is that this operating cost recovery ratio is—even when looking at the top performers—very low in relation to the cost structure of water and wastewater services. Whittington et al. (2009) estimate that the economic cost of conventional water and wastewater infrastructure is US$2.50 per cubic meter[2] (at a discount rate of 10 percent[3] in 2006 prices), assuming very low opportunity cost of raw water and very limited externalities associated with the discharge of treated wastewater,[4] which would translate to more than US$3 in 2013 prices. Hence, with typical O&M cost of water and wastewater of US$0.86, operating cost recovery is likely to cover only a fraction of the actual economic costs of water services. Even the best performers are very far from being able to cover the financial and economic cost of the services. This is not just a trend happening in Sub-Saharan Africa; it is common around the world.

Water supply services are provided in a complex environment in which various objectives in the provision of water and wastewater services are at play. With low levels of per capita income, people are often too poor to actually consume much piped water (let alone pay for wastewater collection) and this lack of capacity results in a very small revenue basis for the utility. This affects financial performance and makes utilities highly dependent on government funding to pay for part of the O&M costs, crowding out investments and slowing the growth in access to (quality) water (and wastewater) services. As incomes rise, more can be spent on water (in absolute terms), which improves the financial footing for utilities. However, this is not what we see in our database, possibly because of the limited number of utilities in middle-income countries. Even though water consumption levels are going up when countries' gross domestic product is increasing, the total revenues per capita do not see an increase despite these higher water consumption levels.

Yet, higher incomes result in better collection of revenues as the difference between the OCCR measured in billed and collected revenues is smaller in middle-income countries than in low-income countries.

At the same time, as economic development accelerates and water consumption increases, the nature of the service changes. In low-income countries, water utilities mainly provide water supply services with little emphasis on dealing with the wastewater flows that accompany the provision of water supply services. Yet, in middle-income countries, wastewater collection becomes a more important additional service as higher incomes mostly coincide with higher per capita water consumption. When countries grow even richer, this collected wastewater is to be treated and disposed of against increasingly high environmental standards. Danilenko et al. (2014) found that the OCCR—a sign of financial health of utilities—in a global sample (of more than 1,800 utilities) barely changed between 2000 and 2011 (even though countries' economies grew rapidly everywhere in the world).

Customer Performance

A rapid trend analysis over the period 2010 to 2013 shows that utilities in Africa saw an increase in water coverage (see figure 3.11). This is not in line with the data provided by the JMP that saw at best a stagnation of piped water coverage. Yet, it should be taken into account that the service area of a utility may not coincide with the urban areas as defined

FIGURE 3.11. Median Water Coverage, 2010–13

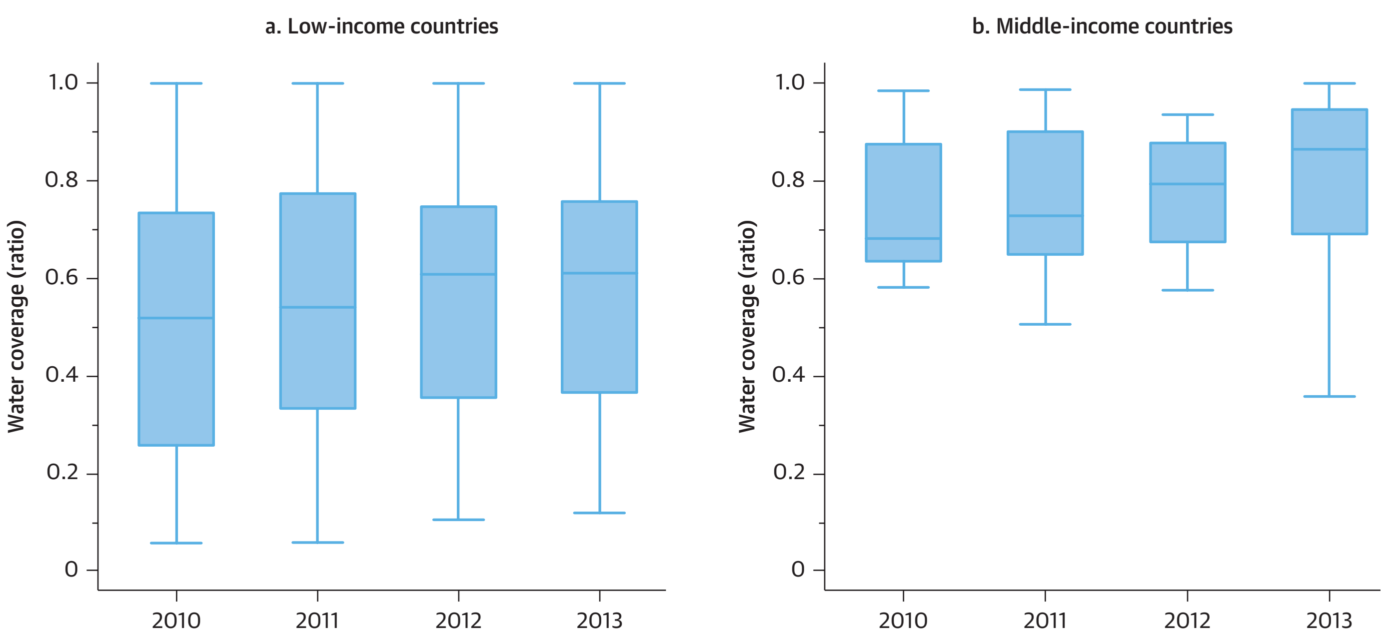
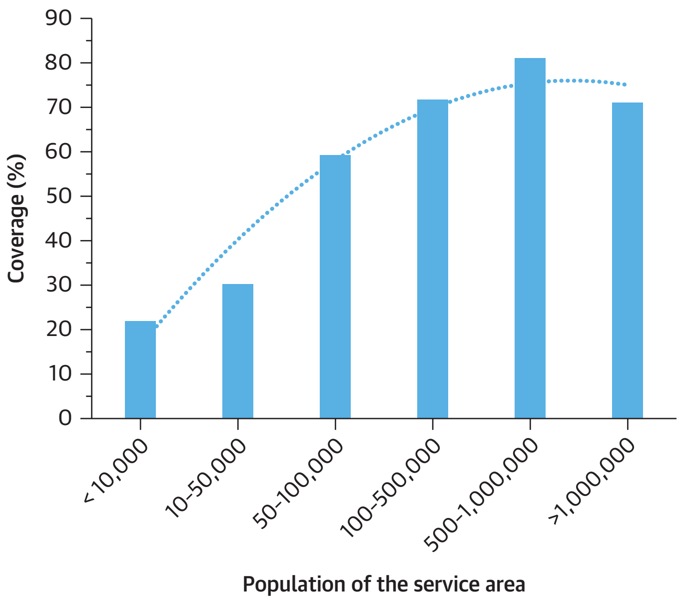


FIGURE 3.12. Median Water Coverage, by Size of Utility



by the household surveys. Service area boundaries may—especially in a period of rapid urbanization—adjust much slower than the pace of urbanization. In addition, utilities manage connections, without often having a good insight into the use of these connections. Hence, the household surveys and utility data often differ.

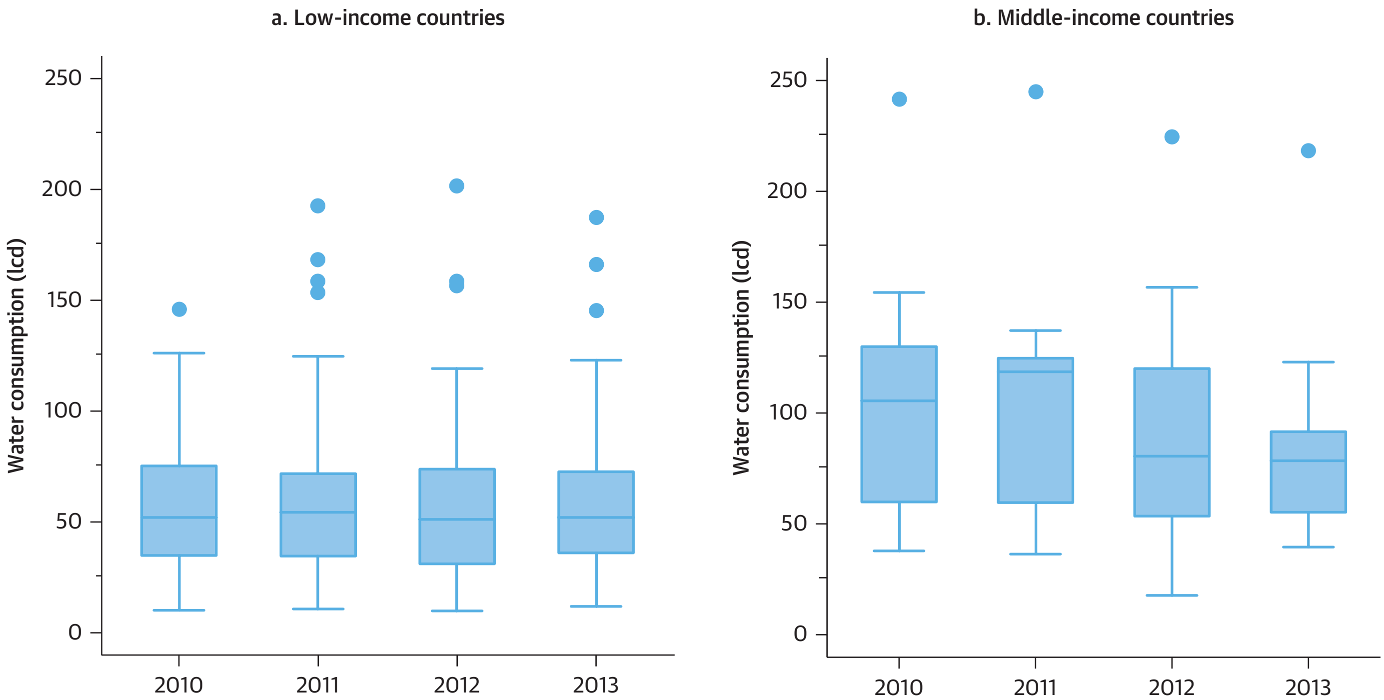
Although the utilities in the sample have seen an increase in coverage, this increase in uptake has been rather uneven between utilities and between countries in the sample.

As can be seen in figure 3.12, the smaller the utility, the lower the water coverage—with the exception of the largest utilities. This phenomenon is linked to the fact that smaller utilities tend to be more recently established and hence tend to have lower coverage rates. The increase in water coverage has been accompanied by a slow decline in wastewater coverage for those utilities that provide the service (which is only a small number of utilities). This is a challenge because wastewater coverage already lagged far behind that of water coverage—with possible adverse effects on water quality in the region as the lack of wastewater coverage increases public health risks and the occurrence of water pollution.

The slow increase in water coverage also coincided with very modest progress in the quality of services provided. The decline in wastewater coverage, noted above, is one manifestation of the deficits in service quality, but the quality of service challenges are also reflected in (a) the low levels of per capita water consumption (at around 56 liters per capita per day [lcd]),[5] (b) the drop in hours of water supplied, and (c) the very modest progress in improvement in service levels (the number of people per connection declined slowly to 10.6). The low levels of water consumption are especially prevalent in low-income countries and are linked to the common practice of sharing water connections. This sharing of connections is the result of both supply and demand constraints. The prevalence of increasing block rates in tariff setting will not provide consumers with much of an incentive to consume large quantities of water (even if the water services are available). As water metering is fairly widespread in the sample of utilities, consumers are able to have some control over their water use and, hence, may restrict consumption to avoid paying the higher block tariffs.

Figure 3.13 shows the very low levels of total consumption in utilities in low-income countries. Even in the upper 10 percent (top decile) of utilities, consumers use only 100 lcd. The World Health Organization assumes that a consumption of at least 50 to 100 lcd is needed for all residential water uses. In 2013, slightly under 50 percent of the households

FIGURE 3.13. Median Water Consumption, by Income Status, 2010–13



using utility services used 50 lcd of water or less and 25 percent did not exceed consumption levels of 77 lcd. This low level of consumption means that the revenue-generating potential of many utilities is small, especially as overall water coverage is low. The typical consumer (both residential and nonresidential) in the sample of utilities pays less than US$15 per year for the service. Yet, the overall cost of producing water is mostly fixed, leaving the utilities often cash-strapped.

Supply constraints also play a role: most utilities have only limited production capacity—assuming that water production is a reflection of the capacity to produce water (in 2013, median water production was 88 lcd compared with 96 lcd in 2010). As can be seen in figure 3.14, production in low-income countries is in general very low—below 100 lcd—and is slowly declining. In middle-income countries, the production is much higher: closer to 200 lcd. The production levels in utilities in low-income countries are very low in comparison with other countries and utilities, and explain partially the low consumption levels in many utilities in the sample.

Service Levels. The population per connection is high in Africa; much higher than the global benchmark of three people per connection. The median number of people per connection was around 11 in 2013. But there are large differences—with the best-performing utilities

FIGURE 3.14. **Median Water Production, by Country, 2010–13**

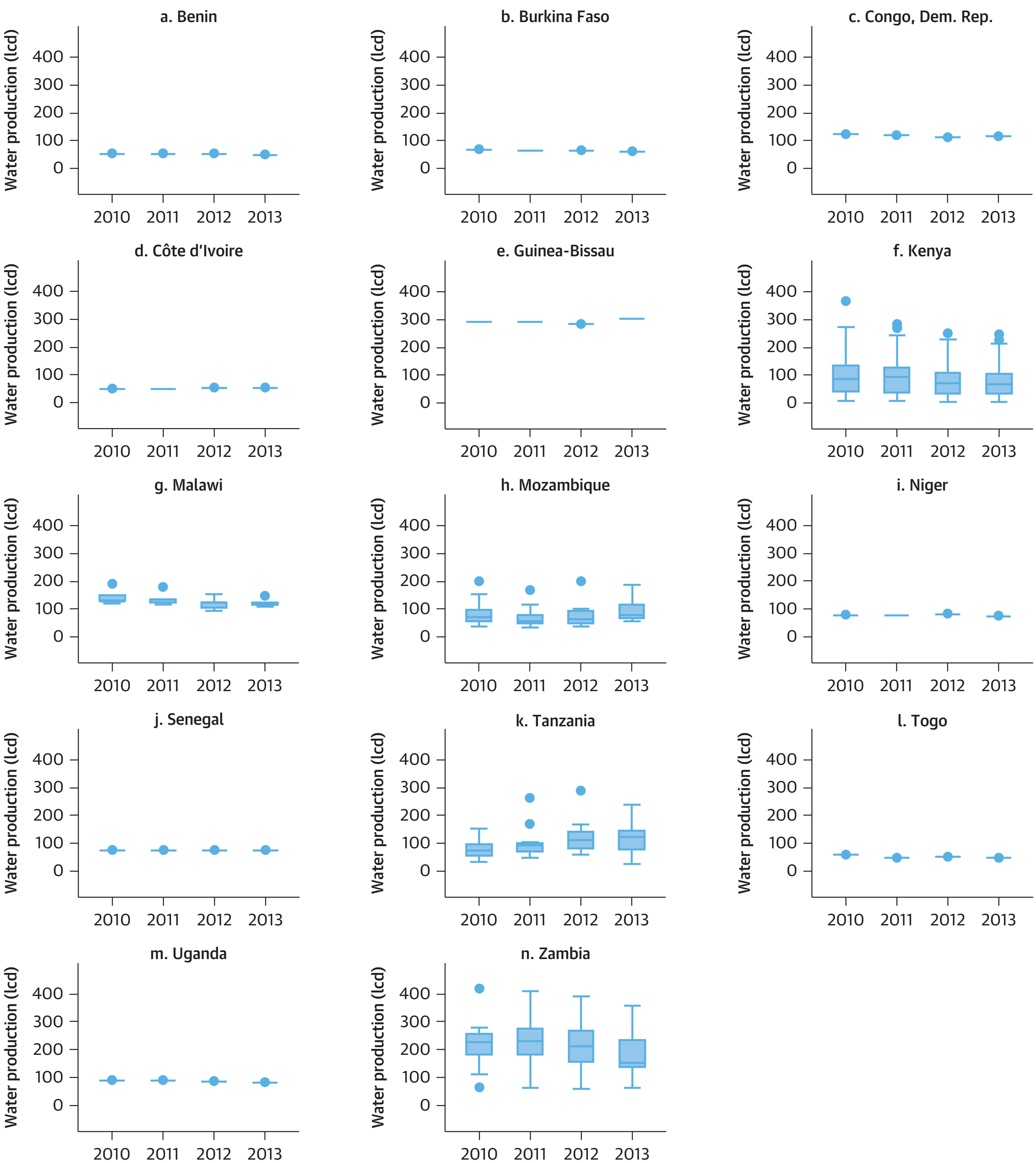
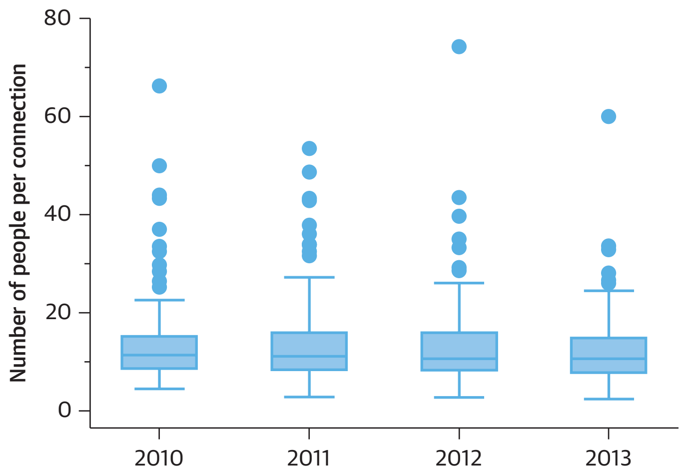


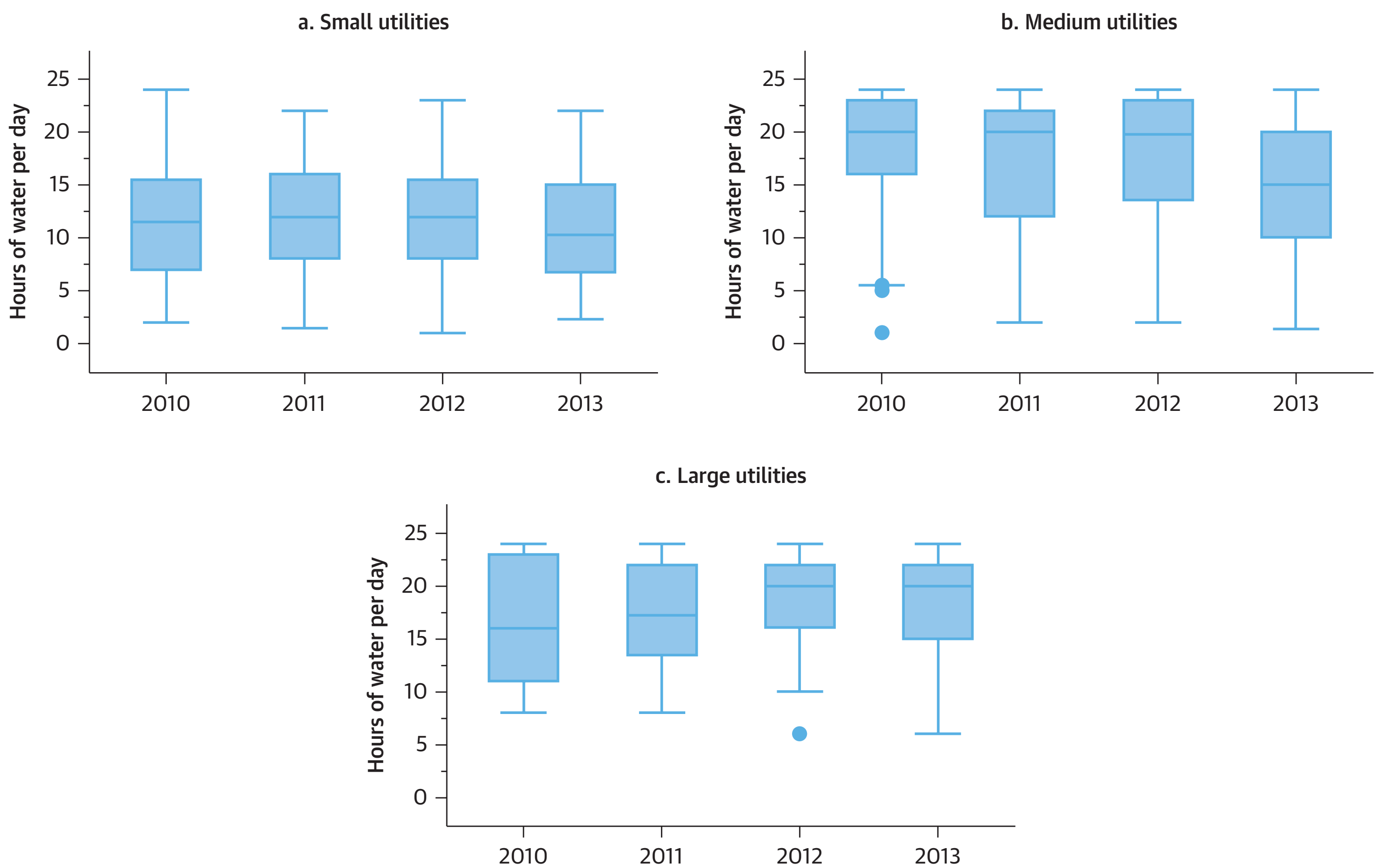
FIGURE 3.15. Population per Connection, 2010–13



providing services to about six people per connection and the worst mainly providing services through standposts and kiosks as can be seen in figure 3.15.

Hours of Supply. Many utilities in Africa ration water. A typical utility only provides water supply for 15 hours per day (compared with 18 in 2010). The smallest utilities provide the least hours of water supply and the largest utilities provide the most (figure 3.16). The progress is rather uneven between utilities; the largest utilities show improvements, whereas the medium-size utilities show a reduction in the median hours of water supplied.

FIGURE 3.16. Hours of Water Supplied per Day, by Utility Size, 2010–13



Affordability. In recent years, affordability improved and people spent proportionally less on water (and wastewater) services. This trend also occurred in Sub-Saharan Africa. In 2013, users served by utilities in low-income countries spent 1.8 percent of income compared with 0.9 percent in middle-income countries. As noted by the Africa Country Diagnostic Surveys, service provision in Sub-Saharan Africa tends to be significantly more expensive than elsewhere in the world. In 2011, median affordability in low-income countries (including Africa) was 0.82 percent compared with 2.0 percent in Sub-Saharan Africa; in that same year (2011), the median O&M cost in Africa stood at US$0.83 compared with US$0.68 for all low-income countries.

A t-test analysis shows that utilities with good financial performance tend to have lower levels of affordability. Utilities with good financial performance registered that on average customers spent 3.2 percent of GNI per capita on water supply services compared with 2.3 percent for those that had weak financial performance (figure 3.17). This effect was noticeable in small- and medium-size utilities: consumers are paying a larger share of their income on services. The opposite held true for the largest utilities; the better-performing utilities are able to charge customers on average smaller shares of their income on water services (figure 3.18). Median affordability for different countries presented in table 3.2.

FIGURE 3.17. Median Affordability, 2010-13

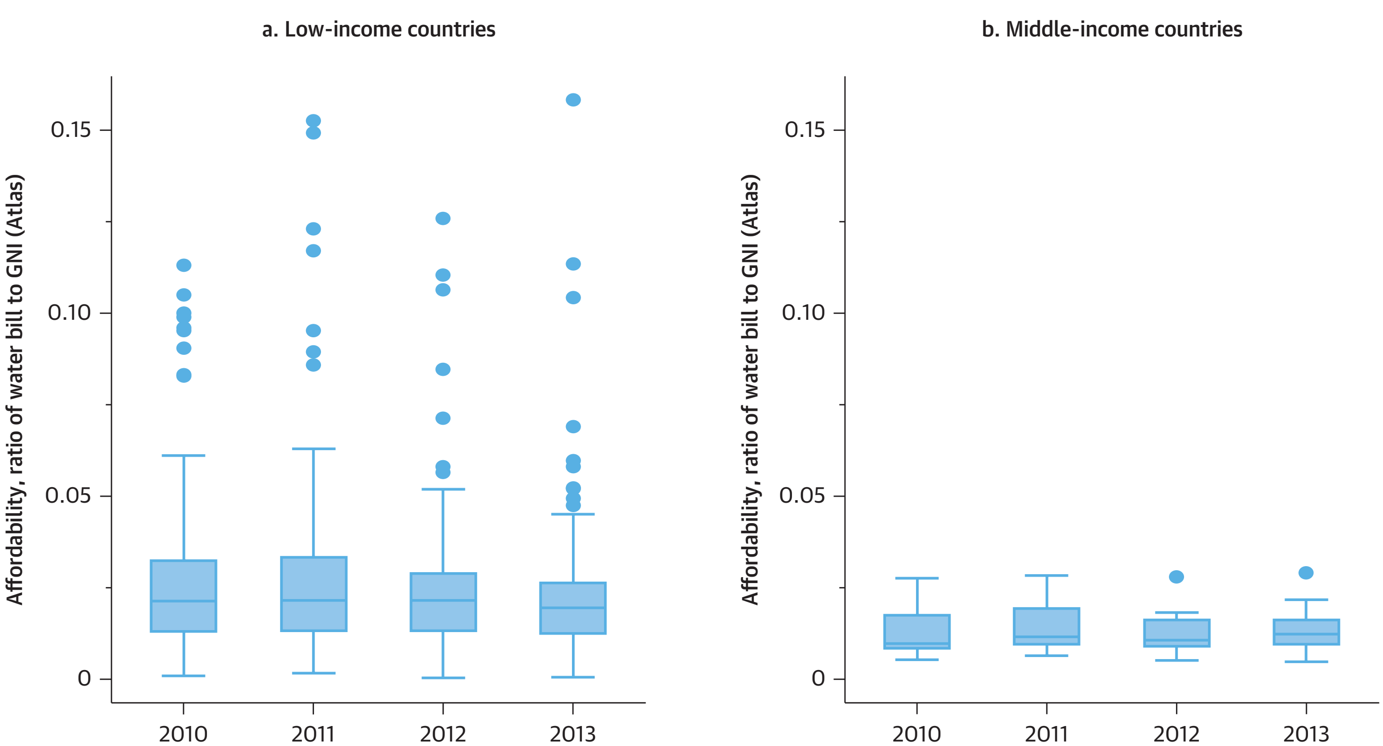


FIGURE 3.18. Median Affordability, by Size of Utility, 2010-13

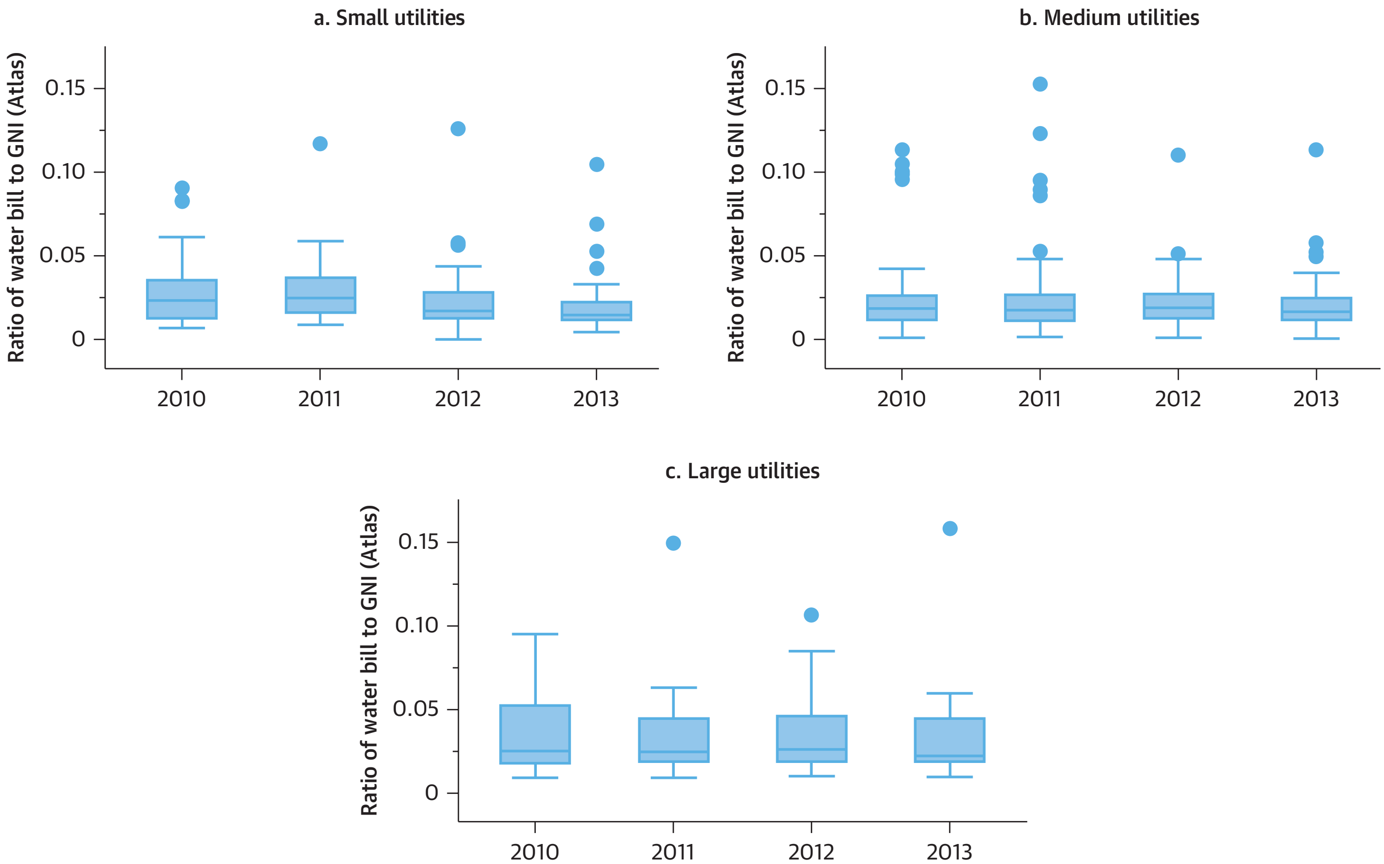


TABLE 3.2. Median Affordability, by Country, 2010-13

Country	Median revenues per cubic meter sold (US$), proxy for tariff	Median annual revenues Per connection	Median affordability (% of country's GNI per capita)
Benin	1.20	201	2.4
Burkina Faso	1.10	269	3.2
Congo, Dem. Rep.	0.75	440	5.2
Côte d'Ivoire	0.82	171	0.9
Kenya	1.01	173	1.7
Malawi	0.83	238	9.2
Mali	0.64	279	2.6
Mozambique	0.70	122	3.9
Niger	0.60	234	1.8
Senegal	1.09	266	2.3
Tanzania	0.43	98	1.7
Togo	0.64	215	2.2
Uganda	1.14	207	4.7
Zambia	0.46	185	1.1

Conclusions

Coverage has increased slowly between 2010 and 2013. Overall coverage rates are slightly above 60 percent in the service areas of the utilities covered in the sample, suggesting that the utilities are not able to serve large parts of the population in the areas they are responsible for.

The combination of relatively high O&M costs of water (and even more so wastewater) services and the increasing affordability of water services suggest that, in many utilities, even in Sub-Saharan Africa, there is some scope for balancing the goals of revenue sufficiency and affordability more in favor of the former as government subsidies will otherwise need to increase rapidly in some countries.

A little less than half the utilities in the sample are not able to cover their operating and maintenance costs through their revenues. The high dependence on subsidies raises questions about the equity of such subsidies that tend to disadvantage those not yet connected to piped network services.[6]

The variance of utilities' performance within and between countries is very large. This is, for the most part, because water and wastewater services are locally provided. These local factors can vary widely between utilities and include factors such as the distance to the water source and the effect on the cost to store and transport water, the quality of the water source and the need for treatment, and design standards, among others. Yet, more general policies in the country (for example, energy subsidies and labor policies) also affect the cost of O&M. The O&M costs vary widely in the sample, from less than US$0.23 to more than US$2.07 per m^3 sold. The actual O&M costs can vary even more when utilities with less than four years of data are included in the sample. In that case, O&M costs vary from US$0.12 per m^3 of water sold in Nigeria to more than US$4.75 in Cape Verde (because of dependence on desalinated water).

The implication of this large variance on performance is that specific local circumstances have a major impact on revenue sufficiency and affordability. Policy makers will need to understand how the variation in the costs of water and wastewater services affects the balance between the objectives of revenue sufficiency and affordability[7] in their pricing policies. This will require much more information and research than is currently available.

Finally, as the fixed cost component in water and wastewater service provision is very large, the design (and other) standards under which water infrastructure is constructed will determine the cost of the services for decades to come. Hence, it is important to undertake a proper least-cost analysis when investment decisions are made to ensure that the benefits and costs of such investments are properly analyzed. The financial, organizational, and social implications of such investment decisions will be felt for many decades.

Notes

1. Owing to the high incidence of shared connections, through house connections and public taps, the often-used indicator of staff per 1,000 connections is not used. In addition, as the number of connections was not collected systematically, the actual number of utilities providing this information results in biased results.

2. It should be noted that these estimates are highly variable. For instance, in places where water has to be hauled over long distances or where water scarcity is a reality, the costs can be significantly higher.

3. This assumes that, for utilities, financing is available against international market rates, whereas it is also assumed that no particular country risks are included.

4. There is some trade-off between wastewater treatment costs and externalities associated with discharge of treated wastewater. The higher the levels of wastewater treatment, the lower the externalities associated with the discharge of treated wastewater.

5. Note that this refers to total water consumption (including consumption from all types of consumers). Residential water consumption data, where available, suggest that consumption is significantly lower than the 56 lcd.

6. In most developing countries, those not connected to the piped network services are disproportionally poorer citizens or disadvantaged future generations (Komives et al. 2005).

7. And any other policy objectives that are to be included, such as economic efficiency, transparency, and so on.

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Chapter 4 Performance of Utilities in Africa: Composite Performance Index

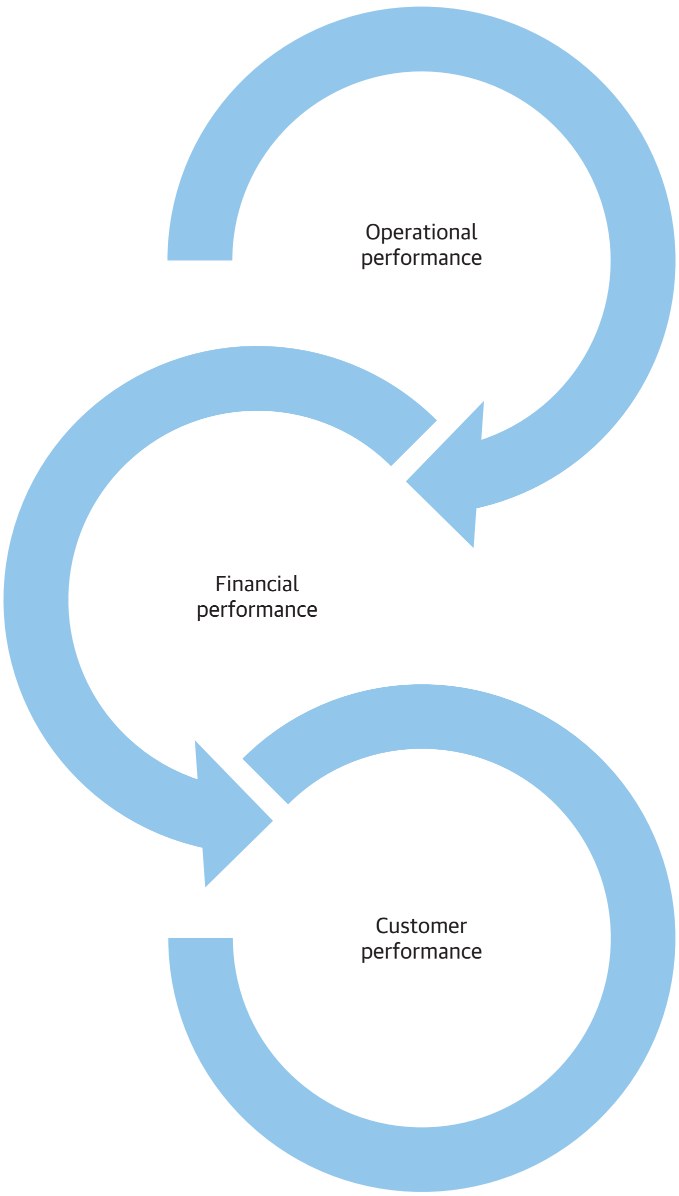
This analysis used the same sample as the previous analysis.[1] Three composite performance indicators that, respectively, measure different aspects of customer performance, financial performance, and operational performance are used. The theory suggests that good operational performance translates into better financial performance because of a reduction of the operation and maintenance (O&M) cost. Good financial performance allows the utility to generate excess funds that could—once the utility generates sufficient cash to pay for O&M costs, depreciation, and debt service—be used for improvements to service levels or water coverage (see figure 4.1). The hypothesis is that once the customer experiences improved service level, the utility will be able to generate more revenues that then can fund further improvements in operational and/or customer performance.

Calculation of the Composite Performance Index

For each of the two performance indexes measuring operational and customer performance, we calculated a composite index that provides some insight into the various aspects of performance. The major reason for setting up a composite index is to gain a wider perspective of the situation, while being aware of the pros and cons of using composite performance indexes (for more details, see box 4.1).

The criteria for a well-performing utility with regard to operational performance relate to behaviors that are under management control, including metering, nonrevenue water (NRW)

FIGURE 4.1. Performance Indicators



(as measured by NRW per connection per day), and staff efficiency (measuring the revenue generated as a proportion of cost per employee). Customer performance is measured by service level quality (population per connection: the higher the number of people per connection, the lower the service level as there is more dependence on sharing connections, standposts, and kiosks), reliability (number of hours that water is supplied), and affordability,[2] which is mostly under management control. We did not include water coverage (or water consumption) as these indicators are highly dependent on investment infrastructure that may or may not be funded by government.

For each variable, the value was calculated for the best-performing quartile of utilities, and then the variance with this threshold was calculated (see table 4.1). The larger the deviance toward the well-performing threshold, the lower the value. No specific weights were given to the different indicators. In case of missing information on any one of the underlying indicators, the utility's performance is not reported; only utilities that have a complete set of data to calculate the indicators were included. The maximum value that a utility can achieve on the indicator is 1. In theory, the lowest value is zero, but in practice utilities will always produce some level of service. Yet, as can as can be seen in figure 4.2, the minimum operational performance using African benchmarks is set at only about 0.10, with a maximum value of 1.00. Hence, there is a wide variation in operational performance between the utilities in the sample.

Composite Performance Index

Operational Performance

As can be seen in figures 4.2 and 4.3, the typical utility saw an improvement in operational performance. The variation between utilities is large. This improvement coincides with a slight decrease in standard deviation, with worse-performing utilities seeing operational performance increase more than better-performing utilities A full list of operational performance and the underlying indicators is provided in appendix C.

As can be seen in figures 4.2 and 4.3, African utilities have a reasonably good operational performance but when using a global benchmark, African utilities perform slightly worse. The typical utility in the Africa sample had an operational performance score of 0.71 (African benchmark) and 0.64 (global benchmark) in 2013, which means that most

BOX 4.1. Pros and Cons of Composite Performance Indexes

Pros	Cons
They can summarize complex, multi-dimensional realities with a view to supporting decision makers	They may be misinterpreted
They can provide the "big picture"	They may require more data
They are easier to interpret than a large set of individual indicators	The selection of indicators and weights could be the subject of political debate
They reduce the size of indicators to analyze without dropping the underlying information	They will require judgment (and hence can bring in some subjectivity)
They can assess performance over time	

TABLE 4.1. Setting Benchmarks

Indicator	Best-performing quartile of African utilities in sample	Best-performing quartile of global utilities as per Blue Book
Operational performance		
Metering (%)	100	100
NRW per connection per day (in m^3)	0.205	0.121
Staff efficiency (revenues per staff employee as ratio of cost per staff employee)	4.21	4.27
Financial performance		
OCCR	1.19	1.38
Customer performance		
Population per connection (as proxy for service levels)	8.3	3.0
Reliability (hours of supply)	21.6	24
Affordability (%)	1.22	0.5
Other		
Water coverage (%)	77	100
Water consumption (lcd)	76.6	220

utilities are working on their operational performance. However, the best African utilities are able to meet global benchmarks in operational performance. In general, African benchmarks are about 10 percent below global benchmarks when evaluating operational performance.

When disaggregating operational performance trends by country (again using the subset of utilities with data from 2010 to 2013), 116 utilities in 14 countries can provide operational performance data. As can be expected, national utilities show much less variation than utilities that are using regional or district service delivered approaches; these utilities tend

FIGURE 4.2. Operational Performance Index against African Benchmark, 2010–13

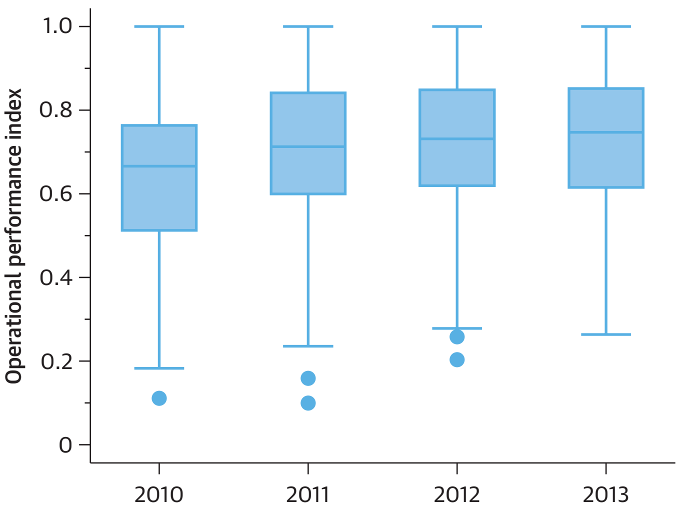
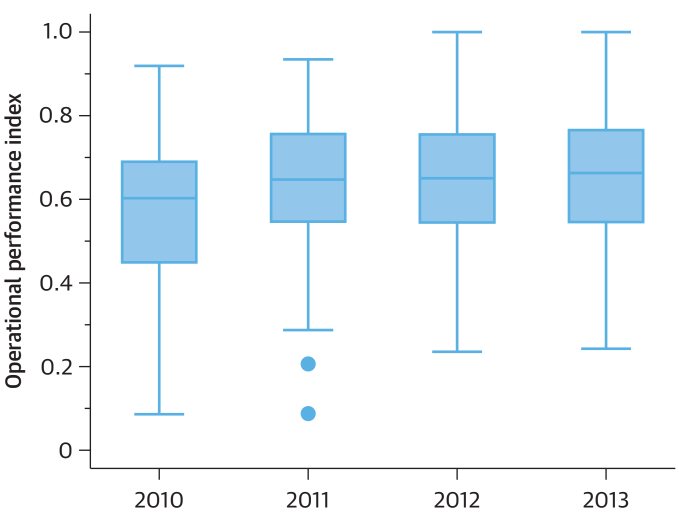


FIGURE 4.3. Operational Performance Index against Global Benchmark, 2010–13



to give very high operational performance—with values close to 1.000. The countries with regional utilities (Kenya, Malawi, Mozambique, Tanzania, and Zambia) show much more variation in operational performance. They may register very high values (with the exception of Zambia) but they also register utilities with the worst operational performance.

As can be seen in figure 4.4 (for a more detailed list, see appendix A), well-performing utilities can be found in different countries, working under different types of regulatory frameworks and at different levels of economic development. For those utilities that consistently provide data between 2010 and 2013, the change in the composite operational performance index varies significantly. The fastest-improving utilities over that period are found in Kenya, but this country also shows the largest variation in operational performance. Most national utilities—with the exception of Benin—show a very stable performance over the observation period.

Financial Performance

Operating Cost Coverage Ratio. As can be seen in figures 4.5 and 4.6, the typical utility saw a slow decline in financial performance. The variation between utilities is large. A full list of financial performance is provided in appendix A. Yet, the top 25 percent of utilities are able to obtain a perfect score of 1.000 (equivalent to an operating cost coverage ratio [OCCR] of 1.19). It is interesting to note that the majority of the utilities are clustered. This may point to the fact that most utilities are located in countries that are poor.

Using a global benchmark of 1.38, the top performers in Africa can meet global benchmarks. Yet, as was shown in the composite operational performance index, African top performers can meet global benchmarks, but the typical African utility is not performing as well as its global counterparts.

When disaggregating financial performance trends by country (again using the subset of utilities with data from 2010 to 2013), data from 118 utilities in 13 countries are available. Different countries register variations in financial performance improvements. In some

FIGURE 4.4. Median Operational Performance, by Country, 2010–13

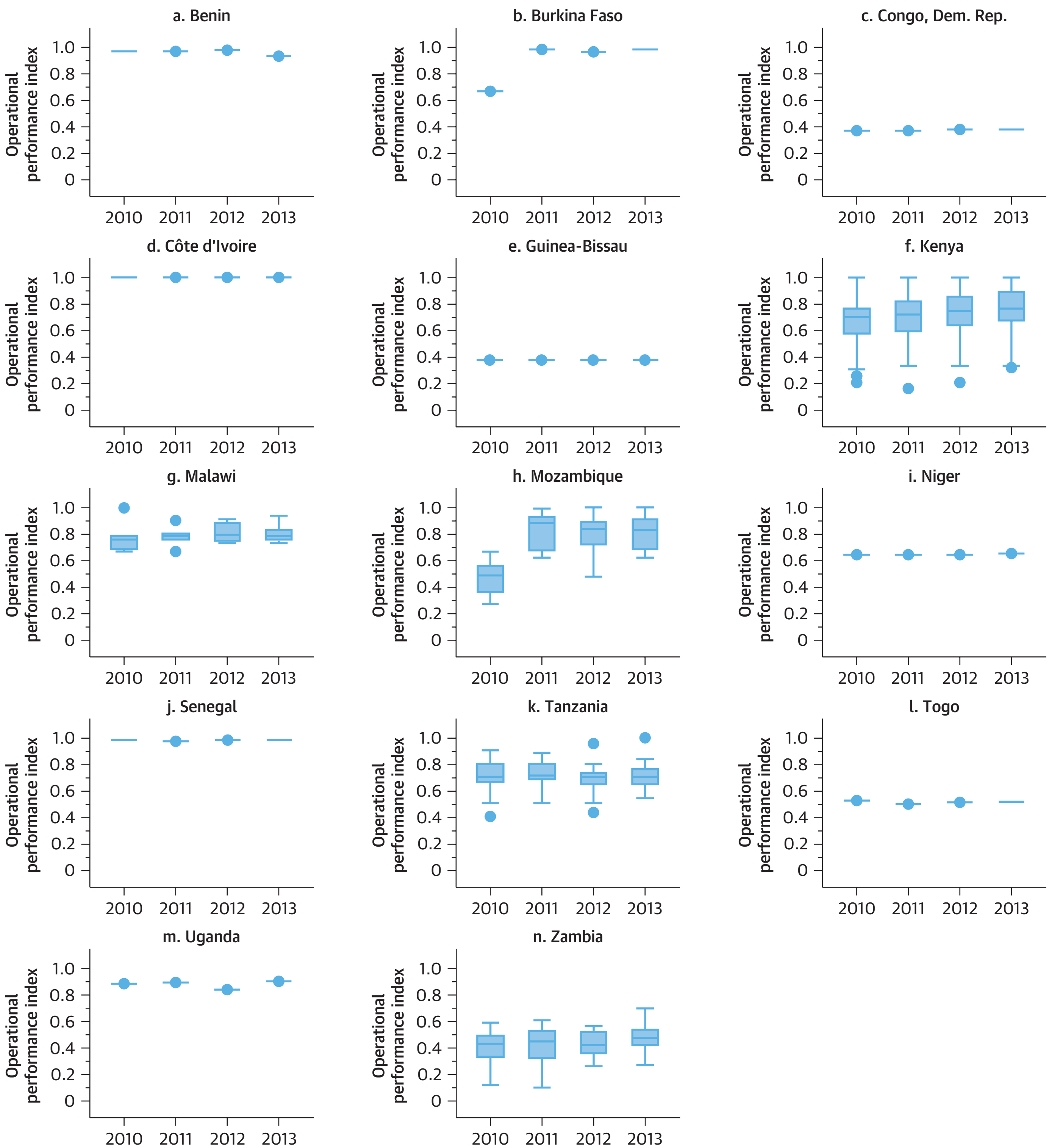


FIGURE 4.5. Financial Performance Index Using the Operating Cost Coverage Ratio against African Benchmark, 2010–13

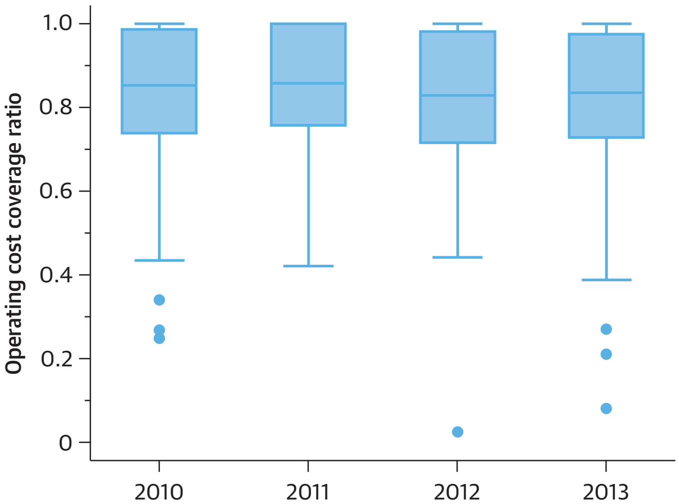
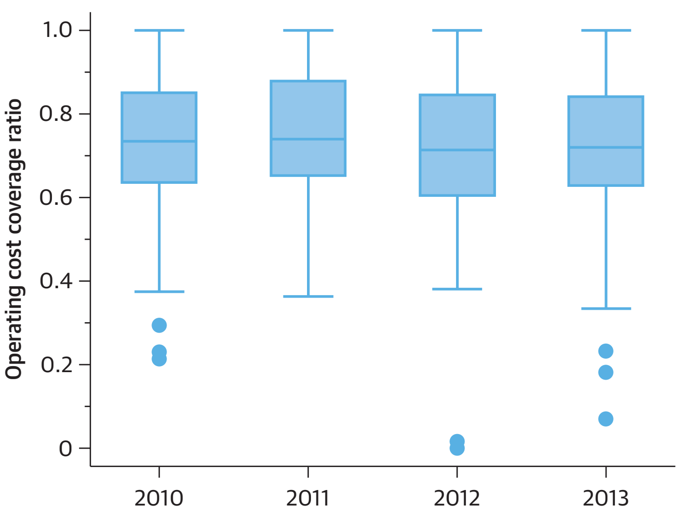


FIGURE 4.6. Financial Performance Index Using the Operating Cost Coverage Ratio against Global Benchmark, 2010–13



countries, utilities see an improvement in financial performance, in others a decline in financial performance, and again in others performance is rather stable (figure 4.7).

Cash-Based Operating Cost Coverage Ratio. This ratio is a variation on the normally used OCCR, and instead of using billed revenues as a percentage of O&M costs, it uses collected revenues as a percentage of O&M costs (see figure 4.8). Utilities in middle-income countries show better performance than utilities in low-income countries (figure 4.9): they tend to have overall higher levels of cash-based financial performance, but also much less variation within the sample suggesting that affordability can be a challenge at times.

Customer Performance

Customer performance is the ultimate goal of each utility. As can be seen in figure 4.10 the typical utility did not see much change in this indicator between 2010 and 2013. The variation between utilities is large. A full list of customer performance, including its underlying indicators, is provided in appendix C.

African utilities lag behind in the provision of high-quality water services (see figure 4.10). The type of services provided with regard to hours of supply, affordability, and service levels (high dependence on shared connections) is in stark contrast with global benchmarks. Even the better-performing utilities in Africa are far from achieving global benchmarks. Break-down by the country income is presented in figure 4.11.

When disaggregating absolute performance trends by country (again using the subset of utilities with data from 2010 to 2013), it is clear that the well-performing utilities on this aspect of performance tend to concentrate in countries with a larger number of utilities, most notably Kenya, Tanzania, and Zambia. The national utilities tend to showcase lower levels of customer performance (figure 4.12).

In general, there are more utilities that provide better financial and operational performance than those that provide good customer performance. This means that the translation of better operational and financial performance into better customer performance is not automatic.

FIGURE 4.7. **Median Financial Performance Index, by Country, 2010–13**

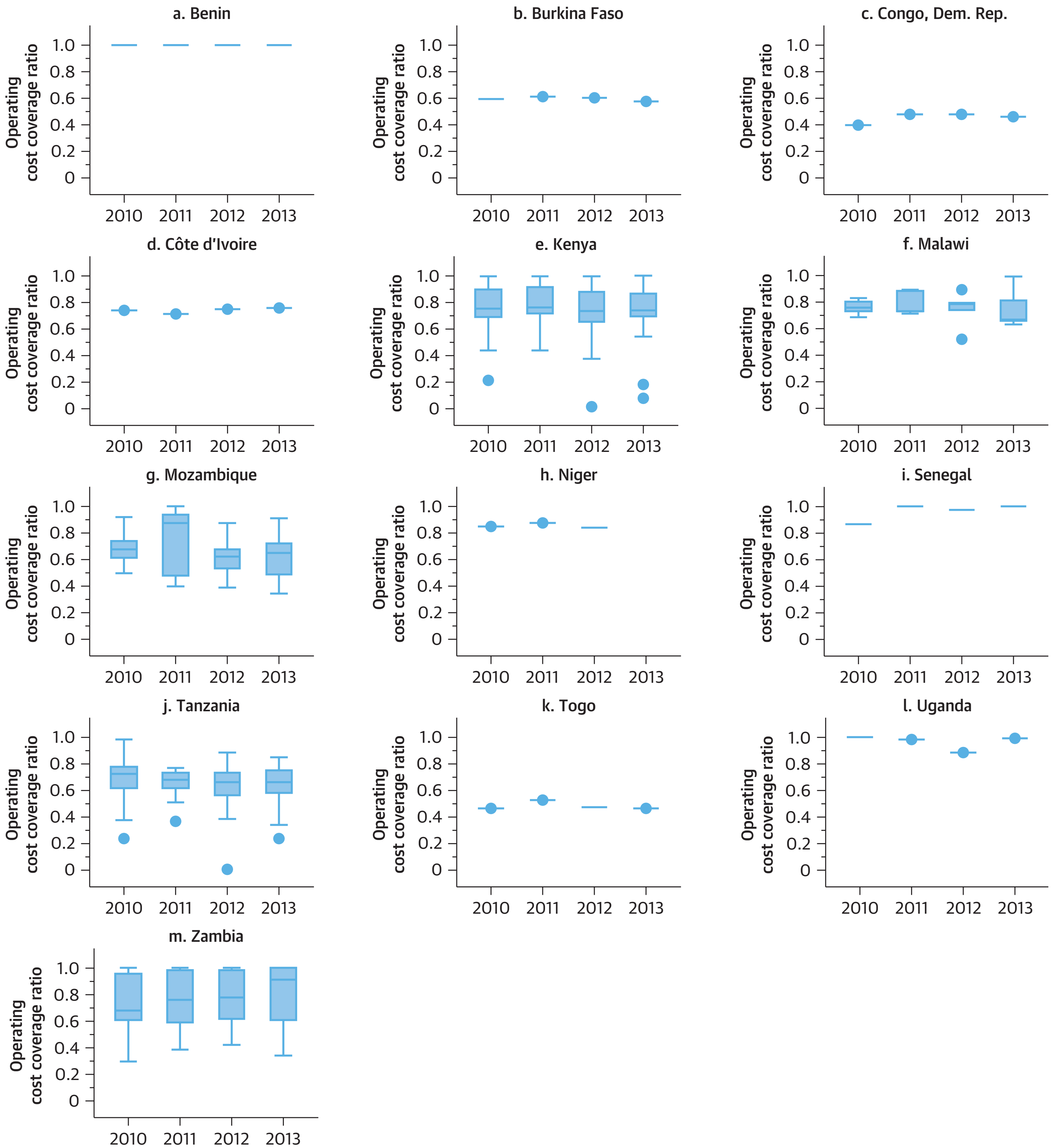
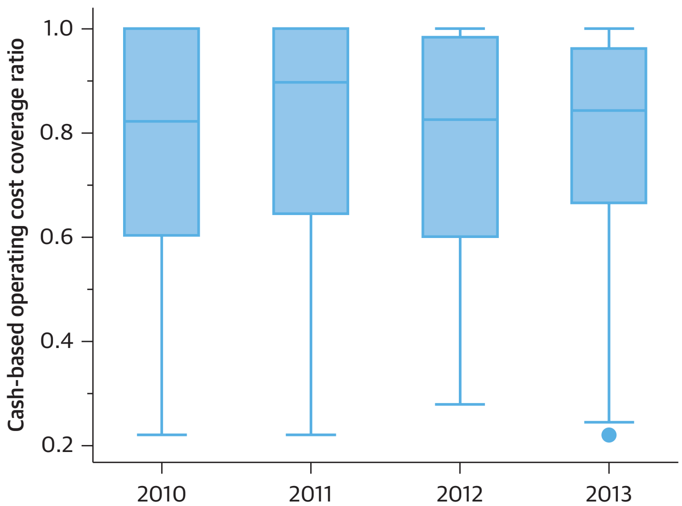


FIGURE 4.8. Median Financial Performance Index based on Cash-Based Operating Cost Coverage Ratio, 2010–13



Some analysis using t-tests between good financial performance and customer performance shows that most of the proxies for service level (that is, hours of supply and people per connection) do not differ between utilities with good financial performance and those that are operating with lower OCCRs. Water coverage is not higher when utilities are better able to cover their O&M costs through their revenues. Yet, utilities with better financial performance are able to generate more revenues because of significantly higher water tariffs; this may be linked to demand patterns because utilities in Africa show large variations in the dependence on different types of consumers and the use of cross-subsidies in their tariff structures (see box 4.2). Although higher water tariff revenues are not always collected—as collection efficiencies tend to decline with

FIGURE 4.9. Median Financial Performance Index based on Cash-Based Operating Cost Coverage Ratio, by Income Status, 2010–13

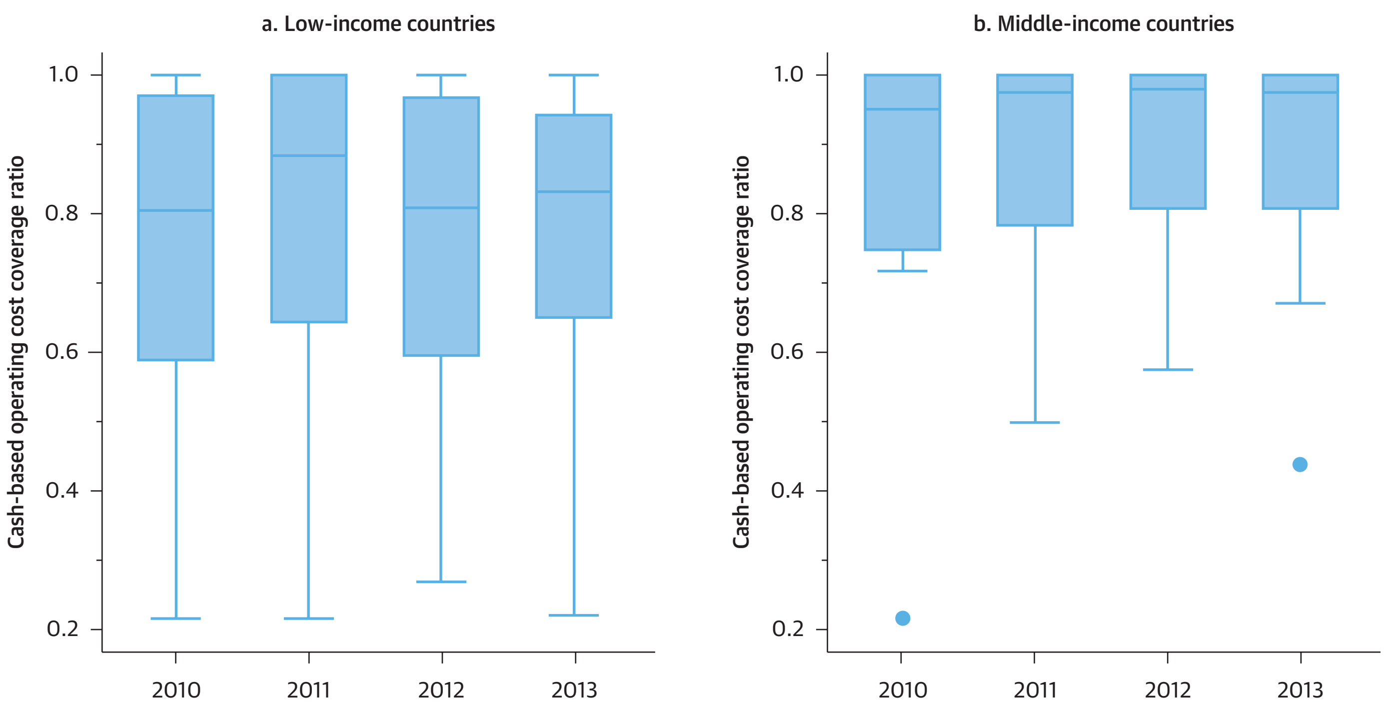
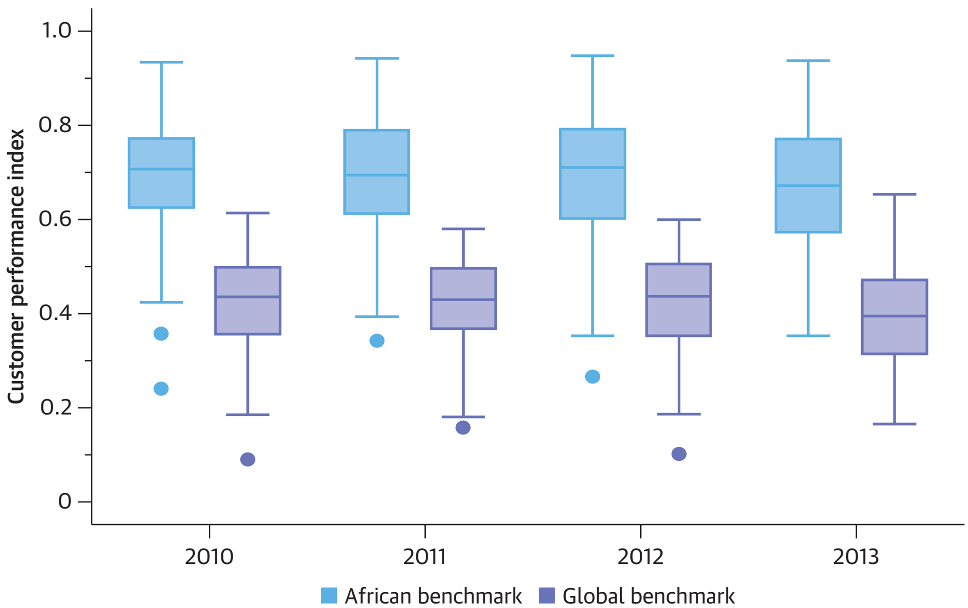


FIGURE 4.10. Customer Performance Index against African and Global Benchmarks, 2010–13



tariff levels—the effective water rates are still significantly above those of the utilities that apply lower water tariffs. Hence, using not only tariff levels but also tariff structures as a tool to kick-start financial performance against a backdrop of poor customer performance may be useful depending on the types of customers utilities are serving. Many utilities do not provide much detail about their clients and their demand patterns, but this is key information that a utility should have to better plan and manage its performance.

FIGURE 4.11. Customer Performance Index against Africa Benchmark, by Income Status, 2010–13

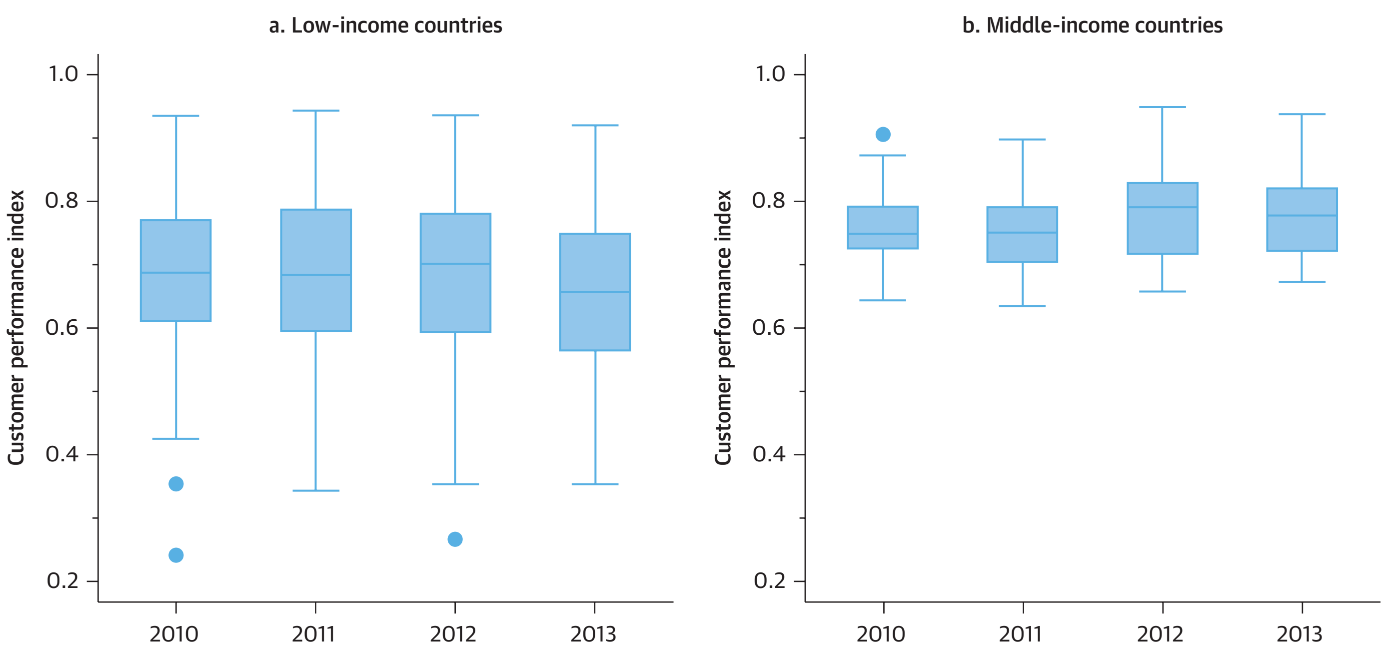
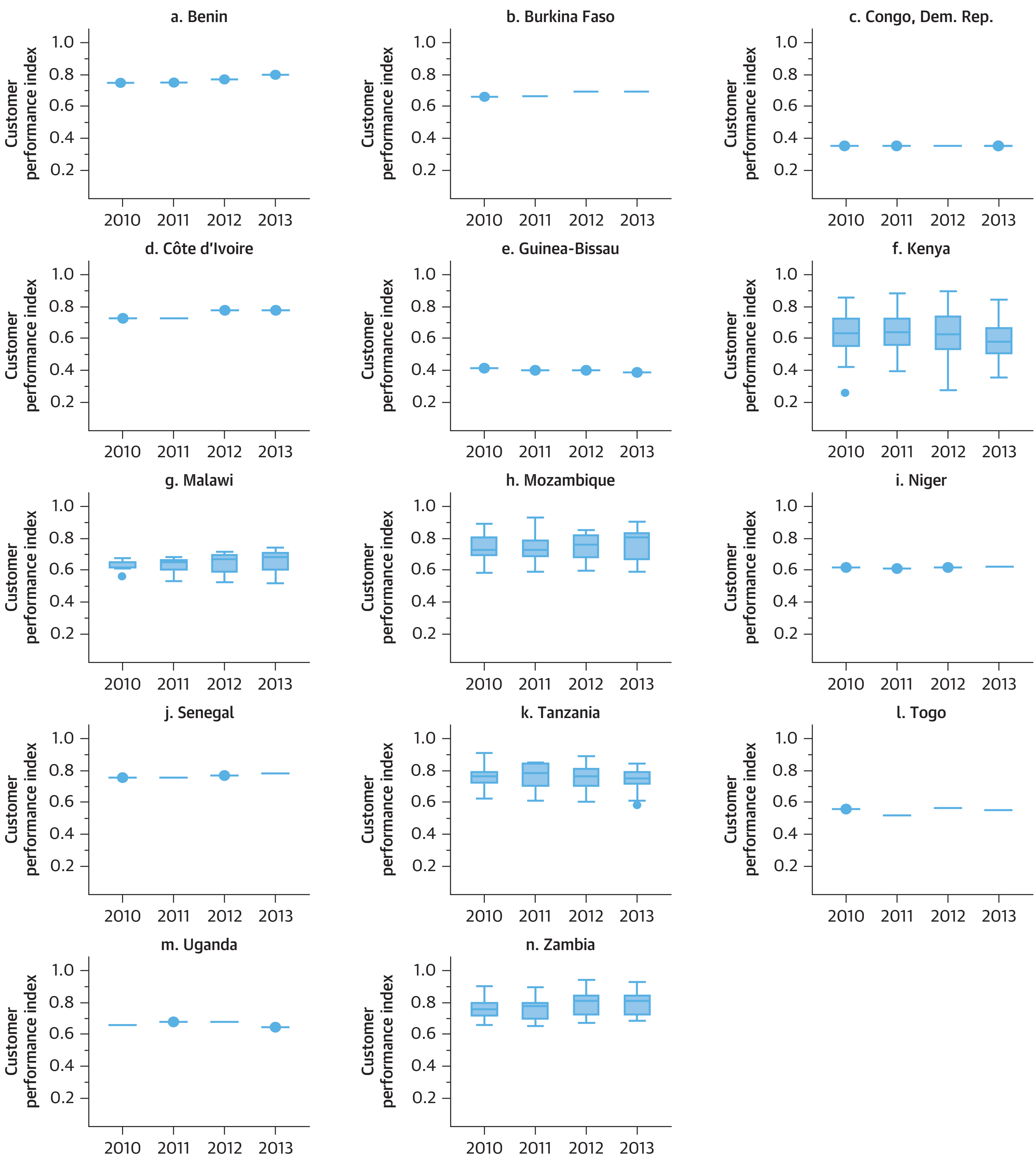


FIGURE 4.12. Customer Performance Index against African Benchmark, by Country, 2010–13



BOX 4.2. Cross-Subsidies in SDE and ONEA

Senegal's increasing block tariff structure has a subsidized social tariff for levels of consumption below 20 m^3 (CFAF 202; US$0.40) per two months. There is also a regular tariff for consumption from 21 m^3 to 40 m^3 (CFAF 697.97; US$1.39), and a "dissuasive" or discouraging tariff for consumption above 40 m^3 (CFAF 878.35; US$1.75). The dissuasive tariff is designed to be a disincentive for excessive water use. It can be seen that the tariff for household consumption of less than 20 m^3 per 60 days is less than a third of the regular tariff, and less than a quarter of the tariff for consumption in the top block. Bills are sent every two months based on meter readings, and Sénégalaise des Eaux (Senegal) (SDE) can cut off water supply for nonpayment.[a]

Nonresidential, nongovernmental customers must pay the higher tariff regardless of amount consumed. As of 2013, just 7 percent of SDE customers were classified as nonresidential, down from 33 percent in 2004. High tariffs could be a contributing factor to this trend. Government customers pay more than twice the high tariff—their tariff is CFAF 1,868.88 per m^3 (US$3.72 per m^3). The structure has been like this since 2007. In that year, the government agreed to raise tariffs for government customers by 70 percent, while keeping tariffs for other customers constant. This was introduced as a way to keep domestic tariffs from rising while still ensuring cost recovery for Société Nationale des Eaux du Sénégal (SONES) and SDE. In 2015, domestic tariffs were also raised—the lowest tariff block was raised by 4 percent and other rates were increased by 9 percent.

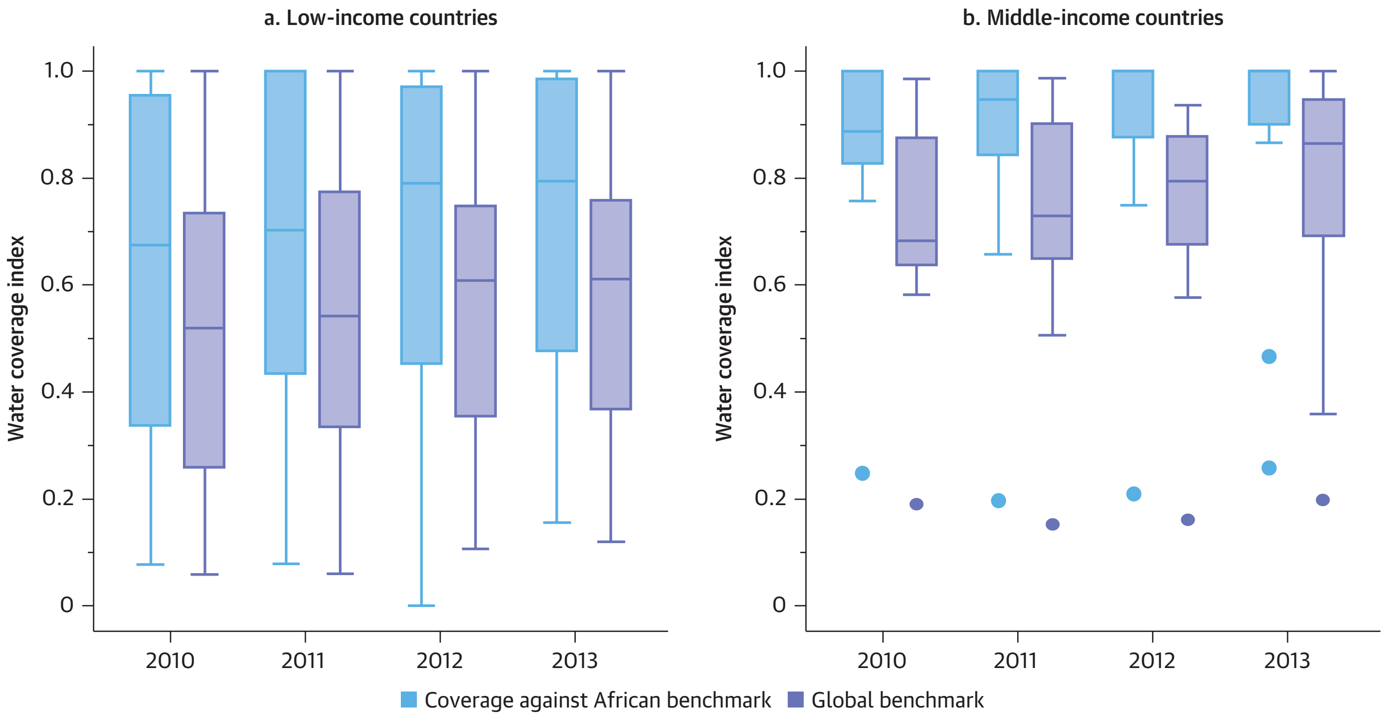
Office National de l'Eau et de l'Assainissement (Burkina Faso) (ONEA) subsidizes consumption for basic needs by charging much higher tariffs for what it regards to be excessive consumption. ONEA's tariff for the first consumption block (up to 8 m^3 per month) is just 18 percent of the tariff for consumption in excess of 30 m^3. This subsidized tariff is US$0.39 per m^3, compared with US$2.16 per m^3 for consumption above 30 m^3. The latter is designed to be a disincentive for excessive water use. There are two other residential tariff blocks—above 8 m^3 and up to 15 m^3 (US$0.89), and above 15 m^3 and up to 30 m^3 (US$1.06). The standpipe tariff is equal to the basic needs tariff (US$0.39 per m^3).[b] Nonresidential tariffs help cross-subsidize. They are set at US$2.16 per m^3 regardless of amount consumed. Industrial customers account for 5 percent of consumption by volume.

a. Every 2 months. http://sde.sn/Pages/Votre-facture-a-la-loupe.aspx.
b. ONEA, "Les tarifs," http://oneabf.com/les-tarifs/.

Water Coverage

When water coverage is also taken into account, the picture does not change significantly. Because of lower access to piped water coverage, Africa is lagging behind global benchmarks (figure 4.13). Progress is made—faster than in other dimensions of performance. It can be seen again that the variation within countries can be very large as a result of more decentralized service delivery and the inclusion of many less-established utilities in the sample

FIGURE 4.13. Water Coverage Index against African and Global Benchmarks, 2010–13



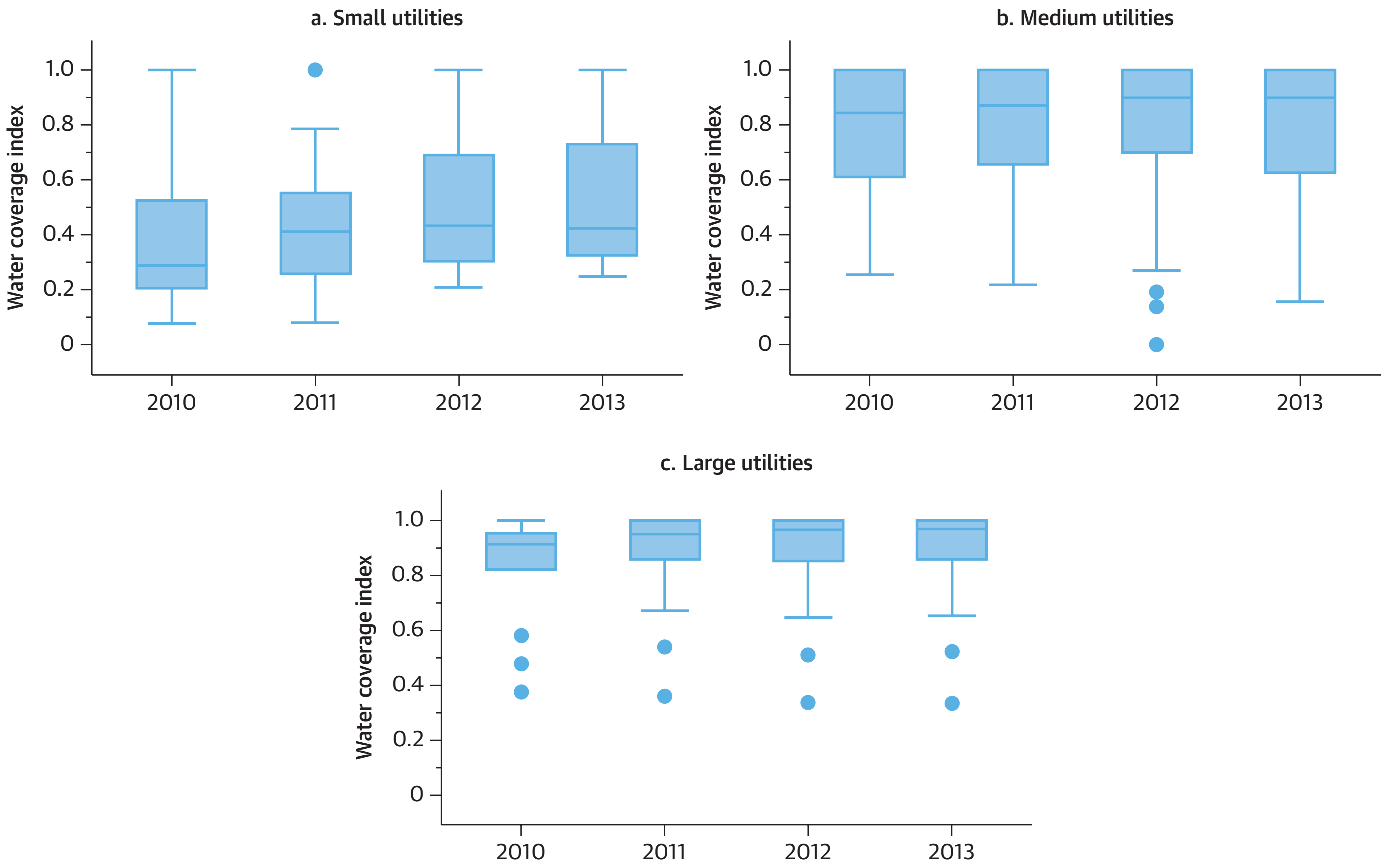
(see figures 4.14 and 4.15). Newly established, often smaller utilities tend to have much lower coverage rates than utilities that have been in business for decades, which shows essentially that the development of utilities and the provision of piped water started later in Africa than in other parts of the world.

The overall performance index shows that performance has improved marginally between 2010 and 2013 (figure 4.16). In tables 4.2 and 4.3, the best-performing utilities with regard to operational, financial, and customer performance are shown for the sample for 2013 by type of service delivery. The results show that some of the best-performing utilities in Africa are the ones you have probably never heard of. It should be noted that different definitions of performance will result in very different lists of well-performing utilities.

Different definitions of performance will result in different rankings whereas the use of weightings for different forms of performance will also result in different rankings. Yet, many utilities—even among the best-performing—show some variation in performance, not only between utilities but also within the same utility over time. This points to utilities being relatively vulnerable to factors that can affect their performance quite dramatically.

As can be seen in table 4.3 utility performance also varies between smaller and larger utilities. Smaller utilities typically have lower scores than larger utilities, but once utilities are much bigger that benefit becomes less obvious. We will look into the importance of economies of scale in water supply service delivery in the chapter 5.

FIGURE 4.14. Water Coverage Index against Global Benchmark, 2010–13



Utilities under a regulator do not show better performance than those that are not under a regulatory regime, but these utilities tend to show less variance in performance than those utilities that are not subject to regulation (figure 4.17). The difference in standard deviation in the overall performance index is significantly lower with regulation, suggesting that regulation may have a positive impact on reducing vulnerability in utility performance.

DEA Efficiency

A data envelopment analysis (DEA) was conducted to measure the relative efficiency of utilities. The DEA creates a performance index from indicators—referred to as inputs and outputs in the DEA literature—that can be related to other factors that drive performance. Under basic DEA, a water utility is regarded as a relatively efficient utility if its observed inputs can be scaled to yield outputs that equal or exceed any combination or scaling of what other utilities' observed. Productive efficiency was assessed through a DEA. Water billed was considered as the major output while number of staff and number of connections are considered as inputs.

FIGURE 4.15. Water Coverage Index, by Country, 2010–13 against African Benchmark

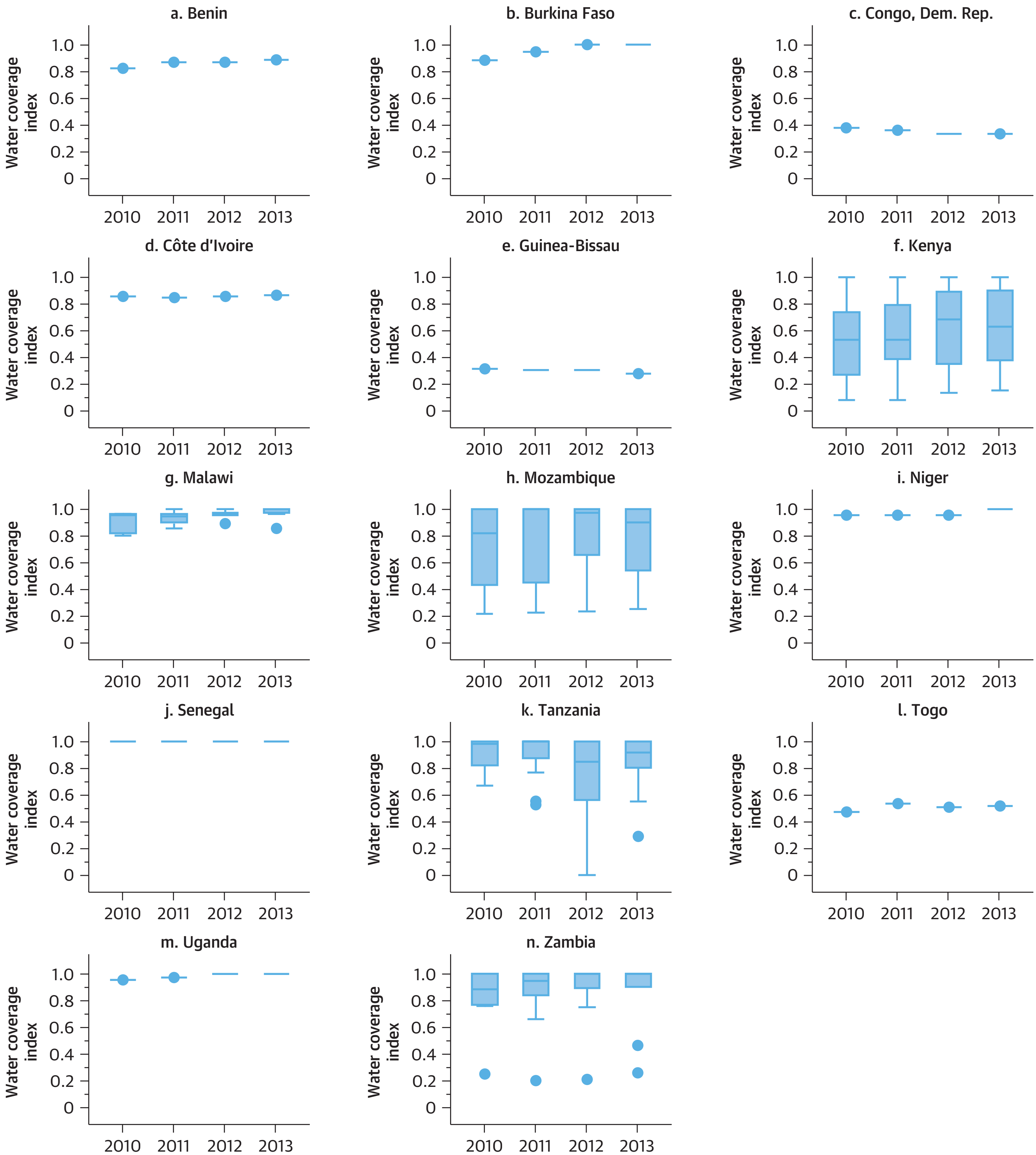


FIGURE 4.16. Overall Performance Index (Unweighted Average of Operational Performance, Customer Performance [Service Quality], and Financial Performance) against African Benchmark, 2010–13

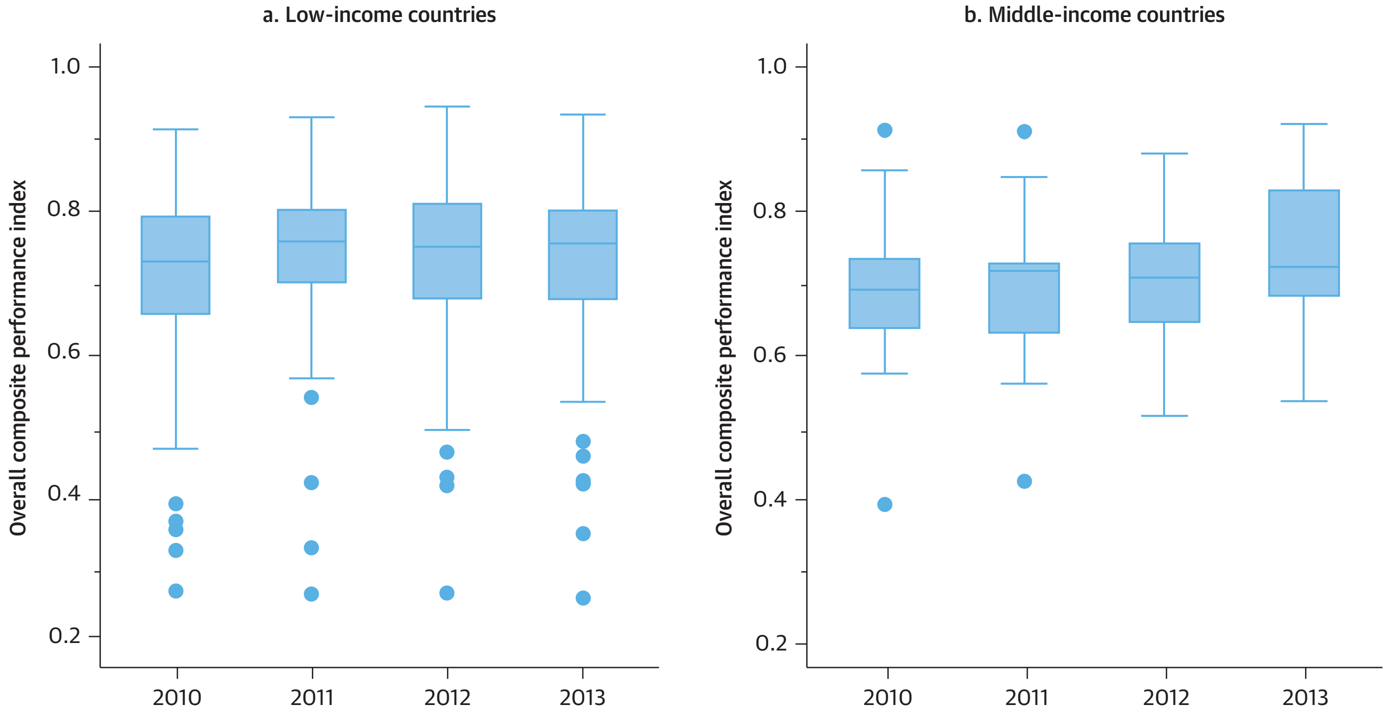


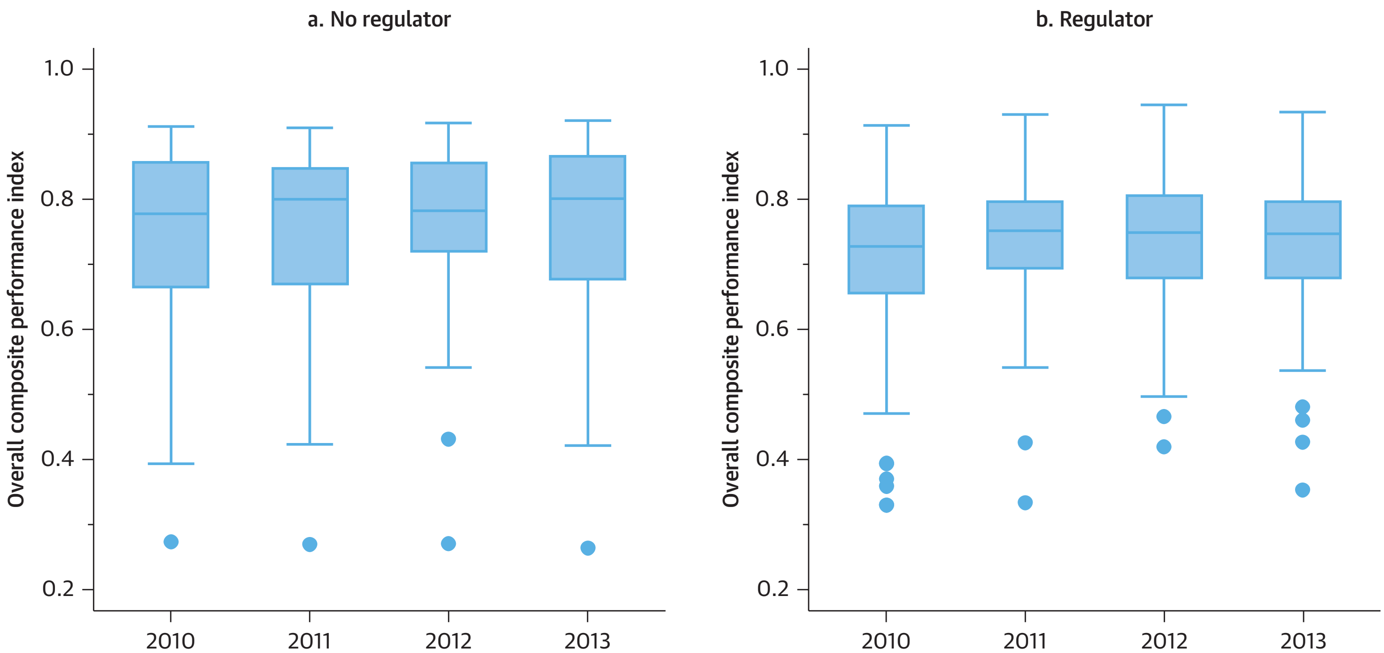
TABLE 4.2. Best-Performing Utilities in 2013: Unweighted Average of Operational Performance, Customer Performance (Service Quality), and Financial Performance

National		Regional		Municipal/District	
Senegal, SDE	0.94	Malawi, SRWB	0.88	Kenya, Kiamumbi	0.93
Uganda, NWSC	0.92	Zambia, North Western WSC	0.85	Kenya, Nyeri	0.90
Côte d'Ivoire, SODECI	0.89	Zambia, Southern WSC	0.83	Tanzania, Tanga	0.87
Burkina Faso, ONEA	0.89	Malawi, NRWB	0.83	Kenya, Lodwar	0.88
Benin, SONEB	0.83	Malawi, CRWB	0.82	Kenya, Olkalou	0.88

TABLE 4.3. Relationship between Utility Performance (Unweighted Average of Operational, Financial, and Customer Performance) and Utility Size

Band size by population served	Standard deviation	Bottom 25 percent	Median	Top 25 percent	Maximum
<50,000	0.129	0.624	0.697	0.697	0.959
50,000–500,000	0.112	0.691	0.768	0.768	0.941
>500,000	0.134	0.705	0.750	0.886	0.940

FIGURE 4.17. Overall Performance Index (Unweighted Average of Operational Performance, Customer Performance [Service Quality], and Financial Performance) against African Benchmark, by Presence of a Regulator, 2010–13



This study assessed the relative performance of water utilities in terms of relative productive efficiency using DEA and investigated the role of governance as a driver of relative performance. Analysis of relative performance was conducted for water and wastewater providers from 17 countries in the Africa region, providing a sample representing 130 million people living in the service area of the utilities. The sample utilities served more than 85 million people during 2013. All available observations from these utilities for each year for the period 2010–13 were used in the analysis. The detailed methodology is provided in appendix D.

DEA employed International Benchmarking Network for Water and Sanitation Utilities (IBNET) data. Water billed was considered as the major output while number of staff and number of connections were considered as inputs representing labor and capital, respectively. DEA assigns a number between 0 and 1 to each water utility which describes how efficient the utility is in transforming capital and labor inputs into water output relative to other utilities in the sample. In this scheme, 1 signifies that a utility is efficient when compared with the other utilities in the sample. Hence, DEA efficiency is relative to the other utilities in the sample and may not indicate superior performance in a broader context.

A water utility is regarded as a relatively efficient utility if its observed inputs can be scaled to yield outputs that equal or exceed any combination or scaling of what other sample

FIGURE 4.18. DEA Frontier

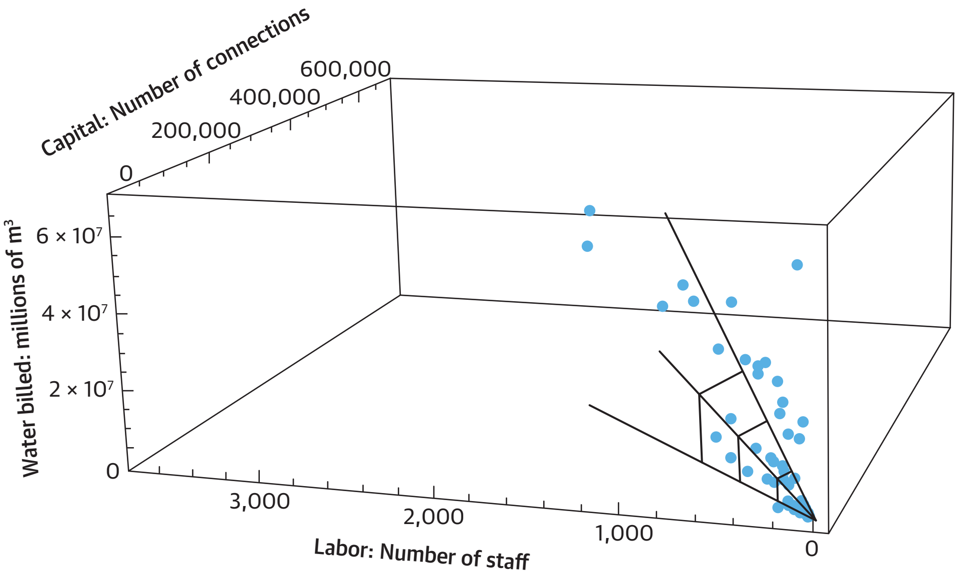
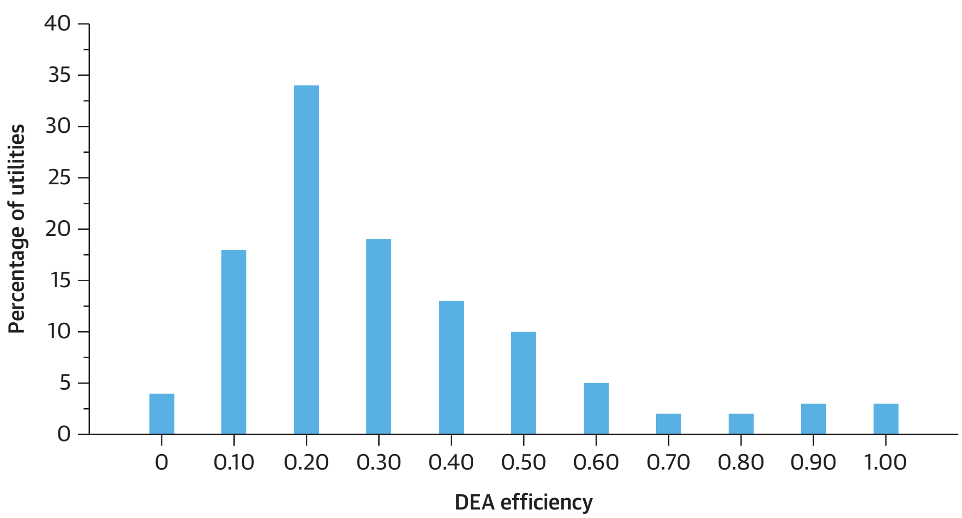


FIGURE 4.19. DEA Assessment of Relative Efficiency



utilities' observed. Scaling of efficient utilities describes a surface which shows the maximum output achievable for every capital and labor combination as far as can be gleaned from the sample of utilities. Figure 4.18 shows a DEA efficiency frontier which is formed by scaling efficient utilities in the sample during 2010. Inefficient utilities are depicted as points below the surface in the figure.

Summary of the results presented in the Figure 4.19:

Only two or three of the utilities in the sample maintain a higher than average level of performance, while the vast majority of utilities do not perform efficiently. This can be seen from year-to-year assessments, where the same set of utilities maintain the highest performance status (table 4.4). These are utilities from Zambia and Mali while in certain years utilities from Senegal and Kenya were also included, reflecting those utilities that need the lowest level of inputs to achieve the highest output of water produced. However the vast majority of the remaining utilities perform far below the most efficient utilities.

Transparency International's Corruption Perceptions Index (CPI) was tested against DEA for correlation. The hypothesis is that a positive correlation between DEA relative efficiency and the CPI indicates that DEA relative efficiency is associated with good governance.

This outcome, including the magnitude of the correlations, suggests that governance may be a driver of efficiency in the water sector. Correlation, of course, does not prove causation.

TABLE 4.4. Best Five Utilities' Relative Performance, by Year, 2010–13

Country	Utility name	DEA score
2010		
Zambia	Mulonga WSC	1.0000
Kenya	Nol Turesh	1.0000
Zambia	Lukanga WSC	0.9189
Zambia	Nkana WSC	0.9117
Senegal	SDE	0.8465
2011		
Zambia	Mulonga WSC	1.0000
Kenya	Gulf	1.0000
Mali	SOMAPEG	1.0000
Zambia	Lusaka WSC	0.8544
Zambia	Lukanga WSC	0.7782
2012		
Mali	SOMAPEG	1.0000
Senegal	SDE	1.0000
Zambia	Lukanga WSC	1.0000
Zambia	Luapula WSC	0.8544
Zambia	Mulonga WSC	0.7782
2013		
Zambia	Mulonga WSC	1.0000
Zambia	Luapula WSC	1.0000
Zambia	Lusaka WSC	0.9149
Zambia	Lukanga WSC	0.8395
Mali	SOMAPEG	0.7384

TABLE 4.5. Correlation between DEA Relative Efficiency and the CPI for Each of the Years, 2010–13

Year	Correlation coefficient
2010	0.6707
2011	0.4225
2012	0.4369
2013	0.5023

Even so, the correlations are positive for each year and large enough to cast serious doubt about their nature being coincidental (see table 4.5).

Conclusions

The overall composite performance index measures several features of good performance defined as operational, financial, and customer performance. As this is an aggregated index, the number of utilities that provide data on all dimensions of performance is not always even. A sample of about 120 utilities shows that there are well-performing utilities in Africa. African utilities tend to be better performing on aspects such as financial and operational performance. In these dimensions of performance, the best of Africa's water utilities are among the best globally (as measured in the IBNET database). But as far as customer performance is concerned, measuring the quality of access, there are still utilities that show good performance, but in general African utilities tend to lag significantly behind global benchmarks. The same is true for water coverage, where African utilities in general do not meet global benchmarks.

When the data are disaggregated at the utility level, huge variations in utility performance are detected—both positive and negative. Hence, utilities can improve their performance dramatically over a span of four years (that is, the time period over which it was possible to analyze the data while maintaining a balanced data panel) but performance can deteriorate equally rapidly, which shows that the performance of utilities in the sector is vulnerable. This vulnerability is especially evident in the smallest and the largest utilities where the standard deviation in the performance index is about 30 percent higher than in utilities that are more medium-size. Utilities that are being regulated in some formtend to show less variance in performance than those utilities that are not subject to a more or less formal set of regulations.

The DEA efficiency analysis showed that although there are some relatively efficient utilities in Africa they make up a small minority. The majority of utilities register an efficiency of 0.30 (which is far below the highest score of 1), showing significant options for improvement. This is not unexpected as most African utilities are not yet mature in terms of coverage, service levels, and consumption levels—often experiencing rationing—and hence inputs less easily translate into outputs. Zambian utilities tend to perform the best in terms of both absolute performance and DEA, and at the same time Zambia is a middle-income country with relatively high coverage and consumption levels compared with many other utilities in Africa. It is important to notice that Mali Water (SOMAGEP) also keeps a high level of performance, despite its recent (2008) split with the National Electricity Company, *Electricité-de-Mali, EdM*, that apparently provided some indirect support to water operations in earlier years. Senegal SDE also shows up in the list of more efficient utilities, but not as systematically as the utilities in Mali and Zambia. DEA tests also show that governance may be a significant driver of water utility performance in Africa and that attention to improving governance may be key to improving performance in water utilities.

Notes

1. The countries included in this sample are Benin, Burkina Faso, Côte d'Ivoire, Kenya, Malawi, Niger, Tanzania, and Zambia. The more complex the indicator becomes, the more likely it is that not all utilities report the data. Hence, the sample loses more than half of its national utilities, whereas the only municipal utilities in this sample come from Tanzania.
2. Affordability is measured as the revenues per capita per year as a percentage of the GNI per capita in the country. The higher the ratio, the more people have to pay for water and the less affordable the service is. It should be noted that piped water access is rarely equally distributed over a country, and most piped water is provided to urban areas, and within these urban areas, more into richer than lower income neighborhoods. Affordability may have an upward bias and actual affordability may be lower than the calculation provided here.

Chapter 5 Performance of Utilities in Africa: Institutional Factors

The IBNET Toolkit includes organizational data, including data on human resources policies, business planning, and so on. Yet, collecting this data turned out to be more challenging than collecting operational and financial data. We have some data on the use of private sector participation in utilities, but the response rate with data on HR policies, planning processes, and customer service was in general very poor, which can result in serious sample biases. Hence, as theory suggests that institutional and organizational factors play an important role in the delivery of water services, we will use the case study approach (in chapter 7) to take a look into these organizational data where possible. In addition, the team collected data—outside the primary data collection effort from secondary sources—that included information on politics and governance at the country level, the role of regulation, the role of different service models (national versus subnational levels of service delivery), and the scope of service delivery (for example, utilities providing only water services).[1] The impact of economic development on utility performance was also tested. The team tested several indicators from the Polity Project, but none of these indicators showed any statistical significance. This may be linked to the fact the utilities and the countries in which they are located are not a random sample, and hence may show too little variance with respect to many of these indicators to generate statistically significant results.

Role of Economic Development

Economic development has a positive impact on customer performance indicators as can be seen in table 5.1. In middle-income countries, water coverage is higher than in low-income countries, and so is the quality of the service provided. Interestingly, operational performance is better in low-income countries and significantly so. This result may be linked to the relatively small number of utilities in middle-income countries included in the sample. Financial performance when measured with the operating cost coverage ratio (OCCR) is not significantly different between low- and middle-income countries; the variation within countries with respect to this indicator tends to be large.

Economic development translates into more consumers (that is, higher water coverage) using more water (that is, higher water consumption), and as such the annual revenues per capita increase rapidly, giving the utilities a more significant revenue flow. In the sample of African utilities, the median per capita total water consumption is only 52 lcd in low-income countries compared with 92 lcd in middle-income countries. When looking at residential water consumption—with a much smaller sample as not all utilities disaggregate consumption data—total residential water consumption is only 32 lcd in low-income countries, compared with 78 lcd in middle-income countries. This low residential consumption provides utilities with a very small revenue basis, but the very low consumption also may make it less compelling for water consumers to use water and/or connect to the supply compared with other water sources at least with regard to service delivered. Hence, increasing coverage and residential consumption may be needed to improve customer and financial performance in the long run. If customers have access to more piped water to consume, the benefits of piped water are more apparent compared with other water supply sources. This focus on improving the infrastructure will require, in the short term, more investments in the sector to improve water coverage and a level of residential water consumption that sets piped water apart from alternative water sources (and in line with WHO public health standards of residential water consumption of at least 50–100 lcd). This increase in investments requires major improvements to ensure that the sector can absorb these investments and use the capital invested more efficiently, including but not limited to (a) detailed analysis of demand for piped water to

TABLE 5.1. Impact of Economic Development on Utility Performance

Indicator	Low-income countries	Middle-income countries	t-test	Significance
Customer performance				
Customer performance as measured by quality of service	0.67	0.77	−5.12	0.000
Water coverage	0.56	0.73	−4.57	0.000
Financial performance (measured by OCCR)	1.06	1.08	−0.44	0.329
Operational performance	0.71	0.51	8.09	0.000

ensure that investments pay off; (b) selecting water supply investments whose benefits exceed their full life-cycle costs; and (c) transparent financing policies that underpin better investment selection.

Role of Regulation

Regulation has been promoted as a tool for improved utility performance while protecting customers. The sample contains three forms of regulation: (a) through government ministries or departments; (b) regulation by contract; and (c) a regulatory authority or agency. The presence of a regulatory agency is not necessarily randomly assigned across countries. In the sample, regulators were present in Niger (western Africa) and Kenya, Mozambique, Tanzania, and Zambia (eastern and southern Africa). As most regulating agencies are active in countries where regional- or district-level utilities are active, the sample contains many utilities under the regime of a regulatory agency and very few under any of the other types of regulation.

A t-test analysis shows that having a regulatory agency in place does not automatically result in better performance. With regard to customer protection, regulation is effective in Africa. As can be seen in table 5.2, service quality is higher in utilities under a regulatory regime than in those that are not. Yet, with regard to water coverage, which includes potential customers, utilities under a regulatory regime show lower water coverage than those that do not have such a system in place. With regard to financial and operational performance, utilities with regulation perform poorer than those without a regulator in place. This is linked with the fact that the average size of a utility (as measured in population served) under a regulatory regime is about 204,000 compared with 2.5 million for those utilities whose performance is not supervised by a regulatory agency. The difference in scale may be part of the explanation why having a regulator in place results in lower financial and operational performance.

Role of Service Delivery Models

The Dublin principles defined in the 1990s made the point that water utility services should be delivered at the lowest appropriate level of government. The sample contains three types of utilities: (a) national; (b) regional; and (c) municipal. National utilities are mostly

TABLE 5.2. Impact of a Regulatory Agency on Utility Performance

Indicator	With a regulatory agency	Without a regulatory agency	t-test	Significance
Customer performance				
Customer performance as measured by quality of service	0.69	0.63	−3.25	0.0006
Water coverage	0.57	0.65	1.75	0.040
Financial performance (measured by OCCR)	1.06	1.05	−0.28	0.612
Operational performance	0.68	0.76	3.01	0.001

concentrated in western and central Africa. The median size of these utilities shows a large variance. The typical municipal utility serves 87,000 people, the typical regional utility serves 261,000 people, and the typical national utility 2.7 million people. Hence, there is a huge difference in size and likely economies of scale between these different utilities. All the municipal service providers in the sample are located in low-income countries and regional utilities are present in both low- and middle-income countries. The effect of decentralization will be examined only in low-income countries.

The results of the effect of decentralization on utility performance are shown in table 5.3. It should be noted that only three countries[2] in the sample use municipal or district service delivery and they are all located in low-income countries. The results show the same ambiguity in results as found in Estache (1995). As far as financial performance is concerned as measured by the OCCR, the effect of municipal service delivery is similar to that of utilities that deliver services through regional or national utilities. Customers from municipal utilities spend significantly less on water than consumers served by other types of utilities. This lower spending comes at a price as customers consume less water. As tariffs are not significantly different from other types of utilities, water services provided by municipal utilities are much more affordable, which explains most of the better customer performance linked to municipal utilities.

Similar to Estache (1995), the team found that decentralization tends to have a negative impact on labor productivity. Yet, even though national utilities tend to have higher labor productivity (fewer staff per 1,000 people served), the employee costs are significantly higher, with the result that the share of labor costs in total operating expenses does not necessarily decline with improvements in labor productivity (table 5.4).

Levels of decentralization are highly correlated with certain Country Policy and Institutional Assessment (CPIA) indicators[3] as can be seen in table 5.5. Municipal service delivery is highly correlated with four CPIA cluster indexes, which themselves are also highly correlated. The question arises whether municipal service delivery is more likely to occur when the overall economic environment is more conducive or municipal service delivery builds a more conducive economic environment.

TABLE 5.3. Effect of District or Municipal Service Delivery on Utility Performance in Low-Income Countries

Indicator	Municipal service delivery	Non-municipal service delivery	t-test	Significance
Customer performance				
Customer performance as measured by quality of service	0.68	0.61	−3.63	0.000
Water coverage	0.55	0.63	1.90	0.029
Financial performance As measured by OCCR	1.06	1.03	−0.42	0.373
Operational performance	0.71	0.72	0.36	0.643

TABLE 5.4. Labor Productivity and Labor Cost per Employee

Type of utility	Median labor productivity measured as staff per 1,000 people[a]	Median annual staff cost per employee (US$)
National	0.31	12,578
Regional	0.86	9,201
Municipal	0.92	4,563

a. We used staff per 1,000 people for two reasons: (a) the number of missing observations on staff per 1,000 connections is relatively high and especially prevalent in western Africa and (b) sharing of connections is relatively high in many utilities—either the sharing of house connections or the dependence on public taps. This results in high staff numbers per connection, as there are relatively few connections compared to an environment where most households do not share connections.

TABLE 5.5. Correlation between CPIA Indicator Clusters and Level of Decentralization

Variable	District/ Municipal service delivery	Economic management	Structural policies	Public sector management and institutions	Policies for social inclusion
Municipal service delivery	1.0000				
Economic management	0.8157	1.0000			
Structural policies	0.6155	0.6212	1.0000		
Public sector management and institutions	0.5259	0.7003	0.4756	1.0000	
Policies for social inclusion	0.6113	0.5898	0.6690	0.7257	1.0000

TABLE 5.6. Correlation between CPIA Indicator Clusters and Utility Performance Indicators

Variable	Customer performance		Financial performance		Operational performance
	Water coverage	Customer performance	OCCR	OCCR dummy	
Economic management	−0.1017**	−0.0010	0.0631	−0.0418	0.2446***
	(0.027)	(0.984)	(0.177)	(0.365)	(0.000)
Structural policies	−0.1562***	0.0742	0.1685***	0.0178	0.0929**
	(0.000)	(0.108)	(0.000)	(0.699)	(0.045)
Public sector management and institutions	0.1000**	0.1440**	0.1010**	−0.0389	0.3333***
	(0.030)	(0.017)	(0.030)	(0.399)	(0.000)
Policies for social inclusion	−0.0820*	−0.0026	0.1173**	−0.1063**	0.2594***
	(0.076)	(0.956)	(0.012)	(0.021)	(0.000)

*$p < 0.10$, **$p < 0.05$, and ***$p < 0.01$.

Customer performance is especially weakly correlated to the quality of the country's political and institutional environment, as can be seen in table 5.6. Higher scores for public sector management and institutions are correlated with better customer performance (and hence higher service quality). Water coverage—mostly the result of large investment programs—is correlated (albeit weakly) to better economic management and structural policies. Yet, the effect is negative; higher scores for economic management and structural policies are correlated with lower levels of water coverage. Yet, higher scores of public sector management are correlated with higher water coverage.

Financial performance is weakly correlated with higher scores of structural policies, and public sector management. Operational performance is correlated with higher scores of all CPIA cluster indicators, but the correlations are still rather weak. More research is needed to understand how the political and institutional country environment affects utility performance, beyond these highly aggregated country indicators.

Economies of Scale and Scope

In many countries, there is a trend to agglomeration, to essentially enable utilities to benefit from economies of scale in service provision. Hence, the performance of larger utilities (utilities with more than 1 million people served) and of those that serve smaller populations have been compared.

Tables 5.7 and 5.8 show that the effect of scale on utility performance by size of utility is not showing a straightforward picture. Customer performance (that is, service quality) is lower in large utilities than in smaller utilities, but medium-size utilities do better than the smallest utilities. For operational performance, a similar pattern of a concave relationship can be seen.

Yet, water coverage is not significantly different between smaller and larger utilities. The effect of scale on utility performance is much more difficult to detect. The size of the utility

TABLE 5.7. Effect of Scale on Utility Performance

Indicator	Small utilities	Large utilities	t-test	Significance
Customer performance				
Customer performance as measured by quality of service	0.703	0.648	2.57	0.010
Water coverage	0.669	0.667	0.18	0.468
Financial performance As measured by OCCR	1.10	1.03	−1.60	−0.109
Operational performance	0.723	0.696	−0.92	−0.179

TABLE 5.8. Economies of Scope on Utility Performance in Low-Income Countries

Indicator	Water and wastewater utilities	Water utilities only	t-test	Significance
Customer performance				
Customer performance as measured by quality of service	0.705	0.670	−2.16	0.016
Water coverage	0.700	0.671	−3.28	0.000
Financial performance (as measured by the OCCR)	1.107	0.971	−4.65	0.000
Operational performance	0.764	0.700	−3.38	0.000

seems to have little effect on the median OCCR (that is, financial performance) or operational performance. The effect of the importance of economies of scale will be tested in chapter 6.

Conclusions

A utility operates in a particular local context. Although an attempt was made to collect organizational data that reflect the characteristics of the particular utility, these data were difficult to collect as the response rate was low (possibly because the team collected a relatively large set of data). Hence, the team used a set of national-level factors that describe the general environment in which utilities operate at the country level. In follow-up work, it is recommended that more attention is paid to collecting organizational data from utilities, as this may help improve the understanding of how institutional and organizational factors affect utility performance. As seen in previous chapters, the quality of governance seems to matter for good utility performance.

Institutional factors play a role in driving utility performance but not necessarily always in the way that is predicted. Regulation is often seen as a shortcut for ensuring better governance in the sector.[4] Yet, the analysis shows that having a regulatory agency in place does not automatically produce better results for customers. In low-income countries, the presence of a regulator results in better customer performance, but having a regulator in place does not extend to other forms of performance, such as operational performance or water coverage. This is as expected because the objective of a regulator is to provide "protection" of existing customers (and hence focuses on providing minimum levels of customer service) but does not necessarily focus on improvements in financial and operational sustainability or improvements in coverage compared with utilities without a regulator.[5]

Decentralization's normally held assumption that service provision at local level tends to increase accountability and improves utility performance is only partially borne out by the analysis of the utilities. The financial and operational performance of utilities is not statistically significantly different from other forms of service delivery. As for customer performance, there are statistically significant differences: district- or municipal-based service delivery shows better results. Yet, coverage lags behind in municipal- or district-based service delivery compared with other levels of service delivery.

The team also looked into the presence of economies of scale and scope. The effect of scale was not easy to detect in the sample, but that might have to do with the fact that there were few very large utilities in the sample and these tend to be mostly concentrated in the category of national utilities. However, economies of scope are evident. Utilities that provide water and wastewater services in low-income countries tend to show slightly higher levels of water coverage (as can be expected because sewerage coverage is provided sequentially after a certain level of water coverage has been achieved). But customer performance (or service quality), operational performance, and financial performance are also higher when sewerage is also provided.

Finally, the level of economic development matters. Economic development translates into more consumers using more water, and as such the annual revenues per capita increase rapidly, giving the utilities a more significant revenue flow. If customers have access to more piped water to consume, the benefits of piped water are more apparent compared with other water supply sources. This focus on improving the infrastructure will require, in the short term, more investments in the sector to improve water coverage and a level of water consumption that sets piped water apart from alternative water sources. At the same time, as economic development accelerates and water consumption increases, the nature of the service changes with more emphasis on wastewater collection and treatment, which will add additional expensive investments to be funded. In the provision of water and wastewater infrastructure, lock-in effects of infrastructure, technology, and product design are a major challenge. In Africa, where a major part of the infrastructure necessary to meet water and wastewater demand is still to be built, the range of alternatives is considerably larger than elsewhere, but will require the adoption of better urban and regional planning, more efficient water, wastewater, and drainage systems, and improvements in investment planning. However, to move in this direction, major barriers, especially institutional and cultural barriers, must be overcome.

Notes

1. The team collected data on private sector participation, but this indicator largely overlapped as most national utilities in the sample also use some form of private sector participation.
2. In the period under review, Kenya, Mozambique, and Tanzania had district-level service delivery. Yet, since then Mozambique has merged its utilities into four regional utilities.
3. CPIA database at www.databank.worldbank.org.
4. Countries that have a regulatory agency in place show higher indexes for public sector management and institutions (as measured by the CPIA) as there is reference in the definitions of CPIA to the existence and functioning of regulatory agencies in the quality of public administration definition (part of the public sector management and institutions overall index).
5. It is unclear whether this is the result of the higher service levels, higher labor costs (as labor efficiencies coincide with higher staff cost per employee), the existence of higher transaction costs for the utility operators, or a multitude of other factors.

Reference

Estache, Antonio, ed. 1995. "Decentralizing Infrastructure: Advantages and Limitations." Discussion Paper 290, World Bank, Washington, DC.

Chapter 6 Drivers of Utility Performance: Panel Data

The panel data of 119 utilities used in the previous chapters is used in this analysis. As mentioned above these utilities represent a significant proportion of the population that was served by piped water in 2013: 58 million out of 108 million people. As possible drivers of performance, a number of country-specific and utility-specific characteristics were tried. The variables that proved to be significant and that were kept in the final version of the models are shown in table 6.1.

The different forms of utility performance are weakly correlated, as can be seen in table 6.2. This may be a surprising result because the hypothesis laid out in figure 4.1 translating good operational performance into better financial performance is hence not borne out by the econometric analysis. Such an improvement allows the utility to generate excess funds that could—once the utility generates sufficient cash to pay for operation and maintenance (O&M) costs, depreciation, and debt service—be used for improvements to service levels or water coverage. The hypothesis is that once the customer experiences improved service level, the utility will be able to generate more revenues that then can fund further improvements in operational and/or customer performance. This virtuous cycle seems to be far from robust when analyzing the data of close to 120 utilities. Table 6.2 shows that there is a weak, albeit statistically significant, correlation between financial performance and operational performance. There is also a weak correlation between financial and customer performance, but it is negative, suggesting that better customer performance (in terms of better quality of service) is correlated with lower levels of financial performance. Access to water services is not correlated to financial performance.

TABLE 6.1. Explanatory Variables Used in the Performance Models

Variable name	Variable definition	Level of observation	Measurement unit
Popserved_water	Population served with water	Utility	1,000,000
Share_laborcost	Share of labor cost in total operational costs	Utility	%
Operational_performance indicator	Operational performance as defined in chapter 4	Utility	0–1 (continuous)
Customer_performance indicator	Customer performance (service quality) as defined in chapter 4	Utility	0–1 (continuous)
Average revenues per cubic meter sold	Total operating revenues per volume water sold in U.S. dollars	Utility	US$
Water consumption	Water consumption per person served (in lcd)	Utility	
Sewerage coverage	Presence of sewerage coverage	Utility	0/1 (dummy)
GNI per capita	GNI per capita (Atlas method)	Country	US$ (current)
Share-urban	Proportion of urban population	Country	%
Large-utility	Takes the value 1 if water services are managed by large utility	Country	0/1 (dummy)
CPIA_economic_management	The higher the value, the better the economic management	Country	1–6
CPIA_transparency	The higher the value, the more transparency	Country	1–6
Trend	Time trend	n.a.	1 (in 2010) to 4 (in 2013)

Note: n.a. = not applicable.

TABLE 6.2. Correlation between Technical and Financial Performance for Water Utilities

Variable	Financial performance	Operational performance	Customer performance	Water coverage
Financial performance (OCCR)	1.0000			
Operational performance	0.1830 (0.0001)	1.0000		
Customer performance (service level)	−0.1365 (0.0034)	0.0573 (0.2469)	1.0000	
Water coverage	−0.0445 (0.3423)	0.1933 (0.0000)	0.3844 (0.0000)	1.0000

Yet, water coverage and quality of service levels are correlated; hence customers seem to be more willing to connect when service levels are higher.

The relatively weak correlation between different performance indicators may be surprising when assuming there is a linear relationship between them, in which better operational performance results in better financial performance which in turn can result in better service delivery to the customers. Yet, this linear approach does not always work. For instance, if the utility increases the level of metering, this should, in theory, result in more revenues for the utility and hence improve the ability of the utility to cover its costs. Yet, if the cost of the metering program (in terms of the O&M costs to manage such a metering program) exceeds the benefits of the metering program, the effect on financial performance of the utility can be negative, even with an increase in revenues. At the same time, the metering program will reduce consumption, which may result in consumers being less willing to pay for the service—resulting in lower consumption levels. In the case of Africa, where many connections are shared, it might also affect the willingness to share connections and could even affect water coverage. Hence, the specific outcomes of different measures to improve utility performance are not given but are highly dependent on the context in which they take place.

In the next sections, the drivers of different aspects of performance will be examined—specifically the drivers of financial performance, water coverage, and customer performance (as measured by the quality of service levels).

Financial Performance

Several models have been used to explain what drives financial performance. As discussed in chapter 3, the typical utility has an operating cost coverage ratio (OCCR) of about 1 in the sample. As such, there are many utilities that have a minimum financial performance. The best-fitting model was the one where a dependent variable that takes only two values was used: 1 if the utility has an OCCR of more than 1.19 (found in the best performing 25 percent of utilities) and 0 if it does not.

The appropriate econometric method to use when the dependent variable is binary is a Probit or Logit model, which describes the probability that the dependent variable takes the value 1. Here a Probit approach was used to be able to control for utility-specific unobserved heterogeneity. The latter may include unobserved variables such as the skills of the utility's manager; the physical location of the area serviced by the utility (topography, distance to and quality of the raw water sources); the technology of the infrastructure; and any other unobserved specific conditions that the utility may face and that could affect its financial performance. Controlling for unobserved heterogeneity is crucial in the presence of panel data, to avoid biased estimated coefficients.

The model has been estimated using 427 observations corresponding to 116 distinct utilities (see table 6.3). The sample size is slightly reduced compared with the original sample because of missing observations for some of the utilities. The Wald test indicates that the model is globally significant. The value for the parameter rho, at the bottom of the table, indicates that 64 percent of the total variance is contributed by the panel-level variance component that is the unobserved utility-specific heterogeneity.

The results show that both utility-specific and country-specific characteristics influence the probability that utilities are performing well financially. When utilities achieve a better

TABLE 6.3. Drivers of Financial Performance, Random-Effects Probit Model

Financial performance (0/1)	Coef.	T-test	P > z
Utility-specific variables			
Operational performance	1.817*	1.72	0.085
Customer performance (quality of service levels)	−2.405**	−2.11	0.035
Popserved_water	1.448***	3.14	0.002
Popserved_water ^2	−0.186**	−1.61	0.022
Staff efficiency	0.3157***	3.71	0.000
Operation and maintenance cost per cubic meter of water produced	−1.285***	−2.80	0/005
Country-specific variables			
GNI_per capita	0.002***	2.61	0.009
CPIA_transparency	0.3149	0.47	0.640
Trend	−0.170	−1.63	0.103
Constant	−3.523	−1.64	0.101
Number of observations	427	n.a.	n.a.
Number of utilities	116	n.a.	n.a.
Wald chi^2 test (*p*-value)	35.82***	(0.000)	n.a.
rho (*p*-value of test: rho = 0)	0.64*	(0.083)	n.a.

Note: n.a. = not applicable.
$^{*}p < 0.10$, $^{**}p < 0.05$, and $^{***}p < 0.01$

operational performance, this reflects positively on the utility's financial performance. Higher service quality is negatively correlated with the probability of achieving better financial performance. This suggests that achieving higher service quality results in costs, whereas lower service quality results in lower revenues, either one affecting the OCCR; albeit that the effect of better operational performance is stronger than the effect of better customer performance.

Utilities of larger size (as measured by the size of the population served with water) are more likely to be good financial performers, but once the utility reaches a certain critical size, the likelihood of being a financially well-performing utility decreases (the coefficient of the square of the variable measuring population served is negative), signifying the existence of economies of scale. Utilities for which staff efficiency (the revenues generated by each employee as a percentage of their costs) is higher tend to have better financial performance than those that have lower efficiency. Utilities with higher O&M cost per cubic meter of water produced tend to perform worse than those with lower O&M cost. Utilities that operate in poorer countries (as measured by the gross national income [GNI] per capita) are less likely to be financially good performers. Finally, the coefficient of the trend variable is negative, which indicates an overall decrease in financial performance over time.

Customer Performance

Water Coverage

The water coverage index can be used as a continuous variable. The model uses 468 observations covering 119 distinct utilities. It is controlled for utility-specific heterogeneity and utility-specific unobserved effects are specified as fixed effects in the model. Estimation results are shown in table 6.4. The Fisher test indicates global significance of the model and overall significance of the utility-specific effects. The R-square is 0.47, which indicates that 47 percent of the total variance in customer performance is explained by the covariates. As such, even though this model is the best performing of all the models tested, the result shows that explaining the drivers of customer performance requires more information. It also shows that it is not always possible to capture all the variance in Africa in panel data regression models as it is likely that variables are omitted, most notably local information on the physical and organizational environment in which utilities are working.

It was found that the quality of service levels matters. Higher service-level quality results in higher water coverage. The price of the service was not found to be statistically significant. More interesting is the effect of good financial performance (as measured by an OCCR of at least 1.19) on water coverage. The relationship shows that good financial performance is

TABLE 6.4. Drivers of Water Coverage, Fixed-Effects Regression Model

Water coverage (0 to 1 scale)	Coef.	T-test	P > t
Utility-specific variables			
Customer_performance indicator (proxy for service quality)	0.7935***	11.76	0.000
Average revenues per cubic meter sold	−0.0124	−1.25	0.212
Popserved	0.1525***	4.13	0.000
popserved_water ^2	−0.0223***	−4.09	0.000
OCCR_DUMMY by incomestatus = 1	0.0229	1.57	0.118
OCCR_DUMMY by incomestatus = 2	0.0935**	2.43	0.016
Country-specific variables			
GNI per capita	0.0001	1.57	0.118
CPIA_economic_management cluster	0.1719***	6.28	0.000
Trend	0.0057	0.94	0.349
Constant	−0.8301***	−6.33	0.000
Number of observations	468	n.a.	n.a.
Number of utilities	119	n.a.	n.a.
Fisher test of global significance (*p*-value)	33.31***	(0.000)	n.a.
Fisher test (fixed effects are equal to 0)	9.97***	(0.000)	n.a.
R-square	0.47	n.a.	n.a.

Note: n.a. = not applicable.
**p* < .10, ***p* < .05, and ****p* < .01.

linked to higher water coverage. Yet, this effect does not hold for utilities in low-income countries. In view of the high capital intensity of the water infrastructure, investments in this type of infrastructure tend to be large and usually utilities are unable to pay for the initial investments. The effect holds in middle-income countries, but it should be noted that the effect of good financial performance—even in these countries—is rather limited in increasing access to water supply services. Hence, utilities may be able to fund some of the investments but are unlikely to pay for most of the up-front investments, as shown in the case studies described in chapter 7.

The model shows a concave relationship between utility size (as measured by population size) and water coverage: water coverage increases more rapidly when utilities are larger and then decreases afterwards—suggesting economies of scale in providing water access. Yet, it is also likely that countries provide funds to expand coverage to larger utilities first before providing funds to utilities in smaller towns and localities.

Utilities that operate in richer countries (as measured by GNI per capita) demonstrate higher water coverage in general, but only at the 10 percent level. Utilities that operate in countries that are associated with better economic management (as measured by the Country Policy and Institutional Assessment [CPIA] economic management cluster) tend to be associated with higher water coverage. The effect of better economic management is rather significant and could point to the fact that better economic management ensures that more resources are available to increase water coverage. Finally, the trend is found to be statistically insignificant.

The model was run on water coverage again and distinguished by large utilities and those that are smaller—with large utilities classified as those serving more than 1 million customers. Although similar factors play a role, the importance of the variables differs significantly for the two models, showing that the behavior of utilities is far from similar. In general, utilities started to be established in capital cities; hence large utilities tend to have been in place much longer and by definition tend to have higher coverage than smaller utilities.

When comparing what drives coverage in large and smaller utilities, some similarities and some important differences (see table 6.5) were seen. For both types of utilities, service quality matters. Both models show a concave relationship between utility size (as measured by population size) and water coverage: water coverage increases more rapidly when utilities are larger and then decreases afterwards. However, the role of tariffs is much less significant as a driver for performance for large utilities than for smaller utilities. This may be linked to the fact that large utilities have a much larger customer base and, because of the relative anonymity of the individual client, it is much easier to not pay the bill. This is reflected by the generally lower collection efficiencies in larger utilities. The effect of good financial performance (as measured by an OCCR of at least 1.19) on water coverage shows that good financial performance is not linked to higher water coverage in smaller utilities—independent of the level of economic development of the country. For large utilities in low-income

TABLE 6.5. Drivers of Water Coverage, Fixed-Effects Regression Model, by Size of Utility

Water coverage (0 to 1 scale)	Smaller utilities			Large utilities		
	Coef.	T-test	P > t	Coef.	T-test	P > t
Utility-specific variables						
Customer_performance indicator (proxy for service quality)	0.634***	9.86	0.000	0.2447**	2.57	0.018
Average revenues per cubic meter sold by incomestatus = 1	−0.007	−0.83	0.408	0.023	0.45	0.657
Average revenues per cubic meter sold by incomestatus = 2	−0.062	−1.18	0.240	0.108	0.99	0.333
Popserved	1.6909***	10.88	0.000	0.2099***	6.27	0.000
Popserved_water ^2	−1.5416***	−8.07	0.000	−0.011***	−6.17	0.000
OCCR_DUMMY by incomestatus = 1	0.0151	1.13	0.260	0.0258**	2.13	0.046
OCCR_DUMMY by incomestatus = 2	−0.0004	−0.01	0.991	−0.075	−0.58	0.568
Country-specific variables						
GNI per capita	0.0001**	1.17	0.245	0.0001	1.57	0.132
CPIA_economic_management cluster	0.1582***	5.68	0.000	0.0182	0.89	0.386
Trend	0.0028	0.41	0.686	−0.0156***	−3.21	0.004
Constant	−0.8133***	−5.44	0.000	−0.194***	−3.05	0.006
Number of observations	426	n.a.	n.a.	42	n.a.	n.a.
Number of utilities	111	n.a.	n.a.	12	n.a.	n.a.
Fisher test of global significance (*p*-value)	30.95***	(0.000)	n.a.	60.92***	n.a.	n.a.
Fisher test (fixed effects are equal to 0)	10.15***	(0.000)	n.a.	30.99***	n.a.	n.a.
R-square	0.62	n.a.	n.a.	0.97	n.a.	n.a.

Note: n.a. = not applicable.
*$p < .10$, **$p < .05$, and ***$p < .01$.

countries, good financial performance has a small, but positive effect on water coverage. Yet, this effect disappears for utilities in middle-income countries.

Whether utilities operate in richer countries (as measured by GNI per capita) is statistically insignificant in both low-income and middle-income countries. Utilities that operate in countries that are associated with better economic management (as measured by the CPIA economic management cluster) tend to be associated with higher water coverage in the case of smaller utilities. Yet, the effect of the quality of economic management on large utilities is insignificant. As larger utilities are mostly located in the capital or larger cities, the quality of economic management may be less important as governments may have most likely already provided funds to these larger utilities. Finally, the trend is found to be statistically insignificant in smaller utilities, but negative and significant in larger utilities.

Service Quality

The customer performance index can be used as a continuous variable with data observations ranging between 0 and 1. The model uses 468 observations covering 119 distinct utilities. It is controlled for utility-specific heterogeneity and utility-specific unobserved effects are specified as fixed effects in the model. Estimation results are shown in table 6.6. The Fisher test indicates global significance of the model and overall significance of the utility-specific effects. The R-square is 0.14, which indicates that only 14 percent of the total variance in customer performance is explained by the covariates. As such, even though this model is the best performing of all the models tested, the result shows that explaining the drivers of customer performance requires much more information. It also shows that it is not always possible to capture all the variance in Africa in panel data regression models as it is more than likely that variables are omitted, most notably local information on the physical and organizational environment in which utilities are working.

The higher service quality for consumers (as measured with the indicator defined in chapter 4) is linked to the cost of the service. The more people spend on water services, the lower the service quality tends to be. One of the drivers of service quality is the depth of rationing. The more the water consumed per person per day and hence the less rationing

TABLE 6.6. Drivers of Customer Performance as Measured by Quality of Service, Fixed-Effects Regression Model

Customer performance (0 to 1)	Coef.	T-test.	P > t
Utility-specific variables			
Average revenues per capita	−0.0037***	−7.00	0.000
Sewerage coverage present (dummy)	0.883***	4.01	0.000
Operational performance	0.0982***	2.78	0.006
Country-specific variables			
GNI per capita	0.0001**	2.08	0.038
share_urban	−0.006***	−2.60	0.010
CPIA_transparency	−0.011	0.45	0.656
Trend	−0.0057	−1.37	0.172
Constant	0.6900***	7.46	0.000
Number of observations	462	n.a.	n.a.
Number of utilities	119	n.a.	n.a.
Fisher test of global significance (*p*-value)	12.64***	(0.000)	n.a.
Fisher test (fixed effects are equal to 0)	11.93***	(0.000)	n.a.
R-square	0.21	n.a.	n.a.

Note: n.a. = not applicable.
*$p < .10$, **$p < .05$, and ***$p < .01$.

customers experience, the higher the service quality. Yet, this effect only shows up in low-income countries, where it is statistically significant. Then, rationing is much more widespread and pertinent in low-income countries than in middle-income countries. Sewerage coverage tends also to be linked to better service quality, which may hint toward economies of scope.

Country-based factors matter but the effect is not very clear. When utilities also provide sewerage coverage, utilities that operate in low-income countries (as measured by GNI per capita) demonstrate higher service quality in general, but it depends on whether sewerage coverage is also provided. Where sewerage coverage is provided, the effect of income is not significant. Transparency (as measured by the CPIA index) is not significant. Finally, the trend is found to be negative, but statistically insignificant.

Operational Performance

This index is also measured on a 0-1 scale, so the same methodology as the one used for assessing the drivers of customer performance is adopted. The model is estimated using 415 observations for 116 distinct utilities (table 6.7). The model is significant overall and the R-square is 0.35, so the overall fit of the model is moderate.

Operational performance is found to have a concave relationship with the size of the population served with water when utilities are smaller: operational performance increases up

TABLE 6.7. Drivers of Operational Performance, Fixed-Effects Regression Model

Operational performance (0 to 1 scale)	Coef.	T-test	P > t
Utility-specific variables			
Popserved_water	0.0732**	2.30	0.022
Popserved_water ^2	−0.0060	−1.21	0.226
Customer performance	0.1830***	2.86	0.004
Financial performance (as measured by the OCCR)	0.1097***	6.30	0.000
Share_labor	−0.3912***	−7.20	0.000
Country-specific variables			
GNI per Capita Atlas	−0.0007	−0.83	0.406
CPIA_economic management	0.0872***	2.86	0.005
Trend	0.0171***	2.70	0.007
Constant	0.2266**	1.60	0.110
Number of observations	415		
Number of utilities	116		
Fisher test of global significance (*p*-value)	19.20***	(0.000)	
Fisher test (fixed effects are equal to 0)	7.61***	(0.000)	
Within R-square	0.35		

Note: *$p < 0.10$, **$p < 0.05$, and ***$p < 0.01$.

to a threshold and then decreases: economies of scale matter.[1] The better the financial performance of the utility, the higher the operational performance. The higher the customer performance, the higher the operational performance. Finally, the higher the share of labor costs, the lower the operational performance. This shows that utilities with a high share of labor in total costs tend to have lower staff efficiencies (that is, the revenues generated by each employee as a percentage of the cost of that employee are significantly lower) suggesting that these utilities tend to be less efficient in employing staff. This lack of efficiency will affect operational performance.

Utilities operating in richer countries, as measured by the GNI per capita, do not show better operational performance. There is evidence of a positive, statistically significant trend. And, interestingly, the better the economic management in the country in which the utility is located, the higher the operational performance.

Overall Performance Index

We ran the models again using the overall composite index (combining customer, operational, and financial performance). This index is also measured on a 0-1 scale, so the same methodology as the one used for assessing the drivers of customer performance is adopted. The model is estimated using 426 observations for 116 distinct utilities (table 6.8). The model is significant overall and the R-square is 0.52, so the overall fit of the model is good.

The economies of scale as measured by the population served show that the larger the population served, the better the overall performance, but up to a threshold; too large a utility will generate diseconomies of scale. The threshold is, however, quite high since the proportion of utilities that are above the threshold is usually small. Utilities which also provide sewerage coverage tend to be correlated with better performance. Economies of scope

TABLE 6.8. Drivers of Overall Performance (Measuring the Combined Scores of Financial, Operational, and Customer Performance), Fixed-Effects Regression Model

Operational performance (0 to 1 scale)	Coef.	T-test	P > t
Utility-specific variables			
Popserved_water for large utilities = 0	1.154***	9.97	0.000
Popserved_water ^2 for large utilities = 0	−1.205***	−8.66	0.000
Popserved_water for large utilities = 1	0.196***	7.56	0.000
Popserved_water ^2 for large utilities = 1	−0.011***	−2.97	0.003
Sewerage coverage (dummy) for low-income countries	0.0297	1.39	0.165
Sewerage coverage (dummy) for middle-income countries	0.237***	4.06	0.000
Operation and maintenance costs per cubic meter of water produced	−0.034***	−5.65	0.000
	0.006***	3.17	0.002

table continues next page

TABLE 6.8. continued

Operational performance (0 to 1 scale)	Coef.	T-test	P > t
Country-specific variables			
GNI per capita, Atlas Method	0.00003	0.44	0.662
CPIA_economic management	0.0802***	3.68	0.000
Trend	−0.0054	−1.20	0.231
Constant	0.2276***	2.35	0.020
Number of observations	426	n.a.	n.a.
Number of utilities	116	n.a.	n.a.
Fisher test of global significance (*p*-value)	28.98***	(0.000)	n.a.
Fisher test (fixed effects are equal to 0)	10.80***	(0.000)	n.a.
Within R-square	0.52	n.a.	n.a.

Note: n.a. = not applicable.
$*p < .10$, $**p < .05$, and $***p < .01$

also play a role, but the effect is only statistically significant in middle-income countries because the number of utilities that provide sewerage services in low-income countries in Africa is relatively limited. Another finding is that costs (measured by the O&M costs per cubic meter of water produced) also play a critical role: the higher the O&M costs per cubic meter produced, the lower the overall performance. The level of O&M costs are the result of investment decisions; these investment decisions lock in costs for decades to come; hence assessing investment decisions properly is key.

Staff efficiency also matters. The higher the staff efficiency, the better the overall performance. Finally, the quality of economic management matters. The better the economic management, the better the utility performance. Interestingly, the quality of the business environment also matters. If the quality of the business environment is high, utility performance benefits.

Conclusions

The performance models are globally significant but for many the predictive power is highly variable with the exception of the water coverage and the overall performance model. It was observed that the major drivers of utility performance are linked to their costs as reflected in the presence of economies of scale, economies of scope, the O&M costs per cubic meter of water produced, and staff-related efficiency.

The economies of scale as measured by the population served shows that the larger the population served, the better the overall performance, but up to a threshold; too large a utility will generate diseconomies of scale. The threshold is, however, quite high since the proportion of utilities that are above the threshold is usually small.

Utilities which also provide sewerage coverage tend to be correlated with better performance. Economies of scope also play a role. Another finding is the impact of costs (measured by the O&M costs per cubic meter of water produced): the higher the O&M costs per cubic meter produced, the lower the overall performance. The level of O&M costs are the result of investment decisions; these investment decisions lock in costs for decades to come; hence assessing investment decisions properly is key. Staff efficiency and share of labor in total costs also matter. The higher the staff efficiency, the better the overall performance. Yet, staff efficiency is the result of a complex of factors, including labor regulations, but also O&M costs and tariff policies.

Interestingly, some of the other drivers of utility performance are beyond the control of the utilities. The quality of economic management in the countries in which utilities operate affects utility performance: the higher the quality of the economic management, the higher the utility performance.

The different aspects of performance affect one another. Higher customer service quality has a positive impact on water coverage whereas financial performance may affect operational performance and water coverage, suggesting that funding is necessary to improve access and measures to improve operations in the utility. In the case of improving water access, the level of economic development matters, but also the quality of economic management, especially for smaller utilities that may depend more than the large ones on external funding to increase access.

The additional findings are that water coverage is directly affected by customer performance (that is, service quality). Better economic management and higher GNI growth have a positive impact as they may be linked to the availability of investment funding. In most cases, there is no link between utilities' financial performance and water coverage—with the exception of large utilities in low-income countries (although the effect is small). This suggests that most utilities are not able to improve access through improved financial performance but depend on external funds to do so.

The hypothesis posed in chapter 4, that better operational performance results in better financial performance and subsequently in better customer performance, is not borne out by the econometric results. Better operational performance tends to have a positive impact on financial performance; but the opposite is true for customer performance. The better the customer performance, the lower the financial performance. Hence, utilities can optimize financial performance by increasing operational performance and/or reducing customer performance. In general, financial, operational, and customer performance affect each other.

There is evidence that unobserved utility-specific heterogeneity explains a large portion of the total variance, which would call for the large-scale collection of additional utility-specific variables, for example, information on local conditions (topography, distance to the raw water source, whether the utility gets water primarily from groundwater or surface water, quality of the raw source, age of the infrastructure, access to alternative water source, and so on) and organizational and institutional data.[2] Hence, much more and detailed information on utility operations and the context in which the utilities operate is required to explain with more clarity what drives utility performance. However, such data collection comes at a price with regard to the cost of collection and the willingness of utilities, regulators, and other stakeholders to provide such information.

Notes

1. A concave relationship (and hence the presence of a threshold) for large utilities is also expected. The fact that it does not show in the estimation results is probably explained by the characteristics of our sample as there is only a small number of large utilities in the sample.

2. The IBNET Toolkit includes organizational data, but in this round of data collection in Africa, this information was not consistently collected by the task teams, and such information was not available in many of the regulatory reports. Hence, this does not allow for including such information in the analysis.

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Chapter 7 Drivers of Utility Performance: Case Study Perspective

Introduction

The purpose of the case studies is to complement the econometric analysis of the larger dataset. Unlike the econometric analysis, the case studies cannot show quantitative relationships between indicators. However, the case studies can:

- Track performance for a single utility over time
- Assess why certain results were achieved
- Analyze management techniques, organizational culture, and capital investment financing

Five utilities were chosen for the case studies: Nairobi City Water and Sewerage Company (NCWSC) in Kenya; National Water and Sewerage Corporation (NWSC) in Uganda; Office National de l'Eau et de l'Assainissement (ONEA) in Burkina Faso; Sénégalaise des Eaux (SDE) in Senegal; and Société de Distribution d'Eau de la Côte d'Ivoire (SODECI) in Côte d'Ivoire. These utilities were selected to ensure consistency with the case studies written by the Electricity Study Team. The Electricity Study Team wrote case studies for electricity utilities for the same set of countries. Each of these countries has a national water utility except Kenya, so in four of five cases the national utility was selected. In Kenya, NCWSC was selected because it is the largest Kenyan utility, serving nearly 3 million people in the capital city, Nairobi.

The selection of the case studies was not at random, so it should be noted that the case study sample is not representative. For instance, all five utilities are large, serving close to or more than 3 million people. By contrast, the typical utility in the econometric database serves about 115,000 people. All five utilities were established decades ago, and hence have a longer track record and relatively more developed infrastructure. All of them are serving capital cities. Apart from Nairobi, none of the utilities provides wastewater services. In addition, the five utilities are mostly well-performing. This allows the case studies to focus on the dynamics of well-performing utilities.

Performance of the Case Study Utilities

Data from the JMP regarding the performance of the five case study countries over the past 15 years are provided in table 7.1 as context. How each case study utility performs on key indicators is shown in table 7.2. These data do not always correspond with utility data partially because the services that utilities provide may be for areas that are smaller than the area that is classified as urban. In addition, utilities use different yardsticks to translate the number of (active) connections into coverage or access.

The indicators included in the table are those used in the econometric analysis, plus three others—nonrevenue water (NRW) as a percentage of production, staff per 1,000 connections, and the collection ratio (table 7.3). These three indicators have been added because they are analyzed substantially in the case studies. Where available, the global benchmark (best quartile of all utilities in the International Benchmarking Network for Water and Sanitation Utilities [IBNET] database) and the African benchmark (best quartile of all utilities in the Africa-specific IBNET analysis) are provided for comparison. Each utility's aggregate performance ranking out of 118 utilities is included.

It should be noted that the focus of the case studies is how these five utilities have been performing in their service areas. This is an important point to make because, as can be seen in tables 7.1 and 7.2, even in national utilities the service areas are not necessarily overlapping with the population to be served, and even though some of the utilities have done excellent work, the increase in service areas has been very different between the various utilities. For the four national utilities for which we have data from 2000 to 2013, we find that the population without improved services has still not decreased in three out of the five countries.

In table 7.1, we see the efforts that have been put in, with sharp increases in the service area and in the population served—significantly beyond the overall population growth rates over a similar period. This also shows the scale of the challenge in providing water supply services in Africa.

Table 7.2 shows some interesting features of the demand for water supply. Based on household surveys in the five case study countries, the population has increased rapidly in

TABLE 7.1. Country Data on the Growth in Access

Country	Increase in service area 2000–13 (%)	Increase in population served 2000–13 (%)	Increase in population 2000–15 (%)	Increase in urban population 2000–15 (%)
Burkina Faso	197	226	154	252
Côte d'Ivoire	220	188	132	164
Senegal	150	172	152	163
Uganda	320	498	165	224

TABLE 7.2. Country Data on Access to Improved Water Sources by Country, According to the JMP

Country	Year	Population (millions)	Population with piped water on premises (millions)	Population with other improved services (millions)	Population without improved services (millions)	Population with piped water on premises (%)	Urban population (millions)	Urban population with piped water on premises (millions)	Urban population with other improved services (millions)	Urban population without improved services (millions)	Urban population with piped water on premises (%)
Burkina Faso	2000	11.60	0.40	6.60	4.70	3.4	2.10	0.40	1.40	0.30	19.0
	2015	17.90	1.40	13.30	3.20	7.8	5.30	1.40	3.80	0.10	26.4
Côte d'Ivoire	2000	16.10	4.80	7.70	3.60	29.8	7.00	4.00	2.50	0.60	57.1
	2015	21.30	9.10	8.40	3.80	42.7	11.50	7.60	3.10	0.80	66.1
Kenya	2000	31.30	6.00	10.20	15.10	19.2	6.20	3.20	2.30	0.80	51.6
	2015	46.70	10.10	19.40	17.20	21.6	12.00	5.40	4.40	2.20	45.0
Senegal	2000	9.90	3.00	3.60	3.20	30.3	4.00	2.40	1.20	0.40	60.0
	2015	15.00	7.90	3.80	3.20	52.7	6.50	5.30	0.80	0.50	81.5
Uganda	2000	24.30	0.50	13.10	10.60	2.1	2.90	0.40	2.10	0.40	13.8
	2015	40.10	2.00	29.70	8.40	5.0	6.50	1.50	4.70	0.30	23.1

Source: wssinfo.org.

the past 15 years, but the increase has been especially fast in urban areas. Utilities that provide piped water services have been able to improve access to piped water on the premises, but the largest number of people are serviced by other means: standposts, kiosks, but also point-sources such as dependence on groundwater. Despite massive efforts, only in Burkina Faso and Uganda did the population with access to unimproved services decline, including in urban areas. Between 2000 and 2015, 16.8 million people in the five case study countries got access to piped water on the premises (of which 10.8 million were in urban areas). But most of the growth took place for other improved services which increased by 31.9 million people (of which only 7.3 million were in urban areas). So a significant part of the growth in access to water supply even in urban areas is not in piped water on the premises, but depends on other sources of improved services. The role of small private sector providers

TABLE 7.3. Summary of Performance of Case Study Utilities

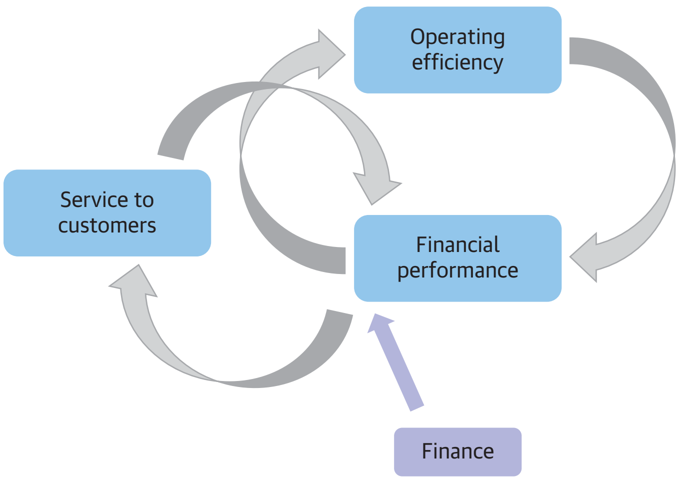
Indicator	Global benchmark	Africa benchmark	Kenya, NCWSC (2014)	Uganda, NWSC (2013)	Burkina Faso, ONEA (2014)	Senegal, SDE/ SONES (2013)	Côte d'Ivoire SODECI (2014)
NRW (m^3 per connection per day)	0.121	0.205	0.697	0.265	0.135	0.159	0.174
NRW (%)	—	30.3	39	35	19	20	24
Metering (%)	100	100	94	100	97	96	98
Staff-efficiency	4.27	4.21	2.10	4.34	3.04	5.24	5.83
Staff per 1,000 connections	—	5.0	5.0	5.4	3.2	2.4	2.9
OCCR*	1.38	1.19	1.01	1.30	1.13	1.33	1.06
Collection ratio (%)	—	91.3	91	96	97	94	86
People per connection	3.0	8.3	9.6	9.4	12.9	10.8	14.9
Reliability (hours of supply)	24	21.6	18	20	23	23	20
Affordability (%)	0.5	1.22	2.14	3.40	2.53	2.16	0.96
Water consumption per capita per day	—	77.1	110	52	47	59	39
Water coverage (%)	100	77	75	78	86	98	69
Water coverage in people served in utility (2013), millions	n.a.	n.a.	2.9	3.0	3.9	5.8	11.7
Population in service area of utility (2013), millions	n.a.	n.a.	3.9	3.8	4.8	5.9	17.0
Population according to JMP with piped water on premises (2015), millions	n.a.	n.a.	10.1	2.0	1.4	7.9	9.1
Ranking	n.a.	n.a.	42	4	5	1	12

Note: the OCCR from the data collected through the TTLs and the annual reports show some discrepancy for Burkina Faso and Uganda. This may be linked to a different interpretation of the costs (including some financing costs). — = not available; n.a. = not applicable

can be very significant in different parts of the continent (for example in Uganda). This paper will not look into these small-scale providers but it is important to realize that utilities in Africa in many cases operate in an environment where there are multiple providers active—including in the service area of the utilities.

Table 7.3 shows that the utilities perform reasonably well against African benchmarks. At least 91 percent of connections are metered at all five utilities. There are fewer than six staff per 1,000 connections. Water supply is available, on average, for 18 hours per day or more in all five utilities. There is considerable dispersion among the cases on some indicators. Coverage in the utilities' service area ranges from 69 percent (SODECI) to 98 percent (SDE/Société Nationale des Eaux du Sénégal [SONES]). ONEA's NRW level (0.135 m^3 per connection per day) is less than one-fourth of NCWSC's NRW (0.697 m^3 per

FIGURE 7.1. Impact of the Dimensions of Performance



connection per day). NCWSC's revenues barely cover operating costs, whereas SDE/SONES has an operating cost coverage ratio (OCCR) of 1.33.

Lessons Learned from the Case Studies

The case studies show that the three measures of performance (financial, operational, and customer) are linked. This relationship is shown in figure 7.1.

As shown in figure 7.1, operating efficiency translates into better financial performance because O&M costs are controlled. In turn, good financial performance allows a utility to make operational improvements. Better financial performance allows a utility to generate cash to finance network expansion, or other projects that will minimize costs and improve water supply service. With new customers and increased consumption, revenues can increase and financial performance will continue to improve. Thus, there is a feedback loop between the three measures of performance. Finance is another important element, which leads to better operational performance and customer performance.

How the relationship shown in figure 7.1 works in practice was analyzed through the five case studies. Six key findings are summarized in this section:

- Good financial performance enables financing, which enables utilities to expand access to piped water and provide higher quality water supply service.
- Operating efficiency and financial performance are linked.
- Successful utilities combine cost recovery with affordable access to water supply services.
- A variety of strategies have been successful in expanding water supply access.
- Incentivized contracts are successful in generating performance.
- National utilities can be a management model to expand water supply services to small towns.

Financing through Good Financial Performance

When discussing good financial performance, it should be noted that the use of the OCCR is the bare minimum of financial performance. When a utility is able to cover its operating costs through its revenues, a utility will be able to provide services to its existing customers in the short run. In case a utility wants to ensure service provision in the medium term (it should be able to cover its depreciation) and if it wants to expand services it will have to be able to generate even more cash flow. As mentioned in Whittington et al. (2009) the variable costs of water service provision are relatively small in comparison with the capital costs.

Over the last 20 years, three of the utilities—NWSC, ONEA, and SDE/SONES—have turned around their performance. Figures 7.2 to 7.7 show how water coverage and reliability improved substantially in each case.[1] NWSC in Uganda has increased coverage in its service area from 47 percent in 1998 to 78 percent in 2013. Water is available 20 hours per day on average, compared with 8 hours on average in 1996. ONEA in Burkina Faso has achieved similar success, with coverage increasing from 50 percent (1998) to 86 percent (2014). Water supply, once intermittent, is now available almost 24-7. In Senegal, 98 percent of the service area's population is now served, with water available 23 hours per day on average. In all three cases, improvements in access and service were achieved even as the service area population was expanding.

How did these utilities achieve these improvements in access to piped water and water supply service? Historical data on the sources of investment financing help answer this question. The utilities were on-lent donor finance on concessional terms, at low interest rates with long grace periods. The loans were repaid with operating cash, generated by improving operating efficiency (thus minimizing costs) and expanding access (thus increasing revenue). Some of the finance was given as an equity contribution—essentially a grant or investment subsidy. Table 7.4 shows the sources and amounts of capital expenditure for the three utilities. It is important to note that Uganda's capital cost per person served was much lower than in the two other countries.

FIGURE 7.2. Water Coverage, NWSC Uganda, 1998–2013

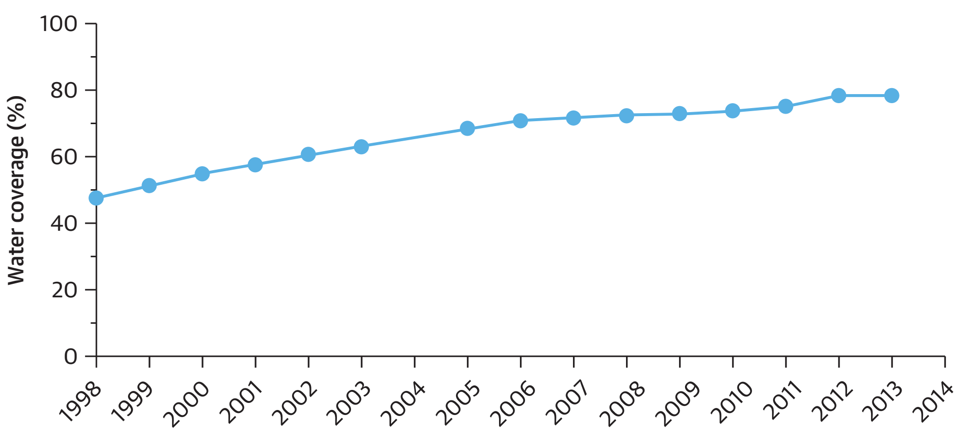
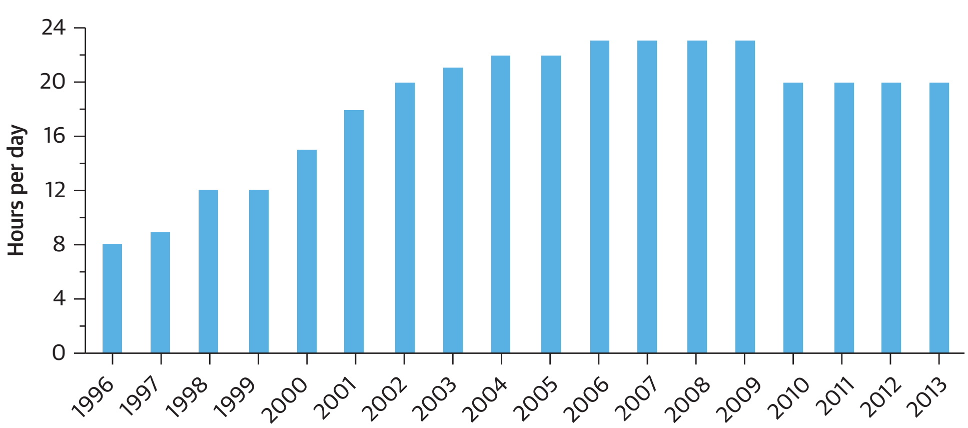
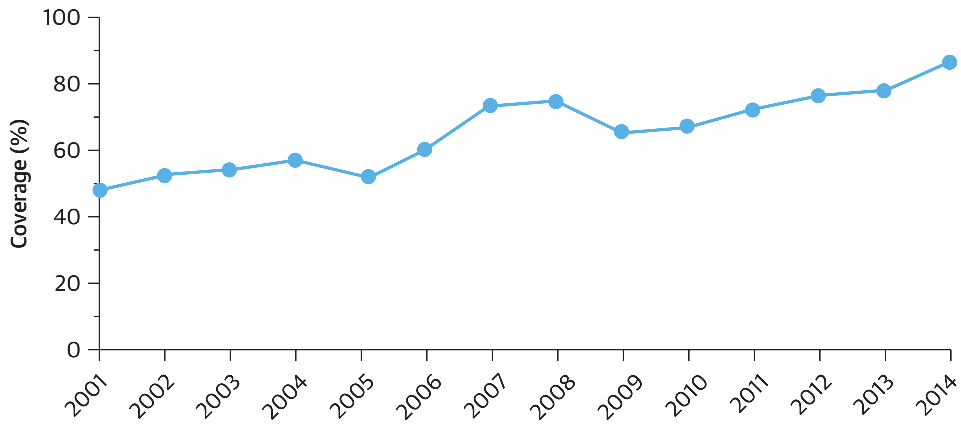


FIGURE 7.3. Reliability, NWSC Uganda, 1996–2013



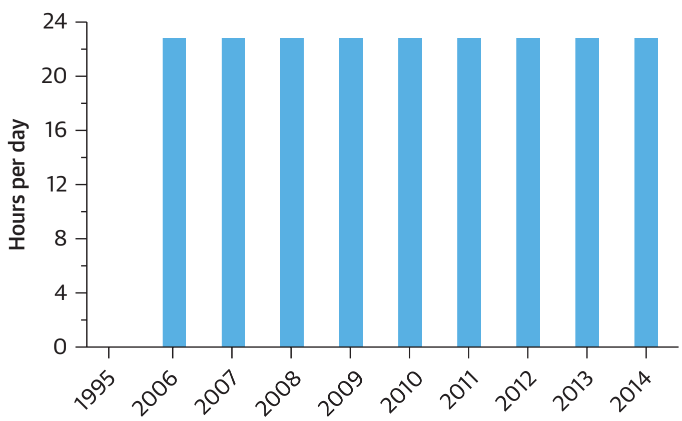
NWSC, Uganda. In the early 2000s, NWSC did not repay its loans with operating cash. The government of Uganda agreed to a moratorium on debt service for a period, which gave NWSC financial breathing space. Then, in 2007, the government converted the outstanding loan balance of US$47 million into equity—effectively forgiving the debt.

FIGURE 7.4. Water Coverage, ONEA Burkina Faso, 2001–14



Note: Data pre-2006 was not available; however, it is known that reliability was low in the late 1990s and early 2000s because of a water shortage in Ouagadougou.

FIGURE 7.5. Reliability, ONEA Burkina Faso, 2006–14



Note: Data pre-2006 was not available; however, it is known that reliability was low in the late 1990s and early 2000s because of a water shortage in Ouagadougou.

Since then, NWSC has borrowed from commercial banks and is servicing the debt with cash generated from operations.

One project NWSC undertook during the 2002-11 period was the construction of the Gaba III water treatment plant and associated transmission mains (U Sh 52.7 billion; US$28.8 million; 2006). This project increased water production for Kampala and nearby areas by 80,000 m^3 per day. In 2010, a commercial loan of US$2 million was obtained for financing the extension of the Ggaba intake plant, which supplies water to Kampala city and the surrounding areas. This loan is being serviced from the operating cash flow.

Increasing operating cash flow was key to achieving expansion in service. NWSC increased collection efficiency (from 85 percent in 2001 to 95 percent in 2011), reduced NRW (from 43 percent in 2001 to 33 percent in 2011), and increased labor productivity by limiting staff growth as connections increased. Real tariffs increased at a modest 3 percent per year. Together, these factors provided an operating cash surplus that was used repay debt. However, as can be seen from the last four years of audit reports, NWSC remains dependent on grants for financing its investments (table 7.5).

ONEA, Burkina Faso and SDE/SONES, Senegal. In the 1990s, the cities of Ouagadougou and Dakar both faced water shortages. Supply was rationed and water coverage was low. ONEA and SDE/SONES—the utilities that serve these cities, respectively—both received large loans to finance bulk supply. The Bank was a major financier in both cases.

For ONEA, a major program was the Ouagadougou Water Supply Project (US$269 million, 2001-07). The program included construction of the Ziga Dam, Boudtenga Reservoir (5,400 m^3), a water treatment plant and pumping station, and extension of the distribution network. Increased water production led to near perfect water supply reliability (23 hours per day), whereas before the project, service was intermittent.

FIGURE 7.6. Water Coverage, SDE/SONES Senegal, 1995–2013

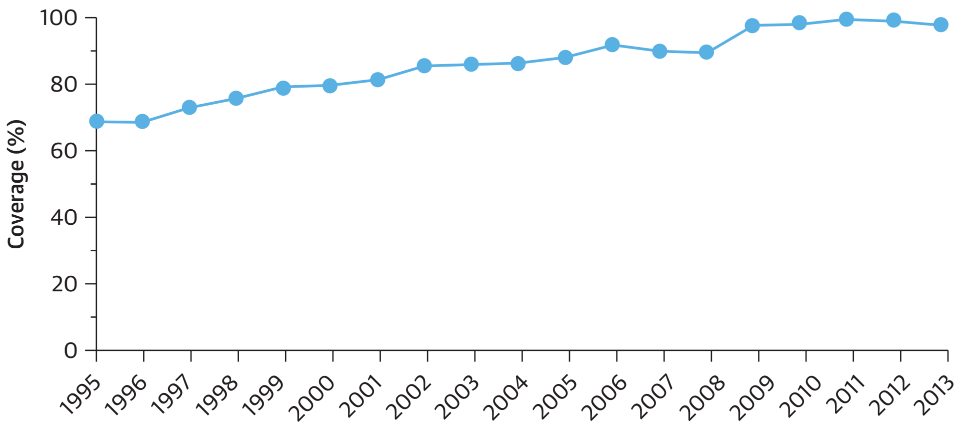
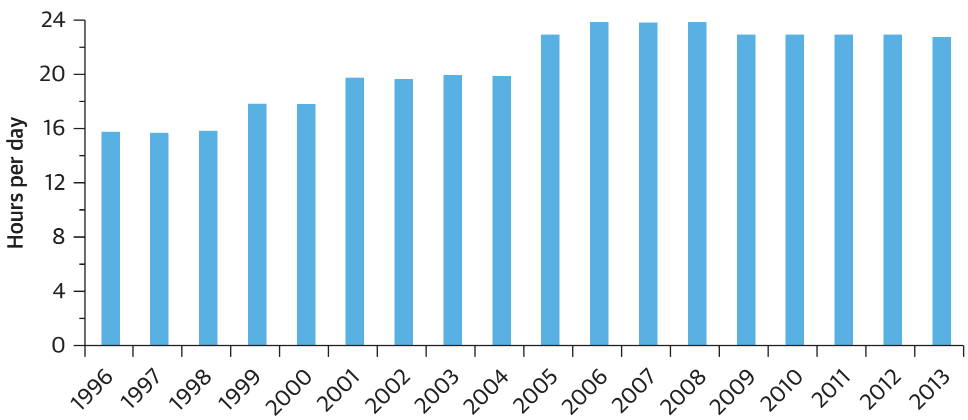


FIGURE 7.7. Reliability, SDE/SONES Senegal, 1996–2013



In Senegal, two major programs were implemented—the Senegal Water Project (US$223 million, 1996-2004) and the Long Term Water Project (US$255 million, 2002-09).[2] The first project focused on urgent investments needed to increase water supply in Dakar. This included additional boreholes, expansion of a treatment plant, and leakage reduction works. The second phase of reforms involved the construction of the much larger Keur Momar Sarr water treatment plant (in 2005, 65,000 m^3 per day; upgraded in 2008 to 130,000 m^3 per day) along with a continued expansion in the distribution network.

Programs in both countries introduced private sector participation, which led to operational efficiency, which in turn led to increased operating cash flow. At ONEA, Veolia was hired under a

TABLE 7.4. Sources and Amounts of Capital Investment Financing

	NWSC (2002-11)	ONEA (2002-13)	SDE/SONES (1996-2013)
Incremental coverage between start and end	1,112,387	2,632,000	3,230,391
Estimated total capital investment (US$, millions)[a]	100	600	770
Percentage grant-financed	28	52	29
Percentage financed by internal cash flow	52	19	23
Percentage financed by loans	16	29	47
Capital investment per additional person served (US$)	90	228	238

a. For NWSC, total capital expenditure was estimated using cash flow statements. Cash outflow was summed from the following financing activities: capital work-in-progress; purchase of property; plant and equipment; and purchase of computer software. For ONEA and SDE/SONES, investment data was provided by the Bank.

TABLE 7.5. Sources of Financing in NWSC (US$,000)

	2011	2012	2013	2014
Cash flow from operations	14,201	(15,735)	13,831	(7,635)
Investment financing	33,933	31,451	45,988	51,408
Total cash flow from operations and investments	19,732	47,186	32,157	59,043
Financing				
Payments of borrowings	(2,114)	(3,894)	0	(4,056)
Proceeds from grants	11,562	51,859	38,749	85,474
Increase in cash equivalents	(10,344)	778	6,593	22,375

Note: Annual Reports from NWSC, Auditor General.

performance-based service contract in 2001 to help manage the commercial function. As a result, collection efficiency rose from 78 percent in 2002 to 95 percent in 2006. This has been sustained and even improved, measuring 97 percent in 2013. Low levels of NRW were maintained. In Senegal, the private operator (SDE) was brought in through the Senegal Water Project. Signing a public-private partnership (PPP) contract satisfactory to the Bank was a condition of the Bank loan. SDE steadily reduced NRW from 1996 to 2003 (29 percent to 20 percent) because the *affermage* contract included strong incentives to do so. Collection rates were maintained at 95 percent or above.

Correlation of Operational and Financial Performance

The case studies show an association between good operating efficiency and financial performance. Higher levels of operating efficiency are correlated with higher levels of financial performance. Good financial performance can provide financial resources that allow the utility to invest in further operating efficiencies, for example by replacing leaky mains, worn-out meters, and inefficient, unreliable pumps.

The relationship between operational and financial performance at NWSC, ONEA, and SDE/SONES is described in the previous section on financing investment. A similar relationship is present at SODECI, whose peak performance on operational and financial indicators was in 2000. The OCCR was 1.09 and the collection ratio 92 percent. NRW was 131 liters per connection per day, or just 17 percent in percentage terms. There was an average of just three staff per 1,000 water connections. During the Ivorian Civil Wars (2002-11), however, financial and operational performance declined. Since 2011, performance has improved. As of 2014, SODECI is again a good performer. It ranks 12th of all utilities in the econometric analysis (though its performance is still below the level it reached before the war).

Nairobi's utility, NCWSC, provides a contrast to the other four utilities. Its OCCR is 1.01, which indicates that revenue barely covers operating costs. NRW is also relatively high, at 697 liters per connection per day—partially the result of inefficiencies and partially the result of significantly higher levels of water consumption than are provided in the other four utilities. Although collection efficiency has improved, the lack of cash generated from operations limits resources available for fixing pipes and replacing meters.

Combining Cost Recovery with Affordable Water Supply Service

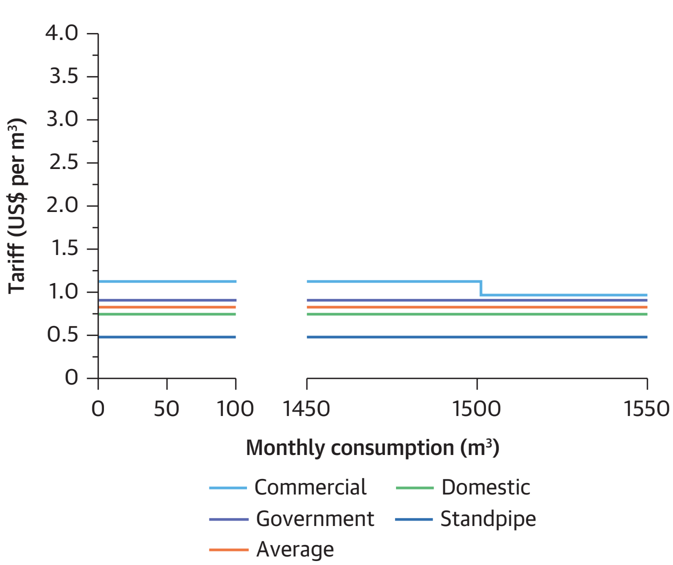
It is often assumed that there is a trade-off between cost recovery and affordable service. And indeed, all of the case study utilities—with the exception of Nairobi and to some extent SDE in Senegal—are providing low levels of water consumption (especially low levels of residential water consumption) and show lower than average levels of affordability compared with African benchmarks (table 7.3). Yet, the use of cross-subsidies in several of the case study utilities shows that this tool can to a large extent transcend this trade-off.

There are two basic cross-subsidization strategies:

- Charging nonresidential customers more than residential customers
- Selling a basic needs quantity of water at a below average tariff and selling water above the basic needs quantity at an above average tariff

NWSC's tariff structure is an example of the first strategy (figure 7.8). Residents are charged less than nonresidents, at a rate below the average tariff, no matter how much they consume. Senegal's tariff structure is an example of applying both strategies in parallel (figure 7.9).

FIGURE 7.8. NWSC, Uganda Tariff Structure

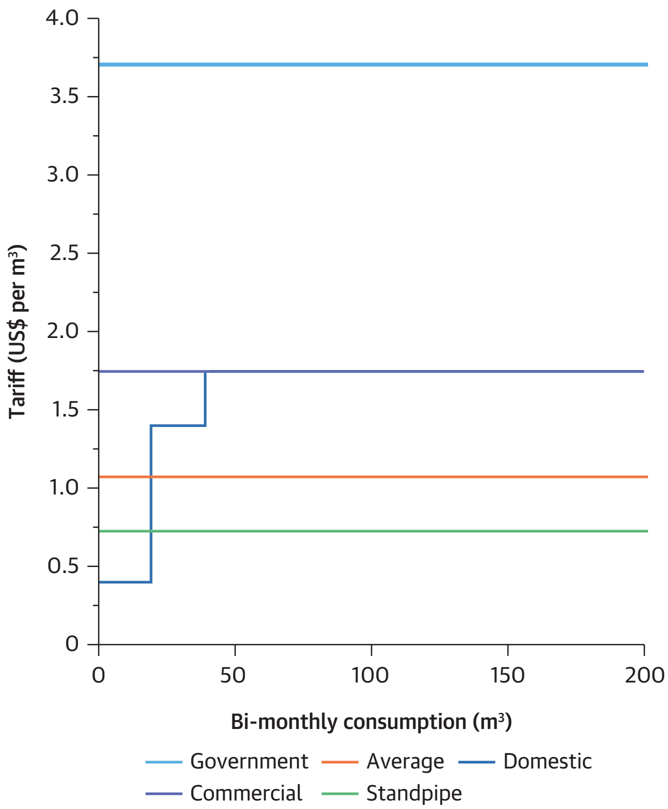


Source: NWSC, Annual Report 2012/2013.

NWSC, Uganda. NWSC charges households US$0.77 per m³, a rate slightly below the weighted average tariff (US$0.82 per m³). The standpipe tariff is even lower at US$0.47 per m³. To compensate for the low rates charged to households, the tariff for institutional and commercial customers is above average, at US$0.91 per m³ and US$1.12 per m³, respectively. However, to encourage large users to stay on the system, the tariff for commercial consumption above 1,500 m³ per month (at US$0.95) is lower than the tariff for consumption below that amount (US$1.12).

SDE and SONES, Senegal. Senegal's increasing block tariff structure has a subsidized social tariff for levels of consumption below 20 m³ (CFAF 202; US$0.40) in a two-month period. There is also a regular tariff for consumption from 21 m³ to 40 m³ (CFAF 697.97; US$1.39), and a "dissuasive" tariff for consumption above 40 m³ (CFAF 878.35; US$1.75). The dissuasive tariff is designed to be a

FIGURE 7.9. SDE/SONES, Senegal Tariff Structure



Source: SONES, "Grille tarifaire, 5éme Bimestre 2014."

disincentive for excessive water use. It can be seen that the tariff for household consumption of less than 20 m³ per 60 days is less than a third of the regular tariff, and less than a quarter of the tariff for consumption in the top block. Only the social tariff and the standpipe tariff (CFAF 366; US$0.73) are below the average tariff (CFAF 494; US$1.08).

Nonresidential, nongovernmental customers must pay the dissuasive tariff regardless of the amount consumed. Government customers pay more than twice the dissuasive tariff—their tariff is CFAF 1,868.88 per m³ (US$3.72 per m³). The structure was established in 2007. In that year, the government agreed to raise tariffs for government customers by 70 percent, while keeping tariffs for other customers constant.[3] This cross-subsidy structure was introduced as a way to keep domestic tariffs from rising while still ensuring cost recovery for SONES/SDE. In 2015, domestic tariffs were again raised—the lowest tariff block was raised by 4 percent and other rates were increased by 9 percent.

As can be seen in table 7.6, the case study utilities have been using cross-subsidization to a large extent to facilitate water supply services (that is, not including any wastewater services); however, in three of the case study utilities, the residential water consumption is still significantly below the level that the World Health Organization (WHO) recommends for good health (that is, below 50 lcd).

Share of Nonresidential Customers in Consumption by Volume. Both SDE and NWSC rely on nonresidential customers to cross-subsidize residential consumption. At NWSC, all domestic customers, regardless of amount consumed, are charged at a rate below the average tariff. This type of tariff structure has been in place at NWSC since at least 2005.

TABLE 7.6. Effect on Residents of Cross-subsidization in the Five Case Study Utilities

Type of consumer	Kenya, NCWSC	Uganda, NWSC	Burkina Faso, ONEA	Senegal, SDE/SONES	Côte d'Ivoire, SODECI
Average affordability (%)	2.14	3.40	2.53	2.16	0.96
Affordability for residential consumers (%)	1.11	1.05	1.62	0.58	0.32
Residential consumption per capita per day (lcd)	70	23	39	55	32

Since then, the share of commercial consumption has risen from 21 percent to 33 percent (by volume), as commercial consumption by volume has risen by an average of 11.1 percent per year. These trends indicate that charging commercial customers at rates above the average tariff has not resulted in reduced consumption. The decreasing block tariff for commercial customers could also be a reason the cross-subsidization mechanism continues to work well.

Senegal's tariff structure also relies heavily on nonresidential consumption for cross-subsidies. However, unlike NWSC, nonresidential revenues have decreased over time, from 39 percent of all revenue billed (2004) to 29 percent (2013); over the same period, the volume of water sold to nonresidential water users dropped to only 8 percent in 2013. High nonresidential tariffs could be a contributing factor to this trend. These cross-subsidies are summarized in the table 7.7

The takeaway from these cases is that cross-subsidization can be helpful in keeping the service more affordable as long as certain principles are followed. The average tariff should be sufficient for cost recovery. To ensure affordability for households, residential tariffs can be set lower than the average tariff. Commercial tariffs or tariffs for high levels of consumption can be set higher than the average tariff, but not too high. To keep nonresidential users connected to the piped network, nonresidential tariffs must be set lower than the cost of alternate water sources.

Strategies for Expanding Access

Utilities have employed different strategies to expand access in their service area. SDE is an example for serving a large proportion of all customers with piped water to their premises (89 percent). Other utilities—such as ONEA (Ouagadougou) and NWSC (Kampala)—serve about half of the population with public taps. Household survey data for Dakar and Ouagadougou are shown in figure 7.10 and figure 7.11.[4]

ONEA's strategy is to focus first on achieving good access for the poor through public taps, then to increase individual connections. Household survey data for Ouagadougou,

TABLE 7.7. Effect of Cross-Subsidization on Consumption Patterns in the Five Case Study Utilities

Type of consumer	Kenya, NCWSC	Uganda, NWSC	Burkina Faso, ONEA	Senegal, SDE/ SONES	Côte d'Ivoire, SODECI
Share in volume of water sold (%)					
Residential	65	44	85	92	76
Nonresidential	35	56	15	8	24
Share in billed revenue (%)					
Residential	60	n.a.	65	71	n.a.
Nonresidential	40	n.a.	35	29	n.a.

Note: n.a. = not applicable.

FIGURE 7.10. Access to Water, Dakar, 2000–14

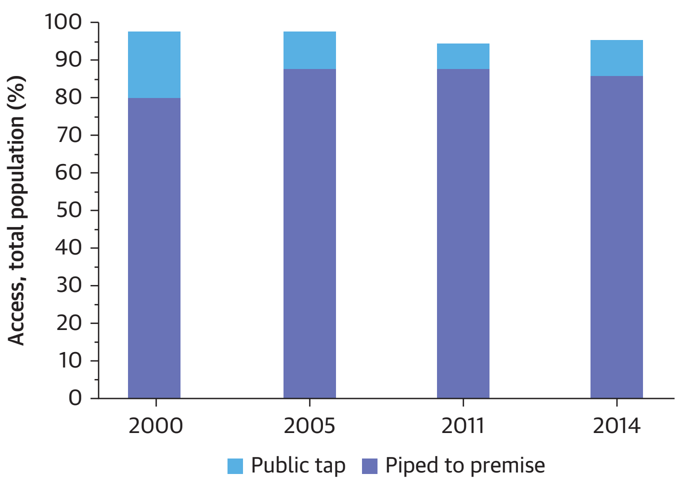
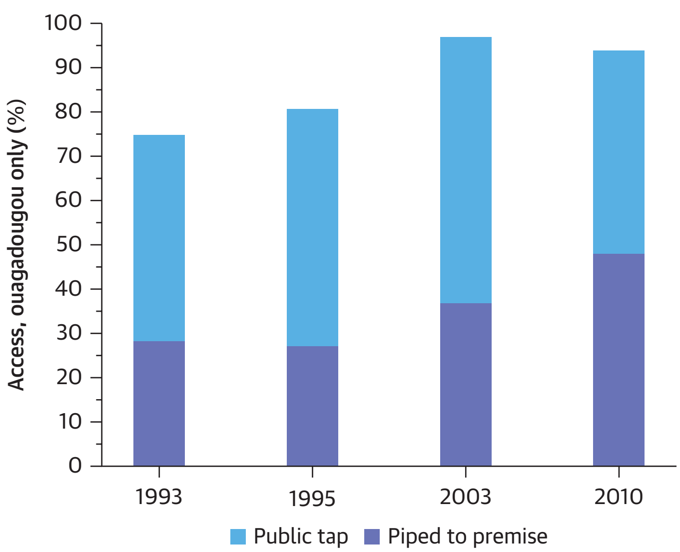


FIGURE 7.11. Access to Water, Ouagadougou



the capital, show the utility is executing this strategy successfully (see figure 7.11). In 1993, 28 percent of people in the city reported access to piped water to the premises. This proportion rose to 37 percent in 2003 and 47 percent in 2010. ONEA plans to serve 80 percent of its service area population with piped water to the premises by 2030.

Generating Performance through Incentivized Contracts

Credible commitments through legally binding contracts between public and private parties, incentivized contracts with senior management teams, performance-based contracts, and multi-stakeholder frameworks have worked to sustain successful governance and utility management models. The four well-performing utilities—NWSC, SDE/SONES, ONEA, and SODECI—all have some form of incentivized contract in place.

Affermage Contract. In 1995, the Government of Senegal (GoS) split SONES, the existing national utility, into three entities: an asset-holding company for water service assets (SONES), a private operator for water services engaged via an affermage contract (SDE), and a public, combined asset-owner and operator for wastewater services (ONAS). SDE has an affermage contract with SONES and the government. SONES and ONAS have entered into performance contracts with the GoS. SODECI in Côte d'Ivoire operates under a similar contract with the government. SDE's affermage contract included strong incentives to reduce NRW and improve collection efficiency. The desired results were achieved—NRW fell from 29 percent in 1996 to 20 percent in 2003. Collection efficiency averaged 97 percent from 1996 to 2013. These performance improvements allowed the utility to generate operating cash that financed investment and service improvement.

The affermage contract also helped increase the durability of service improvements. The contract defined the asset regime, service standards and conditions, regime governing the works, the remuneration regime for the operator, monitoring mechanisms, and sanctions. While a contract between a public utility and its government owner is generally easily amended or ignored if the government so wishes, a contract with a private party cannot be changed without the consent of both parties.

Incentivized Management Contract. NWSC's internally delegated management contracts (IDAMCs) have been another successful initiative. In 2004, each town was established as a business unit and managers were held accountable for meeting set performance targets. Kampala was further divided into branches, each responsible for operational activities in its service area and incentivized to meet targets set in the branch performance contract. Those who do meet the targets can earn bonuses up to 120 percent of their gross salary, whereas those who do not can attract a penalty of up to 25 percent of their salary. This concept was derived in part from two initial management contracts with private operators (Gauff and Ondeo) from 1998 to 2004. Gauff was contracted to undertake a massive overhaul of water services, including deploying geographic information systems (GIS), improving metering and billing procedures, achieving yearly connections targets, and reducing NRW. Ondeo's contract had similar objectives. These contracts rapidly improved NRW, which fell from 50 percent to 38 percent from 1998 to 2004. The collection ratio and staff productivity also rose. When the second management contract with Ondeo ended, NWSC maintained these performance standards without private sector involvement. The IDAMCs, as described above, ensured sustained performance.

Performance-Based Contract for the Commercial Function. When ONEA needed donor finance for a large bulk water scheme, the Bank suggested an affermage contract, citing Senegal's recent success. However, the Burkina Faso government was committed to public sector control of the utility. An alternative model was developed involving strong multi-stakeholder accountability arrangements and a performance-based contract with a specialist firm to boost ONEA's commercial performance. Financing partners found this proposal credible, and the bulk water scheme and institutional reforms to ONEA proceeded in parallel.

ONEA had a performance-based service contract for commercial management with Veolia from 2001 to 2006 (Marin, Fall, and Ouibiga 2010). Veolia provided two deputy managers, plus other short-term advisers, for ONEA's commercial and finance departments. They set up new accounting and customer management systems, and helped ONEA identify illegal customers, improve meter reading and meter repairs, and improve customer service. After an initial decline from 85 percent to 78 percent, collection efficiency rose to 95 percent by the end of the contract. ONEA has maintained high cash collection rates above 95 percent since the end of the contract. This includes collections from the government, which is obliged to settle its water bills according to the terms of the performance contract.

Formal Supervision Involving Multiple Stakeholders. Another innovative model used by ONEA is the multi-stakeholder supervision committee at ONEA. ONEA's management credits this committee with an important role in making sure that both the utility and the government play their agreed roles under the *contract plan* (performance contract with operational targets). The multi-stakeholder committee comprises representatives of customers, NGOs, and donors. The committee monitors performance of both the utility and the government under the contract, on the basis of independently audited financial and technical reports. The committee's monitoring role is centered on an annual meeting. Prior to the meeting, committee members receive not just a report from ONEA on its performance against the contract, but also the report of a financial auditor and a technical auditor, whose job it is to assure the quality of the information. The auditors' reports indicate the degree of confidence they have in the information presented. The auditors appear in person before the committee, and explain their reports.

National Utilities as a Model for Expansion of Water Supply Service

There is a continuous debate about what the optimal scale for utilities is, and whether utilities should be organized and controlled at the national, regional, or local level. All five utilities in this sample are large, serving close to or more than 3 million people. Four of the five are national utilities. Thus, based on the case study sample, it is not possible to address the optimal scale issue. However, the case studies do show that national utilities can be successful in expanding water supply service to small towns.

In Uganda, the NWSC service area grew from 3 towns (1972) to 15 towns (2003) to 23 towns (2013).[5] The original three were relatively large urban centers—Kampala, Jinja, and Entebbe. Since then, the utility has expanded to smaller towns with preexisting networks. This arrangement works well because the smaller towns benefit from the managerial and technical know-how of NWSC. Also, the towns cross-subsidize each other. In 2013, 14 of 23 towns served had average unit production costs that were higher than the weighted average tariff. Kampala, which accounts for more than 60 percent of revenue, has the lowest average unit production cost.

In Côte d'Ivoire, the concession contract awarded to SAUR in 1959 was exclusively for water services in Abidjan, the capital. Over the next 15 years, SODECI (the operator) gradually signed contracts with local governments in 10 other towns. In 1974, SODECI became responsible for all water supply systems in the country. As of 2014, SODECI serves nearly 900 towns.

Similar patterns are present in Senegal and Burkina Faso. The case studies cannot conclude that national utilities are performing *better* than regional or local utilities in providing water supply service to smaller urban centers. However, they do show that national utilities can provide water supply services to smaller towns.

Conclusions

The case studies show that well-performing utilities do exist in Africa. The utilities in the case studies show that operating efficiency and financial performance are linked. Successful utilities are able to ensure that they cover their operation and maintenance costs and generate additional funds to at least cover (part of the) depreciation of the existing infrastructure and possibly allow for some debt repayment. Nevertheless, even though the five case studies show that utilities in Africa can generate cash to pay for the operation and maintenance, depreciation, and some debt repayments, many of these utilities are not able to depend on only their own funds to pay for all of their investments.

Affordability remains a challenge also in the case study utilities. Increasing water rates do not necessarily result in higher revenues if nonpayment increases. In some cases, top-performing utilities have used cross-subsidies to much effect to reduce the burden on the residential consumer, but this has at times resulted in a very small customer base, with nonresidential water users opting out. Of the five case study utilities, most were able—with varying degrees of cross-subsidization—to make the water supply services more affordable. Only two of the five case study utilities—Nairobi's NCWSC and Senegal's SDE—were providing piped water services at levels above the thresholds set by WHO as necessary for good health and hygiene (that is, at least 50 lcd provided to residential water consumers). Cross-subsidies that ensure long-term financial viability will require that the higher tariffs charged to nonresidential users are not set higher than the costs of alternative water supplies (such as groundwater) so that they opt out of the piped network system. If these tariff prices are set too high, in the long run, the nonresidential basis on which to provide cross-subsidies to residential consumers will erode.

Incentivized contracts can be successful in improving performance. Credible commitments through legally binding contracts between public and private parties, incentivized contracts with senior management teams, performance-based contracts, and multi-stakeholder frameworks have worked to sustain successful governance and utility management models. The four well-performing utilities—NWSC, SDE/SONES, ONEA, and SODECI—all have or had some form of incentivized contract in place.

Notes

1. The focus of this section is how utilities have financed improvements in their *water supply* service. The case studies show that expanding a piped network has been successful in these utilities. For technical and financial reasons, the same does not apply for the sewerage network. Due to the complexity of increasing access to sanitation services, and because this responsibility is outside the mandate of some utilities in the sample, water supply is the focus of this section.

2. Implementation Completion Report, Senegal Water Project; Implementation Completion Report, Long Term Water Project. Note: These projects included sanitation components, which are overseen by ONAS, not SDE or SONES.

3. This very high water tariff for government customers essentially amounts to a government subsidy to the utility.

4. All data are from the Demographic and Health Survey (DHS) except Dakar, 2000, which is from the Multiple Indicator Cluster Survey (MICS). Dakar and Ouagadougou each account for about half of the total service area population of SDE and ONEA, respectively. This access data applies only to the capital cities and differs from that for the entire service area which in both utilities includes areas and towns outside the capital city.

5. NWSC operates in 146 towns as of March 2016. However, for the case studies, performance after 2014 was not studied.

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Chapter 8 Lessons Learned

There is a lack of agreement on what constitutes good performance in utilities. In this report, good performance has been defined as utilities that provide water and wastewater services that are efficient, affordable, sustainable, and with a minimum service quality. Hence, performance has many different dimensions. A definition that focuses on these different aspects of performance—financial, operational, and customer performance—has been used. When disaggregating the different elements measuring financial performance, customer performance, and operational performance, while separately addressing water coverage, it was found that these four indicators are in general not very strongly correlated (with the exception of water coverage and customer performance), meaning that good performance in one aspect of performance does not automatically predict good performance in other aspects. Even in the case study utilities, which were in general well-performing, some aspects of good performance—especially with regard to customer performance—were less well articulated. It was found that incentive structures within and outside the sector can distort aspects of performance. The findings of literature about economies of scale and scope were confirmed, while the overall economic management in the economy and governance also matter in how well utilities are performing.

Lesson 1: Although Utilities in Africa in General Underperform, There Are Relatively Well-Performing Utilities Operating in the Continent

Well-performing utilities are in general doing well in terms of operational and financial performance. It was found that good performance varies widely between countries and also within countries. This suggests that water is indeed a local service and that local circumstances have a big impact on how well utilities are performing. Unfortunately, it was not possible to capture all these local particularities in the data collection. Variation in local circumstances can include, among others, the distance to water sources, the quality of water resources available to the utilities and water users, the availability of other water resources, spatial patterns and levels of economic development that affect the cost of infrastructure and service delivery, the types of consumers, the willingness of water users to connect and pay for utility services, but also the quality of management.

Lesson 2: Customer Performance Is Relatively Weak Even among the Best-Performing Utilities

Customer performance is not necessarily very well developed in African utilities, especially not when compared with global benchmarks. Water tends to be supplied for fewer than 24 hours a day. In addition, many utilities provide relatively low levels of service compared with utilities elsewhere in the world in terms of a much heavier reliance on shared connections and public standposts. This results in significantly lower levels of consumption per capita. Residential water consumption tends to be very low; in many utilities, less than 50 lcd (the minimum volume of water set by World Health Organization [WHO] to guarantee good health and hygiene). Hence, even though tariffs are not necessarily low, the very low consumption levels provide utilities with a relatively weak revenue basis (especially when the utility is small in size). This low consumption also makes it less compelling for water consumers to use or connect to the service compared with other water sources at least in terms of service delivered (that is, consumption levels, convenience of service which is limited if households share connections and/or are dependent on public taps, and the often high number of supply interruptions). It was found that higher levels of service as measured by customer performance are positively connected to water coverage. Hence, when alternative water sources are available, the low levels of service provided can deter households from connecting to the piped water network.

Lesson 3: The Major Drivers of Water Utility Performance Are Linked to the Cost of Service, While an Enabling Environment as Reflected in Good Economic Management also Matters

It was observed that one of the major drivers of utility performance is economies of scale: size (as measured by the size of the population served with water) matters, but when a utility becomes too large the benefits become disadvantages. Economies of scope also matter. Utilities with sewerage coverage tend to show better performance, although this result has to be interpreted against a context in which sewerage coverage is very low especially in low-income countries in Africa; and this may be linked with higher gross domestic product (GDP) in environments where utilities that provide wastewater services are located. Another finding, linked to the economies of scale and scope, is the impact of costs (either measured by the operation and maintenance [O&M] costs per cubic meter of water produced or the share of labor in the total costs): higher O&M costs per cubic meter of water produced are linked with lower utility performance. A large part of the O&M costs are the result of investment decisions, and these decisions lock in costs for decades to come. It is, therefore, important to assess investment decisions properly. Some of the other drivers of utility performance are beyond the control of the utilities. The quality of economic management in the countries in which utilities operate is affecting utility performance: the higher the quality of economic management, the higher the utility performance.

Lesson 4: Improving Water Coverage in Africa Will Require Large Investments that Will Have to Be Mostly Paid for by Government Funds

Customer performance (that is, service quality) has a direct impact on improvements in water coverage. Better economic management and higher gross national income (GNI) growth have a positive impact on coverage as it is likely linked to the availability of investment funding for the sector. As per capita income rises, a larger amount of money can be spent on water, ensuring a more sustainable footing for utilities. Experience shows that most utilities are able to provide more or less universal access to water supply only when they reach a certain level of economic development; and even higher levels of economic development are needed to ensure proper management of wastewater services.

In the sample of utilities, it was found that the link between utilities' financial performance and water coverage was only in place for certain groups of utilities. For other utilities, the contribution of good financial performance to water coverage is very weak. This suggests that most utilities, especially smaller ones in low-income countries are not able to improve access through improved financial performance but depend on external funds to do so. The case studies confirmed these findings: many of the best performing utilities still depend on some form of government funding to finance their investments.

Hence, increases in water coverage will have to be matched by government priorities to fund the sector, especially as the current investment in the sector is mostly limited to water supply (that is, most utilities in Africa, especially in low-income countries, do not provide wastewater services). Utilities with few exceptions are also not able to provide services efficiently, as was reflected in the results of the data envelopment analysis (DEA)—most utilities were very far from the DEA frontier. The case studies—where data were available—showed that more efficient levels of investment spending allow more financial space for utilities.

As many utilities are underperforming, government funding for the sector should be subject to much more stringent criteria for investment selection and priority setting as these decisions will determine the O&M costs for decades after. The investment selection criteria must be linked to, among others:

(a) More comprehensive processes and methods for investment project selection (with proper technical, economic, financial, and social due diligence);

(b) Sufficient attention to the performance of the utility to operate and maintain its existing and new infrastructure so as to ensure the long-term sustainability of water (and waste-water services) by ensuring that these investments will generate the most value for money and through the inclusion of all life-cycle costs in investment decision making;

(c) Ensuring that investment expansion and institutional capacity to manage the new infra-structure assets are in synch; and

(d) Putting in place adequate and transparent sector financing policies (that is, tariff and subsidy policies that ensure that the assets can be properly operated and maintained).

Lesson 5: Specific Measures Are Needed to Ensure that Progress in Financial Cost Recovery Does Not Translate into Less Affordable Services

The better performing utilities tend to charge higher water rates to their customers. Yet, affordability remains a significant challenge for many utilities, even though most utilities in Africa provide only water services.[1] In some cases, top-performing utilities have used cross-subsidies to much effect to reduce the burden on the residential consumer, but this has at times resulted in a very skewed customer base, with nonresidential water users opting out. In the five case study utilities, most of these utilities were able—with cross-subsidization—to make the water supply services more affordable. Yet, only two of the five case study utilities (Nairobi's NCWSC and Senegal's SDE) were able to provide piped water services at levels that are above the thresholds set by WHO as necessary for good health and hygiene (i.e., 50-100 lcd for residential water consumers). Cross-subsidies can help make the service more affordable, but care should be taken to ensure that the high tariffs charged to nonresidential users are not set higher than the costs of alternative water supplies (such as groundwater) so that the nonresidential users opt out of the piped network system.

Lesson 6: Availability of Data is Critical to Assess Performance and Guide Sector Planning

To enable anyone to investigate the performance of utilities in Africa and elsewhere, availability of reliable and complete data is critical. For this analysis, the team could benefit from a tested instrument like the IBNET Toolkit. Even so, the quality and, especially, the completeness of the collected data remained a major challenge. Organizational data were collected but overall response rate for this type of information was low; utilities do not always collect even basic data on their performance. There is a huge demand from many professionals for more data beyond the basic financial and operational data collected for this study. Basic performance monitoring is most common in countries where a regulator is active. In countries where utilities have no specific regulator in place, performance monitoring is generally underdeveloped. Yet, it is hard to improve performance without reliable data and basic reporting mechanisms in place that are available to the public (externally audited financial statements are often missing).

It should be noted that focusing on a very small set of indicators may result in a distorted picture. For instance, cost recovery—at least O&M cost recovery—has become a major area of focus to measure utility performance. Although, in theory, many utilities in Africa cover their O&M costs, the actual cash flow performance of utilities is a major challenge because collection efficiencies are typically significantly below 100 percent. This means that the cash flowing into the utilities is insufficient to cover the basic expenditures, resulting in a decline in service levels and slow progress in increasing access to piped water supply. Data on collection efficiency (let alone working capital) are often either left unreported or are only partially reported (with certain groups of consumers missing) and so, on paper, a utility may be able to generate sufficient billed revenue to pay for its O&M.

Finally, most utilities have little insight into their customers' behavior. There are large discrepancies between the data provided by utilities on the access to water supply services and those registered in household surveys. Utilities should at frequent intervals calibrate their insights into their customers' behavior to better predict the demand for their services and the investment plans that are based on this demand.

Note

1. In general, the provision of wastewater services is significantly more expensive than the provision of water supply services.

Appendix A Customer Performance and Water Coverage

TABLE A.1. Customer Performance and Water Coverage, National

Country	Utility	Coverage, %	Hours of Operation, hours a day	Total Consumption (lpcd)	Operating Cost Coverage	Full Definition (including hours of operation)		Limited Definition (excluding hours of operation)	
						Sustainability Performance	Absolute Performance	Sustainability Performance	Absolute Performance
Benin	SONEB S.A.U.	68.44	24.0	37.94	1.5	0.752	0.814	0.628	0.752
Burkina Faso	ONEA	78.63	23.0	47.44	0.83	0.793	0.783	0.690	0.711
Congo, Dem. Rep.	REGIDESO	25.69		69.59	0.63	0.303	0.370	0.454	0.493
Cote dIvoire	SODECI	66.74	16.6	39.33	1.04	0.645	0.721	0.621	0.731
Guinea-Bussau	EAGB Guinea-Bissau	21.23	8.0	166.12		0.483	0.612	0.558	0.705
Lesotho	Lethoto WASCO	56.00	18.0	135.42	0.98	0.770	0.799	0.780	0.816
Malawi	LWB	65.79	20.0	92.05	0.86	0.830	0.819	0.829	0.815
Mali	SOMAGEP-Mali	67.68		72.71	1.15	0.779	0.834	0.668	0.779
Niger	SPEN	86.71	22.0	63.85		0.851	0.888	0.818	0.878
Rwanda	Rwanda WASAC	77.72	12.0	31.01		0.612	0.709	0.667	0.778
Senegal	SDE	97.94	22.8	58.85	1.39	0.874	0.906	0.811	0.874
Togo	SODECA	40.01		40.38	0.65	0.326	0.392	0.489	0.522
Uganda	NWSC	77.82	20.0	51.97	1.36	0.739	0.804	0.691	0.794

TABLE A.2. Customer Performance and Water Coverage, Regional

Country	Utility	Coverage, %	Hours of Operation, hours a day	Total Consumption (lpcd)	Operating Cost Coverage	Full Definition (including hours of operation)		Limited Definition (excluding hours of operation)	
						Sustainability Performance	Absolute Performance	Sustainability Performance	Absolute Performance
Kenya	Tavevo	72.13		103.99	0.1	0.907	0.702	0.861	0.603
Kenya	Thika	95.09	15.0	94.93	1.12	0.875	0.906	1.000	1.000
Kenya	Runda	100.00	15.0	145.21	1.09	0.875	0.903	1.000	0.996
Kenya	Nyeri	85.07	14.07	95.65	1.08	0.862	0.893	1.000	0.995
Kenya	Garissa	86.00		40.14	1.19	0.859	0.894	0.789	0.859
Kenya	Nairobi	75.23	18.0	110.38	1.18	0.834	0.876	0.876	0.917
Kenya	Kericho	77.33		21.02	0.95	0.770	0.793	0.656	0.724
Kenya	Kakamega Busia	72.51		37.56	1.88	0.766	0.824	0.648	0.766
Kenya	Mandera	25.84		102.44	1.09	0.753	0.812	0.629	0.749
Kenya	Malindi	85.02	15.0	59.76	0.98	0.750	0.785	0.812	0.838
Kenya	Moyale	66.67		8.22	1.0	0.727	0.773	0.590	0.698
Kenya	Naivasha	64.73		7.39	1.39	0.720	0.790	0.580	0.720
Kenya	Eldama Ravine	56.25		44.14	0.87	0.716	0.734	0.574	0.646
Kenya	Mombasa	56.79		41.6	1.05	0.716	0.776	0.574	0.701
Kenya	Nyanas	61.45		1.9	0.86	0.706	0.725	0.559	0.634
Kenya	Tililbei	54.89		24.96	0.89	0.698	0.725	0.547	0.633
Kenya	Kiamumbi	77.78	15.0	62.62	1.83	0.678	0.759	0.705	0.803
Kenya	Isiolo	40.00		61.64	1.02	0.676	0.739	0.515	0.652
Kenya	Eldoret	71.73	15.0	72.72	0.83	0.667	0.690	0.689	0.711
Kenya	Nanyuki	91.23	8.75	64.28	1.3	0.667	0.750	0.818	0.879
Kenya	Rumuruti	45.45		16.44	0.95	0.661	0.712	0.492	0.616
Kenya	Muranga	78.13	14.16	53.15	0.98	0.660	0.717	0.694	0.759
Kenya	Gusii	45.20		12.3	0.92	0.658	0.703	0.487	0.604
Kenya	Machakos	41.21		14.03	1.19	0.646	0.734	0.468	0.646
Kenya	Nakuru Rural	24.22		68.71	0.88	0.630	0.672	0.445	0.563
Kenya	Kisumu	66.80	15.0	37.51	0.99	0.621	0.692	0.620	0.714
Kenya	Kapenguria	29.31		37.07	0.83	0.621	0.654	0.432	0.539

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TABLE A.2. continued

Country	Utility	Coverage, %	Hours of Operation, hours a day	Total Consumption (lpcd)	Operating Cost Coverage	Full Definition (including hours of operation)		Limited Definition (excluding hours of operation)	
						Sustainability Performance	Absolute Performance	Sustainability Performance	Absolute Performance
Kenya	Embu	62.25	14.17	67.91	1.19	0.620	0.715	0.634	0.756
Kenya	Kiambu	34.74	11.7	85.51	1.01	0.612	0.687	0.674	0.754
Kenya	Nakuru	93.47	5.53	51.81	1.12	0.612	0.709	0.802	0.868
Kenya	Iten Tambach	19.23		57.53	2.45	0.604	0.703	0.405	0.604
Kenya	Amatsi	24.06		35.96	1.59	0.603	0.702	0.404	0.603
Kenya	Mavoko	79.62	11.63	14.9	1.96	0.602	0.702	0.661	0.774
Kenya	Lamu	68.18	11.7	60.27	0.99	0.598	0.673	0.654	0.735
Kenya	Meru	58.72	13.47	66.78	1.05	0.597	0.686	0.615	0.727
Kenya	Ruiru Juja	60.78	15.0	21.43	1.29	0.590	0.693	0.573	0.715
Kenya	Gulf	20.43		28.84	0.82	0.586	0.626	0.379	0.501
Kenya	Kilifi Mariakani	55.76	15.0	23.14	0.93	0.575	0.643	0.550	0.650
Kenya	Tarda Kiambere	69.14	11.43	19.08	0.89	0.567	0.627	0.613	0.678
Kenya	South Nyanza	12.04		15.53	1.42	0.549	0.662	0.324	0.549
Kenya	Kitui	46.20	15.0	12.54	1.08	0.536	0.647	0.492	0.654
Kenya	Limuru	40.00	14.99	32.72	1.04	0.529	0.634	0.481	0.637
Kenya	Nzoia	62.77	8.82	39.85	1.02	0.524	0.625	0.602	0.710
Kenya	Nyahururu	48.18	11.26	51.69	1.12	0.518	0.639	0.543	0.695
Kenya	Kibwezi Makindu	38.38	14.98	21.07	0.84	0.515	0.576	0.461	0.560
Kenya	Karuri	59.21	9.56	17.96	0.83	0.507	0.570	0.562	0.627
Kenya	Olkalou	36.36	15.0	7.83	2.8	0.501	0.626	0.439	0.626
Kenya	Narok	36.96	10.27	70.91	1.81	0.484	0.613	0.512	0.675
Kenya	Mathira	31.54	2.89	82.19	0.97	0.479	0.579	0.658	0.731
Kenya	Mwala	26.92	15.0	11.74	0.99	0.472	0.578	0.395	0.562
Kenya	Lodwar	47.86	7.62	32.78	1.6	0.452	0.589	0.520	0.680
Kenya	Wote	20.31	15.0	14.75	1.03	0.451	0.572	0.364	0.554
Kenya	Kapsabet Nandi	45.45	5.74	60.27	0.94	0.440	0.543	0.540	0.645
Kenya	Kikuyu	26.42	9.57	54.14	0.94	0.424	0.531	0.437	0.575
Kenya	Namanga	57.89	3.01	27.4	1.75	0.418	0.564	0.565	0.710

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TABLE A.2. continued

Country	Utility	Coverage, %	Hours of Operation, hours a day	Total Consumption (lpcd)	Operating Cost Coverage	Full Definition (including hours of operation)		Limited Definition (excluding hours of operation)	
						Sustainability Performance	Absolute Performance	Sustainability Performance	Absolute Performance
Kenya	Oloolaiser	27.07	9.12	40.33	0.97	0.409	0.528	0.424	0.577
Kenya	Olkejuado	32.50	7.58	33.72	0.25	0.401	0.358	0.444	0.372
Kenya	Kirinyaga	29.42	7.57	37.52	1.01	0.394	0.525	0.433	0.595
Kenya	Matungulu Kangundo	26.09	8.06	27.4	1.15	0.382	0.537	0.406	0.604
Kenya	Yatta	29.03	6.72	18.26	0.91	0.368	0.482	0.411	0.550
Kenya	Sibo	23.17	7.4	26.32	1.0	0.363	0.498	0.390	0.562
Kenya	NolTuresh Loitoktok	18.84	7.2	36.35	0.75	0.352	0.434	0.379	0.479
Kenya	Mikutra	19.89	2.33	7.61	1.29	0.270	0.452	0.356	0.571
Kenya	Kwale	17.01	1.41	28.8	0.99	0.261	0.420	0.362	0.540
Malawi	CRWB	73.53	22.0	81.34	1.12	0.884	0.913	0.868	0.912
Malawi	SRWB	77.82	22.0	73.97	1.36	0.786	0.840	0.721	0.814
Malawi	NRWB	79.00	20.0	71.8	0.89	0.760	0.773	0.724	0.752
Malawi	BWB	73.80	20.0	62.98	0.92	0.735	0.761	0.685	0.736
Mozambique	Inhambane	95.43	24.0	82.85	0.88	1.000	0.951	1.000	0.935
Mozambique	Tete	75.99	22.0	86.13	1.15	0.892	0.919	0.880	0.920
Mozambique	Xai-Xai	107.54	24.0	67.13	0.83	0.881	0.851	0.822	0.801
Mozambique	Chókwé	99.18	22.0	56.37	0.83	0.844	0.821	0.808	0.789
Mozambique	Beira	71.04	24.0	65.61	1.2	0.783	0.838	0.675	0.783
Mozambique	AdeM	63.13	17.0	81.6	0.93	0.780	0.797	0.816	0.827
Mozambique	Maxixe	69.40	24.0	50.37	0.77	0.765	0.749	0.647	0.666
Mozambique	Chimoio	53.27	24.0	65.56	1.1	0.724	0.793	0.586	0.724
Mozambique	Pemba	72.78	10.0	111.97	1.22	0.715	0.786	0.864	0.909
Mozambique	Quelimane	54.35	20.0	50.85	0.78	0.660	0.495	0.573	0.382
Mozambique	Angoche	24.86	22.0	36.05	1.0	0.578	0.660	0.408	0.574
Mozambique	Nacala	40.57	15.0	42.45	0.93	0.538	0.614	0.494	0.611
Mozambique	Lichinga	21.79	17.0	63.54	0.86	0.520	0.587	0.426	0.546
Mozambique	Nampula	50.11	9.0	43.16	1.06	0.487	0.605	0.543	0.682

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TABLE A.2. continued

Country	Utility	Coverage, %	Hours of Operation, hours a day	Total Consumption (lpcd)	Operating Cost Coverage	Full Definition (including hours of operation)		Limited Definition (excluding hours of operation)	
						Sustainability Performance	Absolute Performance	Sustainability Performance	Absolute Performance
Mozambique	Cuamba	14.61	10.0	47.81	0.57	0.386	0.419	0.370	0.420
Nigeria	KSWB, Kaduna State	91.62	15.0	68.89	0.6	0.758	0.705	0.825	0.732
Nigeria	JSWB, Jigawa State	100.00	16.0	14.05	0.11	0.730	0.573	0.762	0.542
Nigeria	FCT WB, Abuja	32.78	24.0	202.28	5.52	0.690	0.767	0.535	0.690
Nigeria	KGWB, Kogi State	53.58	18.0	58.17		0.635	0.727	0.578	0.719
Nigeria	SSWB, Sokoto State	65.00	6.0	85.97	0.66	0.633	0.624	0.825	0.749
Nigeria	KBSWB, Kebbi State	32.76	12.0	147.07	1.25	0.609	0.707	0.664	0.776
Nigeria	KNSWB, Kano State	41.23	18.0	40.41	0.71	0.580	0.596	0.495	0.545
Nigeria	BYSWB, Bayelsa State	99.36	5.0	9.86	0.0	0.575	0.431	0.758	0.506
Nigeria	LWC, Lagos	39.83	17.7	17.89	0.38	0.556	0.503	0.465	0.425
Nigeria	ASWB, Adamawa State	33.33	8.0	143.21	0.52	0.556	0.534	0.667	0.601
Nigeria	ZSWB, Zamfara State	75.00	6.0	74.18	0.0	0.555	0.416	0.707	0.471
Nigeria	ENSWC, Enugu State	69.37	9.0	14.22	1.34	0.531	0.648	0.609	0.740
Nigeria	WCOS , Oyo State	53.90	12.0	4.98	1.3	0.516	0.637	0.524	0.682
Nigeria	CRSWBL, Cross River State	55.37	24.0	27.18	2.48	0.701	0.776	0.552	0.701
Nigeria	YSWC, Yobe State	67.00	6.0	58.97	0.07	0.514	0.401	0.646	0.451
Nigeria	TSWSA, Taraba State	36.09	12.0	49.4	0.04	0.486	0.373	0.480	0.331
Nigeria	PSWB, Plateau State	15.82	7.0	142.84	1.47	0.483	0.612	0.579	0.719
Nigeria	ESUWB, Edo State	64.29	7.0	0.78	0.11	0.479	0.383	0.572	0.414
Nigeria	ANSWC, Anambra State	49.25	9.0	25.51	0.46	0.471	0.459	0.519	0.486
Nigeria	BSWB, Bauchi State	55.06	5.0	63.39	0.63	0.464	0.492	0.592	0.586
Nigeria	EBSWC, Ebonyi State	12.42	18.0	7.4	0.26	0.462	0.405	0.318	0.290
Nigeria	GSWB, Gombe State	41.48	9.0	44.41	0.09	0.459	0.366	0.501	0.363
Nigeria	ABSWB, Abia State	60.00	5.0	16.54	0.07	0.446	0.351	0.565	0.398

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TABLE A.2. continued

Country	Utility	Coverage, %	Hours of Operation, hours a day	Total Consumption (lpcd)	Operating Cost Coverage	Full Definition (including hours of operation)		Limited Definition (excluding hours of operation)	
						Sustainability Performance	Absolute Performance	Sustainability Performance	Absolute Performance
Nigeria	KTSWB, Katsina State	40.00	9.0	30.57	1.09	0.444	0.582	0.478	0.650
Nigeria	OSWC, Osun State	37.00	9.82	22.04	0.23	0.440	0.382	0.455	0.373
Nigeria	OGSWC, Ogun State	44.66	8.0	6.51	0.5	0.430	0.438	0.479	0.472
Nigeria	NSWB, Nasarawa Sate	30.55	6.0	72.65	0.15	0.405	0.339	0.483	0.368
Nigeria	AKWCL, Akwa Ibom	40.75	3.0	4.51	1.38	0.347	0.510	0.458	0.638
Nigeria	DSUWB, Delta State	26.60	6.0	11.32	0.08	0.345	0.277	0.393	0.286
Nigeria	RSWB, Rivers State	4.87	8.0	55.0	0.65	0.331	0.397	0.330	0.418
Nigeria	BSWB, Benue State , Makurdi.	5.50	10.0	8.81	0.26	0.329	0.307	0.285	0.270
Nigeria	ODWC, Ondo State	11.45	8.0	15.27	0.1	0.325	0.266	0.321	0.244
Nigeria	NSWB, Niger State	12.64	5.0	30.0	0.0	0.297	0.223	0.341	0.227
Nigeria	EKSWC, Ekiti State	20.00	4.0	7.25	0.04	0.293	0.228	0.356	0.249
Nigeria	ISWC, Imo State	2.60	6.0	18.78	0.84	0.270	0.392	0.280	0.440
Zambia	Southern WSC	89.24	21.0	82.25	1.26	0.958	0.969	1.000	1.000
Zambia	Lusaka WSC	86.48	20.0	85.63	1.26	0.944	0.958	1.000	1.000
Zambia	Kafubu WSC	86.71	17.0	91.64	1.45	0.903	0.927	1.000	1.000
Zambia	Nkana WSC	94.87	15.0	78.49	1.44	0.875	0.906	1.000	1.000
Zambia	North Western WSC	82.78	23.0	46.01	1.39	0.864	0.898	0.795	0.864
Zambia	Lukanga WSC	69.23	20.0	122.93	0.99	0.842	0.856	0.846	0.863
Zambia	Eastern WSC	114.25	20.0	66.79	0.83	0.826	0.807	0.822	0.798
Zambia	Mulonga WSC	94.69	18.0	218.47	1.39	0.812	0.859	0.843	0.896
Zambia	Chambeshi WSC	70.85	10.0	49.74	0.83	0.575	0.619	0.654	0.686
Zambia	Luapula WSC	19.86	9.0	101.3	0.46	0.525	0.498	0.599	0.539
Zambia	Western WSC	35.94	13.0	54.88	0.83	0.504	0.566	0.486	0.574

TABLE A.3. Customer Performance and Water Coverage, Municipal

Country	Utility	Coverage, %	Hours of Operation, hours a day	Total Consumption (lpcd)	Operating Cost Coverage	Full Definition (including hours of operation)		Limited Definition (excluding hours of operation)	
						Sustainability Performance	Absolute Performance	Sustainability Performance	Absolute Performance
South Africa	Emfuleni	100.00	24.0	147.52	1.18	1.000	1.000	1.000	1.000
South Africa	Mogale	100.00	24.0	142.42	0.85	1.000	0.943	1.000	0.924
South Africa	Buffalo City	100.00	24.0	131.84	0.64	1.000	0.896	1.000	0.861
South Africa	George	100.00	24.0	128.72	0.68	1.000	0.905	1.000	0.874
South Africa	Nelson Mandela Bay	100.00	24.0	140.05	1.35	1.000	1.000	1.000	1.000
South Africa	Rustenburg	100.00	24.0	145.19	0.98	1.000	0.974	1.000	0.965
South Africa	Silulumanzi	100.00	24.0	153.33	0.15	0.993	0.778	0.989	0.704
South Africa	EWS	100.00	24.0	157.68	0.66	0.984	0.888	0.976	0.850
South Africa	The Msunduzi	100.00	24.0	159.39	0.84	0.980	0.925	0.971	0.900
South Africa	Ekurhuleni	100.00	24.0	164.68	1.33	0.970	0.978	0.955	0.970
South Africa	Drakenstein	100.00	24.0	182.04	1.39	0.941	0.956	0.912	0.941
South Africa	Cape Town	100.00	24.0	184.4	0.7	0.938	0.862	0.907	0.816
South Africa	Mangaung	100.00	24.0	196.13	0.92	0.922	0.900	0.882	0.867
South Africa	Stellenbosch	100.00	24.0	196.46	1.16	0.921	0.941	0.882	0.921
South Africa	Joburg Water	100.00	24.0	207.72	0.96	0.907	0.900	0.861	0.866
South Africa	Sol Plaatje	100.00	24.0	208.34	1.41	0.907	0.930	0.860	0.907
South Africa	Tshwane	100.00	24.0	246.11	1.2	0.870	0.902	0.805	0.870
South Africa	Newcastle	100.00	24.0	0.0	0.18	0.833	0.666	0.750	0.555
South Africa	Polokwane	100.00	24.0	0.0	0.61	0.833	0.763	0.750	0.685

table continues next page

TABLE A.3. continued

Country	Utility	Coverage, %	Hours of Operation, hours a day	Total Consumption (lpcd)	Operating Cost Coverage	Full Definition (including hours of operation)		Limited Definition (excluding hours of operation)	
						Sustainability Performance	Absolute Performance	Sustainability Performance	Absolute Performance
Tanzania	Tanga	94.50	23.5	81.74	1.12	1.000	1.000	1.000	1.000
Tanzania	Moshi	89.40	20.0	110.15	1.05	0.944	0.947	1.000	0.984
Tanzania	Iringa	95.80	24.0	69.64	1.01	0.884	0.893	0.826	0.857
Tanzania	Mbeya	96.90	21.0	64.14	1.01	0.837	0.856	0.818	0.850
Tanzania	Dodoma	70.20	19.0	83.15	1.05	0.831	0.863	0.851	0.887
Tanzania	Musoma	66.50	18.9	96.36	0.88	0.818	0.814	0.833	0.822
Tanzania	Morogoro	72.00	17.4	88.44	0.47	0.815	0.717	0.860	0.715
Tanzania	Mwanza	72.50	22.0	70.12	1.04	0.765	0.811	0.689	0.775
Tanzania	Arusha	70.40	12.0	78.43	1.17	0.735	0.801	0.852	0.901
Tanzania	Babati	84.20	14.0	26.19	1.0	0.710	0.759	0.774	0.818
Tanzania	Bukoba	56.90	21.3	65.61	0.91	0.699	0.732	0.604	0.680
Tanzania	Mtwara	51.60	13.6	78.1	0.79	0.694	0.700	0.758	0.744
Tanzania	Tabora	71.00	18.2	49.77	0.92	0.689	0.727	0.655	0.716
Tanzania	Songea	76.50	17.1	36.18	0.74	0.682	0.679	0.667	0.668
Tanzania	Shinyanga	22.00	21.3	187.18	0.97	0.636	0.699	0.511	0.636
Tanzania	Singida	81.20	5.7	38.71	0.84	0.604	0.644	0.787	0.780
Tanzania	Kigoma	42.80	9.1	122.88	0.81	0.602	0.635	0.714	0.721
Tanzania	Sumbawanga	61.60	10.6	20.84	0.73	0.532	0.564	0.577	0.605
Tanzania	Bariati	33.61	16.0	15.87	0.33	0.510	0.457	0.432	0.387
Tanzania	DAWASCO	62.28	8.0	38.28	0.81	0.510	0.566	0.598	0.643
Tanzania	Lindi	70.00	6.0	14.11	0.32	0.492	0.442	0.612	0.506
Tanzania	Mpanda	71.24	3.0	44.0	1.17	0.474	0.606	0.649	0.766
Tanzania	Njombe	53.00	6.0	61.74	0.91	0.470	0.560	0.580	0.663
Tanzania	Geita	6.59	4.0	19.68	0.53	0.256	0.312	0.300	0.361

Appendix B Case Studies

Burkina Faso, ONEA (L'Office National de l'Eau et de l'Assainissement)

Background

ONEA is a national utility that provides water supply, wastewater, and excreta treatment services to 54 towns in Burkina Faso (Sawadogo 2015). Ouagadougou, the capital, accounts for more than 60 percent of customers.

ONEA was established as a public water utility in 1985. Access was low and reliability was poor throughout the early 1990s. In 1994, ONEA was corporatized. In the same year, the first *contract plan* (performance contract with operational targets) was established between the utility and the government of Burkina Faso. A performance-based service contract with Veolia was in place from 2001 to 2006.

Today, ONEA is publicly owned and operated. Its contract plan with the government is supervised by a multi-stakeholder committee comprising representatives of customers, nongovernmental organizations, and donors. The committee monitors performance of both the utility and the government under the contract, on the basis of independently audited financial and technical reports.

The committee's monitoring role is centered on an annual meeting. Before the meeting, committee members receive not just a report from ONEA on its performance against the contract, but also the report of a financial auditor and a technical auditor whose job it is to assure the quality of the information. The auditors' reports indicate the degree of confidence they have in the information presented. The auditors appear in person before the committee and explain their reports.

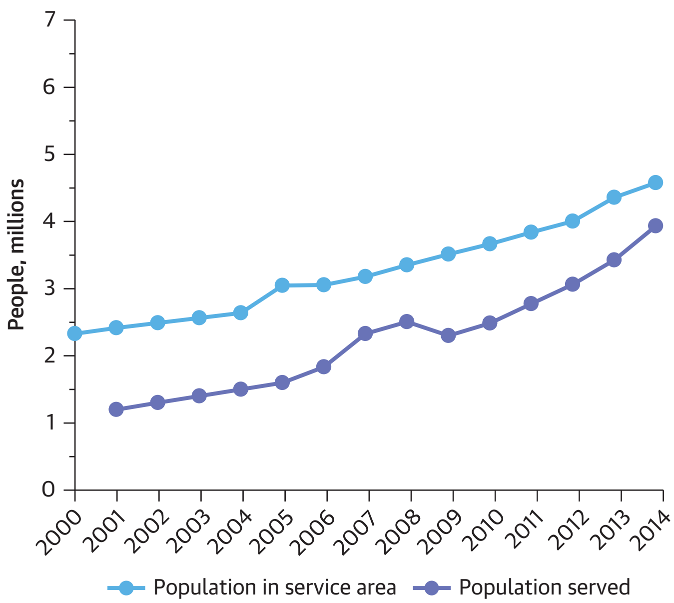
Performance

Customer Performance

Access to Water Services. In 2000, ONEA served about half of its service area population—2.3 million people. By 2014, nearly 4 million people were served out of 4.6 million people (86 percent coverage). This progress is extraordinary considering that from 2000 to 2015 Ouagadougou was the fastest growing Sub-Saharan African city (out of the set of cities with a 2015 population above 1 million). Ouagadougou grew at an average annual rate of 7.5 percent during this period (United Nations 2014).

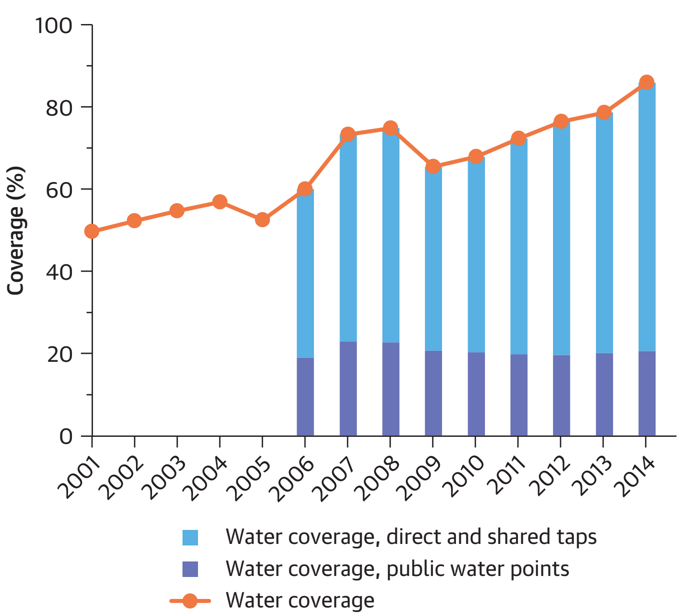
Growth in the service area population and population served are shown in figure B.1. Figure B.2 shows the growth in water coverage, defined as the proportion of the service area population served by ONEA. A breakdown of those served by direct or shared taps and those served by public water points is included for years 2006-14.

FIGURE B.1. Population Served Compared with Service Area Population, 2000–14



Source: IBNET, www.ib-net.org.

FIGURE B.2. Water Coverage (Population Served Divided by Service Area Population), 2001–14



Source: IBNET, www.ib-net.org.

The decrease in population served from 2008 to 2009 is due to revised estimation techniques. As shown in figure B.2, ONEA reports that the percentage of people served by public water points has remained relatively constant since 2006, at 20 percent. Meanwhile, the share of those served by direct or shared taps has increased from 41 percent to 65 percent.

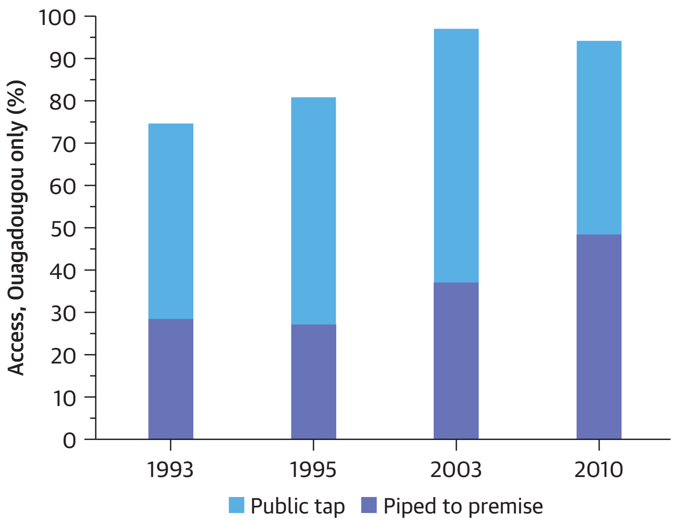
However, household survey data for Ouagadougou present a different picture. In 2010, only about 48 percent of people reported accessing water from a tap piped to their premises.[1] Forty-six percent reported accessing water from a public tap. In other words, the DHS data (for Ouagadougou only) show lower access to piped water to their premises, higher access to public taps, and higher total access in comparison with the utility-reported data. The DHS data do confirm that the share of people with access to a household connection has increased—in 2003, just 37 percent reported accessing piped water supplied to their premises. DHS data for 1993, 1995, 2003, and 2010 are shown in figure B.3. The number of people served per connection is shown in figure B.4.

ONEA's strategy is to first focus on achieving good access for the poor through public taps and then increase individual connections. The above data show that the utility is executing this strategy successfully. ONEA plans to serve 80 percent of its service area population with piped water to the premises by 2030. For the time being, however, the average number of people per connection remains high. There were 13 people per connection in 2014, down from 19 people per connection in 2000.

Network Expansion and Growth in Connections. A Bank-funded expansion project, implemented in 2004, led to rapid growth in connections and the distribution network (figures B.5 and B.6). From 2004 to 2014, the annual average rate of connections was 15 percent, up from an average increase of 7 percent in the previous decade.

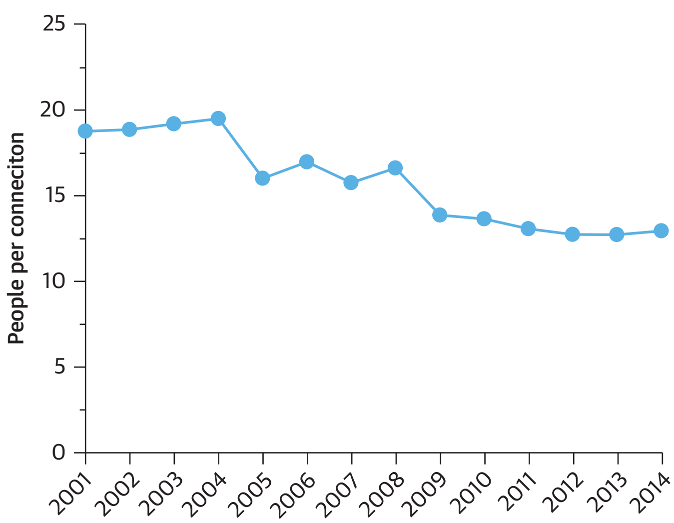
Reliability. In the 1990s, Burkina Faso faced a severe water shortage. Data from this period are not available, but it is known that ONEA's water supply was intermittent. After construction

FIGURE B.3. Access to Water Service, Ouagadougou Only



Source: IBNET, www.ib-net.org.

FIGURE B.4. People Served per Connection, 2001–14



Source: IBNET, www.ib-net.org.

of the Ziga Dam near Ouagadougou, ONEA has achieved near-perfect reliability at 23 hours per day (see figure B.7). This is significant, especially considering that the country has just 732 m^3 of renewable internal freshwater resources per capita. The Ziga II Project aims to attain 24 hours of service by 2017 (Sawadogo 2015).

Water Consumption. Average residential water consumption per capita is relatively low at 39 lcd. Residents consume about 87 percent of the volume of water sold.

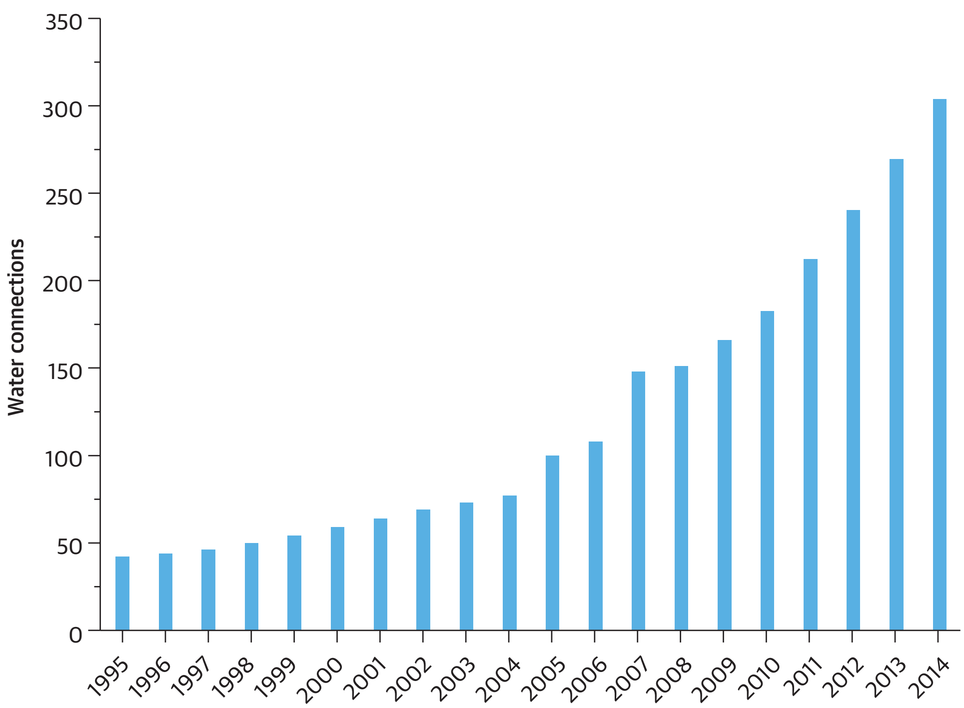
Affordability. One measure of affordability is the percentage of income spent on water consumption. A proxy for the average annual per capita expenditure on water is total revenue from sales divided by the number of people served. A proxy for average per capita income is Burkina Faso's GNI per capita. Dividing the proxy for water expenditure into the proxy for income gives an average expenditure on water at 2.7 percent of income.[2] By contrast, the regional benchmark for this indicator is 1.22 percent. The benchmark is the first quartile of all African water utilities included in the sample; in other words, it is the middle number between the most affordable water (lowest ratio) and the median. Affordability is reduced by the low consumption levels of residential water users (at about 39 lcd; see figure B.8).

Safety. ONEA tests water quality and reports that the samples consistently pass a defined standard for drinking water. However, drinking water quality data are neither published nor independently verified.

Operational Performance

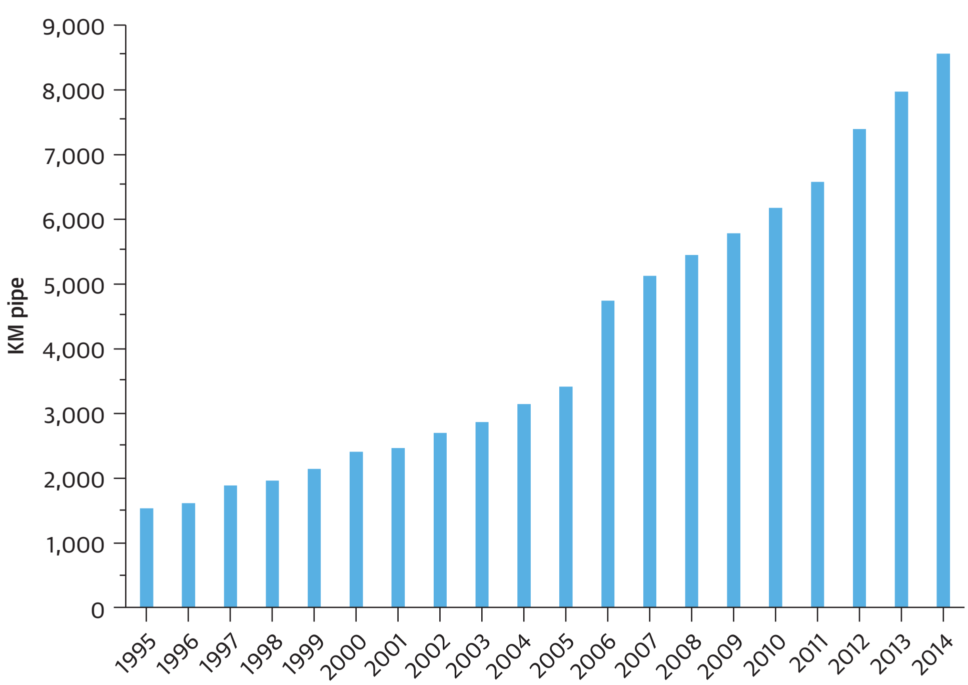
NRW. ONEA has maintained low levels of NRW since 1995, the first year with data available. Measured in percentage terms, NRW has been about 20 percent for the last 20 years. NRW per connection per day was more than halved during this period, dropping to just 135 liters per connection per day. This is close to the global benchmark of 121 liters per connection per day and better than the African benchmark (at 205 liters per connection per day). NRW trends over time, measured in liters per connection per day and percentage of production, are shown in figure B.9 and figure B.10, respectively. NRW spikes in 2004 correspond to

FIGURE B.5. Number of Water Connections



Source: IBNET, www.ib-net.org.

FIGURE B.6. Network Expansion



Source: IBNET, www.ib-net.org.

when the Ziga scheme began supplying water.

NRW in percentage terms is relatively flat because production and consumption increase at about the same average annual rate (6 percent). NRW in liters per connection per day reduces because of a significant increase in connections, even as the total amount of NRW rises. Metering across the service area has been nearly universal (about 97 percent) since 2000.

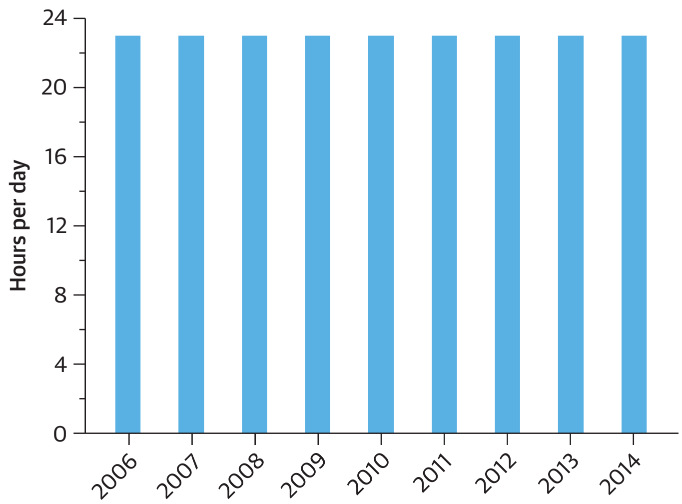
Staff Productivity. Staff productivity has improved significantly since 2000, with the number of staff per 1,000 water connections falling from 10 to 3 by 2014 (see figure B.11). This progress was achieved as both staff numbers and productivity grew. This was possible because network expansion significantly outpaced hiring of new labor.

ONEA's staff efficiency—revenue per employee divided by labor costs per employee, or simply revenue divided by labor costs—has fallen from about 5 in 2003 and 2004 to 4 from 2009 to 2013. At 3.94 in 2013, ONEA is below the regional benchmark of 4.21.[3]

Financial Performance

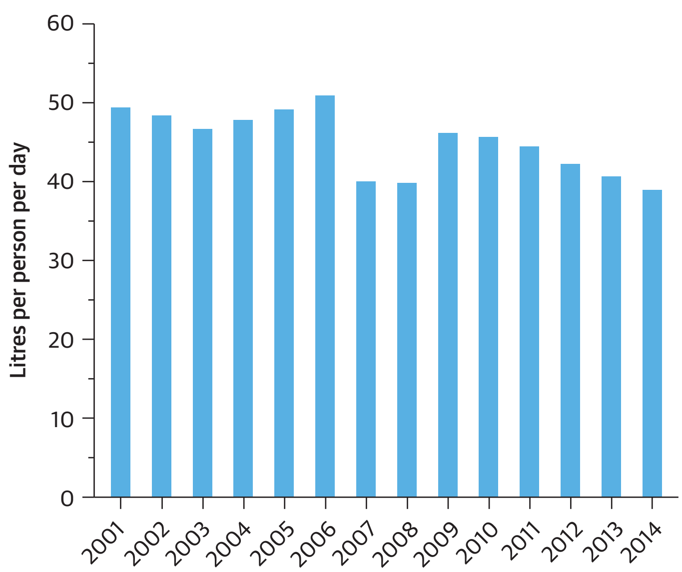
Collection Efficiency. ONEA had a performance-based service contract for commercial management

FIGURE B.7. Hours of Supply per Day, 2006–14



Source: IBNET, www.ib-net.org.

FIGURE B.8. Sufficiency of Residential Consumption, 2001–14



Source: IBNET, www.ib-net.org.

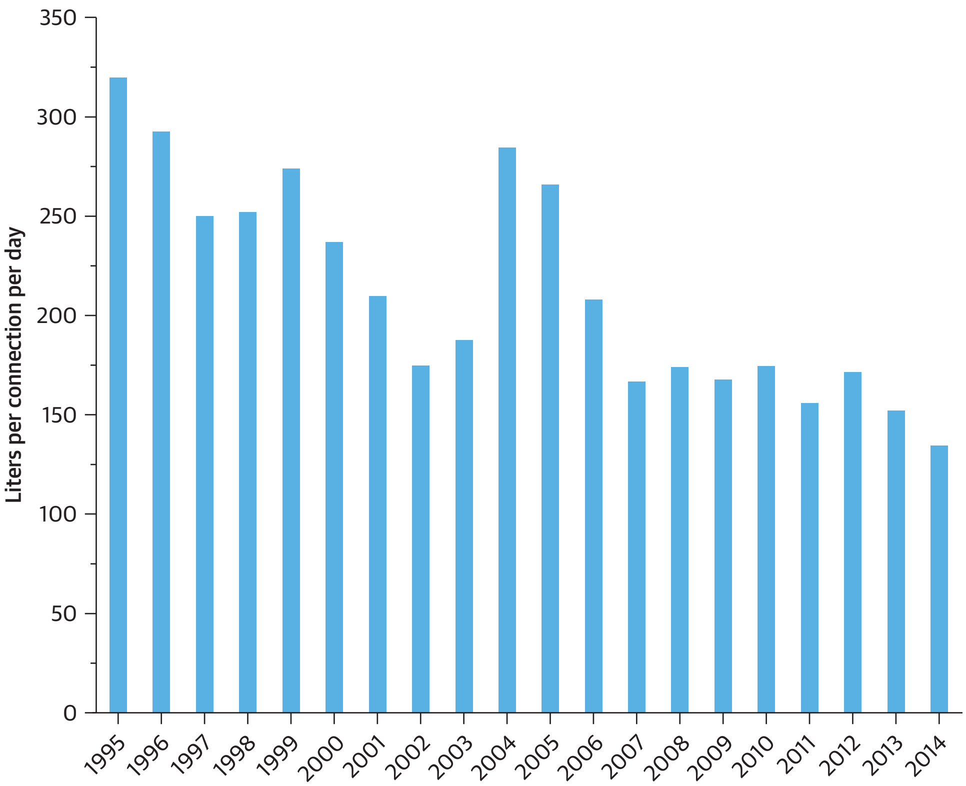
with Veolia from 2001 to 2006 (Marin, Fall, and Ouibiga 2010). Veolia provided two deputy managers, in addition to other short-term advisers, for ONEA's commercial and finance departments. They set up new accounting and customer management systems and helped ONEA identify illegal customers, improve meter reading and meter repairs, and improve customer service. After an initial decline from 85 percent to 78 percent, collection efficiency rose to 95 percent by the end of the contract (see figure B.12).

ONEA has maintained high cash collection rates above 95 percent since the end of the contract. This includes collections from the government, which is obliged to settle its water bills in the terms of the performance contract. ONEA's collection ratio from 2001 to 2013 is shown in figure B.12.

Operating Cost Coverage. ONEA's OCCR has fluctuated over time, reaching a high of 1.63 in 2007. This high is attributed to an increase in revenue after completion of the Ziga dam project and related network expansion efforts. In 2012 and 2013, the operating cost ratio dropped to its lowest levels since 2002: 1.19 and 1.13, respectively. Operating expenses nearly doubled from 2008 to 2013, with the share of non-labor expenses also rising. The trend in the operating cost recovery ratio is shown in figure B.13. Real average tariffs and real average costs per m^3, in the local currency, are shown in figure B.14. The U.S. dollar equivalents for 2013 are also noted in the figure.

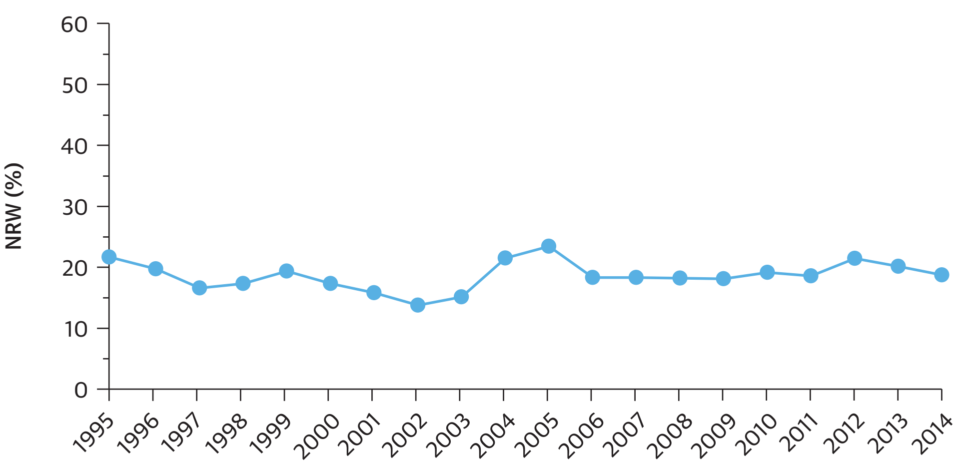
In real terms, ONEA's average tariff has declined at an average annual rate of 1.7 percent since 2002. In 2013, it was equivalent to US$1.12. Real average costs have fluctuated significantly from 2002 to 2013. They were US$0.99 in 2013. ONEA subsidizes consumption for basic needs by charging much higher tariffs for what it regards to be excessive consumption. ONEA's tariff for the first consumption block (up to 8 m^3 per month) is just 18 percent of the tariff for consumption in excess of 30 m^3. This subsidized tariff is US$0.39 per m^3, compared with US$2.16 per m^3 for consumption above 30 m^3. The latter is designed to be a disincentive for excessive water use.[4] There are two other residential tariff blocks—above 8 m^3 and up to 15 m^3 (US$0.89) and above 15 m^3 and up to 30 m^3 (US$1.06). The standpipe tariff is equal to the basic needs tariff (US$0.39 per m^3).[5] Nonresidential tariffs to help cross-subsidize are set at US$2.16 per m^3 regardless of

FIGURE B.9. Nonrevenue Water, by Connection, 1995–2014



Source: IBNET, www.ib-net.org.

FIGURE B.10. Nonrevenue Water as a Percentage of Production



Source: IBNET, www.ib-net.org.

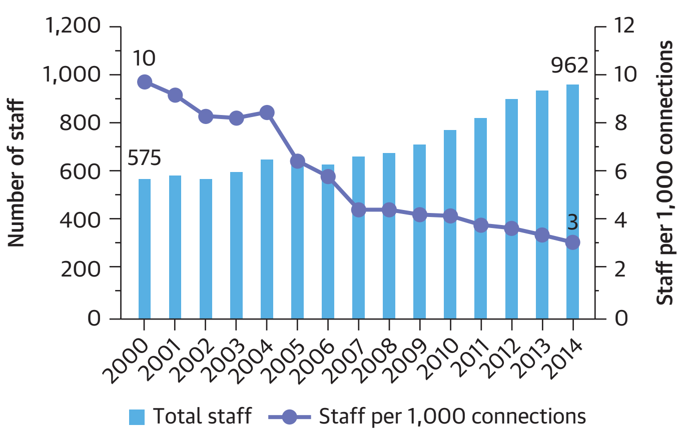
amount consumed. Industrial customers account for 5 percent of consumption by volume.[6]

Financial Transparency. ONEA does not publish an annual report or financial statements. The 2015 performance contract (with targets) is published on its website, but actuals are not included. The tariff schedule is posted online.

Investment. For ONEA to increase access and improve service, investment totaling about US$600 million was required from 2002 to 2013.[7] This amounts to about US$23 per person served per year over this 12-year period. Figure B.15 shows the sources and amounts of investment financing during this period. While about 52 percent was grant financed, 19 percent was financed by own cash and 29 percent from loans. ONEA can service its debt with operating cash flows.

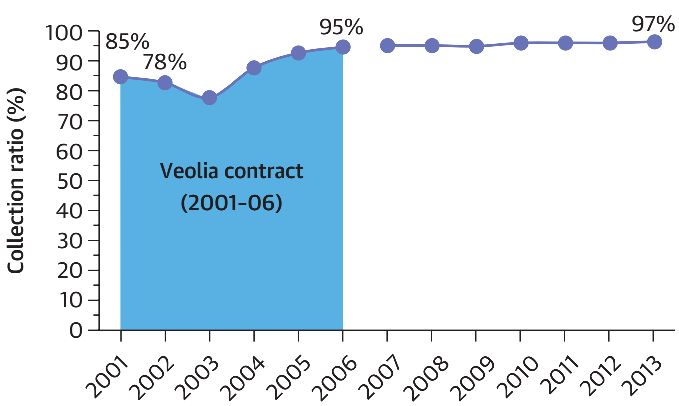
A major program was the Ouagadougou Water Supply Project (US$269 million, 2001-07). The Bank was a major financier along with 10 other donors. The Bank lent US$70 million to the government of Burkina Faso. The amount on-lent to ONEA was US$28 million and the remaining US$42 million was given as an equity contribution. The interest rate was 5.4 percent and the tenor was 20 years (including a 10-year grace period). The program included the extension of the distribution network and construction of the Ziga dam, Boudtenga reservoir (5,400 m^3), a water treatment plant, and pumping station. Increased water

FIGURE B.11. Staff Numbers and Staff per 1,000 Water and Sewer Connections, 2000–14



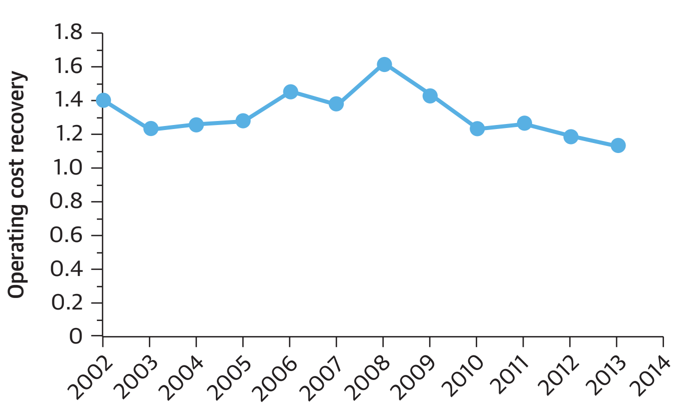
Source: IBNET, www.ib-net.org.

FIGURE B.12. Collection Ratio, 2001–13



Source: IBNET, www.ib-net.org.

FIGURE B.13. Operating Cost Recovery Ratio, 2002–14



Source: IBNET, www.ib-net.org.

production led to near-perfect water supply reliability (23 hours per day), whereas before the project service was intermittent. Another component of the project was the hiring of Veolia under a performance-based service contract to help manage the commercial function.

Increasing operating cash flow was key to achieving expansion in service. As the cash flows allowed ONEA to service the debt and invest directly, 48 percent of investment was thus supported by the free cash flow ONEA created through its operations. Important drivers of increasing cash flow were increasing collection efficiency (78 percent in 2002 to 97 percent in 2013), maintaining low levels of NRW, and increasing labor productivity by limiting the growth of staff numbers as connections increased.

Organization

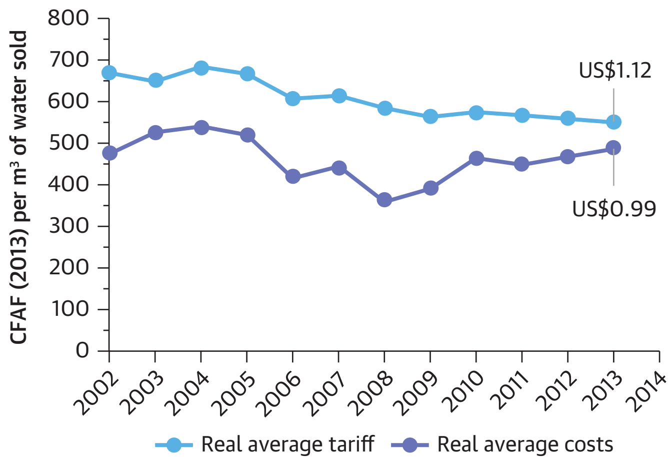
Human Resources

ONEA has instituted a performance management system with clearly documented processes, job descriptions, and targets for each position. Annual performance reviews let team members know where they have to improve. Targets from the utility's contract with the government are reflected in the board's contract with the managing director. The managing director then cascades these targets down to lower-level managers in the organization. This method of performance-based management helped to build strong managers throughout the company. By creating a deep management bench, ONEA has reduced the risk that losing a leader will undo its success.

Strategic Planning

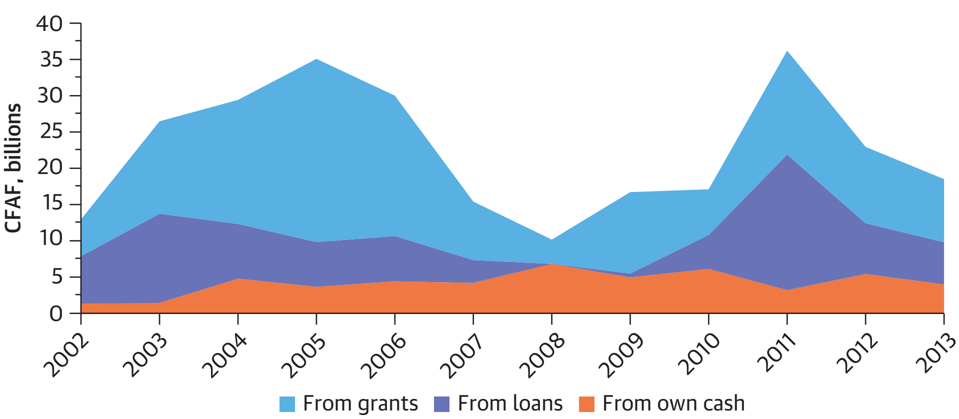
ONEA uses strategic planning to develop the contract plans, which are at the heart of its accountability arrangements. The plans set out what the utility needs to do to meet service targets and what this will cost. The plans are independently scrutinized by external stakeholders. When these stakeholders are satisfied that the plans are reasonable, the service targets in the plan and the tariffs required to cover the costs of services are incorporated in a multiyear

FIGURE B.14. Average Tariffs, Average Costs per m³, 2002–14



Source: IBNET, www.ib-net.org.

FIGURE B.15. Sources and Amounts of Investment Financing, 2002–13



Source: IBNET, www.ib-net.org.

contract plan. ONEA started strategic planning in 2004. It is now on its third plan.

ONEA is ISO 9001 certified. ONEA reports that certification provides internal discipline in the company and a credible external validation of reliability. In addition, ONEA's annual reports against the key performance indicators in its contract with the government are audited by financial and technical auditors, who submit their reports to a multi-stakeholder supervisory committee.

Commercial Practices

ONEA's mandate prevents it from providing services directly to informal settlements because they are unplanned, and so the residents lack formal title. The utility has delegated service provision to small entrepreneurial providers. These providers typically start business by operating a water kiosk. However, they can then expand their delivery options, with some offering flexible piped connections to the home, run from the water point controlled by the small entrepreneurial provider. ONEA controls the prices that the small providers charge, helping reduce the risk of small providers using local monopoly power to on-sell water at excessive prices. Even so, ONEA does not regard this as a long-term solution. It would like to progressively extend formally piped water connections to more and more households in the informal settlements.

Summary

As a result of ONEA's turnaround, about 78 percent of people in the utility service area in 2013 have access to piped water services, up from just 50 percent in 2001. On average, water is available for 23 hours per day. Cross-subsidies help ensure that water is affordable to residential customers. Revenue covers all operating costs and some capital costs, a result of operational efficiency and a cost recovery tariff.

In the 1990s, Burkina Faso faced a severe water shortage. A new water source was desperately needed. The success of Senegal's affermage contract made that an obvious choice for Burkina Faso. However, the government was committed to public sector control of the utility. An alternative model was developed involving strong multi-stakeholder accountability arrangements and a performance-based contract with a specialist firm to boost ONEA's commercial performance. Financing partners found this proposal credible, and the bulk water scheme and institutional reforms to ONEA proceeded in parallel.

Veolia's contract from 2001 to 2006 increased collection efficiency from 85 percent to 95 percent, success ONEA has maintained in the decade after the contract's end. At the same time, the Ouagadougou Water Supply Project ensured greater supply reliability for ONEA's customers, and included network expansion and the installation of new connections and standposts. Low levels of NRW were maintained. Staff productivity rose while new staff were hired.

Today, ONEA's innovative Supervisory Committee, strong performance culture, and operational efficiency are sustaining the benefits achieved by these reforms.

Côte d'Ivoire, SODECI (la Société de Distribution d'Eau de la Côte d'Ivoire)

Background

SODECI, founded in 1960, is the oldest PPP water utility in the developing world, serving over 11 million customers. The partnership between the national government and the private operator has allowed effective expansion of access to water services, while increasing the efficiency and profitability of the national utility over time. This PPP has endured even as utilities in neighboring countries were nationalized. It has remained private since its founding more than 50 years ago. More notably, SODECI has shown remarkable resilience and continuity of service during and after the First Ivorian Civil War from 2002 until 2007 and the Second Ivorian Civil War from late 2010 until early 2011. The history of SODECI is summarized in five time periods below (Marin et al. 2009).

1960–74. Côte d'Ivoire gained independence in 1960. The year before that, the French water operator SAUR had been awarded a concession contract to provide water supply services in Abidjan. SODECI, the new Ivorian company established in 1960, gradually signed operating contracts with municipalities in 10 other cities.

1974–88. In 1974, Côte d'Ivoire's water sector was reformed. Municipal water utilities were consolidated into one national utility, which signed an operations contract with SODECI. From 1974 to 1988, US$400 million of public investment were used to install piped water in 200 additional towns. Before these reforms, only 34 percent of households had access to piped water. By 1983, household coverage almost doubled to 63 percent. The company's management was gradually transferred to Ivorian nationals. In 1978, the French group SAUR sold 48 percent of the shares in an initial public offering on the Abidjan stock exchange.

1988–2001. From 1988 to 2001, SODECI financed rapid expansion of the water network through a tariff surcharge. SODECI more than doubled the number of households served by piped water. During this period, major gains in efficiency were achieved (losses decreased from 180 liters per connection per day to 130 liters per connection per day). At the end of this period, SODECI's operational performance was at the level of present-day global benchmarks. The expansion of the network added many more customers. Increased revenues as a result of expansion, as well as efficiency gains, gradually improved the overall financial performance of the utility. Average tariffs decreased in real terms over the same time period.

2002–11. During the First Ivorian Civil War (2002-07) and Second Ivorian Civil War (2010-11), SODECI continued to provide water services to existing and new customers. Nearly 4 million additional people were served during this period.[8] As would be expected, however, service and operational performance declined during this time. Reliability of service was nearly halved. NRW rose. Revenue fell slightly.

2012–14. After 2011, when the conflict stabilized, performance began improving. While pre-conflict performance has not been attained since then, SODECI is still a successful utility in the context of Sub-Saharan Africa. Most indicator values for 2014 are on par with or better than the regional benchmark, a significant accomplishment given nearly a decade of political instability and factual division of the country. The Eranove Group, formerly known as Finagestion, is a main shareholder of SODECI.

Performance

Customer Performance

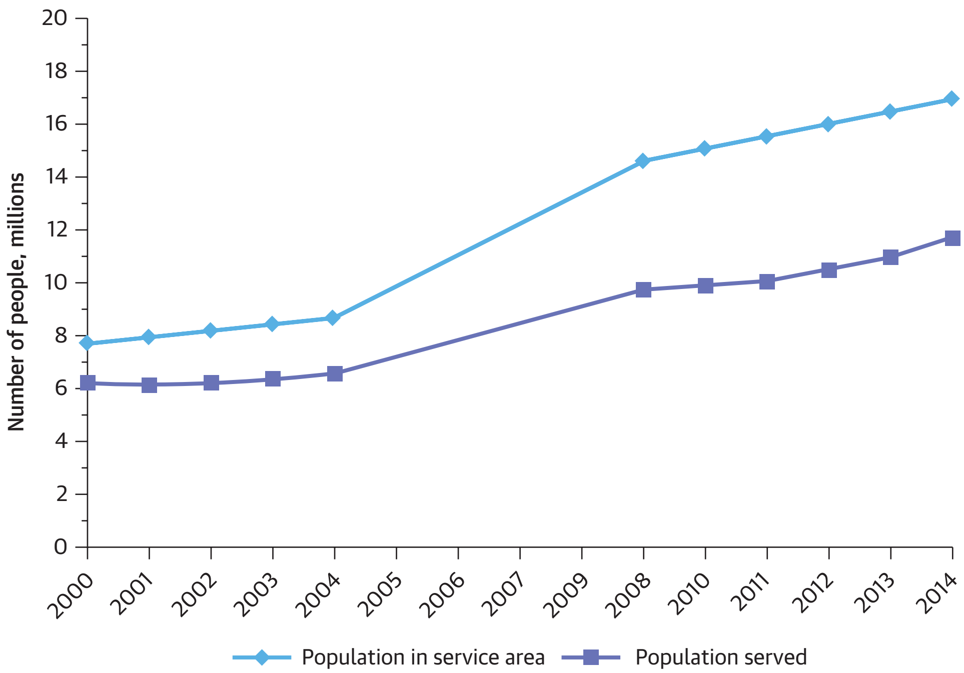
Access to Water Services. Between 2000 and 2014, SODECI extended water service to 5.5 million additional people. This was achieved despite the civil wars from 2002 to 2007 and 2010 to 2011. Owing to rapid migration to major cities and towns during the crises, water coverage declined in the early 2000s. Since 2011, coverage has been steadily rising as SODECI regains its footing.

Growth in SODECI's service area population and population served over this period is shown in figure B.16. Figure B.17 shows the growth in water coverage, defined as the proportion of the service area population served by SODECI.

As of 2006, about 25 percent of people in the served area population were served by community tap stands (Fall et al. 2009). In 2014, the average number of people served per connection was 15, up from 12 people per connection during the 2000-04 period (see figure B.18).

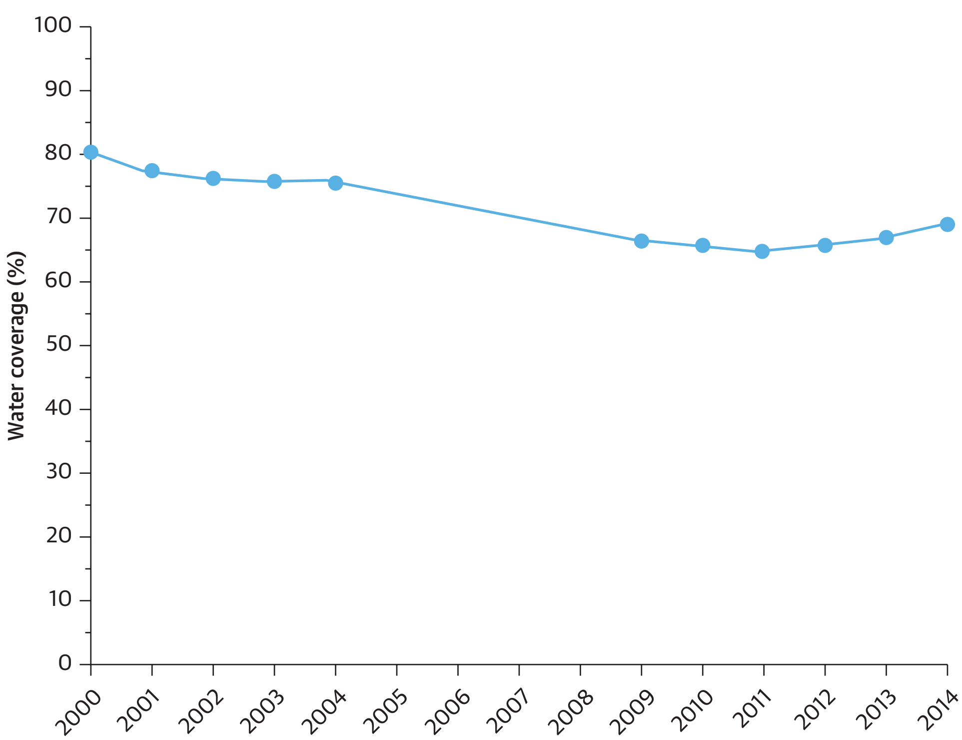
Sufficiency. Average residential water consumption per capita has declined over time, from about 40 lcd in the early 2000s to 32 lcd in 2014 (see figure B.19). Historically, per capita consumption has been higher in Abidjan than in secondary centers.

FIGURE B.16. Population Served Compared with Service Area Population, 2000–14



Source: IBNET, www.ib-net.org.

FIGURE B.17. Water Coverage (Population Served Divided by Service Area Population)



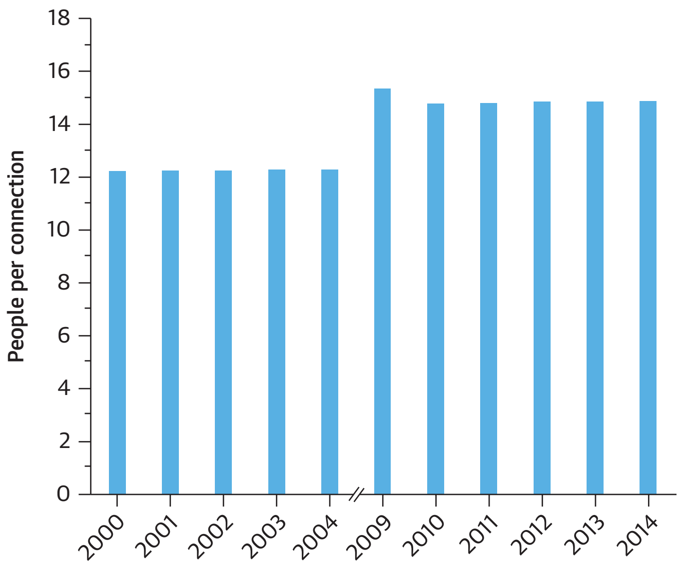
Source: IBNET, www.ib-net.org.

Reliability. Reliability of water supply was perfect (24 hours per day) from 2000 to 2004. By 2009, between the two conflicts, it had dropped to just 13 hours per day. Since then, SODECI has improved substantially on this indicator, with water available 20 hours per day on average, as of 2014 (see figure B. 20).

Affordability. One measure of affordability is the percentage of income spent on water consumption. A proxy for the average annual per capita expenditure on water is total revenue from sales divided by the number of people served. A proxy for average per capita income is Côte d'Ivoire's GNI per capita. Dividing the proxy for water expenditure into the proxy for income gives an average expenditure on water at 0.96 percent of income (see figure B.21). This is better than the regional benchmark for this indicator, 1.22 percent, indicating that SODECI's service is more affordable than over 75 percent of African water utilities.

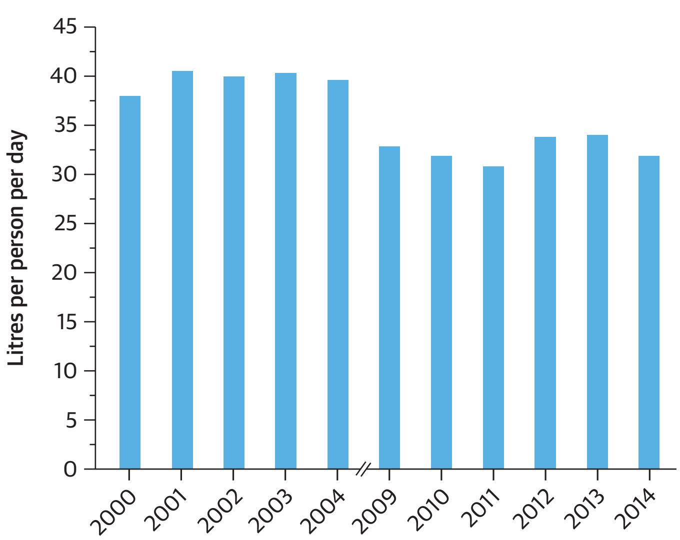
Quality. Results of water quality tests are published in SODECI's Annual Reports. About 38,000 tests were conducted in 2012. The passing rate for residual chlorine tests fell to 91 percent after the First Ivorian Civil War, then recovered to pre-conflict levels of 98 percent in 2012

FIGURE B.18. People Served per Connection, 2000–14



Source: IBNET, www.ib-net.org.

FIGURE B.19. Sufficiency of Consumption, 2000–14



Source: IBNET, www.ib-net.org.

(SODECI 2012). From 2007 to 2012, 99 percent of microbiological tests passed in Abidjan (the capital), on average. Passing rates outside of Abidjan were lower, at times as low as 88 percent (SODECI 2012). A description of passing requirements is not included in these reports.

Operational Performance

NRW. SODECI was very successful in reducing NRW in the late 1990s, reaching a low of 131 liters per connection per day (or 17 percent) in 2000. However, by 2011, NRW levels had risen to 204 liters per connection per day or 28 percent. By regional standards, these levels are still quite good, slightly better than the African benchmark of 205 liters per connection per day. In percentage terms, since 2011, SODECI has made rapid progress in reducing NRW, although it still has not been brought down to pre-conflict levels (figure B.22). As of 2014, it was 174 liters per connection per day or 24 percent (see figure B.23). Metering has been virtually universal since 2000.

Staff Productivity. Staff productivity is excellent and has remained stable since 2000, at less than three staff per 1,000 water connections. This was achieved even as 900 staff were employed. Good performance on this indicator is attributed to SODECI's long history of being privately operated since 1960.

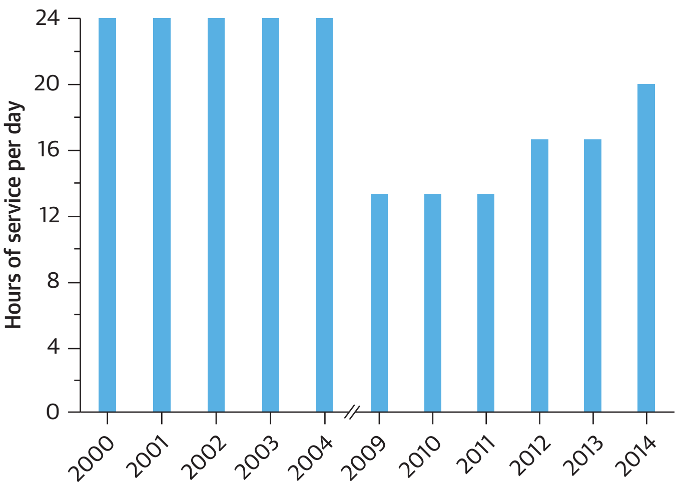
Figure B.24 shows staff per 1,000 water connections *only*. The productivity ratio for water *and* sewer connections is even lower—at just 2.2 in 2000. Data on the number of sewer connections were not available after 2004. This indicator was not graphed.

SODECI's staff efficiency (revenue per employee divided by labor costs per employee, or simply revenue divided by labor costs) has ranged from 4.9 to 5.55 from 2000 to 2004 and averaged 5.4 between 2009 and 2014. At 5.84 in 2014, SODECI was above the Africa benchmark of 4.27.

Financial Performance

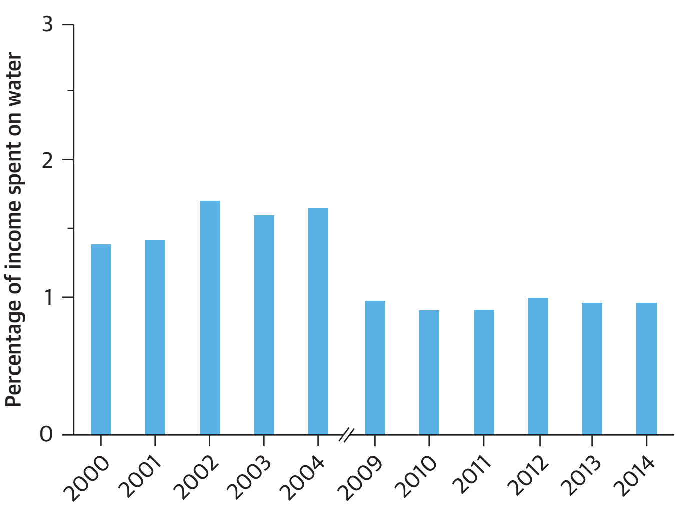
Operating Cost Coverage. SODECI's OCCR has remained relatively stable since 2000, just slightly over 1.0 in most years and below 1.0 in two years (figure B.25). It seems that SODECI earns just enough revenue to cover operating expenses, but nothing more. This

FIGURE B.20. Hours of Water Supply per Day, 2000–14



Source: IBNET, www.ib-net.org.

FIGURE B.21. Affordability, 2000–14



Source: IBNET, www.ib-net.org.

is surprising considering SODECI's excellent performance in the early 2000s and postconflict improvements since 2011. A relatively low OCCR close to 1.0 implies that SODECI would have difficulty financing network expansion, servicing debt for major capital projects, and paying dividends to its shareholders.

Real average tariffs rose at an average annual rate of 10.3 percent from 2011 to 2014, while operating expenses per m^3 rose at an average annual rate of 7.5 percent. At the 2014 U.S. dollar value, the average tariff and average cost per m^3 were US$0.99 and US$0.94, respectively (see figure B.26).

Collection Efficiency. From 2002 to 2004, SODECI's collection ratio was 95 percent. This dropped to below 90 percent from 2009 to 2011—and the latter values represent the collections rate from private customers and large consumers *only* (see figure B.27).[9]

It is likely that the conflict prevented SODECI from collecting bills from all customers, and that customers were less willing to pay their bills due to declining service levels. SODECI's collection period has been over one year since 2010, reaching a high of 533 days in 2011.[10] As of 2014, SODECI's receivables have decreased, indicating that customers are paying their outstanding bills. For now, however, the collection period remains high at 457 days.

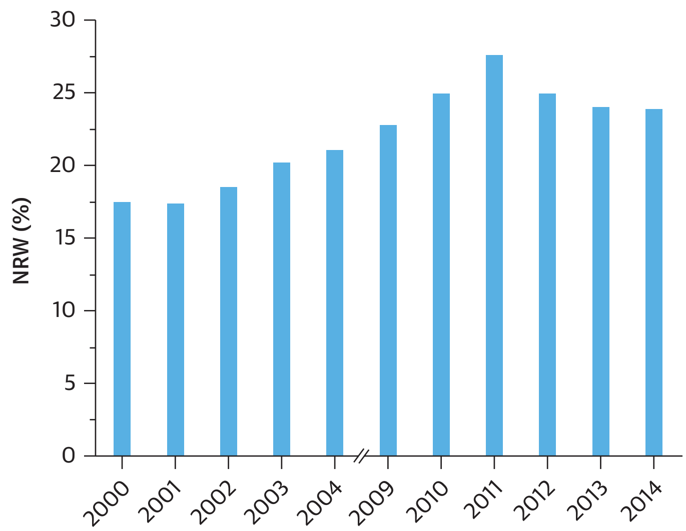
Financial Transparency. SODECI publishes annual reports with audited financial statements on its website. As of March 2016, reports for the years 2010–14 are available.

Organization

Human Resources. SODECI began as the subsidiary of its French mother company, SAUR, in 1960. Early on, management was gradually transferred to Ivorian nationals. Today, the company's management is almost universally Ivorian. SODECI strives for corporate social responsibility. The utility has set up several funds for its employees—such as an AIDS fund offering free treatments, an employee shareholder scheme, a supplementary pension scheme, and a mutual financing fund offering financial services.

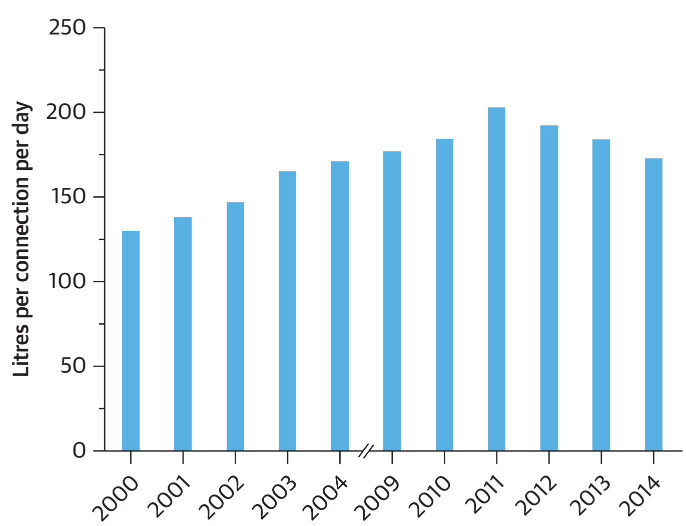
In partnership with its mother company, the Eranove Group, SODECI operates a training center, the Centre des Métiers de l'Eau (Water Training Center) which covers production, transport, distribution, and commercialization.[11]

FIGURE B.22. Nonrevenue Water as a Percentage of Production, 2000–14



Source: IBNET, www.ib-net.org.

FIGURE B.23. Nonrevenue Water by Connection, 2000–14



Source: IBNET, www.ib-net.org.

Commercial Techniques. In addition to traditional payment methods—cash, direct debit, and check—SODECI has introduced new electronic payment mechanisms. SODECI partners with several mobile money providers and offers bill payment at select automated teller machines.

Summary

SODECI remains a relatively well-performing African water utility today, despite two civil wars that split the country from 2002 to 2007 and 2010 to 2011. Founded as a PPP in 1960, the utility achieved remarkable efficiency in the 1990s. In 2000—with just three staff per 1,000 water connections, NRW of 17 percent, and service 24 hours a day—SODECI's performance was virtually unmatched in the region.

National conflict took a toll on this success, but the company was resilient. NRW worsened, reaching a high of 28 percent in 2011. Collection efficiency fell to 86 percent. Although performance was worse than in the earlier decade, SODECI still compared favorably to its peers. Access, in absolute terms, actually rose from 2002 to 2011.

Since 2011, when the conflict ended, service has improved again. Reliability is up from a low of 13 hours to 20 hours per day, on average. Water coverage, as a percentage, is now increasing, from 65 percent in 2011 to 69 percent in 2014.

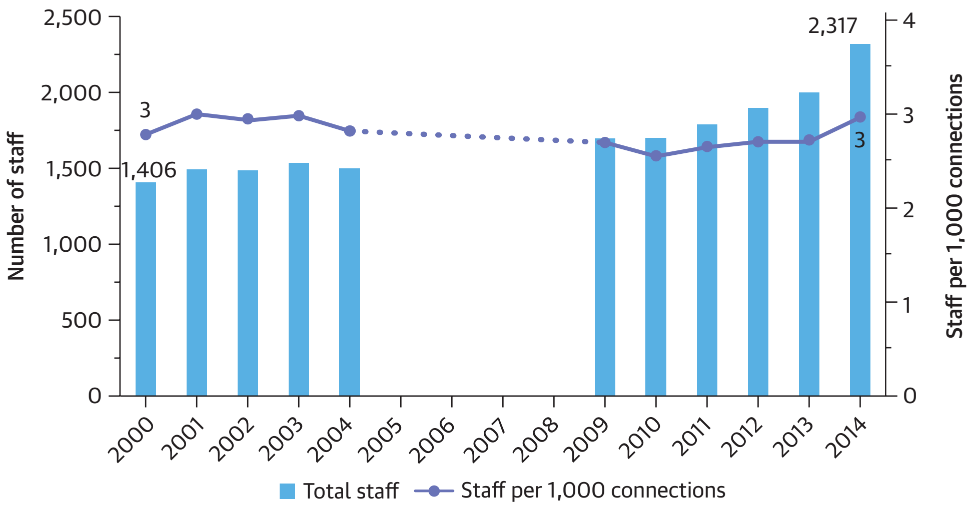
Kenya, NCWSC (Nairobi City Water and Sewerage Company)

Background

The NCWSC is Kenya's largest water service provider (WSP) by service area population, with responsibility for the 3.8 million residents of Nairobi County (NCWSC 2014). The NCWSC was incorporated in 2003 as a wholly owned subsidiary of the Nairobi City County. The service area is divided into six principal administrative regions (Northern, Eastern, North Eastern, Central, Southern, and Western), which are further subdivided into 25 zones. The county borders largely align with the borders of Nairobi City.

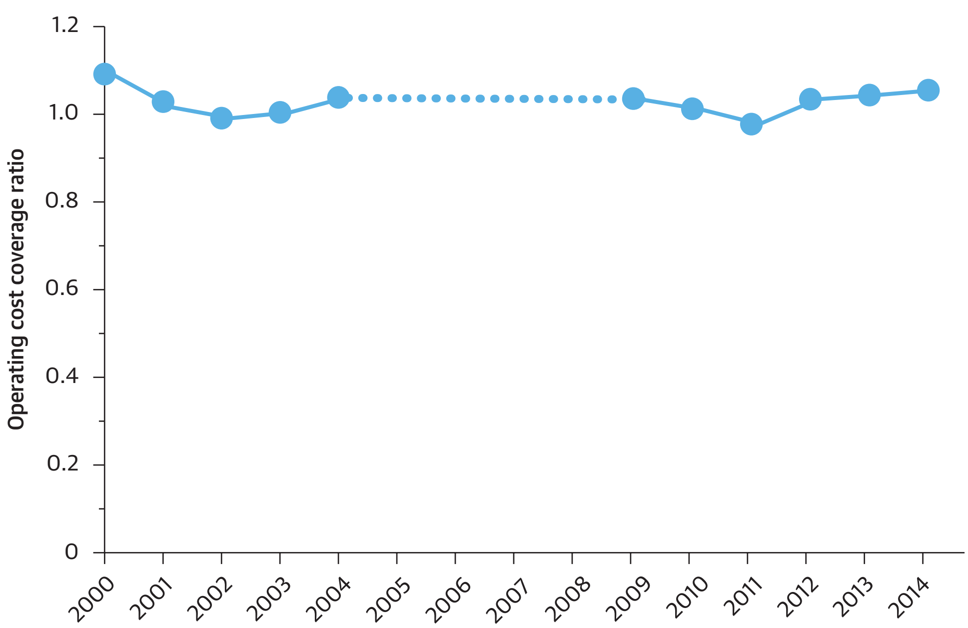
The NCWSC is a licensee of the Athi Water Services Board (WSB). The WSBs are licensed by the government of Kenya, under the Water Act 2002, to be responsible for water resources management in a particular area.[12] The WSPs (such as the NCWSC) are licensed in turn by the WSBs to be responsible for water and sewerage services provision in a particular area. Athi

FIGURE B.24. Staff Numbers and Staff per 1,000 Water and Sewer Connections



Source: IBNET, www.ib-net.org.

FIGURE B.25. Operating Cost Recovery



Source: IBNET, www.ib-net.org.

WSB's jurisdiction covers a population of 5.5 million people and 12 WSPs, including the NCWSC.[13] The constitution of 2010 devolved water and sewerage services provision to the counties. A national Water Bill is currently being considered in parliament to operationalize this devolution of responsibilities. Once the Water Bill is enacted, it will be the county of Nairobi that delegates water service responsibilities to the NCWSC.

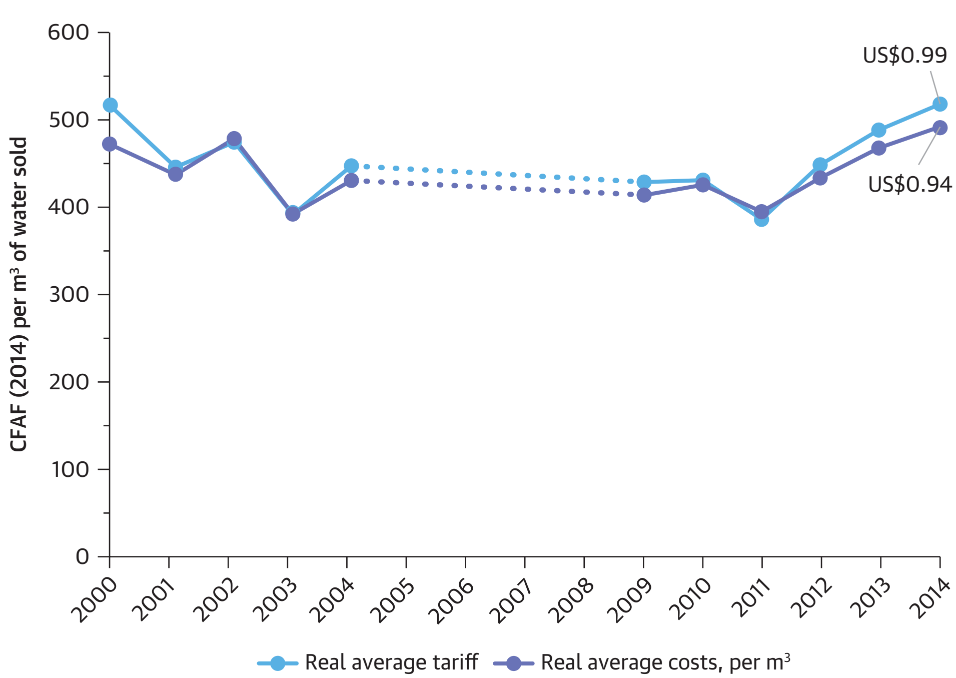
The Water Act 2002 also establishes the Water Services Regulatory Board (WASREB), which is the national regulatory body for Kenya's water services sector. WASREB oversees the implementation of policies and strategies relating to the provision of water and sanitation services and monitors and regularly reports on the performance of the WSBs and WSPs (WASREB 2015).

Performance

Customer Performance

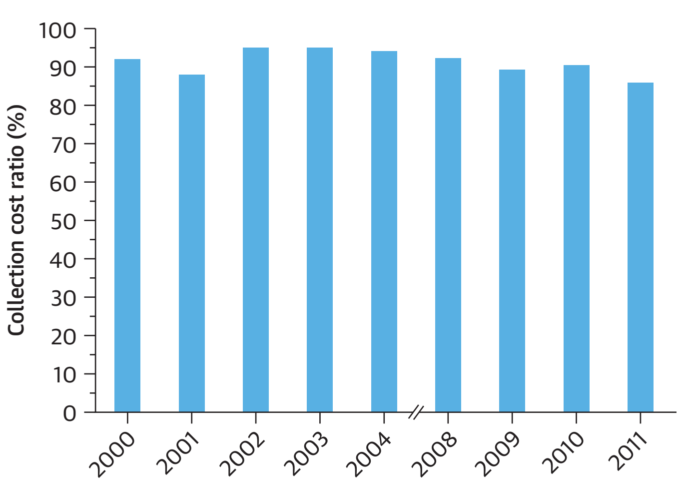
Access to Water Services. Coverage in the NCWSC service area has increased from 66 percent (2008) to 80 percent (2014), while the service area population grew from 3.1 million to 3.7 million. The NCWSC forecasts that the population in its service area will grow to 4.5 million by 2019 (NCWSC 2014). Figure B.28 shows growth in the NCWSC's service area population and the population served over this period. Figure B.29 shows the NCWSC's growth in water coverage; that is, the proportion of the NCWSC's service area population being served by the NCWSC. The NCWSC is also providing sewerage services. Sewerage coverage in 2013 was 28 percent.

FIGURE B.26. Average Tariffs, Average Costs per m³



Source: IBNET, www.ib-net.org.

FIGURE B.27. Collection Efficiency, 2000–11



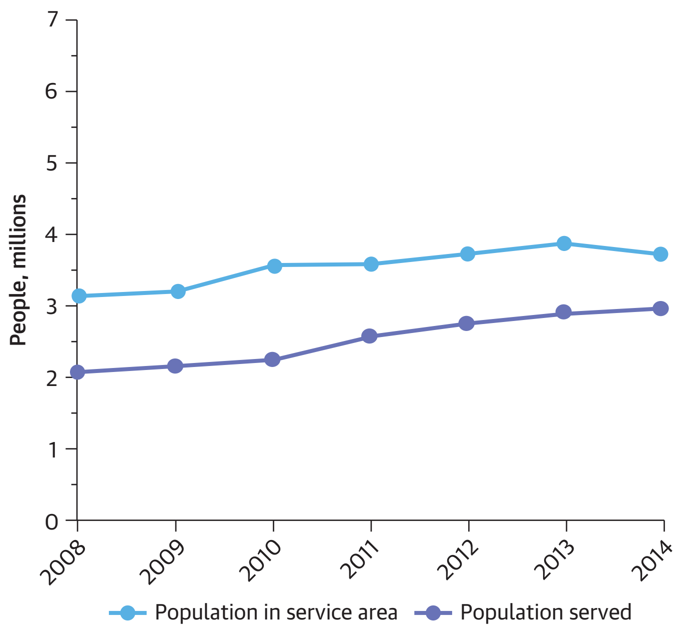
Source: IBNET, www.ib-net.org.

According to the NCWSC, about 50 percent of Nairobi's residents have access to water piped to their premises. The rest obtain water from kiosks, vendors, and illegal connections. These estimates match household survey data for Nairobi City. In the 2012–13 Kenya Baseline "State of the City" survey, about 55 percent of households reported access to piped water to their premises, while 23 percent reported access to a water kiosk.

A major challenge in increasing water coverage has been the limited water distribution network within Nairobi's densely populated informal settlements. To meet this challenge, in 2008, the NCWSC formed an administrative unit solely responsible for improving access to services in these settlements. The unit was later upgraded to a region to give it greater status with respect to investment and operations. This pro-poor initiative has contributed to the marked increase in the NCWSC's water coverage between 2008 and 2014 (see figures B.28 and B.29).[14] The NCWSC also provides sewerage services. In 2014, 46 percent of the service area population was covered, up from 28 percent sewerage coverage in 2010.

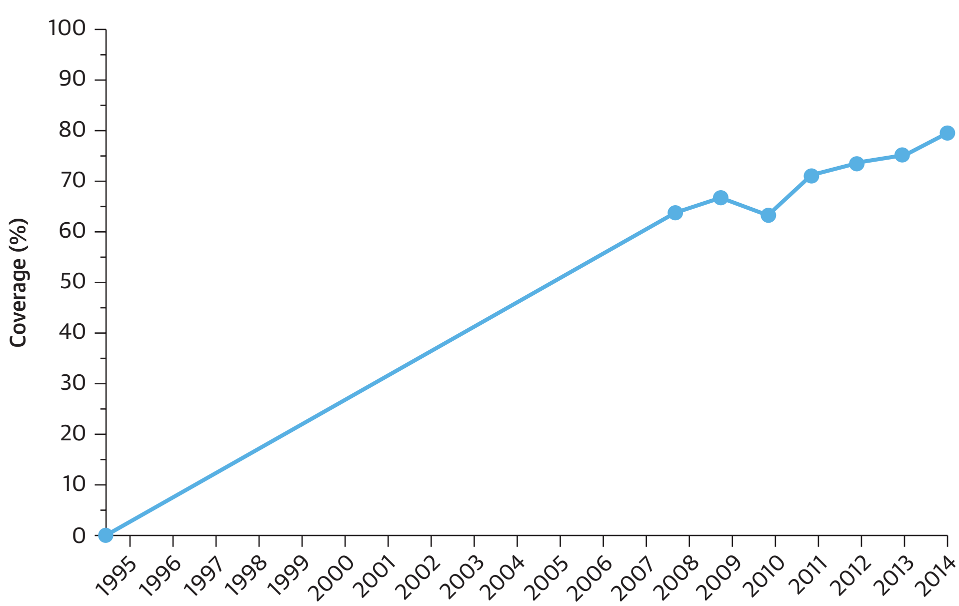
Reliability. Reliability of water supply increased from 16 hours per day in 2011 to 18 hours per day in 2014. This brings the NCWSC's reliability toward the higher end of WASREB's "acceptable" rating, and in line with the national average for Kenya (WASREB 2015). It falls short of the benchmark for Africa, however, which is 21 hours. According to the NCWSC, about 40 percent of its customers currently receive water for 24 hours per day.[15] The utility aims to attain reliability of 24 hours per day for all customers by 2018 (NCWSC 2014). Figure B.30 shows the average daily duration of the NCWSC's water supply in its service area between 2011 and 2014.

FIGURE B.28. Population Served Compared with Service Area Population, 2008–14



Source: IBNET, www.ib-net.org.

FIGURE B.29. Water Coverage (Population Served Divided by Service Area Population)



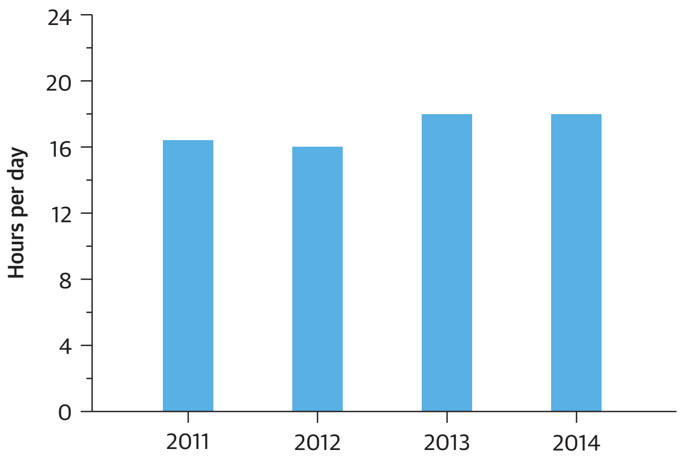
Source: IBNET, www.ib-net.org.

Sufficiency. Average residential consumption is good, at about 70 liters per person served per day (see figure B.31). This is more than double the level reported at well-performing utilities in Sub-Saharan Africa. SODECI's average residential consumption is 32 liters per person per day whereas the NWSC's is just 23 liters per person per day. If the NCWSC were able to reduce NRW from current levels of 700 liters per connection per day (see figure B.32), this high level of sufficiency could be maintained without significant increases in water supply. The cause of the large jump in reported volume sold to residential customers between 2010 and 2011—46.6 million m^3 in 2010 to 73.2 million m^3 2011—is unknown.

Affordability. One measure of affordability is the percentage of income spent on water consumption. A proxy for the average annual per capita expenditure on water within the NCWSC's service area is total revenue from water sales divided by the number of people served. A proxy for average per capita income is Kenya's GNI per capita (US$1,280 in 2014). Dividing the proxy for water expenditure into the proxy for income gives average expenditure on water at 2.1 percent of income in 2014. The regional benchmark for this indicator is 1.22 percent.

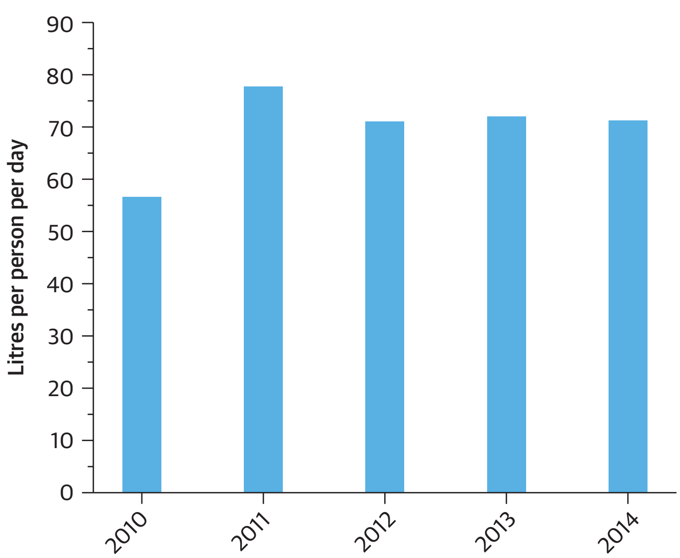
Safety. The NCWSC's water quality performance compares favorably to other WSPs in Kenya, with an overall water quality performance of 95 percent in the 2012/13 to 2013/14 reporting period (measured by adherence to WASREB water quality standards) (WASREB 2015). Kenya's overall water quality performance against these standards was lower, at 91 percent. WASREB has stated that the Athi WSB, along with most other WSBs, needs to do more to ensure compliance with its

FIGURE B.30. Hours of Water Supply per Day, 2011–14



Source: IBNET, www.ib-net.org.

FIGURE B.31. Sufficiency of Consumption, 2010–14



Source: IBNET, www.ib-net.org.

water quality and effluent monitoring standards, including further investment in laboratory facilities and ensuring adequate provision for water quality analysis in tariff proposals (WASREB 2015).

Operational Performance

NRW. NRW levels remained at a consistently high level between 2010 and 2014, ranging from 600 liters per connection per day to 700 liters per connection per day. In percentage terms, there was a slight downward trend over that period (from 42 percent in 2010 to 39 percent in 2014). This level of inefficiency is in line with average performance in Kenya (42 percent), but far short of the "acceptable" standard set by WASREB (less than 25 percent) and the NCWSC's own target of 30 percent. According to the NCWSC, this underperformance is mainly due to low investment in NRW reduction projects. The utility included NRW reduction efforts in its strategic plan for 2019; it estimates the cost to be K Sh 3.2 million (US$37 million) to reduce NRW to 16 percent by 2019 (NCWSC 2014). Figure B.32 shows the NCWSC's NRW trend over time measured in liters per connection per day. Figure B.33 shows NRW as a percentage of the NCWSC's total water production.

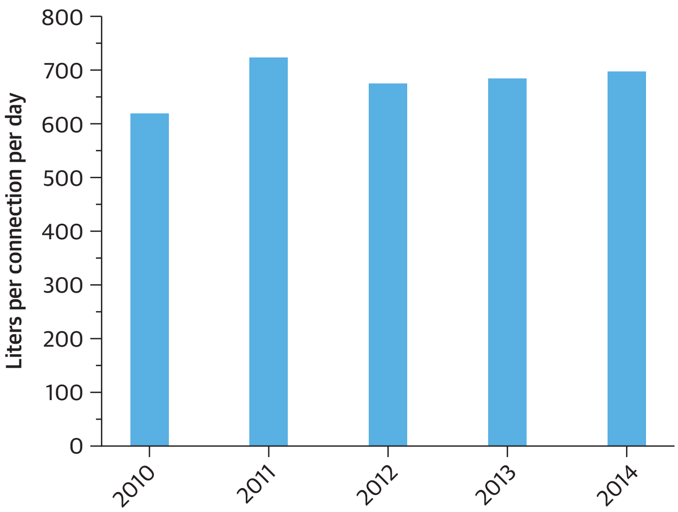
Staff Productivity. The ratio of staff employed per 1,000 water and sewer connections has been fairly constant since 2009, at 5, while staff numbers rose by about 700. These trends are shown in figure B.34.

The NCWSC's staff efficiency (revenue per employee divided by labor costs per employee, or simply revenue divided by labor costs) has stayed relatively constant from 2009 to 2013, slightly above 2. At 2.13 in 2013, the NCWSC is far below the regional benchmark of 4.21, indicating that staff expenses are a large portion of their operating expenses.

Financial Performance

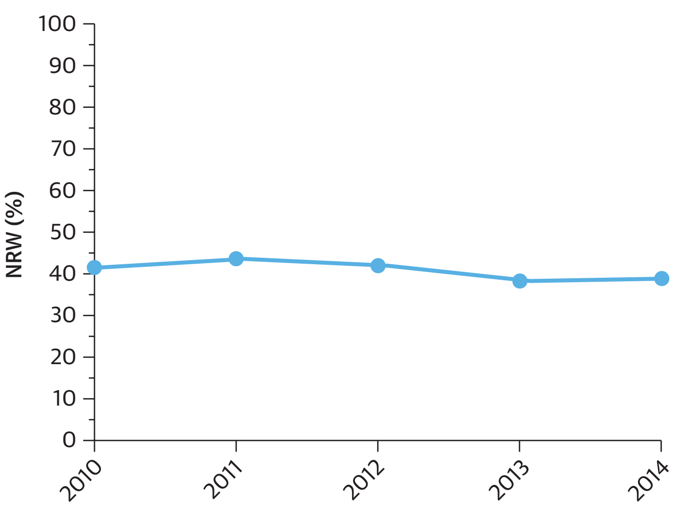
Collection Efficiency. Collection efficiency increased substantially in 2014, reaching 91 percent. This is a significant improvement from previous years, in which this ratio ranged from 75 percent to 85 percent (see figure B.35). However, it remains lower than many well-performing utilities in Africa—such as ONEA and the NWSC—who almost consistently achieve collection efficiency rates of 95 percent and above. This improvement can be attributed to a number of factors. In 2014, the NCWSC introduced *Jisomee Mita*, which

FIGURE B.32. Nonrevenue Water, by Connection, 2010–14



Source: IBNET, www.ib-net.org.

FIGURE B.33. Nonrevenue Water as a Percentage of Production, 2010–14



Source: IBNET, www.ib-net.org.

enables customers to use a mobile phone to receive their water bill and pay for water use. Increased reliability of water supply (see figure B.30) could be another factor. According to WASREB, improvement in hours of supply increases customer satisfaction, which translates to willingness to pay, which has a direct correlation with collection efficiency (WASREB 2015).

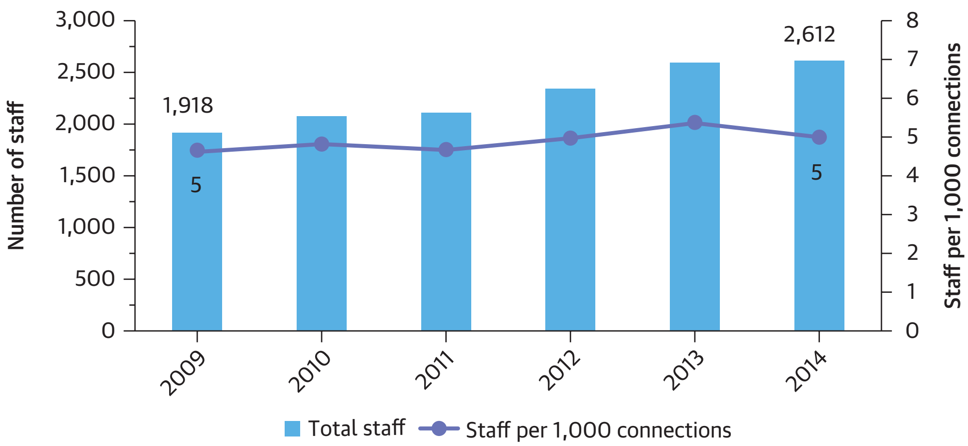
Operating Cost Coverage. The trend in the operating cost recovery ratio is shown in figure B.36. Real average tariffs and real average costs per m³, in Kenya shillings, are shown in figure B.37. The U.S. dollar equivalents for 2014 are also noted in the figure.

The NCWSC's OCCR has been slightly above 1 since 2009, except in 2012 when the ratio fell to 0.96. Staff expenses comprise a large proportion of operating expenses—on average, about 40 percent during this period. In real terms, average labor costs per employee rose by 6.7 percent per year during this period. The OCCR may be overstated, however, because it seems that the NCWSC is underproviding for bad debts. From 2009 to 2014, provisions accounted for 11 percent of revenue. However, the collection ratio (see figure B.35) mostly ranged from about 75 percent to 85 percent, rising to 91 percent in 2014 only. This suggests that provisions for bad debts should have been in between 15 percent and 25 percent of revenue for much of this period.

Since 2010, the real average tariff (measured in 2014 Kenya shillings) has declined at an average annual rate of 8.9 percent. Tariffs were not changed during this period. At the same time, real operating expenses per m³ sold decreased at a similar rate.[16]

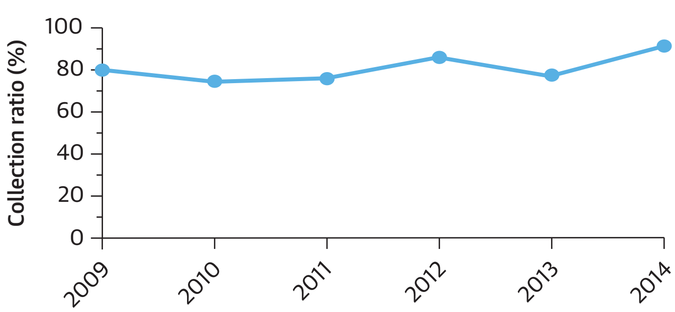
In U.S. dollars, the average tariff (water and sewerage) was US$0.66 in 2014 (see figure B.37). This is low compared with some other large utilities in the region—ONEA's average tariff is US$1.12, the NWSC's average tariff is US$1.16, and SODECI's average tariff is US$0.99. In November 2015, a new tariff structure came into effect. Consumption up to 6 m³ per month is charged at a flat rate of K Sh 204 (US$2.00)—about K Sh 34 per m³ (US$0.33 per m³) if 6 m³ were consumed. This rate applies to both domestic and commercial customers. The highest block, for consumption greater than 60 m³ per month, is K Sh 64 (US$0.63). Sewerage is charged at 75 percent of water billed for all customers with a connection.

FIGURE B.34. Staff Numbers and Staff per 1,000 Water and Sewer Connections, 2009–14



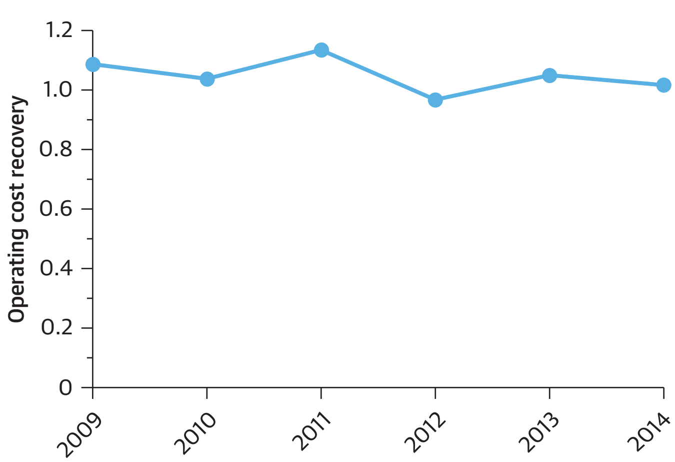
Source: IBNET, www.ib-net.org.

FIGURE B.35. Collection Ratio, 2009–14



Source: IBNET, www.ib-net.org.

FIGURE B.36. Operating Cost Recovery Ratio, 2009–14



Source: IBNET, www.ib-net.org.

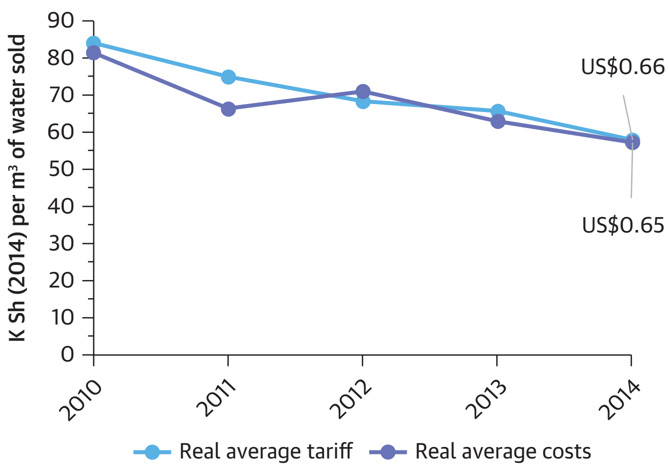
Financial Transparency. The NCWSC does not publish an annual report or financial statements on its website. Up-to-date tariffs are not posted either. The Strategic Plan for the 2014/2015 to 2018/2019 planning period (dated March 2014) is available on the NCWSC website. WASREB publishes the NCWSC's key performance indicators in its annual impact report.

Investment. No data were available on past investment expenditure. According to the NCWSC, about K Sh 42 billion (US$478 million, 2014) is required to effectively implement its strategic plan over the 2014/15 and 2018/19 financial years (NCWSC 2014). This would be around US$24 per person served per year. The NCWSC expects to finance a large portion of this plan with internally generated funds. This will require a combination of cost savings and an increase in revenues. As of 2013, the utility was barely able to pay its O&M through its billed revenues. As collection efficiencies were below 1, there was insufficient cash available in 2013 for the utility to pay for its investments through internal funds. Development partners will help finance the larger projects, such as new dams, water intake works, water treatment works, water trunk mains, and the distribution network. The utility expects a limited number of projects to be financed through the PPPs.

Organization

Human Resources. Upon formation, the NCWSC inherited the majority of its staff from the Nairobi City Council, which was previously responsible for Nairobi's water services. With the support of the Bank, the NCWSC reduced its workforce. This included the introduction of human resource management and payroll software (Mugo 2006). The NCWSC recruits its senior management team competitively,

FIGURE B.37. Average Tariffs, Average Costs per m³, 2010–14



Source: IBNET, www.ib-net.org.

advertising for the positions. Senior management are on performance contracts with specific targets. All directors and senior management are bound by a code of ethics and all staff are bound by a code of conduct which aims to enhance integrity and improve service delivery.

Strategic Planning and Accountability. The NCWSC has used strategic planning since its inception in 2003 (NCWSC 2014). The NCWSC pursued two, three-year rolling strategic plans up to June 2010 and a five-year strategic plan between 2011 and 2015. The current strategic plan covers 2014–19. The NCWSC's strategic planning includes a monitoring and evaluation framework, which provides for assessment of performance against a number of key performance indicators over time.

Commercial Techniques. A key element of the NCWSC's strategic planning is to leverage technology to improve performance. A particular area of focus has been on initiatives which take advantage of the high rates of mobile phone use in Kenya, including *Jisomee Mita*, which enables water consumers to use a mobile phone to query and receive current water bills and pay for water use; *MajiVoice*, a mobile phone customer complaint resolution tool; and Mobile Field Assistant, a mobile meter reader which allows staff to collect information on geo-references, meter readings, and location of households through a smartphone (Ndaw 2015).

Summary

The NCWSC is expanding coverage, which rose from 66 percent in 2009 to 80 percent in 2014. On average, water is available for 18 hours per day. Average residential consumption is at a good level by regional standards, at 70 liters per person served per day. However, operational performance as measured by NRW, metering, and staff efficiency (as discussed in chapter 2) is below what is seen in the typical utility in Africa.

However, NRW is high at 700 liters per connection per day (39 percent). Poor performance on this indicator could be one of the contributing factors to the NCWSC's mediocre operating cost recovery ratio—which has hovered around 1.0 since 2009. The NCWSC supplies a lot of water to its network (more than 200 million m³ in 2014), yet just about 60 percent of what is supplied is actually billed. Relatively low tariffs could be another contributing factor.

On other efficiency indicators, the NCWSC is a fair performer—better than the "typical" African water utility, but not on par with the best performers in the region. The staff productivity ratio has been maintained at five staff per 1,000 water and sewer connections. The collection ratio is rising—at 91 percent in 2014, compared with an average of about 80 percent in the previous five years. Mobile bill payment and other innovative commercial techniques are contributing factors.

Nairobi is a rapidly growing city, expected to reach 4.5 million people by 2019. The NCWSC will need to finance significant capital investment to keep pace with population growth *and* reach the 20 percent still unserved today, while improving supply reliability. The required investment (2014–19) is estimated to be US$478 million.

Senegal, SDE and SONES

Background

In 1995, the GoS split SONEES, the existing national utility, into three entities: an asset-holding company for water service assets (SONES), a private operator for water services engaged through an affermage contract (SDE), and a public, combined asset-owner and operator for wastewater services (ONAS). SONES and ONAS have entered into performance contracts with the GoS, represented by the Ministry of Water and Sanitation (Ministère de l'Hydraulique et de l'Assainissement) and the Ministry of Finance (Ministère de l'Économie, des Finances et du Plan). The SDE has an affermage contract with SONES and the government.

The SDE, the private operator, is responsible for water supply services in 66 towns. Dakar, the capital, accounts for more than 50 percent of connections. The provision of water supply and sanitation services in Senegal is governed by the Water and Sanitation Law (*Loi portant organisation du service public d'eau potable et d'assainissement des eaux usées domestiques*) of September 24, 2008, which defines the responsibilities for managing urban and rural water and sanitation services and their delegation (including to private entities), the principles for delivering services, the monitoring and controlling of the delivery of services, and the cost recovery of these services.

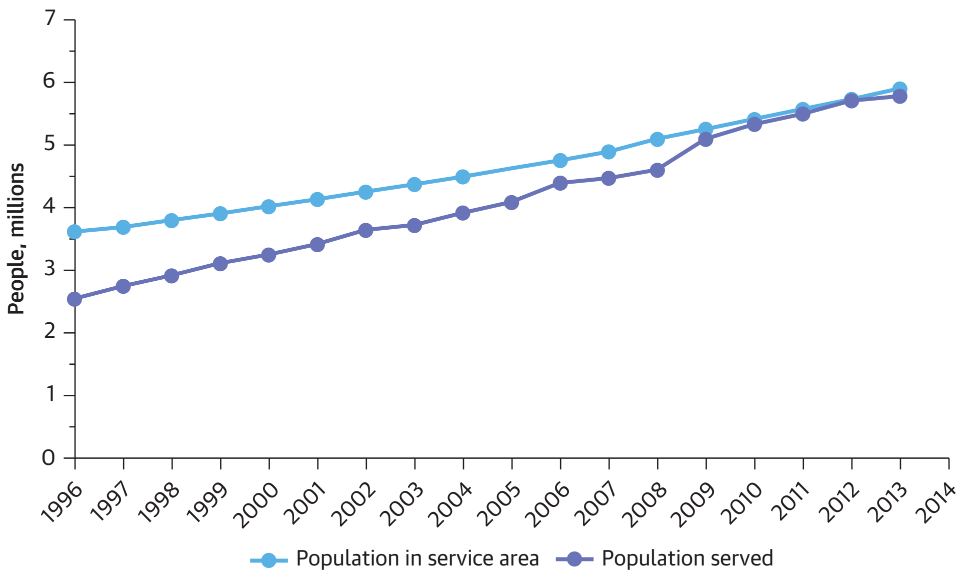
Performance

Customer Performance

Access to Water Services. In 1995, the SDE served about 69 percent of its service area population—3.6 million people. By 2013, nearly 5.8 million people were served, out of 5.9 million people (98 percent coverage).[17] Growth in the service area population and the population served are shown in figure B.38. Figure B.39 shows the growth in water coverage, defined as the proportion of the service area population served by the SDE. A breakdown of those served by connections and those served by standpipes is also included.

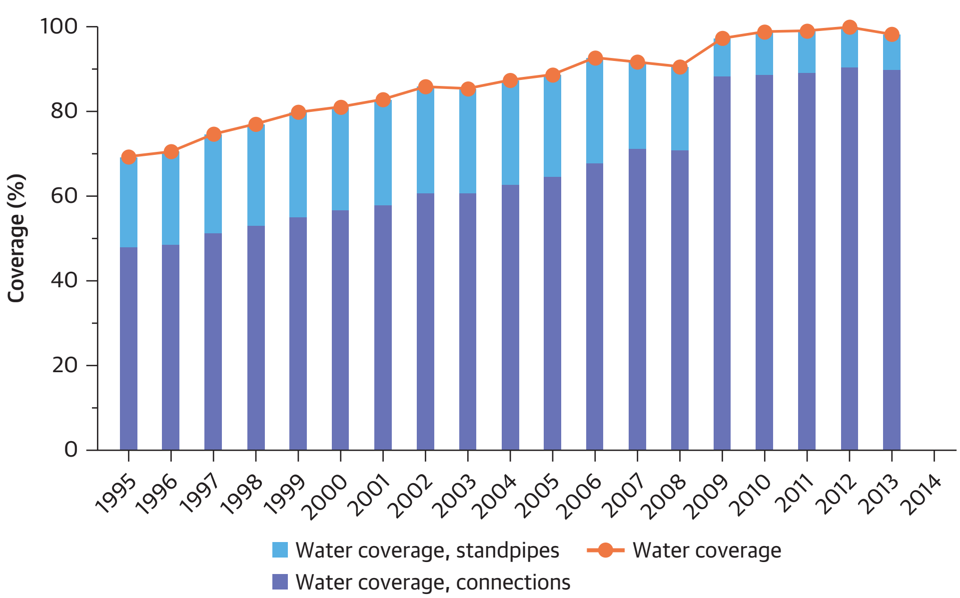
Today, the SDE serves most people (89 percent) with a direct connection. Just 9 percent are served by public taps. These utility-reported estimates closely match household survey data for Dakar. In 2014, 86 percent of people reported access to piped water to their premises and 9 percent of people reported access to standpipes (see figure B.40).[18] In 2005, however, the DHS data differed from the utility-reported data. Eighty-eight percent of those living in Dakar reported accessing water through a connection piped to their premises. For the same year, the SDE reported direct access for just 64 percent of its service area. This seems to indicate that direct connections were first promoted in Dakar and then in other

FIGURE B.38. Population Served Compared with Service Area Population, 1996–2014



Source: IBNET, www.ib-net.org.

FIGURE B.39. Water Coverage (Population Served Divided by Service Area Population), 1995–2014



Source: IBNET, www.ib-net.org.

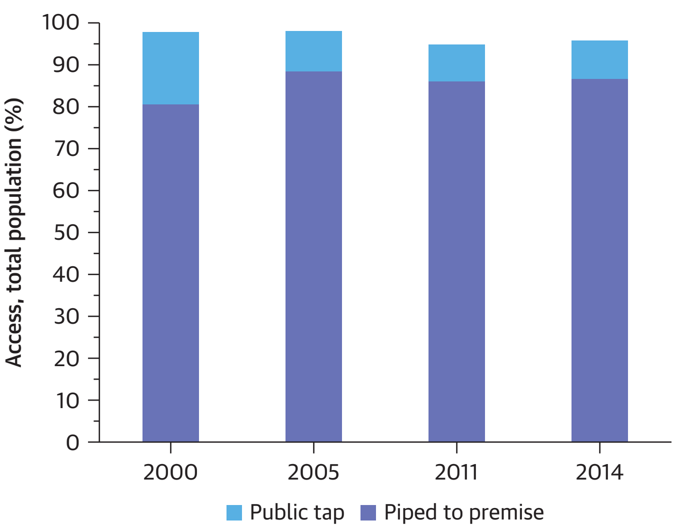
centers. Alternatively, the SDE may have historically underestimated the number served by direct connections. There is a jump in the coverage data from 2008 to 2009, which could indicate that the estimation methodology was revised. The household survey data for Dakar is shown in figure B.40.[19] The differences in coverage estimates between the household survey and the SDE estimates persisted in the 2013 household survey—with the SDE estimates significantly higher than the household survey's estimates. It is important that the utility undertakes some research on the number of people it is actually serving as lower service coverage would mean significantly higher water consumption levels than are currently reported.

Despite the improvement in the type of service provided to customers, the average number of people served per connection has declined only slowly. In 1995, an average of 12 people were served per connection. By 2013, that ratio was 11 people per connection (see figure B.41).

Network Expansion and Growth in Connections. Between 1995 and 2013, the distribution network in the SDE/SONES service area more than doubled, with 4,800 km of pipe added (see figure B.42). Active connections rose by 332,000 during this period (see figure B.43).

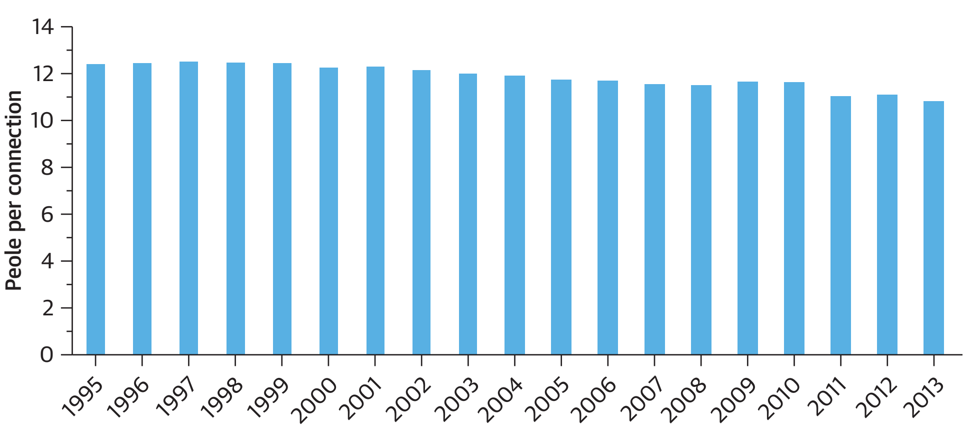
Reliability. In the mid-1990s, Dakar faced a severe water shortage. SONEES (the utility at the time) could only supply about 60 percent of demand in the city. Overexploitation of

FIGURE B.40. Access to Water Service, Dakar Only



Sources: DHS 2005, 2011, 2014; MICS 2000.

FIGURE B.41. People Served per Connection, 1995–2013



Sources: DHS 2005, 2011, 2014; MICS 2000.

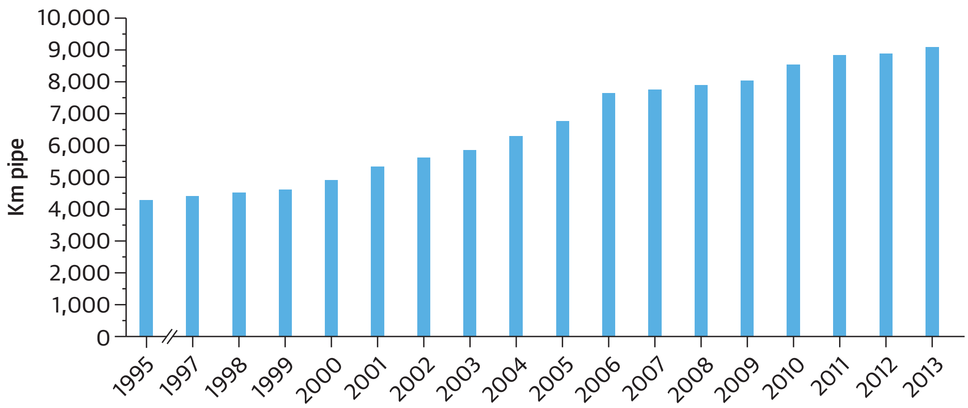
groundwater resources led to the risk of saline intrusion. In some areas, groundwater was declining at 1.5 m per year. This crisis forced the utility to ration water. Service was available for about 16 hours per day on average. A new production source was needed to provide 24-hour service.[20] To improve service in the short term, new boreholes were constructed and the existing treatment works were expanded. This program led to increased supply reliability in the late 1990s and early 2000s. As shown in figure B.44, average hours of service per day increased to 18 hours (1999–2000) and then to 20 hours (2001–04).

In a second phase of improvement, 10 years later, a new 130 million liter per day treatment plant and associated transmission works were constructed. Upon completion of this project, the SDE could meet water demand in Dakar. Average reliability across the network reached 24 hours per day from 2006 to 2008. Recently, however, supply constraints have reemerged as an issue and new production facilities are needed to return to 24-hour service.

Sufficiency. The SDE reports that average residential consumption has remained relatively constant from 2006 to 2013, at 55 liters per person per day, up from 44 liters per person per day in 2004 (see figure B.45). This increase corresponds to the completion of the new treatment plant to serve Dakar. Before this project, demand was not met. Over this period, the share of residential consumption has risen—from 67 percent in 2004 to 93 percent in 2013. This could be due to the high nonresidential tariffs depressing nonresidential consumption.

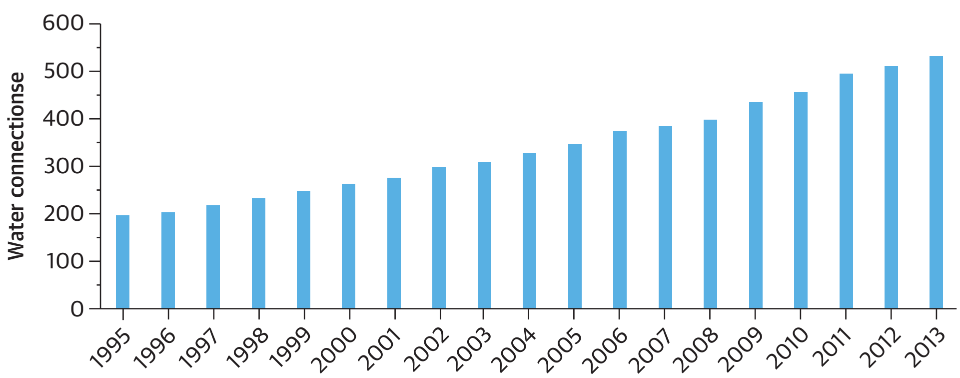
Affordability. One measure of affordability is the percentage of income spent on water consumption. A proxy for the average annual per capita expenditure on water is total revenue from sales divided by the number of people served. A proxy for average per capita income is Senegal's GNI per capita. Dividing the proxy for water expenditure into the proxy for income gives average expenditure on water at 2.2 percent of income. By contrast, the regional

FIGURE B.42. **Network Expansion, 1995–2013**



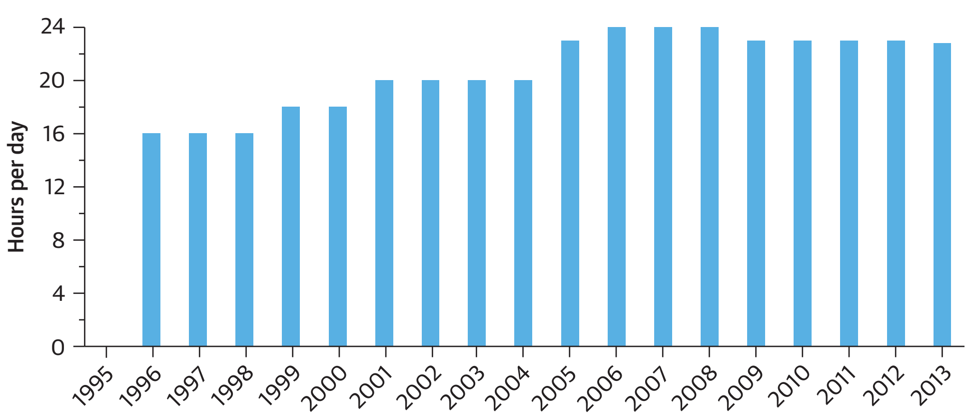
Sources: DHS 2005, 2011, 2014; MICS 2000.

FIGURE B.43. **Number of Water Connections, 1995–2013**



Sources: DHS 2005, 2011, 2014; MICS 2000.

FIGURE B.44. **Hours of Supply per Day, 1995–2013**



Sources: DHS 2005, 2011, 2014; MICS 2000.

benchmark for this indicator is 1.22 percent.

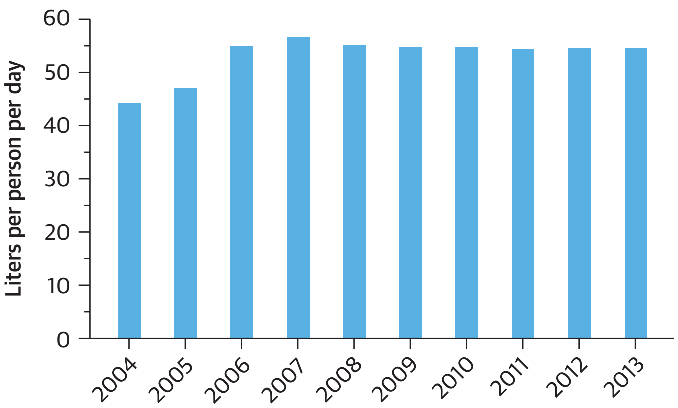
Safety. The SDE has conducted water quality tests since 1996. At least 99 percent of samples passed water quality tests from 2010 to 2014. However, the data shows a huge break in 2008/09, with the absolute number of water quality tests dropping to about 8,000 per year, which translates to only one test every three days in every town served by the SDE. The data on water quality testing are not published.

Operational Performance

NRW. The SDE steadily reduced NRW from 1996 to 2003 (29 percent to 20 percent) because the affermage contract included strong incentives to do so. Since the early 2000s, however, NRW has plateaued at about 20 percent. In 2013, NRW was 159 liters per connection per day. This is close to the global benchmark of 121 liters per connection per day and better than the African benchmark (at 205 liters per connection per day). NRW trends over time, measured in liters per connection per day and percentage of production, are shown in figure B.46 and figure B.47, respectively.

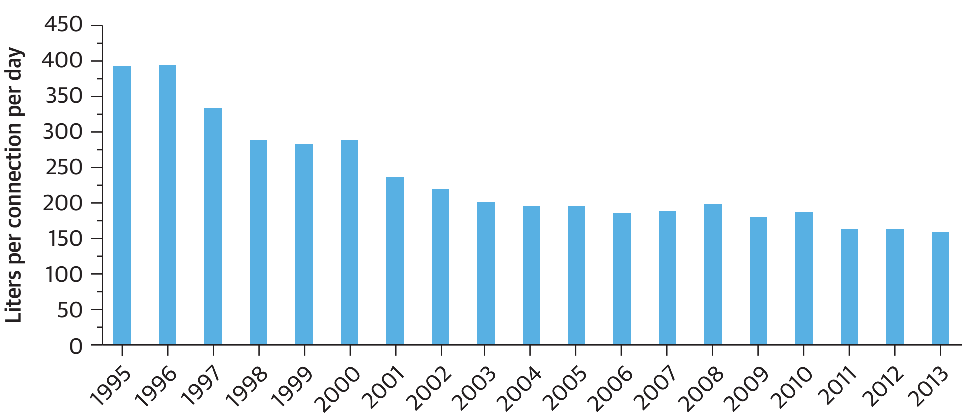
Metering across the service area has been nearly universal (about 97 percent) since 2000.

FIGURE B.45. Sufficiency of Consumption, 2004–13



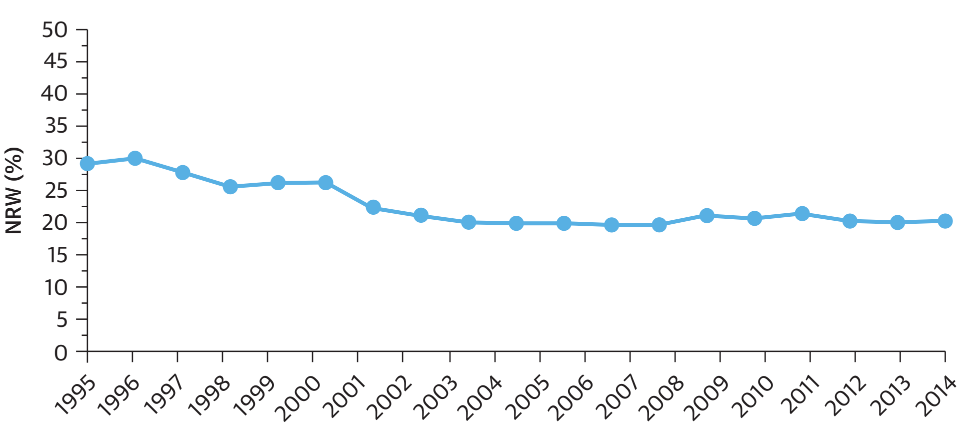
Sources: DHS 2005, 2011, 2014; MICS 2000.

FIGURE B.46. Nonrevenue Water, by Connection, 1995–2013



Sources: DHS 2005, 2011, 2014; MICS 2000.

FIGURE B.47. Nonrevenue Water as a Percentage of Production, 1995–2014



Sources: DHS 2005, 2011, 2014; MICS 2000.

Staff Productivity. Staff productivity has improved significantly since 1996, with the number of staff per 1,000 water connections falling from seven to two by 2013 (see figure B.48). Staff numbers declined only slightly during this period.

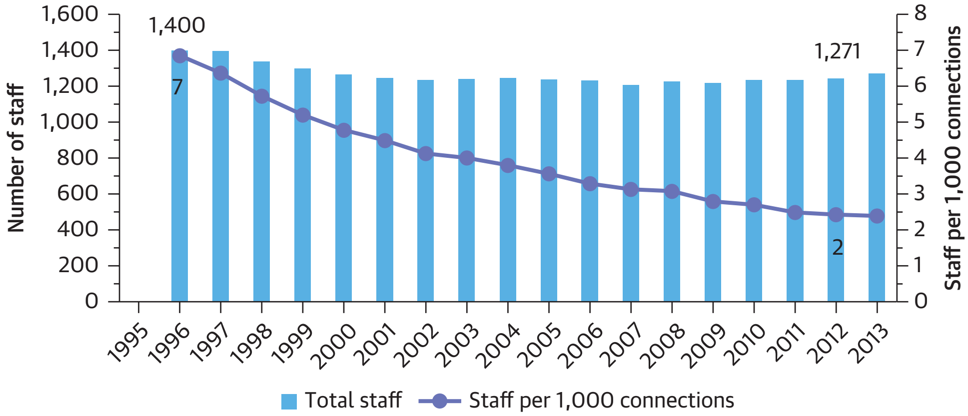
Staff efficiency (revenue per employee divided by labor costs per employee, or simply revenue divided by labor costs) has risen from about four in 1998 to slightly more than five (since 2007). This puts the SDE significantly above the regional benchmark of 4.21.

Financial Performance

Collection Efficiency. The SDE has consistently maintained a high collection ratio, as shown in figure B.49. A target for collections is included in the affermage contract, and the operator has financial incentives to ensure collections. In 2013, the collection ratio fell to 94 percent. It is not clear from the data whether this includes collections from all customers or only from residential consumers, as anecdotal evidence seems to suggest that government users have trouble paying their bills on time.

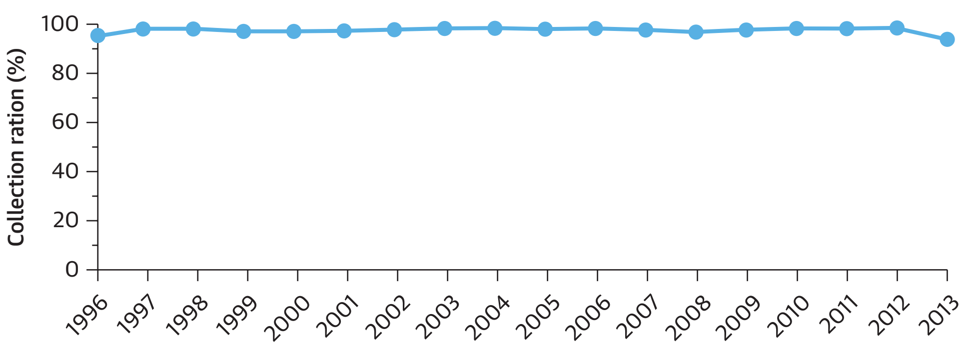
Operating Cost Coverage. The SDE's OCCR has fluctuated over time, reaching a high of 1.55 in 2007. This could be attributed to an increase in revenue after completion of the new production facility near Dakar. Since then, the OCCR has fluctuated, but remained well above 1. The trend in the operating cost recovery ratio is shown in figure B.50. Real average tariffs and real average costs per m^3, in the local currency, are shown in figure B.51. The U.S.

FIGURE B.48. Staff Numbers and Staff per 1,000 Water and Sewer Connections, 1996–2013



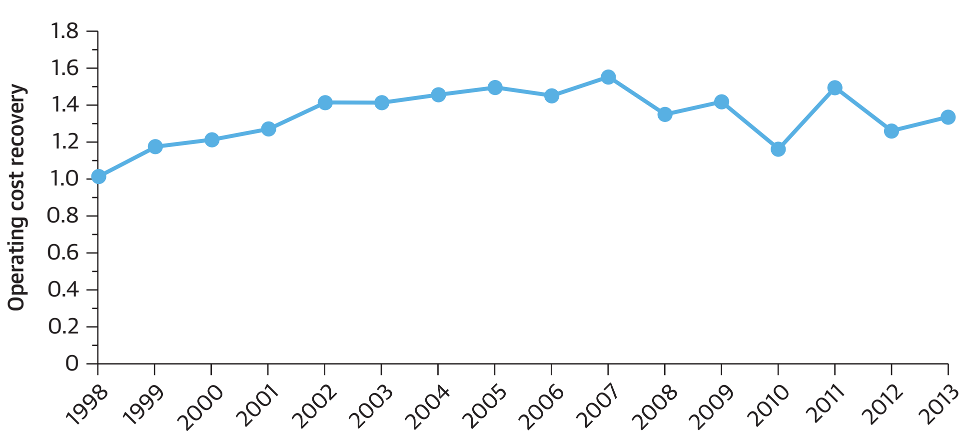
Sources: DHS 2005, 2011, 2014; MICS 2000.

FIGURE B.49. Collection Ratio, 1996–2013



Sources: DHS 2005, 2011, 2014; MICS 2000.

FIGURE B.50. Operating Cost Recovery Ratio, 1998–2013



Sources: DHS 2005, 2011, 2014; MICS 2000.

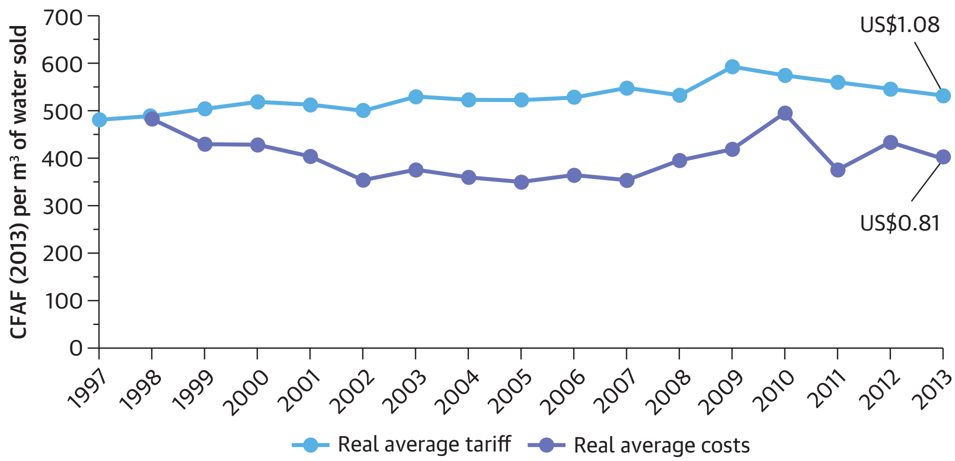
dollar equivalents for 2013 are also noted in the figure.

Real Average Tariff. In real terms, the average tariff has declined at an average annual rate of 2.8 percent since 2009 (see figure B.51). This could be attributed to the increased share of residential consumption because domestic customers have a lower tariff. In 2013, the average tariff was equivalent to US$1.08.

Senegal's increasing block tariff structure has a subsidized social tariff for levels of consumption below 20 m^3 (CFAF 202; US$0.40) per two months. There is also a regular tariff for consumption from 21 m^3 to 40 m^3 (CFAF 697.97; US$1.39) and a "dissuasive" tariff for consumption above 40 m^3 (CFAF 878.35; US$1.75). The dissuasive tariff is designed to be a disincentive for excessive water use. It can be seen that the tariff for household consumption of less than 20 m^3 per 60 days is less than a third of the regular tariff, and less than a quarter of the tariff for consumption in the top block. Bills are sent every two months based on meter readings, and the SDE can cut off water supply for nonpayment.

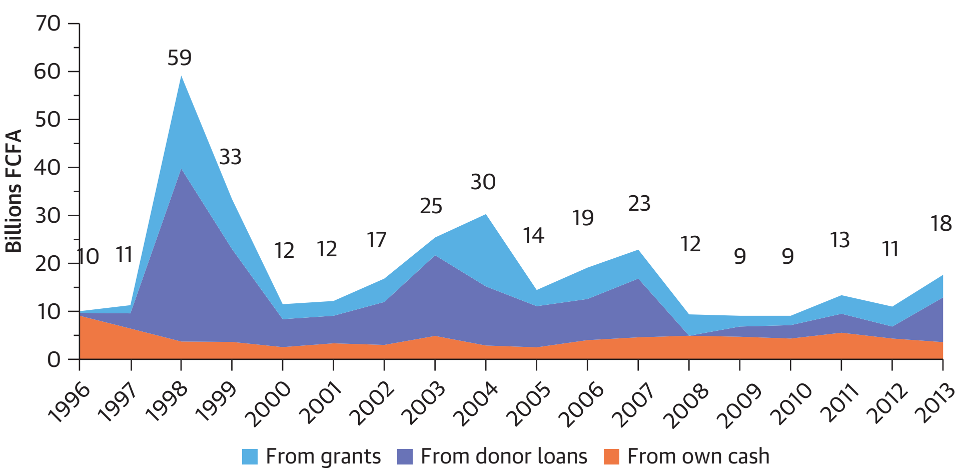
Nonresidential, nongovernmental customers must pay the dissuasive tariff regardless of amount consumed. As of 2013, just 7 percent of SDE customers were

FIGURE B.51. Average Tariffs, Average Costs per m³, 1997–2013



Sources: DHS 2005, 2011, 2014; MICS 2000.

FIGURE B.52. Sources and Amounts of Investment Financing, 1996–2013



Sources: DHS 2005, 2011, 2014; MICS 2000.

classified as nonresidential, down from 33 percent in 2004. High tariffs could be a contributing factor to this trend. Government customers pay more than twice the dissuasive tariff—their tariff is CFAF 1,868.88 per m³ (US$3.72 per m³). The structure has been in place since 2007. In that year, the government agreed to raise tariffs for government customers by 70 percent, while keeping tariffs for other customers constant. This was introduced as a way to keep domestic tariffs from rising while still ensuring cost recovery for SONES/SDE. In 2015, domestic tariffs were also raised—the lowest tariff block was raised by 4 percent and other rates were increased by 9 percent.

Real Average Cost per m³ Sold. From 1998 to 2005, real average costs declined by an average of 4.5 percent per year (see figure B.51). In recent years, real average costs have fluctuated. Average costs per m³ were equivalent to US$0.81 per m³ in 2013.

Financial Transparency. The SDE and SONES do not publish annual reports or financial statements. Tariffs are posted on the SDE website, but they are out of date (from 2003). Performance results are also out-of-date—the most recent data published are from 2012.

Investment. For the SDE and SONES to increase access and improve service, investment totaling about US$770 million was required from 1996 to 2013.[21] This amounts to about US$10 per person served per year. Figure B.52 shows the sources and amounts of investment financing during this period. While about 29 percent was grant financed, 23 percent was financed by own cash and 47 percent from loans from donors. The loans from donors are repaid from tariff revenue, which is allocated to SONES for this purpose.

Two major programs implemented during this period were the Senegal Water Project (US$223 million, 1996-2004) and the Long Term Water Project (US$255 million, 2002-09).[22] The Bank was a major financier for both projects, providing US$85 million and US$146 million, respectively. Overall borrowing terms were similar to International Bank for Reconstruction and Development terms, with interest rates around 6 percent and tenors of 20 years (including five-year grace periods).[23] The cost of finance was kept down through the financing structure used. Because the investments were the responsibility of the publicly owned SONES, the funds were lent to the government on concessional International Development Association terms.

The first project focused on urgent investments needed to increase water supply in Dakar. This included additional boreholes, expansion of a treatment plant, and leakage reduction works. A private operator was brought in through this project as well. Signing a PPP contract satisfactory to the Bank was a condition of the Bank loan. The second phase of reforms involved the construction of the much larger Keur Momar Sarr water treatment plant (in 2005, 65,000 m^3 per day; upgraded in 2008 to 130,000 m^3 per day) along with a continued expansion in the distribution network.

Organization

Human Resources. Management capability came from both the private and public sectors. The new state-run asset holder, SONES, maintained continuity by retaining the managing director of the forerunner institution, SONEES. All permanent employees of SONEES had guaranteed employment in the new structure. Meanwhile, the affermage contract also brought in private sector expertise from an experienced and specialized international company, SAUR. Senegal's long experience with private sector management—it had an affermage contract before the 1972 nationalization and a consulting contract with SAUR between 1972 and 1995—facilitated trust, familiarity, and cooperation. That operator in turn brought in modern management systems and techniques and skilled managers. The operator trained local staff, so the company is now run almost entirely with national staff at the same high levels of efficiency. Profit incentives for owners in turn led to performance-oriented management for the staff.

Strategic Planning. The various contracts establish a process for investment planning. SONES (the public asset-holding company) has to prepare a 10-year investment plan and a 3-year rolling investment plan, based on the SDE's inputs on demand and service needs. The parties then have to agree on a three-year investment convention containing the detailed planning of the works in the coming three years. No investment work can be carried out if it has not been previously included in that investment convention.

Summary

In Senegal, the SDE estimates that about 98 percent of people in its service area now have access to piped water services. Eighty-nine percent have access to a connection on premises while 9 percent have access to a standpipe. On average, water is available for 23 hours per day. Residential customers consume 92 percent of all water sold, at an average of 55 lcd.

This situation is a significant improvement over that of the mid-1990s, when Dakar faced a water shortage. With groundwater resources depleting rapidly, supply was rationed to 16 hours per day. The utility needed to finance a new production source and turned to development partners for support. The Water Sector Project, supported by the Bank, developed a plan to finance short-term production sources. A condition of this loan was the introduction of a private operator to improve efficiency and management. In 1995, the GoS split SONEES, the existing national utility, into three entities: an asset-holding company for water service assets (SONES), a private operator for water services engaged through an affermage contract (SDE), and a public, combined asset-owner and operator for wastewater services (ONAS).

Private operation did improve efficiency, with NRW falling from 29 percent to 20 percent in eight years (1995–2003) and the collection ratio rising to 98 percent by 1997. Staff productivity improved from seven staff per 1,000 connections (1996) to two staff per 1,000 connections (2013).

Total capital investment in the sector from 1996 to 2013 totaled about US$770 million. About a quarter of this was financed by own funds and half was financed by loans from donors. The SDE is limited by its contract to charge a fixed operator tariff, so the average retail tariff paid by customers has to cover the operator tariff, in addition to an amount to service the debt taken on by SONES to finance the infrastructure. Tariffs are kept at affordable levels by cross-subsidizing households that consume less than 20 m^3 every two months. The nonresidential tariff is four times this social tariff (US$1.75 per m^3), while the tariff for government customers is nine times the social tariff (US$3.72 per m^3). A consistent increase in the residential share of consumption in recent years (92 percent as of 2013 with only 8 percent being consumed by nonresidential water customers) could threaten the sustainability of this cross-subsidy mechanism.

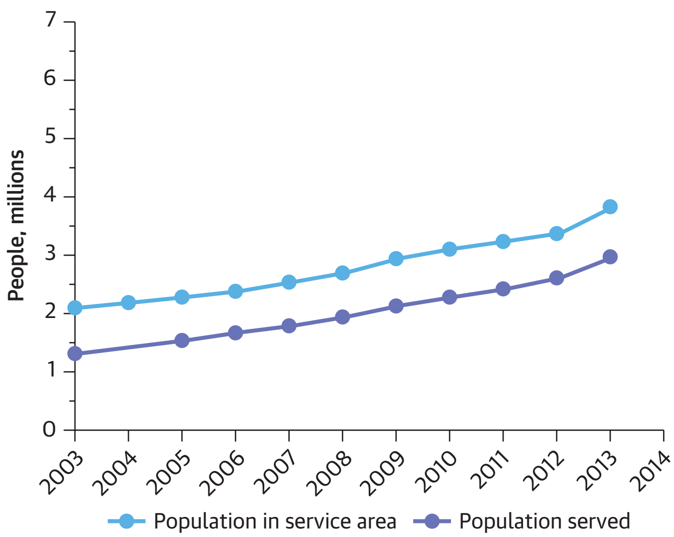
Uganda, NWSC (National Water and Sewerage Corporation)

Background

In 2013 the NWSC was providing water supply and (sometimes) sewerage services to 23 urban centers and towns in Uganda.[24] The NWSC is internationally recognized for its successful performance turnaround, which began in 1998. Two important things happened in 1998: a management contract with a German engineering firm (Gauff) was signed and a new managing director (Dr. William Muhairwe) was appointed. Dr. Muhairwe launched several internal programs to improve operational efficiency, such as the 100 days' program. In 2002, a second management contract was signed, this time with Ondeo.

The IDAMCs, first piloted in 2004, were another successful initiative. Each town was established as a business unit and managers were held accountable for meeting set performance targets. Kampala, which accounts for more than 60 percent of total revenue, was further

FIGURE B.53. **Population Served Compared with Service Area Population, 2003–14**



Sources: DHS 2005, 2011, 2014; MICS 2000.

divided into branches, each responsible for operational activities in its service area and incentivized to meet targets set in the Branch Performance Contract.

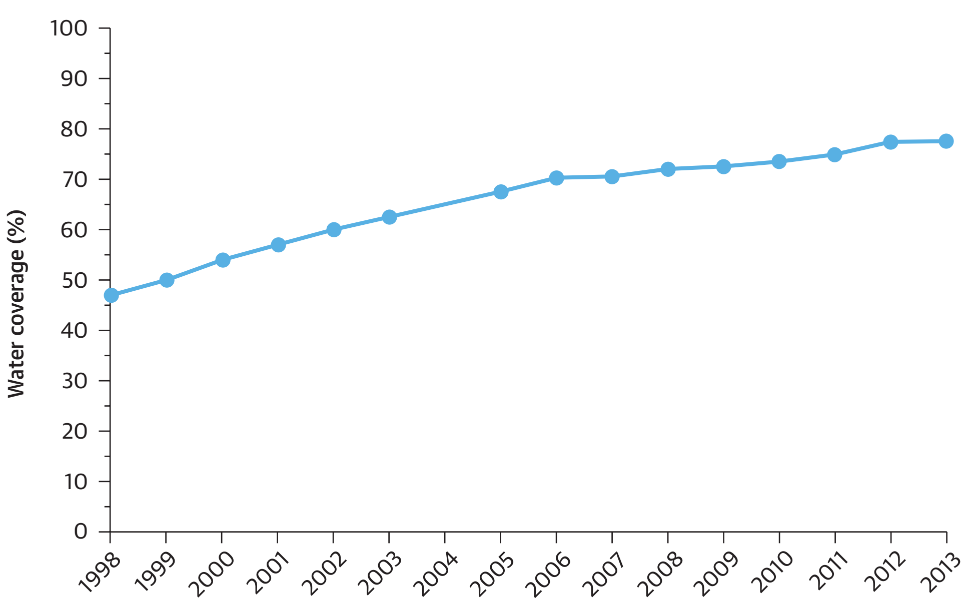
As a result of these reforms, the NWSC's operational and financial performance improved significantly during the late 1990s and early 2000s. Its achievements were maintained up to 2013, the final year analyzed in this case.

Performance

Customer Performance

Access to Water Services. In 1998, the NWSC served about half of its service area population (1 million people). By 2013, nearly 3 million people were served out of 3.8 million people (78 percent coverage). Growth in the service area population and the population served over this period is shown in figure B.53. Figure B.54 shows the growth in water coverage, defined as the proportion of the service area population served by the NWSC.

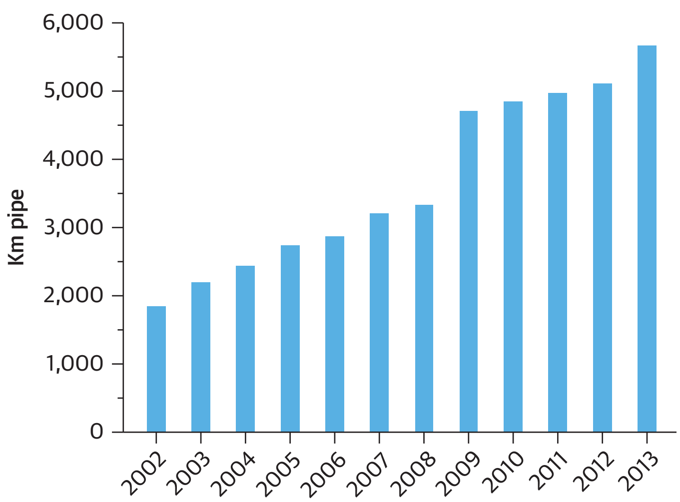
FIGURE B.54. **Water Coverage (Population Served Divided by Service Area Population), 1998–2013**



Sources: DHS 2005, 2011, 2014; MICS 2000.

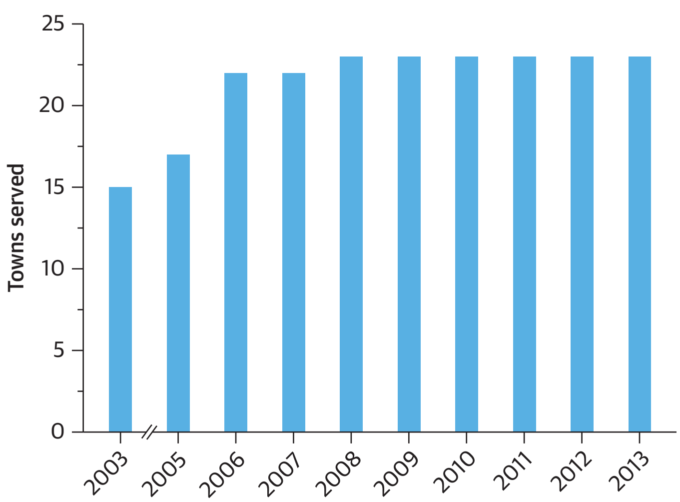
According to the NWSC data, the share of the population served by domestic connections and that served by public taps were roughly equal in 2013, with access to domestic connections having increased slowly over time.[25] However, household survey data for Kampala (the capital city that accounts for more than 60 percent of the NWSC's revenue) differ significantly. About three-quarters of survey respondents with access to piped water reported accessing it from a public tap.[26] Nevertheless, the average number of people served per connection has declined over time—from 15 in 2003 to nine in 2009. From 2009 to 2013, the indicator remained relatively stable at nine people per connection.

FIGURE B.55. Network Length, 2002–13



Sources: DHS 2005, 2011, 2014; MICS 2000.

FIGURE B.56. Towns Served, 2003–13



Sources: DHS 2005, 2011, 2014; MICS 2000.

Network and Town Expansion. From 2002 to 2013, the distribution network length tripled from 1,846 km to 5,670 km due to (a) incorporation of new towns into the service area and (b) extension of service to new customers in Kampala and elsewhere. The growth of the network over time is shown in figure B.55; the increase in towns served is shown in figure B.56. Preliminary data from 2014 and 2015 show that the number of towns to be served by the NWSC will expand rapidly.[27]

Reliability. Reliability of water service is moderate at 20 hours per day, compared with a regional benchmark of 21.6 and a global benchmark of 24 (see figure B.57). Recent challenges in increasing reliability have been drought, unreliable power supply, and growing demand for services. The NWSC's goal for the 2015-18 period is to achieve 24-7 reliability in all towns.[28]

Sufficiency. Average residential water consumption per capita has declined steadily since 2012, from 38 lcd to 23 lcd (2013) (see figure B.58).

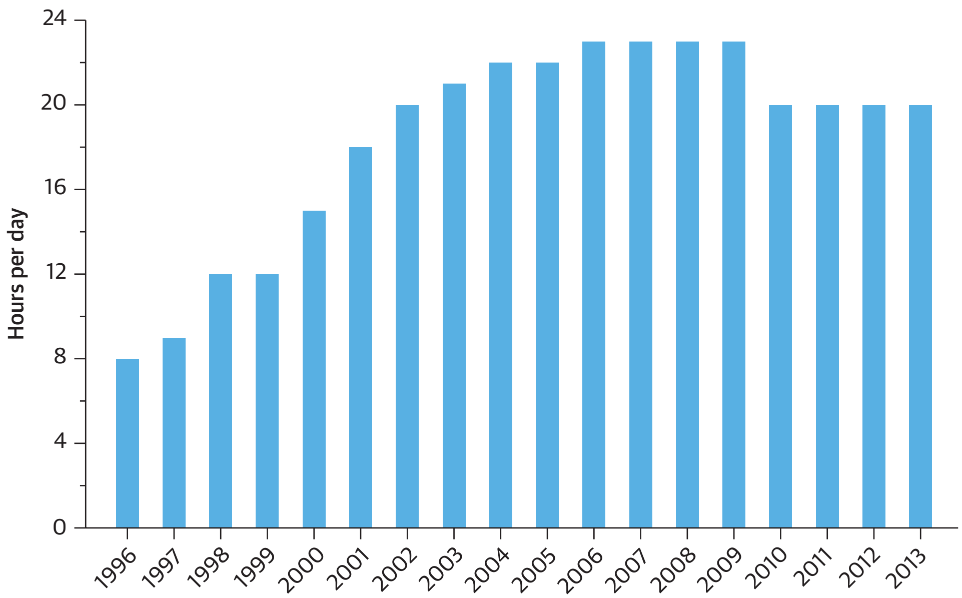
Affordability. One measure of affordability is the percentage of income spent on water consumption. A proxy for the average annual per capita expenditure on water is total revenue from sales divided by the number of people served. A proxy for average per capita income is Uganda's GNI per capita. Dividing the proxy for water expenditure into the proxy for income gives the average expenditure on water at 4.3 percent of income. By contrast, the best regional performance benchmark for this indicator is 1.22 percent.

Safety. Results of water quality tests have been published in the publicly available annual reports since 2010. In 2013, the NWSC tested more than 9,000 water samples for *Escherichia coli*, which translates to about one sample per town per day. At least 97 percent of samples passed *E. coli* tests in all 23 towns. In the same year, 22 of 23 towns in the NWSC service area produced water meeting the national standard for turbidity (less than 5 nephelometric turbidity units [NTU]).[29]

Operational Performance

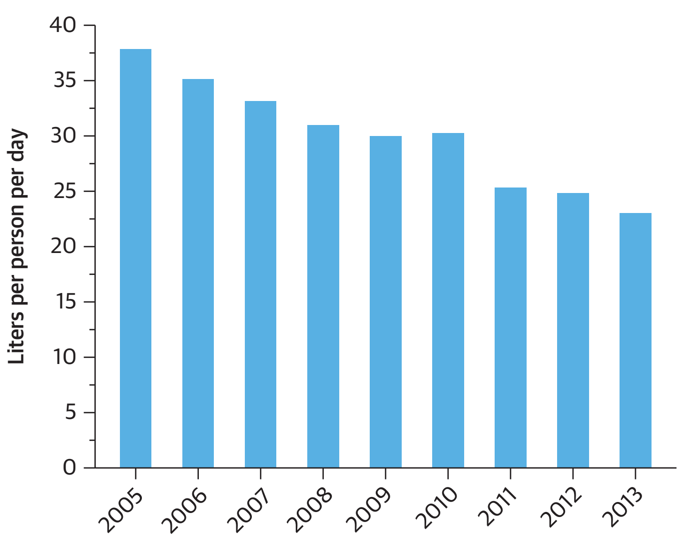
NRW. The NWSC has made significant progress in reducing NRW, which decreased from 1,210 liters per connection per day (1998) to just 200 liters per connection per day (2015). Current performance is slightly better than the regional benchmark of 205 liters per connection per day.

FIGURE B.57. Hours of Water Supply per Day, 1996–2013



Sources: DHS 2005, 2011, 2014; MICS 2000.

FIGURE B.58. Sufficiency of Residential Consumption, 2005–13



Sources: DHS 2005, 2011, 2014; MICS 2000.

NRW trends over time, measured in liters per connection per day and percentage of production, are shown in figure B.59 and figure B.60, respectively.

Measured in percentage terms, NRW has fallen from 50 percent to 32 percent during the same period (see figure B.60). Most progress on this indicator was achieved during the 1998-2006 period during the management contracts (Gauff, 1998-2001; Ondeo, 2002-04) and introduction of the IDAMCs. During this period, service reliability also increased (see figure B.57). Since then, NRW levels have plateaued. One challenge has been reducing NRW in Kampala, the capital city of Uganda, which accounts for about 70 percent of the NWSC's revenue. Metering across the service area has been more or less universal (above 98 percent) since 2005.

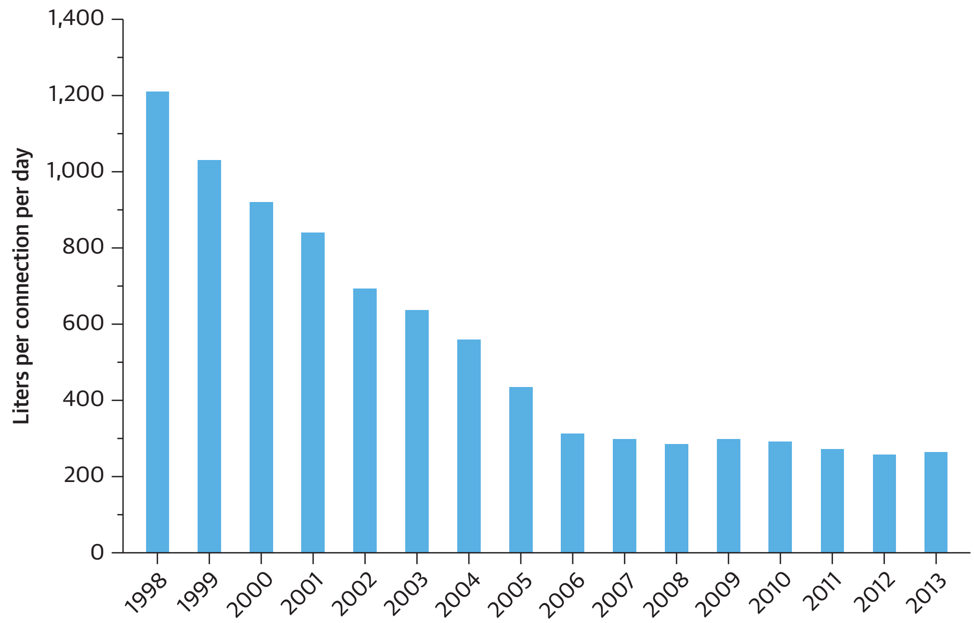
Staff Productivity. Staff productivity has improved significantly since 1998, with the number of staff per 1,000 water and sewer connections falling from 36 to 10 in the first four years (1998-2002) and from 10 to 6 in the following four years (2002-06) (see figure B.61). Early progress was achieved by laying off staff, but from 2002-06, both staff numbers and productivity grew. This was possible because network expansion significantly outpaced hiring of new labor.

Since 2006, staff productivity has stagnated, equaling about five staff per 1,000 water and sewer connections in 2013. The NWSC's staff efficiency (revenue per employee divided by labor costs per employee, or simply revenue divided by labor costs) has ranged from 3 to 4.5 from 2005 to 2013. At 3.4 in 2013, the NWSC is below the African benchmark of 4.27 and the global benchmark of 4.21.

Financial Performance

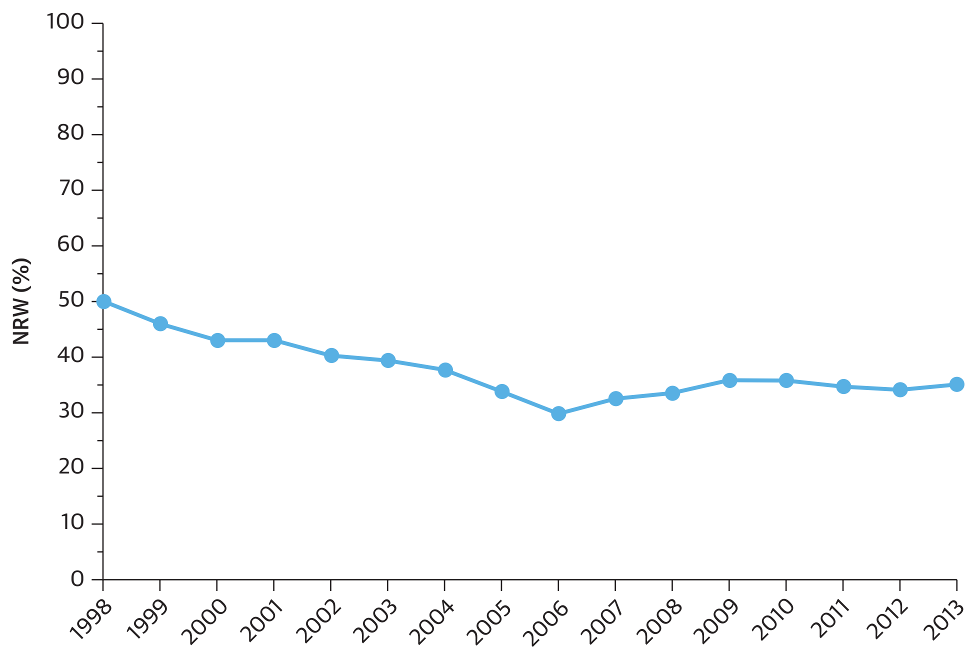
Collection Efficiency. Collection efficiency increased from 85 percent in 2001 to 95 percent or higher from 2009 to 2013 (see figure B.62). Among other initiatives, the NWSC has built

FIGURE B.59. Nonrevenue Water, by Connection, 1998–2013



Sources: DHS 2005, 2011, 2014; MICS 2000.

FIGURE B.60. Nonrevenue Water as a Percentage of Production, 1998–2013



Sources: DHS 2005, 2011, 2014; MICS 2000.

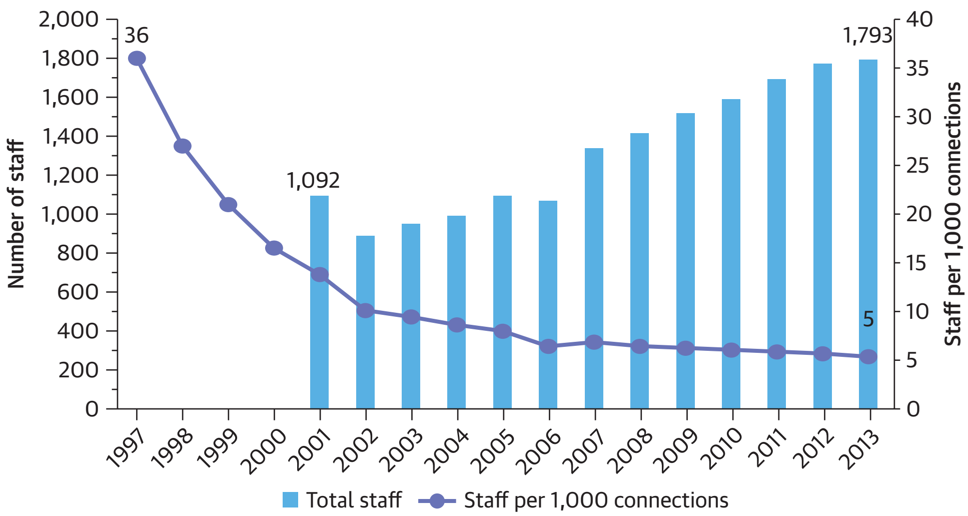
automatic water dispensers (standpipes that dispense water when a prepaid token is inserted) to ensure payment.

Operating Cost Coverage. The NWSC has had an OCCR of 1.20 or higher since 2002, indicating financial sustainability (see figure B.63). This is on par with the best performers in Africa.

Real average tariffs have remained relatively constant from 2002 to 2013, between U Sh 3,000 per m^3 and U Sh 3,500 per m^3—or US$1.16 per m^3 in 2013 U.S. dollars, as shown in figure B.64. Real average operating costs have exhibited a similar pattern, amounting to about US$0.89 per m^3 in 2015. Since 2010, the real average tariff has declined. From 2004, the NWSC's tariff was indexed to inflation. There is no regulator—the indexation mechanism was approved by parliament. This provided legitimacy for the tariff indexation and reduced the risk of future executive action to prevent annual increases.

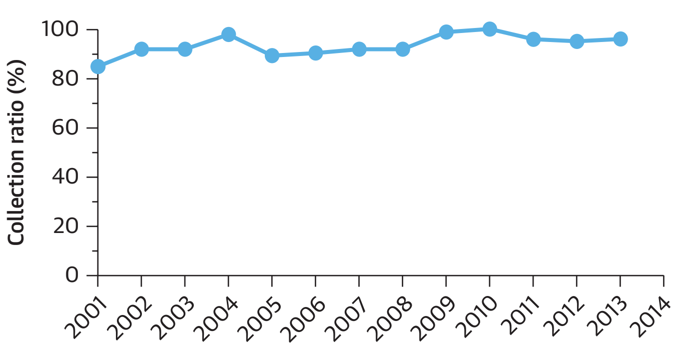
Cross-subsidies are important for the affordability of the NWSC's service. The domestic tariff of US$0.77 is higher than the standpipe tariff of US$0.47. Commercial customers are charged even more. However, to keep large users on the system, the tariff rate for commercial consumption above 1,500 m^3 per month is lower than for consumption below that rate (US$0.93 per m^3 compared with US$1.16 per m^3) (NCWSC 2014). In 2013, commercial users accounted for about one-third of total volume billed.

FIGURE B.61. Staff Numbers and Staff per 1,000 Water and Sewer Connections, 1997–2013



Sources: DHS 2005, 2011, 2014; MICS 2000.

FIGURE B.62. Collection Ratio, 2001–14



Sources: DHS 2005, 2011, 2014; MICS 2000.

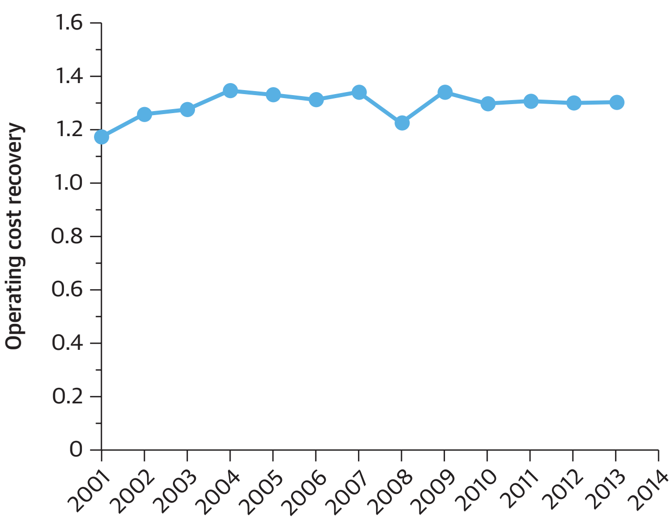
Financial Transparency. The NWSC publishes an annual report that reviews its performance against well-defined targets and includes audited financial statements. These reports are made available on the corporation's website, but they are not up-to-date—the latest available is 2012-13. The Corporate Plan 2015-18 is available on the website.

Investment. For the NWSC to increase access and improve service, about US$100 million in capital expenditure was required from 2002 to 2011 according to cash flow statement analysis.[30] This amounts to about US$3.85 per person served per year. Figure B.65 shows the sources and amounts of capital expenditure financing during this period. While about 28 percent was grant financed, 52 percent was financed by internal cash flow and 16 percent from loans. A small portion was financed by other sources—this includes cash from nonoperating activities, such as proceeds from disposal of property, plant, and equipment.

All values are in nominal Uganda shillings. The exchange rate in 2011 was U Sh 2,340 to US$1. One project the NWSC undertook during this period was the Gaba III water treatment plant and transmission mains (U Sh 52.7 billion; US$28.8 million [2006]). This project increased water production for Kampala and the nearby areas by 80,000 m^3 per day. In 2010, a commercial loan of US$2 million was obtained for financing the extension of the Ggaba intake plant, which supplies water to Kampala City and the surrounding areas. This loan is being serviced from operating cash flow.

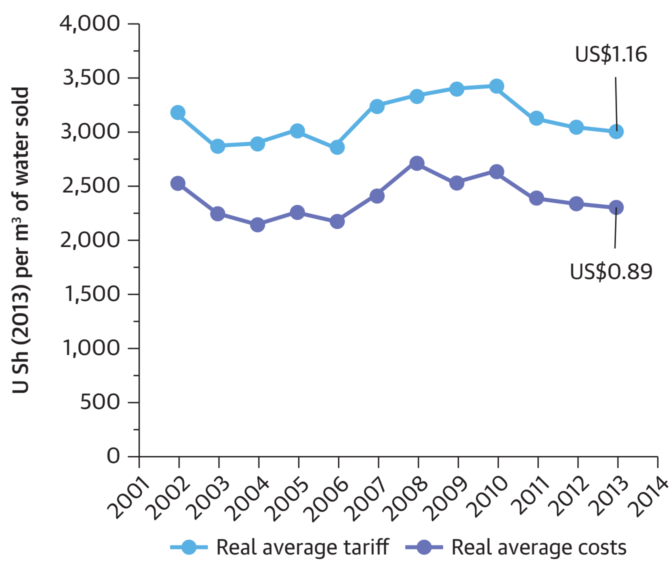
Early in this period, the NWSC did not repay its loans with operating cash. The government of Uganda agreed to a moratorium on debt service for a period, which gave the NWSC financial breathing space. Then, in 2007, the government converted the outstanding balance of US$47 million into equity—effectively forgiving the debt. Since then, the NWSC has borrowed from commercial banks and is repaying from operating cash flow. Increasing operating cash flow contributed to the expansion in service. Important drivers of increasing cash flow were increasing collection efficiency (85 percent in 2001 to 95 percent in 2011),

FIGURE B.63. Operating Cost Recovery Ratio, 2001–14



Sources: DHS 2005, 2011, 2014; MICS 2000.

FIGURE B.64. Average Tariffs, Average Costs per m³, 2001–14



Sources: DHS 2005, 2011, 2014; MICS 2000.

reductions in NRW (43 percent in 2001 to 33 percent in 2011), increasing labor productivity by limiting staff growth as connections increased, and a modest increase in the real tariff of 3 percent annually.

Organization

Human Resources. The former utility manager described a culture of slackness pervading the NWSC when he took over its management (1998). Garbage was left lying around offices. To shock the organization into change, he instituted a 100-day turnaround program (February 1999–May 1999), in which managers and their teams committed to extraordinary goals which they would achieve within the first 100 days. This signaled that things were changing and helped to build a performance culture within the organization. Other initiatives followed, including consultative strategic planning to build a sense of common purpose (Mugisha, Berg, and Muhairwe 2007).

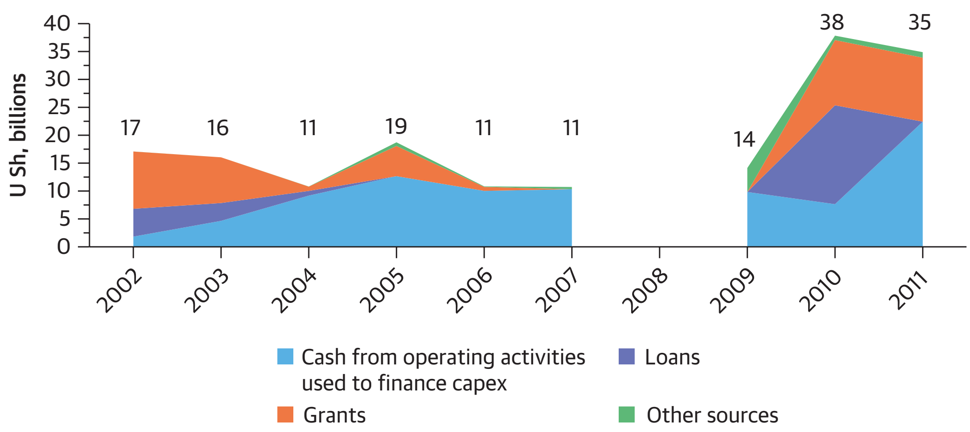
Since 2004, the NWSC has used IDAMCs to motivate management teams in each area of its operation. Management teams are selected competitively through an open process. They commit to put a part of their salary at risk, in exchange for a bonus if they meet targets for service levels and improvements in operating cash flow.

To help staff improve, the NWSC has a training center in Kampala. Courses include customer care, surveying techniques, and ethics and integrity. The NWSC also has a vocational training facility for technical staff. For professional staff, the NWSC finances educational scholarships and provides low-interest study loans to assist well-performing staff with their career development.

Strategic Planning and Accountability. In 2003, a performance contract was agreed between the government and NWSC. The contract set out targets for the NWSC, including developing plans and funding for network expansion. The contract was essentially a corporate strategic plan with quantified targets and milestones, setting out the agreed way forward.[31]

The NWSC has used inclusive strategic planning successfully for some time—the utility recently published its 7th Corporate Plan (2015-18), which is available on its website. In 2013, the utility published its first ever five-year Strategic Direction (2013-18), which staff

FIGURE B.65. Capital Expenditure Financing, 2002–07, 2009–11



Sources: DHS 2005, 2011, 2014; MICS 2000.

at all levels were involved in preparing.

Commercial Techniques. Innovative commercial techniques help the NWSC serve customers better. Most public taps are operated as kiosks by someone who has paid for the connection and then on-sells the water. Some kiosks are municipal, some are run by community groups, and others are private. Although the NWSC standpipe tariff is about 39 percent less than the domestic tariff, the NWSC found that some of the kiosks charge an excessive markup for the water. Once the water is dispensed in 20 liter jerry cans at the kiosk, the effective tariff could be US$1 per m^3 or more (Kariuki et al. 2014). In response, the NWSC has installed standpipes that automatically dispense water when a customer inserts an electronic token. By cutting out the middlemen (the kiosk operator) these prepaid water points ensure that customers can access water at the low standpipe tariff set by the NWSC, without markups.

A similar effort that helps ensure affordability is the NWSC's recognition that some individual yard taps are in fact shared water points. If consumption of water by one direct connection seems high, the NWSC staff will visit to check if the yard tap serves more than two or three households. If so, the tariff for public water points is applied.

Summary

As a result of the NWSC's turnaround, about 76 percent of people in the utility service area now have access to piped water services, up from just 47 percent in 1998. On average, water is available for 18 hours per day. Cross-subsidies—and standpipes that dispense water automatically—help ensure water is affordable to residential customers. Revenue covers all operating costs and some capital costs, a result of operational efficiency and a cost recovery tariff. The NWSC can borrow on commercial terms and service the debt with operating cash.

The reforms were phased. Early on, local and international management models were tried in parallel, with the primary goal of continuing to serve existing customers while reducing financing losses through greater efficiency. This was successful, as evidenced by NRW falling from 50 percent to 30 percent (1998–2006) and staff productivity rising from 36 staff per 1,000 connections to six staff per 1,000 connections (1998–2006). Over time, pragmatic solutions, including tariff indexation and a performance contract rather than a regulator, were developed. The IDAMCs (since 2004) incentivize staff to meet operational and financial targets such as NRW, arrears, the working ratio, and connection efficiency.

Update: 2014–15

In 2013, the NWSC launched an impressive new "water for all" campaign. Now that the NWSC is financially sustainable, the goal is to increase water supply access across the country. The number of towns served rose from 23 to 149 in less than three years (June 2013 to March 2016). In these new towns, the NWSC has mostly taken over the operations and maintenance of existing infrastructure from the Directorate of Water Development. Data on this expansion have been incomplete and hence could not be verified during this study. Prior data collection in the newly added towns was poor, so the NWSC plans to conduct a customer survey to establish better data.

Notes

1. DHS 2010 at Demographic and Health Surveys for selected countries at http://dhsprogram.com/data/
2. This is a very basic indicator for affordability as many utilities only provide services to urban residents (whose incomes tend to be higher than the national average). In addition, the revenues spent on water also include the sales to nondomestic users (as many utilities do not separately report for residential users and hence the effect of cross-subsidies cannot always be detected).
3. This means that more than 25 percent of African utilities in the sample collected have a staff efficiency indicator value higher than ONEA's.
4. The increasing block tariff structure will discourage the sharing of taps.
5. ONEA, "Les tarifs," http://oneabf.com/les-tarifs/.
6. IBNET.
7. Figure quoted based on 2013 dollar value.
8. IBNET at https://database.ib-net.org/utility_profile?uid=5375
9. SODECI Annual Report 2012.
10. The collection period refers to the average number of days it takes customers to pay their bills. It is calculated as follows: accounts receivables at year end/revenue × 365.
11. For more information on the training centers, see the eranove website at http://www.eranove.com/en/collaborators/training/.
12. The Water Act 2002 is under review and is subject to reform by the Water Bill 2014. According to the Kenyan Senate's 2016 "Bills Tracker" (http://www.parliament.go.ke/the-senate/house-business/bills-tracker), the Water Bill 2014 is in the advanced stages of Kenya's legislative process.
13. "Geographical Coverage", Athi Water, http://awsboard.go.ke/about/our-mandate/.
14. https://www.nairobiwater.co.ke/projects.
15. https:// https://www.nairobiwater.co.ke/index.php/en/
16. The reason for the decline in O&M costs is not clear.
17. The household survey of 2013 estimated the total population in Senegal serviced with piped water at only 5.3 million (compared with the SDE's estimate of 5.8 million), with a different split between house and yard connections (4.7 million in household survey compared with 5.3 million by the SDE) and public taps (0.6 million in household survey versus 0.5 million in the SDE's estimates).
18. http://dhsprogram.com/pubs/pdf/FR305/FR305.pdf
19. MICS 2000, "Multiple Indicator Cluster Surveys" at http://www.unicef.org/statistics/index_24302.html. DHS 2005, 2011, 2014, "Demographic and Health Surveys" at http://dhsprogram.com/data/.

20. Staff Appraisal Report, Republic of Senegal, Water Sector Project June 12, 1995, 2–4.

21. Figure quoted in 2013 U.S. dollars.

22. Implementation Completion and Results Report, Senegal Water Project; Implementation Completion and Results Report, Long Term Water Project. These projects included sanitation components which are overseen by ONAS, and not the SDE or SONES.

23. Staff Appraisal Report, Senegal Water Project, iv; Project Appraisal Document: Long Term Water Project, 20.

24. According to the NWSC website, 149 towns were served as of March 17, 2016. The remainder of the case presents data up to June 2013.

25. https://www.nwsc.co.ug/index.php/resources/reports

26. https://dhsprogram.com/pubs/pdf/FR264/FR264.pdf

27. Data on the expansion are not complete, neither are the underlying performance data. Hence, these two years of still incomplete data have not been included in this assessment.

28. NWSC Corporate Plan, 2015-18.

29. NWSC Annual Report, 2013.

30. Figure quoted in 2011 U.S. dollars.

31. Performance contract between the government of the Republic of Uganda and the NWSC dated October 17, 2003.

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Appendix C Data Quality Procedures

The quality of data in International Benchmarking Network for Water and Sanitation Utilities (IBNET) depends on the quality of the submissions by utilities and their associations. IBNET, however, invests substantial efforts to ensure that the data collected are of top quality and adequately reflect the status of the utility performance.

IBNET data in Africa are gained from the following sources: (a) Bank operations in Francophone Africa and Malawi; (b) regulators from Tanzania, Kenya, and Zambia; and (c) individual consultants working under the supervision of the IBNET and Bank teams from Nigeria, South Africa, and Ethiopia. The quality of data sources varied from excellent quality assurance procedures (such as regulatory data) to some with less sound procedures; however, all of the data have gone through a rigorous review by the IBNET team.

Data Quality When Collecting Data. The IBNET data collection tool contains ranges and built-in filters that prevent the input of obviously wrong information. More than 70 filters are set in the IBNET Toolkit that prevent input of wrong as well as non-numeric data.

Data Quality When Uploading the Data. The IBNET site controls data when uploading the data:

- Data are within the expected ranges.
- Time trends appear to be reasonable (red flag if data or indicators changed more than 30 percent within one year, yellow flag when data changed by 10 percent to 30 percent, and green flag when changes are below 10 percent). All yellow- and red-flagged data were sent to data collectors for review and explanation.
- Confidence ratings assigned are as may be expected from experience (urbanization, length of pipes, consumption, and collection rates).

After the dataset is uploaded, it undergoes a review for each of the data items on outliers, data sources, and consistency through the “performers” function in the IBNET database. The IBNET website allows examination of the calculated performance levels provided by all the utilities for consistency, to ensure that data are within the ranges to be expected and time trends appear to be reasonable. The calculated averages for the given set of data help understand the utilities’ outliers, and these performance outliers are reviewed jointly with the data collector to understand the reason for these outliers.

We have a full data sample of more than 1,400 observations in the database, covering 306 utilities from 40 African countries. Observations span a 20-year period (from 1995 to 2014) but not all utilities have reported information each year. There were few utilities which provided information at the beginning of the period (less than 15 utilities each year from 1995 to 1999). The number of utilities in the IBNET database has increased regularly over time. In 2011 and 2012, more than 250 utilities provided information each year, because of large data collection efforts in Ethiopia and Nigeria. Because participation in the IBNET data collection is voluntary, the sample of utilities may not be representative of the entire population of African utilities operating in the water sector.

A subsample of almost 120 utilities from 14 countries covering the period 2010–13 was used for the analyses in chapters 3, 4, 5, and 6. In chapter 7, the case studies use datasets from longer time periods for the five selected utilities.

Appendix D Data Envelopment Analysis Methodology

The data envelopment analysis (DEA) is a nonparametric approach to measuring the relative efficiency of firms in an industry where the firms are often referred to in the DEA literature as decision-making units. The DEA creates a performance index from indicators, referred to as inputs and outputs in the DEA literature, which can be related to other factors that drive performance. Under basic DEA, a water utility is regarded as a relatively efficient utility if its observed inputs can be scaled to yield outputs that equal or exceed any combination or scaling of what the other utilities' observed inputs yield. The origination of the approach is frequently attributed to Charnes, Cooper, and Rhodes (1978) and has been applied in many studies, including studies of water utilities. Extensions of the basic DEA approach to accommodate alternatives to its assumptions have been presented in the decades since the appearance of the seminal paper.

The DEA approach uses mathematical programming methods to determine the performance ranking of firms in an industry. The DEA approach measures the efficiency of firm k in an industry of K firms as the optimal value of the objective function found by solving the following problem where y_{ik} is the amount of the ith of m outputs produced by firm k, x_{jk} is the amount of the jth of n inputs used by firm k, and the maximization is over the m + n nonnegative, choice variables, u_i, and v_j:

Maximize $$\frac{\sum_{i=1}^{m} u_i y_{ik}}{\sum_{j=1}^{n} v_i x_{jk}},$$

subject to $$\frac{\sum_{i=1}^{m} u_i y_{ik}}{\sum_{j=1}^{n} v_i x_{jk}} \leq 1; k = 1, 2, \ldots, K, \qquad \text{(D.1)}$$

where $u_i, v_j \geq 0$; $i = 1, 2, \ldots, m$; $j = 1, 2, \ldots, n$.

Note that the output values, u_i, and input prices, v_j, are evaluated to place firm k in the best light to determine its relative performance. A transformation of variables yields an equivalent model which may be more conveniently solved through the techniques of linear programming (see for example, Alhabeeb and Moffitt 2012); that is,

Maximize $$\sum_{i=1}^{m} u_i y_{ik},$$

subject to $$\sum_{i=1}^{m} u_i y_{ik} - \sum_{j=1}^{n} v_i x_{jk} \leq 0, \qquad \text{(D.2)}$$

$$\sum_{j=1}^{n} v_i x_{jk} = 1,$$

$$u_i, v_j \geq 0.$$

The efficiency of each of the K firms is estimated by varying k in the objective function over $k = 1, 2, \ldots, K$.

Collecting the optimal value of the objective function for each value of k yields a performance index known in the DEA literature as an efficiency ranking of the firms over the [0, 1] interval with a "1" signifying an efficient firm. A relative efficiency frontier can be formed by piecewise linear segments associated with observations from the efficient firms.

An important advantage of the DEA relative to statistical regression techniques is that it does not require specification of a functional form relating outputs and inputs as parametric statistical techniques do. Similarly, specification of distributions for stochastic model components is avoided. An important limitation of the DEA is its sensitivity to errors in sample observations, the potential of which is ignored by the basic DEA approach. The subjectivity involved in selection of inputs and outputs is also a limitation.

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