

Zuin, V. and Nicholson, M. 2021. The impact of pro-poor reforms on consumers and the water utility in Maputo, Mozambique. *Water Alternatives* 14(1): 158-185



The Impact of Pro-Poor Reforms on Consumers and the Water Utility in Maputo, Mozambique

Valentina Zuin

Yale-NUS College, Singapore; valentina.zuin@yale-nus.edu.sg

Maika Nicholson

Sherwood Design Engineers, San Francisco, CA, United States; maikanicholson@gmail.com

ABSTRACT: Over one billion people gained access to piped water between 2000 and 2015. Piped water access in sub-Saharan Africa (SSA), however, is the lowest of all SDG regions and is declining: in 2017, only 56% of the urban population in SSA had access to piped water in their homes, down from 65% in 2000. Increasing water access via private connections is difficult for many of utility providers in SSA, and unconnected households may also choose not to connect to the water utility network because of low-quality utility service, high water charges and high connection fees. This paper focuses on understanding the impact of the pro-poor water reforms implemented between 2010 and 2019 in the Greater Maputo Area (GMA), Mozambique; specifically, it attempts to understand how households were able to obtain piped water access through a water connection campaign, a reduction of the connection fee, and the option of paying in instalments. We use data collected in 2010 and 2012 – before and after these policy changes were introduced – from 1300 households in 6 poor neighbourhoods in peri-urban Maputo. This paper also investigates the broader sectoral impacts of these policies over time from the water utility's perspective, using data from sector reports and interviews with key informants that were conducted by one of the authors in 2019. We found that between 2009 and 2017, the number of domestic private connections more than doubled in the GMA. Both the utility connection campaign and the reduction in connection fees facilitated water access for low-income households – although the poorest households were still unable to access piped water in the studied neighbourhoods – and for a few households, access was made possible by the option of paying the connection fee in instalments. Such rapid increases in the number of connections had two important implications for the water sector: first, as the number of private connections increased, the quality of service decreased significantly; second, the increase in domestic connections among largely low-income and relatively low-consuming customers resulted in major financial challenges for the system. These results are in line with those of other authors who argue that social and financial goals cannot be achieved in tandem; they also support findings in the existing literature on the limited ability of tariffs to deliver subsidies to the poor.

KEYWORDS: Water reforms, urban service provision, pro-poor water services, connection fee, payment in instalments, financial sustainability, coverage increase, Maputo, Mozambique

INTRODUCTION

Over one billion people gained access to piped water between 2000 and 2015 (WHO/UNICEF, 2017). Coverage of piped water access in sub-Saharan Africa (SSA), however, is the lowest of all SDG regions and is declining: in 2017, only 56% of the urban population in SSA had access to piped water to their homes, down from 65% in 2000 (WHO/UNICEF, 2019). Access to an improved water supply is also highly unequal, with the poorest and richest quintiles showing large differences in the percentage of households with access to basic water services. In 2017, for example, only 34% of households in the poorest quintile had access to basic water services compared to 94% of households in the richest quintile (WHO/UNICEF,

2019). Population growth and accelerating urbanisation will continue to widen the gap between the demand for water and available supply in SSA as eight of the world's ten most rapidly urbanising countries are in this region and the urban population of SSA is expected to triple by 2050. The impact of this growth will disproportionately affect the informal settlements where most of SSA's urban population resides (Hopewell and Graham, 2014; dos Santos et al., 2018).

Many reasons have been cited for the low coverage of water connections in SSA. Increasing water access through private connections is difficult for many of the continent's utility providers as their investment capacity is limited (Chitonge, 2013) and extending services to peri-urban and low-income settlements is expensive (Kayaga and Franceys, 2007; Sinharoy et al., 2019). Many utilities, however, find themselves in need of increasing coverage to gain economies of scale, while needing at the same time to increase efficiency and recover costs (Jaglin, 2002; Mugisha and Borisova, 2010; Marson and Savin, 2015; Kemendi and Tutusaus, 2018; Rusca and Schwartz, 2018). Another reason for the low coverage of water connections among the poorer quintiles is that utilities often lack the political will and financial incentives to serve poor and low-consuming customers, instead preferring to extend service to middle- and high-income neighbourhoods where they believe they have a higher likelihood of timely bill payments and full cost recovery (Kayaga and Franceys, 2007; Hadipuro and Indriyanti, 2009; Berg and Mugisha, 2010; Chitonge, 2011). Finally, utilities often consider peri-urban and poor areas to be ungovernable and unserviceable (Bakker et al., 2008; Connors, 2005; Sinharoy et al., 2019).

Unconnected households, however, may choose not to connect to water utilities for a variety of other reasons. Many utilities, for instance, provide intermittent and unsafe water and/or levy water charges that are not easily understood by consumers (Bakker et al., 2008; Boakye-Ansah et al., 2019). The cost of connecting to the water utility network has also often been a significant barrier for poor consumers, even when subsidised (Kayaga and Franceys, 2007; Raghupati and Foster, 2002). Connection fees vary greatly across Africa, ranging from about US\$6 in the Upper Nile in Sudan to more than US\$240 in Niger, Mozambique and Cote d'Ivoire (Banerjee et al., 2010). Connection fees charged by South African utilities such as the eThekweni Municipality and Johannesburg often exceed US\$300 (ibid). Kayaga and Franceys (2007) found that in Uganda the mean cost of a new water connection was US\$500 (median of US\$197), which is unattainable for households living on US\$2 a day. In addition to the expensive formal connection fees, households are often required to pay variable additional costs for trenching and road cutting, and for 'speed money' to obtain the application itself, to encourage timely approval of the application, or to simply recover the costs faced by the utility in delivering services to peri-urban settlements (Kayaga and Franceys, 2007; Wichelns, 2013).

One method of facilitating payment of the connection fee and thus increasing uptake is for utility companies to allow households to pay in instalments or via microcredit, although evidence of such programmes is rare in SSA (Baron et al., 2019). Devoto et al., (2012) highlighted that a programme in Tangiers, Morocco, was highly successful at increasing connection coverage by allowing households to pay water bills in interest-free instalments over three to seven years; this policy was also coupled with an information campaign and administrative support for consumers. According to Devoto et al., by six months after the informational campaign 69% of the households that benefitted from the full programme had obtained a water connection, as compared to only 10% of households that had access to the interest-free loan but did not receive the information or support. According to Baron et al., (2019), however, although repayment rates were high in Tangiers the programme was not profitable for the water utility; this was because of the high upfront investment and the cost of essential administrative tasks such as dealing with missing property titles. While this programme reveals the willingness of many low-income households to improve their access to safe water, it raises doubts about their ability to pay water bills while also servicing a loan; nevertheless, it contributes important information on the introduction of a new method for increasing participation in formal water connections in developing areas.

Since the 2000s, several scholars (Boakye-Ansah et al., 2019; Jimenez-Redal et al., 2014; Kayaga and Franceys, 2007) and practitioners (African Development Bank, 2010; Norman et al., 2012) have argued for the reduction or elimination of connection fees as another method of increasing connection uptake. Reducing the fees that are required to obtain a domestic connection is considered to be more effective at targeting the poor than is subsidising the consumption of water via a tariff; this was successfully illustrated by a study that modelled the impact of connection fees in Cambodia (Basani and Reilly, 2008). In other words, reducing the connection fee allowed households to access utility water which was much cheaper than water from other improved sources (Andres et al., 2019; Komives et al., 2007). There are, however, other caveats such as the connection fee benefitting landlords more than tenants, or the poor being only effectively helped when the utility network is available in poor areas. Reductions of the connection fee have been documented in several contexts, including the Indian cities of Bangalore (Connors, 2005) and Nagpur (Jensen and Chindarkar, 2019), and the Indian states of Madhya Pradesh (Das, 2014) and Karnataka (World Bank, 2013). The wider impacts of such a reduction have not, however, been evaluated rigorously (Baron et al., 2019: 12); as a result, we are not aware of any study that examines the direct impact of reduced connection fees on consumers and/or the water utility.

This paper attempts to fill this gap in the literature by analysing the impacts on households and on the water utility of the pro-poor water reforms implemented between 2010 and 2019 in Greater Maputo, Mozambique. Like other countries on the continent, Mozambique implemented important reforms in the mid-1990s that restructured the institutional arrangement of the sector and introduced private sector participation. In 2010, after food riots paralysed the Mozambican capital, and under pressure to increase urban water coverage to improve the utility's financial sustainability and achieve the Millennium Development Goals, the Government of Mozambique reduced the water connection fee and allowed households to pay it in instalments; the water utility then started a connection campaign for the city's many neighbourhoods. The authors used a plethora of data sources to evaluate how the use of a connection campaign and a reduction in the water connection fee facilitated water access for lower-income households in Maputo. The data used included that from a survey of 1300 households in six low-income neighbourhoods in Maputo before and after the policy change in 2010; it also included interviews with key sector stakeholders, and sector documents. This paper also seeks to explain why only a limited percentage of the households decided to take the opportunity to pay in instalments, despite its track record as an effective method for alleviating financial pressures on the poor. It further highlights that such a rapid increase in the number of water connections without adequate infrastructural support, water supply improvements, and building of capacity in peri-urban areas resulted in financial challenges for the water utility company. This ultimately led to a significant reduction in the number of new connections per year and in the number of subsidies of the connection fee that were awarded.

The paper is organised as follows. The next section provides an overview of the water reforms that took place between 2010 and 2020 in Mozambique in general and in Maputo specifically. The subsequent section describes the methods used in this study, and the section after that analyses the impact of the pro-poor reforms from the perspective of consumers. Following that is a discussion of the political economy of the reforms implemented and of the impact of the pro-poor reforms on the utility and the water sector. The final section offers some conclusions.

WATER REFORMS IN MOZAMBIQUE AND MAPUTO

Contrary to the overall trends in SSA, urban water supply in Mozambique has improved dramatically over the past 20 years; between 2000 and 2017, access to piped water has increased from 55% to 75% and household water access has increased from 29% to 48% (WHO/UNICEF, 2019). Since the mid-1990s, with the support of many international donors, the Government of Mozambique (GoM) has undertaken extensive institutional and policy reforms and increased investments in the water sector. Included among the donors who played a fundamental role in supporting institutional reforms, pro-poor policies and

investments in physical water infrastructure (repairs to reduce water losses, network extensions, and intake and treatment works in the Greater Maputo Area) are the World Bank, the European Investment Bank, the European Commission, the French Development Agency (Agence Française de Développement, or AFD), and the Netherlands Development-Related Export Transactions Programme (Ontwikkelingsrelevante Export Transacties, or ORET). NGOs include Water & Sanitation for the Urban Poor (WSUP), WaterAid, and the USAID-funded Sustainable Water and Sanitation in Africa (SUWASA).

In the first phase of the institutional reforms, the GoM implemented a delegated management framework (Boletim da Republica de Mocambique, 1998c, 1998b, 1998a). Under this framework, physical water supply assets were owned by the state but managed by a state-owned asset holding company, the Water Supply Asset Holding and Investment Fund (Fundo de Investimento e Património do Abastecimento de Água, or FIPAG), while operations of the water supply systems were outsourced to contracted private operators. In 1999, operations of the Maputo water system were leased for 15 years to Águas de Mozambique, an international consortium, but the contract had to be renegotiated at multiple junctures, and since 2010 the lease has been managed by a private Mozambican consortium which is partly owned by FIPAG. In 2010, it was renamed Águas da Região de Maputo (AdeM, Maputo Regional Water). In 2014, the lease contract was renewed for an additional five years, extending it to 2019.¹ As part of the delegated management framework, an independent water regulator called the Water Regulatory Council (Conselho de Regulação de Águas, or CRA) was established to protect and ensure affordability for consumers while also guaranteeing that the tariffs met the financial needs of the water utility. Like other major cities in Africa that have undergone similar changes (Rusca and Schwartz, 2018), the reform in Mozambique was predicated on the notion that the commercialisation of public water utilities would promote cost recovery and general financial sustainability (Boletim da Republica de Mocambique, 1998d).

The second phase of reforms started at end of the 2000s, ten years after the delegated management framework was put in place. Under the leadership of the CRA and FIPAG, the GoM began looking into policies to rapidly increase access to affordable and reliable water supply services for unconnected households in all the major cities. The system of Greater Maputo was considered a priority; coverage there was as low as 32% and the water system there had the highest potential for cost recovery in the country. Greater Maputo was also much larger than the other urban areas in Mozambique, which suggested important potential economies of scale.

In mid-2010, several reforms were implemented in Maputo and four other major cities in Mozambique: 1) a blanket reduction of the connection fee for a private household tap from 4300 Mozambican metical (MZN) (US\$118) to MZN2000 (US\$55);² 2) the option of paying the reduced connection fee in instalments of MZN100 (US\$2.80); 3) importantly, in order to speed up water coverage increases, the water utility undertook 'connect now and pay later' campaigns, whereby the utility would go from neighbourhood to neighbourhood in Maputo advertising the reduced connection fee and offering an immediate connection with the option of paying at a later date.

These changes accompanied a World Bank-funded Output-Based Aid (OBA) initiative, which was approved in 2007 but only became operational in Maputo in 2010. The OBA initiative financed subsidised connections for selected low-income households, reducing the connection fee for these households to MZN750 (US\$20.60) (Global Partnership for Output-Based Aid, 2007).³

Between 2009 and 2017, the number of domestic private connections more than doubled in the Greater Maputo Area, increasing from 110,000 in 2009 to 243,000 in 2017 (Figure 1); key sector

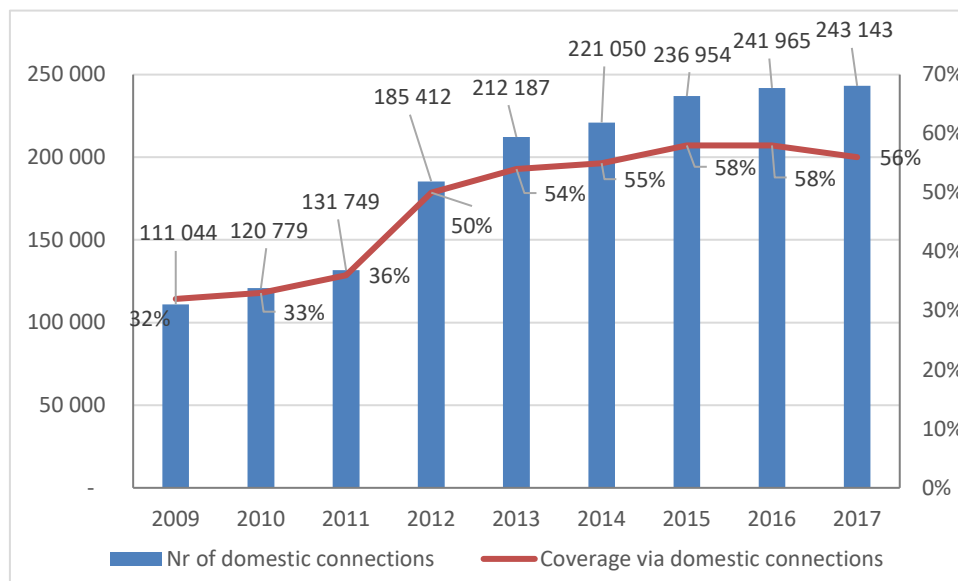
¹ At the moment of writing, it is still unclear whether this lease will again be extended or whether another arrangement will be found.

² In 2010, the exchange rate was US\$1 = MZN36.4; unless otherwise specified, this value of the exchange rate will be used throughout the paper. Since 2010, the Mozambican metical (MZN) has depreciated to about half its value against the US dollar.

³ Between 2009 and 2014, this initiative funded 30,000 connections in peri-urban Maputo.

stakeholders attributed this success to the above-mentioned reforms. It is important to point out that despite this very rapid increase in the number of connections, coverage increased much less significantly (in 2017 it was only 56%) due to the rapid urbanisation rates experienced by the Municipality of Matola and Marracuene District in the GMA. Indeed, population in the GMA increased by 37% between 2007 and 2017, going from 1,863,496 to 2,947,967 inhabitants (INE, 2007, 2010b, 2018).

Figure 1. Greater Maputo Area, 2009 to 2017: number of domestic private connections installed by Águas da Região de Maputo (AdeM) and domestic private connection coverage.



Source: CRA (2010, 2011, 2013, 2014a, 2017).

As connections increased, the GoM and its donors calculated that additional supplies of raw water would be needed by 2015 and they therefore began looking into possible ways to increase water supply capacity in the GMA (World Bank, 2013a). Water in the GMA comes from the Umbeluzi River and the Pequenos Libombos Dam, which are 25 kilometres south of Maputo. The only water treatment plant that serves Maputo is located on this riverbank and is sensitive to extensive periods of drought. The Pequenos Libombos Dam was expected to be operating at its full capacity by 2015/2016, using its full water abstraction license allotment of 240,000 m³/day; it was also expected that by 2015 additional connections would have been made.

The Greater Maputo master plan for water supply, furthermore, identified the Corumana Dam as the GoM's first choice for augmenting and diversifying Maputo's water supply, despite its long distance (90 km) from the GMA (World Bank, 2013a). The Corumana Dam, however, faced significant storage constraints. In 2011, it had a storage volume of 1240 Mm³, which was lower than its supposed full capacity; investments were therefore required to install spillway gates and to increase the facility's maximum operational level of 120,000 m³/day for treatment and domestic usage. The US\$70 million that was required to finance this portion of the dam was contributed by the World Bank National Water Resources Development Project. It was later determined that taking full advantage of the Corumana Dam required the laying of large pipelines capable of transporting the 120,000 m³ of treated water per day, as well as the construction during the first phase of a 60,000 m³/day treatment plant and the addition of another 60,000 m³/day treatment plant during a second phase. These later works were financed by a World Bank loan that was approved in 2013; they were further supplemented by investments in network extension by the World Bank (300 km of pipes at a cost of US\$27 million) and a grant from the Facility for

Infrastructure Development (ORIO) which is funded by the Dutch government (230 km of pipes and four distribution centres at a cost of US\$27 million) (Steinhauer, 2014; World Bank, 2013).

RESEARCH QUESTIONS AND RESEARCH DESIGN

The broad goal of this paper is to examine the pro-poor water reforms implemented by the Government of Mozambique in order to determine their impact on private connection coverage in the Greater Maputo Area and on the GMA's local water utility. The study specifically addresses the following sub-questions:

- 1) Household experiences: the 'connect now and pay later' campaign and the overall connection process
 - What is the role of the 'connect now and pay later' campaign in increasing private connection coverage in the study neighbourhood?
 - What are the time and money costs associated with the connection process?
 - What are the characteristics of households which benefitted from these reforms and, more specifically, from the connection fee reduction?
 - Why did some households remain unconnected?
- 2) Household experiences with the instalment programme
 - To what extent did households decide to take advantage of the option to pay the connection fee in instalments?
 - How did households learn about this opportunity and how accurate was the information they received about the instalment programme?
- 3) Impact on the water utility
 - How did these reforms impact service quality and financial sustainability in the water sector?
 - Are there broader implications of these reforms for the achievement of Mozambique's long-term water goals?

This paper draws on eight years of research on water provision in the Greater Maputo Area. We use multiple data sources, including a longitudinal survey of more than 1300 households before and after the reduction of the connection fee, interviews with key informants, and the analysis of data and sector reports.

Survey data collection took place in 2010 and 2012 (before and after the connection fee was reduced and the connection campaign began); data was collected in six peri-urban neighbourhoods (*bairros*) of Maputo, which had an estimated combined population of 106,000. In collaboration with the Conselho de Regulação de Águas, these six neighbourhoods were purposively selected to be representative of typical peri-urban neighbourhoods that were served by the water utility. The six neighbourhoods are characterised by high urban density, lack of planned roads, complicated land tenure situations, and relatively old buildings and infrastructure. Population density ranges from 5001 to 45,000 inhabitants per km².

In 2010, a total of 1439 households were interviewed; 1284 of these households were also interviewed in the 2012 follow-up study after the policy changes had been implemented. In 2010, households were identified using systematic sampling procedures,⁴ details of which can be found in Zuin et al. (2011).

⁴ Multiple efforts were made to interview the same respondents who were interviewed in 2010. Among the 1439 baseline households, 155 (10.8%) were lost to follow-up; of these, 95 (61%) had relocated, 26 (17%) refused to participate in the follow-up interview, and 34 (22%) could not be found for the follow-up in 2012. Households lost to attrition in 2012 did not appear to

The survey was administered by 12 college-educated Mozambican enumerators who were intensively trained over three weeks in the areas of interviewing skills, the objectives and contents of the household survey, and the use of personal digital assistants (PDAs) for data collection. The survey was coded for the PDAs using The Survey System software package (Creative Research Systems, Petaluma, CA, USA). Each survey was administered in Portuguese or Shangana and took a median of one hour to complete. The free and informed consent of each participant was obtained, and the study protocol was approved by the Institutional Review Board of Stanford University, California, USA. All data collection instruments were also reviewed and approved by the Mozambique National Statistical Institute (INE) in both 2010 and 2012. Household survey data was analysed using descriptive statistics and independent t-tests. Per capita monthly expenditures were used to build the expenditure quintiles used in this analysis.⁵ These quintiles included all households in the sample.

While this consumer survey data does not allow one to see how the reform process impacted consumers over the eight years, the follow-up survey was conducted when most of the policy experiments had already been implemented in the six study neighbourhoods; the year in which the survey was done was also the year which showed the largest increase in the number of new on-site water connections in the GMA. Further, the study neighbourhoods did not experience population growth between 2009 and 2019, as Maputo's population grew only marginally during this period; all population increases occurred, instead, in the GMA, in the Municipality of Matola, and in Marracuene District⁶ and, as such, private connection coverage in 2012 can be considered a low estimate of coverage in these neighbourhoods in 2019. Finally, the proximity of the baseline and follow-up surveys allows to minimise the impact of other factors affecting demand for new water connections, such as the economic crisis that started in Mozambique in 2016.

Key informant interviews were conducted in Portuguese in 2019 and lasted an average of two hours each; some interviewees were interviewed multiple times. The key informants included:

- two senior officials of the water utility AdeM who played key roles in the implementation of the reforms;
- three AdeM staff members;
- the water regulator who led the reform process in Maputo, and two of his staff;
- A senior official of the National Directorate of Water;
- two staff from the National Directorate of Water;
- five staff from donor agencies.

To understand the impact of water reforms on the water utility and water sector, interviews were complemented with an analysis of data contained in the official and publicly available annual and quinquennial reports that are published by the CRA. As the Mozambican water regulator, the CRA reports

be systematically different than those which remained in the sample with regard to water source and wealth (as measured either by income or expenditure); however, as expected, households which exited the sample appeared to be those who were less established in the neighbourhood at the time of the baseline survey. Households lost to attrition between 2010 and 2012 were significantly less likely to own their house (69% versus 92%, $p < 0.01$), to have lived in the neighbourhood for more than 20 years (50% versus 71%, $p < 0.01$), to have electricity in their house (72% versus 80%, $p < 0.01$), and to own a fridge (56 versus 64%, $p < 0.05$).

⁵ Household monthly expenditures were self-reported in separate categories by the respondents. The total was calculated as the sum of daily (for example, food), weekly (transport, food, coal, etc.), monthly (electricity, water, rice, etc.) and annual expenditures (school fees, etc.).

⁶ According to the 2007 and 2017 census data, the population in Maputo grew from 1,094,628 in 2007 to 1,101,170 in 2017 while the population of Matola grew from 682,691 to 1,616,267, and that of Marracuene District from 86,177 to 230,530 (INE, 2007, 2010b, 2018). Effectively, this means that while the population of the Maputo metropolitan area grew from 1,863,496 to 2,947,967 between 2007 and 2017 (increasing by 1,084,471 in ten years), Maputo itself accounts for an increase of only 6542 people, which is less than 0.6%.

annually to the Government of Mozambique; it also files reports at longer intervals about the water sector and the performance of the water utility, documenting dimensions that include the number of new domestic connections, the number of hours during which water is available, the volume of water produced, and non-revenue water.

This paper has two primary limitations. First, both the sample frame and the purposive selection of study neighbourhoods where the survey took place were based on the goal of studying the impact of one of the policies that was implemented by the GoM to improve water access for households buying water from their neighbours; the survey sampling approach did not take into consideration the other policies that were ultimately implemented. Second, the simultaneous implementation of multiple reforms and the absence of a control group makes it impossible to draw causal inferences between these reforms and the outcomes. We thus cannot attribute the increase in connections to any one reform and are only able to attribute it to the combination of changes; as such, the findings presented here focus instead on identifying and interpreting changes in the water market between 2010 and 2012 and are complemented by an analysis of publicly available sector documents.

WATER REFORMS FROM THE PERSPECTIVE OF CONSUMERS

Experiences of consumers: Time, money and other perceived barriers to uptake

Between 2010 and 2012, private water connection coverage in the sampled neighbourhoods increased by an average of 40%; this ranged from less than 25% in some neighbourhoods to as high as 102% in one. This rapid increase in coverage was the result of a connection campaign that facilitated the water connection process by introducing a reduction of the connection fee and the option of paying in instalments.

As part of the effort to rapidly increase connections, the sampled neighbourhoods benefitted from the AdeM *ligou e pagou* ('connect now and pay later') campaign; this allowed households to obtain their connection *before* they signed a contract with AdeM or paid the connection fee (or at least the first instalment of it). The campaign also allowed households to engage with the water utility directly at the local authority's office, which greatly reduced the time and money costs associated with the process. The 'connect now and pay later' campaign focused the water utility works on a few neighbourhoods at a time; it provided the households in that neighbourhood with a water connection as rapidly as technically possible, even if the other departments within the AdeM were unable to process the contract and include clients in the cadastre (official records). The 'connect now and pay later' campaign effectively overcame two typical barriers that impede new household water connections in many cities across the developing world: the difficulty of getting the connection and the burden of time associated with the process. Indeed, because of the campaign there was a significant reduction of the typical barriers to a connection such as long wait times, the difficulty of getting to provider offices, the costs in money and time of putting together the necessary documents, and general misinformation about the connection process.

A high percentage of households in our sampled neighbourhoods took advantage of this programme; 77% of newly connected AdeM households (175 out of 227) reported obtaining their connection before making any payment to AdeM.⁷ The most common payment locations reported by households which participated in the campaign were the AdeM/provider's office (46%), AdeM staff in the neighbourhood secretary's office (32%), and neighbourhood officials (19%). Given our inability to access the water utility data, we do not know the extent to which the connection fees were ultimately collected in the specific study neighbourhoods. More information is needed to better evaluate this policy from the utility

⁷ Paying before or after was self-reported; as such, we do not have information on the impact that this strategy has on the water utility, i.e. whether households actually pay after they are connected and how long after the connection they do so.

perspective, though, as shown below, seven years after the campaign the client cadastre is still a work in progress for the water utility.

While there was a large variation in the amount of time reported by households to have passed between submitting their connection application and the installation of their tap, for the majority of the households the process was extremely fast with about 60% managing to obtain a water connection within a week of their application (Table 1). Perhaps unsurprisingly, a slight majority (54%) of the households considered the process for obtaining a private connection to be easy.

Table 1. Time between connection application and installation among households connected between 2010 and 2012.

	One week or less	One to two weeks	Two weeks to a month	One to two months	More than two months
Percentage of newly connected households (N = 257)	58.8	5.4	20.6	6.6	8.6

On average, households that got connected to the water utility network spent a total of MZN1973 (US\$54.20) on their water connection; this included fees paid directly to the operator for materials such as pipes and meters, as well as contracted labor required, for example, for trenching to install pipes, and bribes. It is worth noting, however, that the standard deviation for this figure is very high, meaning that there was a large range of fees paid (Table 2). The fact that the mean connection fee paid to the operator is MZN1686 (US\$46.30) – less than the original quoted connection price of MZN2000 (US\$55) – reflects the fact that 131 households received an OBA connection with an average discount of MZN750 (US\$20.60). We find that households that received OBA subsidies were:

- Less likely to have cement walls surrounding their yard and more likely to have metal or bush yard walls ($p < 0.01$);
- More likely to have dirt yards and less likely to have cement yards ($p < 0.05$);
- Less likely to have grated windows or doors ($p < 0.01$);
- More likely to have their bathroom indoors ($p < 0.10$).⁸

These results suggest that the OBA selection criteria established by the programme designers were used accordingly in determining which households received the OBA subsidy.

Table 2. Total costs of connection (unit: MZN).

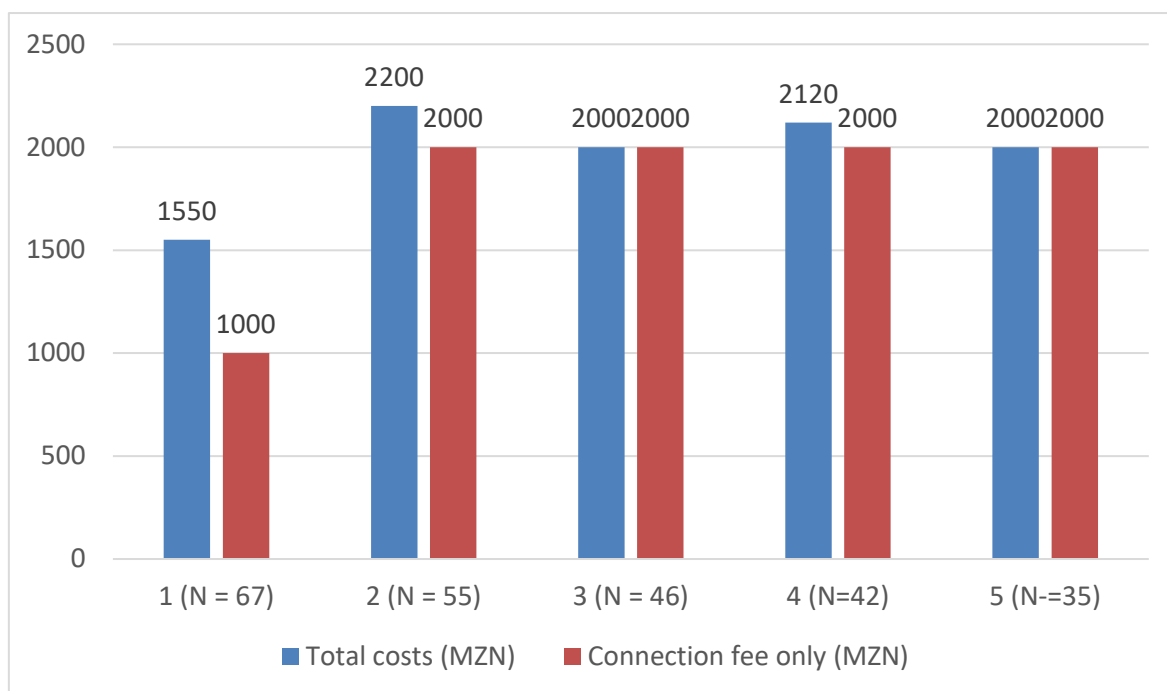
	Total cost of connection			Connection fee paid to operator			Additional material and other costs		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
AdeM (N = 209)	1973 (US\$54)	2000 (US\$55)	1261 (US\$26)	1686 (US\$46.3)	2000 (US\$55)	1043 (US\$38)	297 (US\$8)	0	725 (US\$20)

A comparison of the connection fees reported by households in different per capita expenditure quintiles shows that the median connection fee is indeed significantly lower for households in the lowest expenditure quintile (Figure 2). Median values for connection fees all equalled the theoretical connection fee of MZN2000 (US\$55), with the exception of the lowest quintile which had a median connection fee

⁸ Full results are shown in the Supplemental Information section.

of MZN1000 (US\$27.50). This data suggests that a higher percentage of OBA subsidies are received by households in the poorest quintile than in higher quintiles; this confirms that the targeted policy works as intended, targeting the poorest households in the study neighbourhoods.⁹ Interestingly, the data also suggests that households in the poorest quintile are the only households whose median total costs are significantly higher than the cost of the connection fees paid to the operator; the reason for this is the greater likelihood that poorer households in the study neighbourhoods reside further from the main road, and the fact that the utility required the purchase of additional pipes to extend the network beyond 25 metres from the main network.

Figure 2. Median connection fees and additional costs paid by newly connected households, by per capita expenditure quintile (N = 245).



The majority of households (53.5%) perceived the new connection fee to be affordable and 12% perceived it to be cheap; about 25% of the households considered the connection fee to be expensive.

Households that obtained a connection were asked how they learned about the opportunity to do so. The most commonly cited channels were: speaking to local authorities (25%), talking with one’s neighbour (22%), and asking AdeM (16%). TV, radio and newspaper were either not used to convey information to households or not effective in reaching them.

Payment for the connection fee in instalments

One proven way to alleviate the burden of the connection fee is to allow for payment in instalments; this, at least in principle, should better meet the financial capabilities of low-income households. The purpose of this section is to understand why some households knew and took advantage of this opportunity whereas some households did not. We also look at how effectively this option was communicated to households and their understanding of rules regarding instalment payments.

⁹ For information of how the OBA subsidy specifically targeted the poor, please see the Supplemental Information section.

The resolution 2/2010 (Boletim da Republica de Mocambique, 2010b) implemented by the GoM in September 2010 allowed for payment of the connection fee in instalments, after a down payment of MZN650 (US\$17.90) when the connection is put in place and the payment of a first instalment of MZN100 (US\$2.80). The total sum to be paid for the connection fee when choosing to pay in instalments was MZN2000 (US\$55); no official additional fees or interest payments were included that would raise the total cost of the connection. The GoM resolution also established that households should not be requested to pay more than MZN100 (US\$2.80) per month, and that payment of the connection needed to happen over 13 months. The legislation did not provide details as to the possibility of paying over a shorter period of time if households wanted.

Perhaps unexpectedly, approximately half (48%, N = 119/248)¹⁰ of AdeM households with a new connection chose to pay for a connection all at once; 46% chose to pay in instalments and 6% did not know how they paid. Among the AdeM households that paid all at once (N = 119), the majority (37.8%) reported doing so because had sufficient money and wanted to only make one payment. Another 27.7% (N = 84) mentioned that they preferred not to have debts with the water provider. Of the respondents that made a single payment for a connection with AdeM, however, 31.1% were not aware that they had an alternative, suggesting that a significant proportion of households did not know about the option of paying in instalments and that further outreach efforts may have resulted in a higher percentage of households choosing that option. We compared the socio-economic characteristics and education of households that thought they had no option but to pay at once with households that paid at once for other reasons, and found no significant differences between the two groups (calculations not shown).

Of the 46% (115/248) of newly connected households that decided to pay in instalments, many households reported paying significantly higher amounts over a much shorter period than the 13-month maximum set by legislation. For those who reported a value (N = 77/115), 52% reported that they paid all the instalments within two months, 18% paid within three months and 10% within four months. One-third of households (38/115) responded "don't know" when asked in how many months they paid all the instalments. The average self-reported instalment payment was MZN724 (US\$19.90; median 500, N = 77), which was more than seven times higher than the MZN100 (US\$2.80) per month defined by the resolution. Such large variations in the amount paid per instalment and in the difference between the amount defined by the resolution and what households actually reported paying are perhaps not surprising given the limited knowledge of the rules and methods of payment among households that chose to pay in instalments. The seeming preference for higher instalment payments over a shorter period of time could reflect the fact that even households that chose to pay in instalments still preferred to pay off their debt to the water utility as quickly as possible. Other explanations for the variation could include that the person interviewed did not manage the household's finances, had still not decided in how many months to pay, or was not fully aware of how much was still owed to the water utility. Interestingly, this data suggests that households (and the water utility) found customised solutions that better met households' payment preferences.

Households that took advantage of paying in instalments (N = 115, 46%) were asked how they learned about the instalment option. The highest percentage of households reported that they asked AdeM (40.9%); the next-largest group said they asked local authorities (24.3%), 19.1% said they learned about the instalment option through AdeM visits to their home, 11.3% through visits by authorities, and 7.8% through meetings. It is expected that socio-economic factors would have influenced a household's decision to pay in instalments and that poorer households would be more likely to take advantage of this option; surprisingly, however, the association between wealth and paying in instalments is not strong. Comparing those who paid and did not pay in instalments, we find no significant differences across socio-

¹⁰ N = 248 is used for this analysis; this is the group of newly connected AdeM households whose members reported both that they were obtaining their connection themselves and that they had paid a connection fee.

economic indicators including education, the average number of neighbourhood groups participated in, household assets, or type of house construction.

Differences in characteristics between households which benefitted from the reforms and those that did not

Despite the positive impact of the pro-poor reforms on the number of on-site connections, and the increase in connections among poorer households between 2010 and 2012, the poorest households in the sampled neighbourhoods had yet to obtain a connection by the end of that period; indeed, by the time of the follow-up survey a third of the households (N = 422) in the study neighbourhoods did not yet have a private connection.

Overall, households living in the study neighbourhoods were characterised by relative demographic stability (most of the population had lived in their neighbourhood for more than 20 years) and widespread poverty. Most households in the sample were subsisting on less than US\$2 per capita per day, with an average daily per capita expenditure of US\$1.64 per day (median: US\$1.50/day). This was well below the average expenditure for the city of Maputo at the time, which was reported to be US\$2.57 per capita per day (INE, 2010a).

Table 3 compares the socio-economic characteristics of households that obtained a private connection between 2010 and 2012 (that is, newly connected households) with households that had a private connection before 2010 and households that did not have a private connection on their premises at the time of the follow-up survey (that is, unconnected households). As expected, comparing the newly connected households with those that were connected before 2010, we find that newly connected households were poorer on average; they were significantly less likely to own their house, less likely to have at least one member with secondary education or to have improved sanitation, and less likely to own a fridge, car or cell phone. Newly connected households also had significantly lower average expenditures and income, both monthly and per capita (Table 3).

Similarly, and in line with expectations, socio-economic indicators suggest that households that remained unconnected in 2012 were poorer on average. Comparing them with newly connected households revealed that unconnected households had lower monthly expenditures, although the difference in per capita expenditure was not statistically significant. Unconnected households were found to be significantly less likely to own their house, a fridge, a car or a cell phone, or to have improved sanitation or electricity.

Why did a large share of households remain unconnected?

A third of the households (N = 422) in the study neighbourhoods did not have a private connection at the time of the follow-up survey despite all the policies that were aimed at facilitating connections. This section investigates the specific reasons – beyond economic status – for this failure of uptake. The majority of households that did not have a private connection at the time of the follow-up survey (68%, N = 288) had not attempted to obtain one, and they were asked why they had not tried to get a connection. The most frequently cited reasons included the high connection fee (38.1%), the high cost of water (18.5%), and uncertainty about the process for getting the connection (15.7%). Such results suggest that for a significant share of unconnected households, either 1) the connection fee was still too high even once reforms had substantially reduced its cost, 2) they were not aware of the actual cost of a connection and/or did not know about the possibility of benefitting from an OBA subsidy, or 3) they would have been able to pay the amount but did not know what the payment process was. A possible fourth reason is that they were not interested in obtaining a connection, for example if they were renters.

Table 3. Socio-economic characteristics by connection status, N = 1257.

	Unconnected (N = 422)		New private connection user (N = 295)		Old private connection user (N = 540)	
	Mean (SD)	Median	Mean (SD)	Median	Mean (SD)	Median
Number of members of the household	6.0* (3.22)	5.00	6.5 (3.1)	6	6.5 (2.8)	6
Own their house (%)	87.4%*** (0.33)	-	94.6% (0.23)	-	98.5%* (0.12)	-
Have lived in the neighbourhood for at least 20 years (%)	70.5% (0.46)	-	73.9% (0.44)	-	80.0% (0.40)	-
At least one family member with primary school education (%)	92.9% (0.26)	-	92.5% (0.26)	-	94.1% (0.24)	-
At least one family member with secondary school education (%)	48.6% (0.50)	-	52.5% (0.50)	-	62.6%** (0.48)	-
Have improved sanitation (%)	61.6%*** (0.49)	-	83.1% (0.38)	-	91.5%*** (0.28)	-
Have electricity (%)	88.2%*** (0.32)	-	96.9% (0.17)	-	99.6%** (0.06)	-
Own a fridge (%)	49.2%*** (0.50)	-	75.1% (0.43)	-	90.4%*** (0.30)	-
Own a car (%)	5.5%*** (0.23)	-	13.3% (0.34)	-	23.7%*** (0.42)	-
Own a cell phone (%)	93.3%*** (0.25)	-	98.0% (0.14)	-	98.1% (0.13)	-
Total monthly expenditure (MZN)	8332.8** (3910)	7915.7	9355.2 (5093)	8521.2	11120.5*** (6595)	9793.3
Total monthly expenditure (US\$)	305.0** (143.1)	289.7	342.4 (186.4)	311.9	407.0*** (241.4)	358.4
Total monthly income (MZN)	7327.8 (9836)	4500.0	8517.9 (10489)	6250.0	12108.9*** (15059)	6250
Total monthly income (US\$)	268.2 (360.0)	164.7	311.8 (383.90)	228.8	443.2*** (551.2)	228.9
Per capita daily expenditure (US\$)	2.12 (2.02)	1.74	2.14 (1.88)	1.73	2.46*** (1.84)	1.95
Per capita daily income (US\$)	2.13 (6.90)	1.08	2.06 (3.59)	1.12	2.66*** (3.82)	1.53

Note: Natural log transformations of income and expenditure variables were used for t-tests; 'household' in our survey refers to those who dwell under the same roof and share meals; statistically significant difference in means, as measured from reference group (new private connection users) t-test: *** = $p < 0.01$; ** = $p < 0.05$; * = $p < 0.10$.

Unconnected households which had never had a connection were asked about the maximum amount they were willing to pay to have one. The average reported maximum willingness to pay (WTP) accorded with this assumption that for many households the connection fee was still too high even once reforms had substantially reduced its cost; the mean and median were MZN1337 (US\$36.70) and MZN1000 (US\$27.50) respectively. It is important to note, however, that the WTP of a significant percentage of unconnected households (28.3%; N = 107/380) was MZN2000 (US\$55) or more, confirming that a significant fraction of unconnected households experienced barriers to connection other than connection fees.

One possible barrier is the lack of accurate knowledge about the cost of an on-site connection. To determine if these unconnected households had accurate knowledge of the connection fee, we asked members of households that had never had a connection from the water utility (N = 380) how much they thought it would cost to obtain a private connection from AdeM. About 30% (N = 113) did not know and, for the remaining households that answered the question (N = 267), the average perceived cost was MZN2731 (US\$75; median of MZN2500), which is well above the actual figure of MZN2000 (US\$55). Only 28% of the households responded that they thought it would cost MZN2000 (US\$55), which is the exact cost of a non-subsidised connection after the reforms. This suggests that about 70% of the unconnected households could have benefitted from better clarification of the exact price of connection.

Misinformation and misperception about the cost of connection were also combined with unconnected households' limited knowledge of the option of paying in instalments for the connection fee. Only 30.5% (115/380) were aware of this option, and talking to neighbours (50%) and family members (13.8%) were the most commonly mentioned ways in which households learned about this opportunity. Even among the one-third of households that were aware of this option, understanding of how the instalment plan worked was limited. The majority (58%, 67/115) did not know the number of instalments over which they would be required to pay the connection fee and only 25% of the households that knew about the instalment option thought they would be able to define the number of instalments in which they would pay.

Among those who attempted to get a connection but failed (22%, N = 94), the connection fee was the most commonly mentioned obstacle in the connection process (30.9%), followed by the waiting time (18.1%).

Finally, unconnected households were asked whether they were aware of a connection campaign implemented by AdeM in their own or another neighbourhood, and only 28.6% of the households were aware that AdeM had implemented a campaign.

All in all, this suggests that while the high fee played a role in preventing some households from connecting, the lack of knowledge about the instalment option, the process itself, or the AdeM connection campaigns may also have been reasons why these households did not connect. This suggests that if the water utility and local authorities had invested more in improved communication, the reforms may have benefitted a larger number of households.

THE EFFECTS OF THE REFORMS ON MAPUTO'S WATER UTILITY

In the second half of the 2000s, three factors played a fundamental role in creating demand for pro-poor water reforms and broad support among sector institutions for these reforms; ultimately, the reforms enabled a large increase in the number of domestic connections. The first factor was the lack of success of the delegated management framework in the GMA. It particularly failed to increase the number of connections, and coverage via domestic private connections was only 32% in 2009. Over the first ten years of its contract – 1999 to 2009 – the AdeM performed quite poorly; by 2009, it had high levels (50%) of non-revenue water (CRA, 2010), planned improvements of the water supply systems such as investments and repairs had not been made, and operating revenues were lower than had been

projected. While the CRA had approved a tariff increase at the end of 2009, sector stakeholders understood that the financial sustainability of AdeM – and consequently of FIPAG, whose revenues depend on regular payments by AdeM – could not be guaranteed without a significant increase in the number of connections (ibid).

The second factor was that the Government of Mozambique – which is highly dependent on donor financing in all sectors – was under strong pressure from international donors to achieve the Millennium Development Goals (MDGs), including those for the water sector. Such pressures culminated in 2010 with the unveiling by the GoM of its five-year plan for 2010 to 2014. The plan was specifically designed to increase urban water coverage to 70% and thus achieve the MDGs. To achieve this level of coverage in urban areas, within five years private connections had to increase by 92,000 and standpipes by 1300 (Governo da Republica de Mocambique, 2010). The government's commitment was matched by important donor investments in network expansions that specifically targeted the poor. Infrastructure projects that included 1000 km of new distribution pipes, a new water treatment station, and five new distribution centres were concluded in 2010 (CRA, 2011). The Global Partnership for Output-Based Aid (GPOBA) project financed 30,000 connections between 2007 and 2014 and the Water & Sanitation for the Urban Poor project financed the same number between 2007 and 2011; in 2013, as part of the World Bank's Greater Maputo Water Supply Expansion Project, US\$27 million was also set aside for installing 100,000 new connections and associated meters. In the same year, US\$27 million was made available for the expansion of water networks by the Government of the Netherlands via the Agency for Infrastructure Development (ORIO) and US\$47 million was contributed by the Agence Française de Développement (AFD).

The third factor that created support for pro-poor reforms was the realisation that expanding coverage in peri-urban and poor areas required the letting go of "business-as-usual" approaches (key informant interview) and the adoption of new methods. Hence, with the support of international donors, CRA and FIPAG began several projects and studies to prepare and support sector institutions to make these changes in management approach. One of the policy approaches that CRA and other donors were particularly keen on was the reduction of the connection fee; they were aware that this was an important barrier to connection and that the connection fee was high compared to that of other water utilities in SSA (key informant interviews). They began to specifically study the possibility of reducing the connection fee from MZN4300 (US\$60) to MZN2000 (US\$28). Meanwhile, in 2007, the World Bank and FIPAG negotiated an OBA project to reduce the connection fee for a selected number of poor households in Maputo (Global Partnership for Output-Based Aid, 2007). In 2008, the CRA started looking at alternative approaches to improving water access that did not rely on network extension, including the legalisation of water resale and the formalisation of private network operators (Evans et al., 2008). In 2009, Water & Sanitation for the Urban Poor and AdeM started the Tchemulane Project in three peri-urban neighbourhoods to allow households with illegal water connections to legalise them and households without connections to obtain one and pay for it in three instalments (Water & Sanitation for the Urban Poor, 2011).

The political opportunity to jump-start a reform process on a wider scale, however, came only in 2010; it was the result of a larger political crisis that culminated in widespread riots in Maputo. On 1 September 2010, violent protests erupted in Maputo following a 30% price increase in the cost of bread, and an increase in the cost of fuel which affected fares that were being charged by informal transport operators. The riots prompted the Council of Ministers, under the leadership of the Minister of Public Works and Housing, to approve the reduction of the connection fee to MZN2000 (US\$55) for *all* households on 7 September 2010, just six days after the riots started (Boletim da Republica de Moçambique, 2010b). As explained in the resolution, such a reduction is "a specific measure to reduce costs of living for the population" (ibid). As many key informants reported, such a swift decision to lower the connection fee was only possible because the water sector was "ready" for it after the sector discussions that had occurred in the second half of the 2000s. It is worth noting, however, that many sector stakeholders

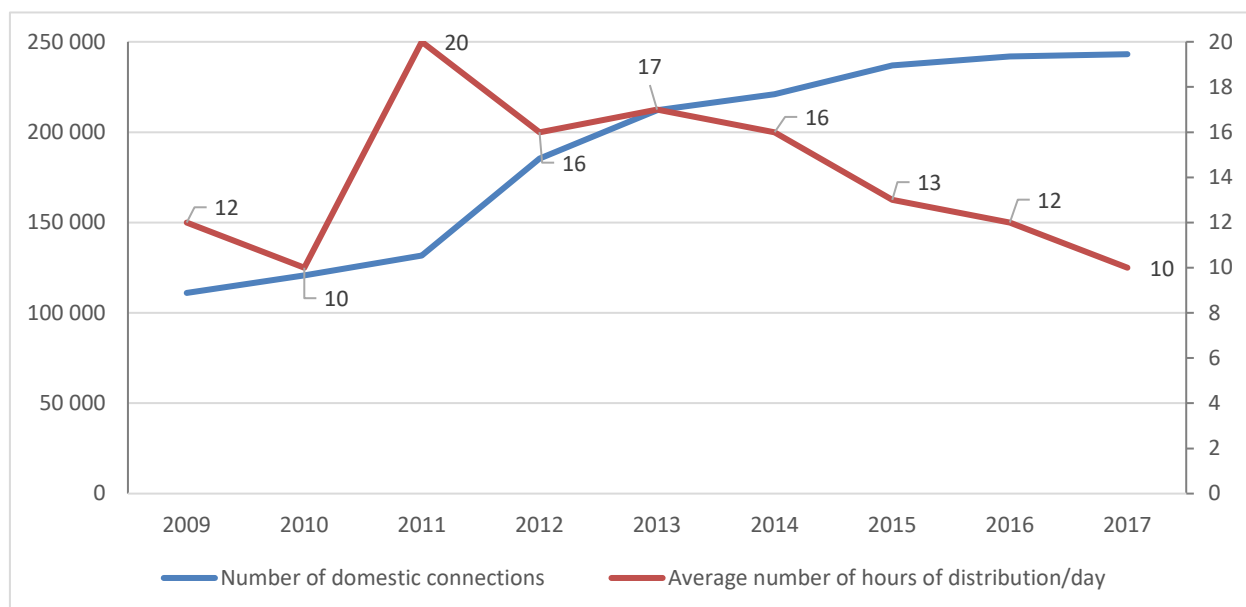
opposed the untargeted nature of the subsidy that had been approved by the Council of Ministers and were left scrambling to find the financial resources to pay for such a subsidy.

On 27 October 2010, the CRA approved a resolution (Boletim da República de Moçambique, 2010a) instituting a special tariff of MZN100/m³ (US\$2.80/m³) to be paid by ships that docked and bought water in the port of Maputo. This tariff was supposed to bring the price of water charged to ships closer to international standards, and revenues from this tariff were expected to cover the costs of the private connection subsidy; as explained in the next section, however, this never materialised. Ultimately, the rapid increase in the number of connections resulted in a decrease in the quality of service and even more financial challenges to the system.

Decrease in service quality

As the number of private connections increased in Maputo, the utility's quality of service – as measured by the average number of hours of distribution available – started to decrease significantly for most (including the wealthiest) consumers. In 2017, the average number of hours of water distribution was as low as 10 hours per day, half of what had been available in 2011 after the 2010 increase in the utility's capacity (Figure 3). Given that this indicator is calculated as the average number of hours of distribution per day by all the distribution centres of the GMA (CRA, 2011, 2016), it further overestimates the number of hours that certain consumers receive, especially when they are not in the proximity of the distribution centres (key informant interviews). Indeed, the CRA reported that service has been highly unequal among and within neighbourhoods, with as many as 38 of 54 neighbourhoods in the GMA classified as critical in 2015, that is, receiving less than four hours of service per day (CRA, 2016).

Figure 3. Relationship between domestic connection increase and number of hours of distribution (hours/day), 2009-2017.



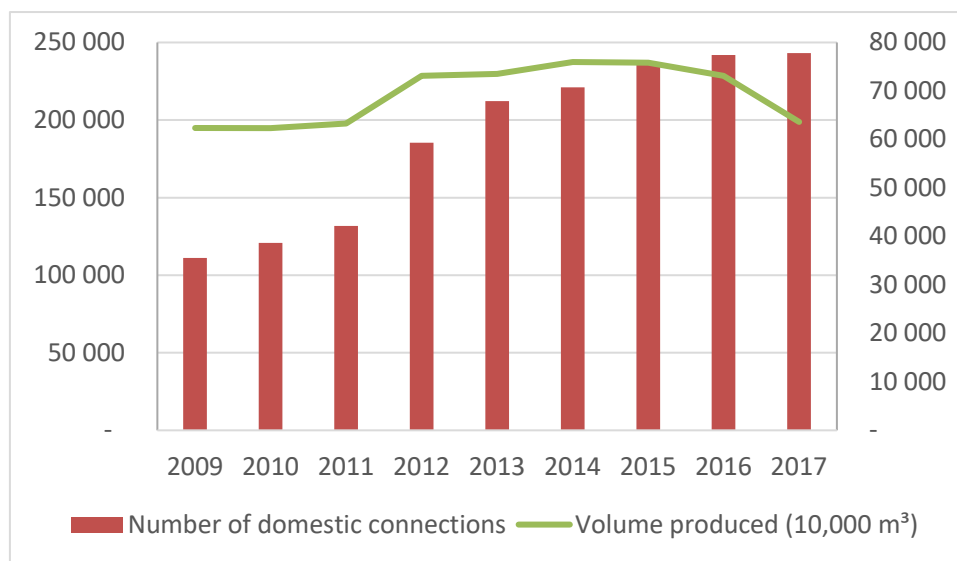
Source: CRA (2010, 2011, 2012, 2013, 2014b, 2014a, 2016, 2017).

Key sector stakeholders report that the decline in quality of service was unsurprising for several reasons. First, given the pressure to rapidly increase coverage to achieve the MDGs by 2015, FIPAG and donors prioritised coverage expansion over service quality. This politically driven prioritisation was also reflected in the way AdeM began rewarding its staff. Inspired by a study tour of Manila, AdeM management

reorganised its staff into five 'operational areas', each one responsible for an area of the GMA water distribution system. Performance of the different operational areas was compared regularly, and staff in better-performing operational areas – as measured by the number of new connections – were rewarded with financial and fringe benefits (key informant interview).

The second reason that it was not surprising that a decrease in service accompanied the rise in the number of domestic connections after 2009 (and particularly after 2011), was that the volume of water produced and distributed was essentially constant between 2012 and 2015, after which it started to decrease (Figure 4).

Figure 4. Increase in domestic connections and water availability as measured by the volume produced per day.



Source: CRA (2010, 2011, 2012, 2013, 2014b, 2014a, 2016, 2017).

At the time, limited water availability was a well-known problem in Maputo among sector stakeholders. Many, including the influential and visionary president of the CRA at the time, whose work was inspired by the motto 'Water for All', felt that it was a worthwhile trade-off to increase access at the expense of service quality; indeed, the then President of the CRA recalls having thought that, "it is better to have equality in misery [than inequality]", meaning, in other words, that it was better to have a larger share of Maputo's population connected to the water network, even with limited per capita water availability, than to have only a few households connected to the utility network. Sector stakeholders expected that the trade-off was going to be temporary as they believed that it would be addressed by the Corumana Dam.

What was not expected by sector stakeholders, however, was the time it would take to address these water quantity issues. In early 2011, FIPAG signed a memorandum of understanding with the South Regional Water Management Authority (Administração Regional de Águas do Sul, or ARA-Sul), guaranteeing the near-term supply of 60,000 m³/day of raw water from the Corumana Dam; an additional supply of 60,000 m³/day of water from the dam was expected by 2015, for a total daily amount of 120,000 m³ (World Bank, 2013b). By May 2019, however, the World Bank-financed works – which were needed for just the first 60,000 m³/day of promised raw water – had yet to be completed. The delay was caused by complications in the procurement process and by FIPAG's limited experience with implementing water resource projects (key informant interviews). Indeed, this water resource project was markedly different

from the typical network or capacity expansion projects that FIPAG had previously managed (key informant interview).

In an effort to rapidly meet current and future demands, the GoM also took a loan from the Government of Brazil (through the Brazilian National Bank for Economic and Social Development, or BNDES) to build a second dam, the Moamba-Major Dam, also on the Incomati River. The construction of the dam started in November 2014; however, due to a corruption scandal involving the Brazilian company that was responsible for the construction of the dam, work was halted in October 2016, and with the halting of the dam's construction BNDES funding was also cut. As of May 2019, construction is yet to resume (World Bank, 2013b).

These delays, combined with a drought which the National Meteorology Institute believes to have been caused by El Niño, greatly reduced water availability in the GMA starting in 2015. In 2017, water levels on the Umbeluzi River at the intake of the Pequenos Libombo Dam fell to as low as 14% of the total dam capacity (AIM, 2017); this heavily affected all households, particularly those in neighbourhoods that were further from water distribution centres. Water restrictions have been in place since April 2016.

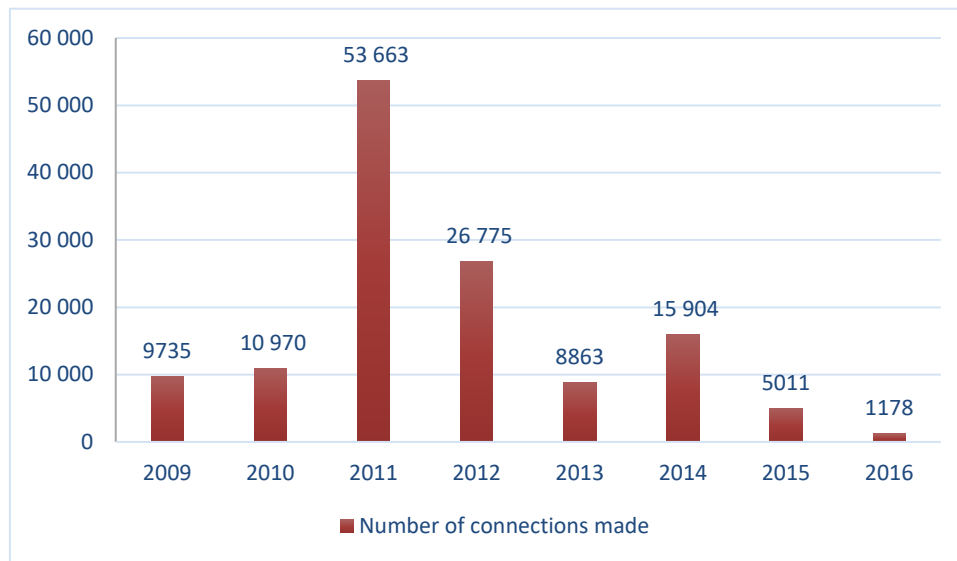
Besides the limited availability of water, the haphazard manner by which these networks were expanded also affected service quality. As explained by several key informants, expansion was "not well-planned", and no hydraulic modelling was done to estimate the impact of such a large increase on the overall system; furthermore, the number of connections increased well beyond what was technically feasible for the system to support, given the constraints on water supply, system hydraulics and distribution centre capacities. As explained by several AdeM engineers (former and current), "we had distribution centers that were planned to serve 5000 connections that ended up serving 40,000 (...). [I]t was a network expanding in all directions". This left many consumers located too far from the distribution centre and thus unable to receive water with sufficient pressure (key informant interviews). Although AdeM was supposed to only connect households located less than 25 metres from the main network, they connected households much further away, which put a significant strain on the system.

Challenges to the financial sustainability of the water system

Increasing the number of clients was expected to increase the financial sustainability of the water utility. As such, in 2010 the utility started to rapidly increase the number of connections; as shown in Figure 5, the number of new connections per year went from 9735 in 2010 to 53,663 in 2011 (a fivefold increase) and increased by a further 26,775 in 2012. The rate of increase, however, began to slow substantially from 2013 onwards (we will expand on the reasons for this below). Contrary to initial predictions, not only did the high number of new private connections not increase the financial sustainability of the water utility, it further decreased it for two reasons.

First, such a large increase in the number of domestic connections was not accompanied by a proportionate increase in the utility's ability to operate in peri-urban areas. While the utility speeded up the connection process considerably from 2010, many of the new consumers could not be located for various reasons, including the lack of a valid address in the system, or having an illegal connection (which, a key informant from AdeM told us, would have come from AdeM), or the consumer having been suspended for other infractions. Between 2010 and 2013, less than 70% of consumers were receiving water bills based on their actual consumption (CRA, 2011, 2012, 2013, 2014b) and non-revenue water increased from 50% in 2009 to 55% in 2011.

Figure 5. Number of new domestic private connections per year, 2009-2016.



Source: CRA (2010, 2011, 2012, 2013, 2014b, 2014a, 2016, 2017).

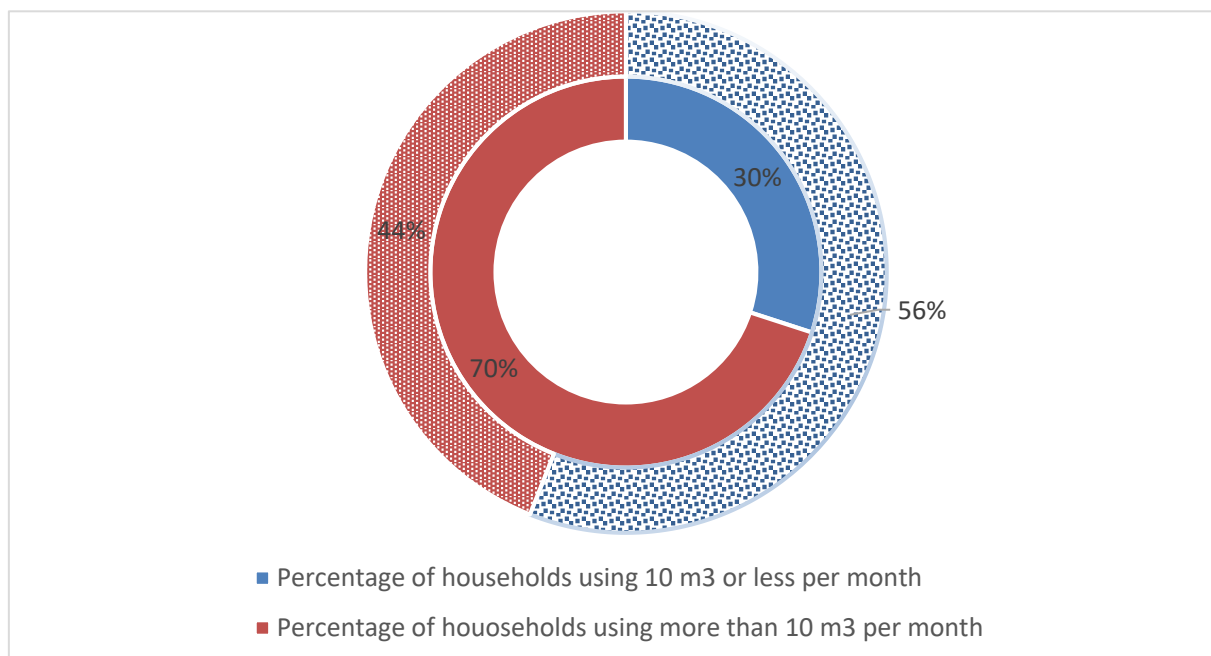
In 2013, in response to these challenges, the newly appointed AdeM president decided to slow down the number of new connections per year; this is reflected in the drop in new connections from 53,663 in 2011 and 26,775 in 2012, to only 8,863 in 2013 (Figure 5). An AdeM official explained that by 2013, "[AdeM] had 3000 km of network (...) [which was] expanding in all directions (...) [and was] three times as much as AdeM had before the expansion started". More notably, he added that, "[AdeM] had lost control of the system". The water utility challenges at that time are also clearly shown by our 2012 survey data, which found that 71.5% (208/291) of AdeM consumer households who showed us their bill had a debt with the water utility and that, of these (N = 208), the average debt was MZN2558 (US\$93.7) (the median was MZN1426 [US\$52.2]).¹¹ Furthermore, in the study neighbourhoods all respondents were asked if within the past year they had complained about water services either directly to the water utility or to field personnel or meter readers; almost half of the respondent (43.2%, N = 284) reported filing at least one complaint in the past year. The top three reasons for complaining related to billing problems; 53.5% mentioned that the value of bills was wrong, 26.8% said that bills did not reflect prior payments made, 15% complained that they did not receive bills or that they were arriving late. While this data may not be representative of all neighbourhoods of Maputo, it provides a sense of the extent of the challenges faced by the utility at the time.

As part of the efforts to address these commercial and financial challenges, AdeM's president decided to 'clean house' by putting together a database of consumers to better track non-revenue water, reduce unaccounted-for water, and reduce consumers' debts. This process started in 2013 and is still ongoing. According to key informant interviews, as of June 2019, about 50,000 clients have still not been accounted for. Non-revenue water dropped in 2013 and has remained close to 50% since. As part of this process to improve commercial viability, AdeM is experimenting with alternative arrangements to reduce non-revenue water; in 2018, it contracted ten community-based organisations to perform meter readings, deliver bills, reduce water leakage, and encourage consumers in some peri-urban neighbourhoods to pay their bills promptly. It is expected that these arrangements will improve AdeM's financial efficiency and performance (key informant interview).

¹¹ 2012 exchange rates were used in this case, that is, US\$1 = MZN27.3.

In addition to the large increase in the number of consumers, another reason for the financial challenge for the utility was the steep increase in water prices for households consuming more than 10 m³ of water per month in 2010. In the words of the utility's then water regulator, the increase in domestic connections coupled with the reduction in the number of larger-quantity consumers resulted in "the death of the cross-subsidy". The increasing block tariff imposed in the GMA was designed to ensure that consumers with higher consumption patterns subsidised lower-consuming – and thus supposedly poorer – customers who fell into the first tier of the increasing block tariff. In 2005, the price paid by households consuming less than 10 m³ of water per month was subsidised, such that these households only paid an average of about 70% of the cost; this cross-subsidy was financed through the higher price paid by households consuming more than 10 m³ of water per month, which mainly targeted larger consumers and industrial users. As shown in Figure 6, in 2005, about 70% of the AdeM domestic consumer base (90,000 consumers) used more than 10 m³ per month and only 30% consumed less.

Figure 6. Percentage of households using more or less than 10 m³ per month in 2005 (inner circle) and 2015 (outer circle).



Source: Figure adapted from CRA (2014a).

In 2013, this situation was reversed; at that point, only a slight majority of consumers (56% of the 220,000) used more than 10 m³ of water per month and the remaining 44% consumed less than that. This change in high-consuming customers can be attributed to both the large number of low-income households that gained access to the network because of the pro-poor reforms and the steep tariff for those consuming 10 m³ of water or more. From 2013 onwards, these changes greatly jeopardised the viability of the cross-subsidy as there were too few large consumers to supplement the large population of smaller consumers (those who consumed 5 m³ or less).

It is worth noting that key sector stakeholders – including the water regulator – largely anticipated this problem. There was a plan in place to address this financial shortfall; it included a special tariff for ships and private tankers and cross-subsidizing domestic consumption by using revenues from water sold to industrial and commercial activities. This plan, however, did not work as intended. Resolution 3, which was passed in 2010 (Boletim da Republica de Mocambique, 2010a), established a special tariff to be

applied to ships buying water in the port of Maputo and to tanker trucks delivering water for non-domestic consumption. This tariff was meant to make up the financial shortfall, however influential private individuals with strong political connections managed to retain control of sales of water to ships, effectively bypassing AdeM (key informant interview) and nullifying the predicted revenues from these sources. Second, the GoM expected new industries and businesses to locate along the Maputo/Moamba corridor - the area that was going to benefit from Corumana Dam's enhanced capacity - and consequently projected a growth of water demand and revenues for the water utility; such an increase in revenue would have allowed the cross-subsidisation of domestic consumption in the GMA. However, the delay in the completion of the dam and the impact of the 2016 economic crisis resulted in lower-than-expected revenues from commercial and industrial activities in the corridor.

The inability to cross-subsidise domestic consumption with commerce and industry ultimately prompted the ongoing sector discussions to review the existing tariff structure and establish alternative mechanisms (CRA, 2014a; key informants interviews). Studies conducted by the CRA show that the current tariff level, even in the lowest blocks, matches the current willingness and ability of low-income households to pay (CRA, 2014b). These studies therefore show that raising domestic tariffs in higher blocks hurts low and middle-income households and reduces middle-class water consumption, ultimately challenging the financial viability of the overall tariff structure.

Unless further measures are employed to ensure the financial sustainability of the subsidy, AdeM will not be able to afford the cost of providing for households most in need (CRA, 2014a). One such measure implemented by the CRA in 2016 was the decision to preserve the connection subsidy only for households that had access to a yard tap, thus excluding those households with piped connection inside their premises (key informant interviews). Among other measures now being considered is the creation of a solidarity fund to be financed by revenues from the value added tax on current consumers' water supply costs.

Overall, these findings illustrate the financial constraints on the provision of water to cities where the majority of the population connected to the water network is poor and consumes relatively little water. These results contribute to a growing body of literature that looks at the relationship between cost recovery and coverage increase and examines the conflict between financial and social objectives (Bakker et al., 2008; Ballance and Trémolet, 2005; Banerjee et al., 2008; Dagdeviren, 2008; Herrera, 2019; Jaglin, 2002; Kemendi and Tutusaus, 2018; Marson and Savin, 2015; Mbuvi et al., 2012; Rusca and Schwartz, 2018; Schwartz et al., 2017). As demonstrated by Berg et al.'s (2010) modelling of Kampala, in the GMA the combination of a social tariff, low consumption, and bill collection risks in lower-income areas make expanding services to these areas financially unattractive.

In Mozambique, ambitious political commitments were made without first ensuring the capacity of utility providers to deliver; this has severely impacted the ability of the utility to provide to its inflated customer base. In wake of the 2010 reforms, the Mozambican government has been considering outsourcing water to private operators to fill this gap. As a top official explained candidly, "[I]t will take time for the utility to service all, and we don't have enough water at least for some years to come". He also added that, "[W]ithout private operators, we are not going to meet the SDGs". The case of Mozambique serves as a cautionary tale to other developing nations that are struggling to meet the SDGs: commitment to water reforms must always proceed alongside an equal commitment to supporting the systems that carry out these reforms.

CONCLUSIONS

In sub-Saharan Africa, coverage of piped water access to private homes is the lowest of all the SDG regions and is declining; in 2017, only 56% of the urban population in SSA had access to piped water on their premises (WHO/UNICEF, 2019). Access to improved water supply is also highly unequal, with large

differences between the poorest and richest quintiles in the percentage of households with access to basic water services.

Among the reasons for this slow rate of increase in coverage of piped water access are the financial, political, technical and organisational challenges that it presents for many of the continent's utility providers. A further possible reason for the failure to increase connections more rapidly is the inability or unwillingness of households to obtain a connection because of the cost of the one-time connection fee, which is often well above what poor households can afford to pay.

This paper focuses on understanding the impact of the pro-poor water reforms that were implemented between 2010 and 2019 in the Greater Maputo Area (GMA), Mozambique. The paper attempts specifically to understand how a connection campaign, the reduction of the connection fee, and the option of paying the fee in instalments benefitted households. While our data did not allow for isolation of the impact of the reduced connection fee, we found that a combination of this reduction with the 'connect now and pay later' campaign resulted in a large increase in water connections. It allowed for the number of connections to increase by about 91,000 in only two years (between 2010 and 2012) – going from 120,000 to 212,000 connections overall in the GMA – and by 40%, on average, among interviewed households.

About 80% of the survey households that had a piped water connection had received the connection before paying AdeM for it; this suggests that the 'connect now and pay later' campaign that was promoted by the water utility had played an undeniable role in the increase in water connections. The impact of the 'connect now and pay later' campaign should, however, be studied further; while we suspect that in this case the campaign played an important role in rapidly meeting demand and building trust for the water utility, there could be longer-term impacts of such a campaign on the water utility. In 2019, it had about 50,000 clients that they could not locate and, while we do not know how many of these clients had become connected during these campaigns, it is possible that the campaigns generated an incomplete and inaccurate client base; this could have resulted in high non-revenue water, as meter readings could not be completed for anonymous clients and thus water consumption can only be estimated for this group. Technology could have played a bigger role in speeding up consumers' registration and payment to prevent such an issue.

The increase in the number of connections occurred even though most of the households did not opt to pay in instalments, either because they preferred not to be indebted to the water utility or did not know about that option. The poorest households, at least in our studied neighbourhoods, were still not connected by 2012, for reasons which included lack of knowledge of the reduced connection fee, the high cost of the connection fee and of water, and/or lack of understanding of the connection process. These results suggest that more targeted communication to poor households about the actual price of a connection, the instalment option, and the connection process may have resulted in higher overall uptake.

The policy reforms had clear benefits for previously unconnected consumers who were in the habit of relying on neighbours or standpipes for water; the policy also had its drawbacks, however, in terms of increasing strain on an already water-stressed utility. The rapid increase in the number of connections also caused reduced service quality and fewer hours of water availability in all neighbourhoods. It should also be noted that different neighbourhoods experienced these new constraints to different extents. This illustrates a post-policy trade-off between service quality and the number of water clients served, especially in the early stages of its implementation, given that the utility did not increase its capacity to meet this demand. The increase in domestic connections largely among low-income and relatively low-consuming customers also posed a major financial challenge for the sustainability of the system; high-consuming users, commercial activities and industry did not cross-subsidise low-consuming and low-income customers. These results are consistent with findings from other authors and emphasise that

social and financial goals cannot be achieved in tandem. This requires important discussions that extend beyond the case of Mozambique.

The Sustainable Development Goal of 'expanded water services to all' stimulated important discussions about how such a goal can be operationalised in contexts where unconnected households are poor and where already connected households are often only marginally wealthier.

More importantly, the results of this paper builds on existing literature on the limited ability of tariffs to enhance water access for the poor (Fuente et al., 2016); they show that, in fact, tariffs have a limited potential for achieving redistribution in systems where high-consuming households are scarce. Furthermore, the friction produced by the drastic increase in connections and the inability of Mozambique's water utility to cater to the new demand for water should serve as a cautionary tale for other governments. Mozambique's story illustrates how a government's commitment to water reforms must be matched by robust measurements which empower their water institutions to fulfill and support these reforms. This paper's authors also encourage the identification of alternative mechanisms (and the launching of pilot projects) for meeting the SDG targets of universal and equitable access to safe and affordable drinking water by 2030.

ACKNOWLEDGEMENT

Funding for this work was provided by the Woods Institute for the Environment, Stanford University, Water & Sanitation for the Urban Poor, the World Bank, and Yale-NUS College. We want to express our gratitude to all households and key informants, who provided critical insights into the history of water reforms in Mozambique in the last 10 years. We also want to thank Manuel Alvarinho, for his guidance to this research and for having spent many hours with one of the authors (VZ) to explain the rationale of many decisions taken. We thank Prof. Jenna Davis and Len Ortolano at Stanford University for their advice and support, the enumerator teams that surveyed in 2010 and 2012, the field coordinator Orlando Matendjua, Odete Muximpua, Clara dos Santos Dimene, and the following members of the research team: Anne Thebo, Kory Russell, and Julienne Baptista. At Yale-NUS College, we would like to thank Prof. Jeannette Ickovics for her advice and encouragement. Rachel Juay's help was invaluable to take the paper over the finishing line. We are also grateful to our anonymous reviewers, whose comments allowed to improve the manuscript substantially.

BIBLIOGRAPHY

- African Development Bank. 2010. Guidelines for user fees and cost recovery for urban, networked water and sanitation delivery. Tunis, Tunisia: African Development Bank.
- AIM. (2017). Water level in Umbeluzi river remains critically low – AIM report. Club of Mozambique. <https://clubofmozambique.com/news/water-level-umbeluzi-river-remains-critically-low-aim-report/> (accessed 13 November 2020)
- Cordoba, L; Thibert, C.; Danilenko, M.D.; Andres, A.V.; Borja-Vega, L.A. and George, C.J. 2019. Doing more with less: Smarter subsidies for water supply and sanitation. Washington, DC: World Bank. <http://documents.worldbank.org/curated/en/330841560517317845/Doing-More-with-Less-Smarter-Subsidies-for-Water-Supply-and-Sanitation> (accessed 13 November 2020)
- Bakker, K.; Kooy, M.; Shofiani, N. and Martijn, E. 2008. Governance failure: Rethinking the institutional dimensions of urban water supply to poor households. *World Development* 36(10): 1891–1915.
- Ballance, T. and Trémolet, S. 2005. Private sector participation in urban water supply in Sub-Saharan Africa. KfW Bankengruppe, Corporate Communication.
- Banerjee, S.; Foster, V.; Ying, Y.; Heather, S. and Quentin, W. 2010. *Cost recovery, equity, and efficiency in water tariffs evidence from African Utilities*. Africa Infrastructure Country Diagnostic, Working Paper No. 7. Washington, DC: World Bank.

- Banerjee, S.; Wodon, Q.; Diallo, A.; Pushak, T.; Uddin, H.; Tsimpo, C. and Foster, V. 2008. *Access, affordability, and alternatives: Modern infrastructure services in Africa*. Africa Infrastructure Country Diagnostic, Working Paper No. 2. Washington, DC: World Bank.
- Baron, C.; Greene, J.; Mader, P. and Morvant-roux, S. 2019. *Water-microcredit models and market inclusion: Shifting debts and responsibility*. IDS Working Paper (Issue 522). Brighton: Institute of Development Studies.
- Basani, M.; Isham, J. and Reilly, B. 2008. The determinants of water connection and water consumption: Empirical evidence from a Cambodian household survey. *World Development* 36(5): 953-968.
- Berg, S. and Mugisha, S. 2010. Pro-poor water service strategies in developing countries: prOmoting justice in Uganda's urban project. *Water Policy* 12(4): 589-601. <https://doi.org/10.3109/15368378209040332>
- Boakye-Ansah, A. S.; Schwartz, K. and Zwarteven, M. 2019. Unravelling pro-poor water services: What does it mean and why is so popular. *Journal of Water, Sanitation, and Hygiene for Development* 9(2): 187-197.
- Boletim da Republica de Moçambique. 1998a. Decreto n.o 72/98 de 23 de Dezembro. Institucionalização do Quadro de Gestão Delegada.
- Boletim da Republica de Moçambique. 1998b. Decreto n.o 73/98 de 23 de Dezembro. Criação do FIPAG – Fundo de Investimento e Património do Abastecimento de Água.
- Boletim da Republica de Moçambique. 1998c. Decreto n.o 74/98 de 23 de Dezembro. Criação do CRA – Conselho de Regulação do Abastecimento de Água.
- Boletim da Republica de Moçambique. 1998d. Resolução n.o 60/98 – Política Tarifária de Águas.
- Boletim da Republica de Moçambique. 2010a. Resolução n.o 3/2010 de 27 de Outubro – Introduz o Mecanismo de Compensação da Taxa das Ligações Domésticas.
- Boletim da Republica de Moçambique. 2010b. Resolução 2/2010 de 22 de Setembro – Taxa de Novas Ligações Domiciliárias.
- Chitonge, H. 2011. A decade of implementing water services reform in Zambia: Review of outcomes, challenges and opportunities. *Water Alternatives* 4(3): 1-22.
- Chitonge, H. 2013. Who will foot the bill? Water services infrastructure backlog in Sub-Saharan Africa. *Journal of African Studies and Development* 5(3): 41-56. <https://doi.org/10.5897/JASD13.001>
- Connors, G. 2005. When Utilities muddle through: Pro-poor governance in Bangalore's public water sector. *Environment and Urbanization* 17: 201-218. <https://doi.org/10.1177/095624780501700107>
- CRA (Conselho de Regulação de Águas – República de Moçambique). (2010). Relatório ao Governo 2009.
- CRA (Conselho de Regulação de Águas – República de Moçambique). (2011). Relatório Ao Governo 2010.
- CRA (Conselho de Regulação de Águas – República de Moçambique). (2012). Relatório ao Governo 2011.
- CRA (Conselho de Regulação de Águas – República de Moçambique). (2013). Relatório Ao Governo 2012.
- CRA (Conselho de Regulação de Águas – República de Moçambique). (2014a). 2009-2014 Retrospective Report. [www.cra.org.mz/pdf/Retrospective Report 2009-2014](http://www.cra.org.mz/pdf/Retrospective%20Report%202009-2014).
- CRA (Conselho de Regulação de Águas – República de Moçambique). (2014b). Relatório ao Governo 2013 (p. 124).
- CRA (Conselho de Regulação de Águas – República de Moçambique). (2016). Relatório Ao Governo 2015.
- CRA (Conselho de Regulação de Águas – República de Moçambique). (2017). Relatório de Desempenho 2016-2017.
- Dagdeviren, H. 2008. Waiting for miracles: The Commercialization of urban water services in Zambia. *Development and Cultural Change* 39(1): 110-121.
- Das, P. 2014. Women's participation in community-level water governance in urban India: The gap between motivation and ability. *World Development* 64: 206-218.
- Devoto, F.; Duflo, E.; Dupas, P.; Parienté, W. and Pons, V. 2012. Happiness on tap: Piped water adoption in urban Morocco. *American Economic Journal: Economic Policy* 4(4): 68-99. <https://doi.org/10.1257/pol.4.4.68>
- Dos Santos, S.; Adams, E.; Neville, G.; Wada, Y., de Sherbinin, A.; Mullin Bernhard, E. and Adamo, S.B. 2017. Urban growth and water access in sub-Saharan Africa: Progress, challenges, and emerging research directions. *Science of the Total Environment* 607-608: 497-508. <https://doi.org/10.1016/j.scitotenv.2017.06.157>
- Evans, B.; Thompson, G. and Trémolet, S. 2008. Support to the Water Regulatory Council in the development of regulatory tools for expanding access and providing services to the poor. , Maputo, MOPH, CRA, WSP/WB.

- Fuente, D.; Gatua, G.J.; Ikiara, M.; Kabubo-Mariara, J.; Mwara, M. and Whittington, D. 2016. Water and sanitation service delivery, pricing and the poor: An empirical estimate of subsidy incidence in Nairobi, Kenya. *Water Resources Research* 52: 4845-4862. <https://doi.org/10.1002/2015WR018375>.
- The Global Partnership for Output Based Aid. 2007. GPOBA Commitment Document Executive Summary: OBA for Coverage Expansion in the Mozambique Water Sector. <http://documents1.worldbank.org/curated/en/312711468111247533/pdf/492960PAD0GPOB101Official0Use0Only1.pdf> (accessed 13 November 2020)
- Governo da Republica de Mocambique. 2010. Programa quinquenal do Governo para 2010-2014.
- Hadipuro, W. and Indriyanti, N.Y. 2009. Typical urban water supply provision in developing countries: A case study of Semarang Cit , Indonesia. *Water Policy* 11: 55-66.
- Herrera, V. 2019. Reconciling global aspirations and local realities: Challenges facing the Sustainable Development Goals for water and sanitation. *World Development* 118: 106-117.
- Hopewell, M.R. and Graham, J.P. 2014. Trends in access to water supply and sanitation in 31 major sub-Saharan African cities: an analysis of DHS data from 2000 to 2012. *BMC Public Health* 14 (208). <https://doi.org/10.1186/1471-2458-14-208>
- INE (Instituto Nacional de Estatística). 2010a. Inquérito sobre Orçamento Familiar 2008/9, Quadros Basicos.
- INE (Instituto Nacional de Estatística). 2010b. III Recenseamento Geral da População e Habitação 2007 Indicadores Sócio-Demográficos – Maputo Provincia.
- INE (Instituto Nacional de Estatística). 2018. Anuário Estatístico 2017 – Moçambique.
- INE (Instituto Nacional de Estatística). 2007. Recenseamento Geral da População e Habitação 2007: Indicadores Sócio-Demográficos, Maputo Cidade. 63.
- Jaglin, S. 2002. The right to water versus cost recovery: Participation, urban water supply and the poor in sub-Saharan Africa. *Environment and Urbanization* 14(1): 231-245. <https://doi.org/10.1177/095624780201400119>
- Jensen, O. and Chindarkar, N. 2019. Sustaining reforms in water service delivery: The role of service quality, salience, trust and financial viability. *Water Resources Management* 33(3): 975- 992.
- Jimenez-Redal, R.; Parker, A. and Jeffrey, P. 2014. Factors influencing the uptake of household water connections in peri-urban Maputo, Mozambique. *Utilities Policy* 28(3): 22-27.
- Kayaga, S. and Franceys, R. 2007. Costs of urban utility water connections: Excessive burden to the poor. *Utilities Policy* 15(4): 270-277.
- Kemendi, T.J. and Tutusaus, M. 2018. The impact of pro-poor interventions on the performance indicators of a water utility: Case studies of Nakuru and Kisumu. *Journal of Water Sanitation and Hygiene for Development* 8(2): 208-216. <https://doi.org/10.2166/washdev.2018.088>
- Komives, K.; Halpern, J.; Foster, V.; Wodon, Q. and Abdullha, R. 2007. Utility subsidies as social transfers: An empirical evaluation of targeting performance. *Development Policy Review* 25(6): 659-679.
- Marson, M. and Savin, I. 2015. Ensuring sustainable access to drinking water in sub saharan Africa: Conflict between financial and social objectives. *World Development* 76: 26-39.
- Mbui, D.; de Witte, K. and Perelman, S. 2012. Urban water sector performance in Africa: A step-wise bias-corrected efficiency and effectiveness analysis. *Utilities Policy* 22(9): 31-40. <https://doi.org/10.1016/j.jup.2012.02.004>.
- Mugisha, S. and Borisova, T. 2010. Balancing coverage and financial sustainability in pro-poor water service initiatives: A case of a Uganda project. *Engineering Economist* 55(4): 305-327.
- Norman, G.; Fonseca, C. and Jacimovic, R. 2012. Financing water and sanitation for the poor: Six key solutions. In Discussion Paper (Vol. 3). www.wsup.com/content/uploads/2017/08/DP003-ENGLISH-Pro-Poor-Finance.pdf (accessed 13 November 2020)
- Raghupati, U. and Foster, V. 2002. *Water tariffs and subsidies in South Asia: A scorecard for India*. Washington, DC: World Bank.
- Rusca, M. and Schwartz, K. 2018. The paradox of cost recovery in heterogeneous municipal water supply systems: Ensuring inclusiveness or exacerbating inequalities? *Habitat International* 73: 101-108.
- Schwartz, K.; Tutusaus, M. and Savelli, E. 2017. Water for the urban poor: Balancing financial and social objectives through service differentiation in the Kenyan water sector. *Utilities Policy* 48: 22-31.

- Sinharoy, S.S.; Pittluck, R. and Clasen, T. 2019. Review of drivers and barriers of water and sanitation policies for urban informal settlements in low-income and middle-income countries. *Utilities Policy* 60: 100957. <https://doi.org/10.1016/j.jup.2019.100957>
- Steinhauer, I. 2014. Quick scan (review) of the draft ESIA Report on Greater Maputo Water Supply Project , Corumana System. www.eia.nl/docs/os/i04/i0403/2014-11_esia_orio_greater_maputo_water_supply-mozambique.pdf (accessed 13 November 2020)
- The Global Partnership for Output Based Aid. 2007. GPOBA Commitment Document Executive Summary: OBA for Coverage Expansion in the Mozambique Water Sector.
- The World Bank. 2013a. Project Appraisal Document of the Greater Maputo Water Supply Expansion Project.
- The World Bank. 2013b. Project Appraisal Document on a Proposed Credit of USD\$178 Equivalent to the Republic of Mozambique for a greater Maputo Water Supply Expansion Project.
- The World Bank. 2013. Karnataka three towns pilot 24/7 water supply. New Delhi, India: Water and Sanitation Program, The World Bank.
- Water and Sanitation for the Urban Poor (WSUP). 2011. Helping people connect to water networks: good for business, good for the poor? <http://search.jamas.or.jp/link/ui/2014009701>
- WHO/UNICEF. 2017. Progress on drinking water, sanitation and hygiene. New York, NY: The World Health Organization and the United Nations Children’s Fund.
- WHO/UNICEF. 2019. Progress on household drinking water, sanitation and hygiene 2000-2017. New York, NY: The World Health Organization and the United Nations Children’s Fund.
- Wichelns, D. 2013. Enhancing the performance of water prices and tariff structures in achieving socially desirable outcomes. *International Journal of Water Resources Development* 29(3): 310-326.
- Zuin, V.; Ortolano, L.; Alvarinho, M.; Russell, K.; Thebo, A.; Muximpua, O. and Davis, J. 2011. Water supply services for Africa’s urban poor: The role of resale. *Journal of Water and Health* 9(4): 773-784.

SUPPLEMENTAL INFORMATION

How successful were OBA subsidies at targeting the poor?

Among 'newly connected households' who are customers of the water utility AdeM, and who provided their bill, 31% had received an OBA subsidy.¹² A number of indicators (designed to target only the poorest households) were used by AdeM to determine household eligibility to receive the subsidised OBA connection fee of MZN750 (US\$20.60); these included the types of material and the construction characteristics of the house and of the surrounding yard area. Two separate aspects are addressed below to evaluate the success of the OBA programme’s goal of targeting only the poorest households: 1) were the households that received OBA status on their bill indeed those with more precarious or informal living conditions, as measured by the OBA indicators; and 2) were the OBA criteria actually successful at targeting the poorest households.

With respect to the first issue, as discussed earlier, we find that households that received OBA subsidies were:

- Less likely to have cement walls surrounding their yard and more likely to have metal or bush yard walls (p<0.01);
- More likely to have dirt yards and less likely to have cement yards (p<0.05);
- Less likely to have grates on either windows or doors (p<0.01);
- More likely to have their bathroom indoors (p<0.10).

¹² We identify OBA households using AdeM bills; therefore, OBA households were only as accurately identified in this study as AdeM’s ability to record the OBA status of a household.

These results suggest that OBA criteria were respected more often than not when selecting the households that received the OBA subsidy, and hence that the rules established by the programme designers were generally complied with.

Examining the second issue – whether OBA criteria were successful at targeting the poorest households – is more complicated. It is interesting to note that OBA criteria are met by both the poorest and less-poor households when poverty is defined using per capita expenditures. As shown in Table S1, there is often a narrow difference between the lowest and highest quintiles in terms of the percentages of households complying with the criteria; for example, 17.3% of households in the lowest quintile and 13.3% in the highest quintile did not have any wall around the yard, while in the lowest quintile 53.8% had a cement wall and in the highest quintile 69.9% did; the same small differences were found for all other wall construction material measured. This suggests that, at least in our sample, there is little difference in the wall construction materials found around the yards of poorer and wealthier households.

Table S1. Construction materials and characteristics, lowest and highest quintiles.

		Quint 1 (N = 249)		Quint 5 (N = 249)	
		Mean	SD	Mean	SD
Wall material	Cement (without plaster)	31.7%	0.47	19.3%	0.40
	Cement (with plaster)	56.2%	0.50	70.7%	0.46
	Canizo	4.0%	0.20	2.4%	0.15
	Chapa	8.0%	0.27	7.2%	0.26
Floor	Cement	95.6%	0.21	84.7%	0.36
	Mosaic/tile	2.4%	0.15	13.3%	0.34
	Wood	0.0%	0.00	0.4%	0.06
	Dirt	1.2%	0.11	1.2%	0.11
Wall around yard	Cement	53.8%	0.50	69.9%	0.46
	Metal (corrugated/scrap)	20.5%	0.40	12.4%	0.33
	Wood	0.0%	0.00	0.4%	0.06
	Bushes	6.0%	0.24	2.4%	0.15
	None	17.3%	0.38	13.3%	0.34
Floor of yard	Cement	14.1%	0.35	34.5%	0.48
	Mosaic/tile	0.0%	0.00	0.8%	0.09
	Dirt	85.9%	0.35	63.5%	0.48
Door	With protective grate	18.9%	0.39	39.0%	0.49
	Without protective grate	80.3%	0.40	60.2%	0.49
	None	0.8%	0.09	0.8%	0.09
Windows	With protective grate	38.6%	0.49	63.5%	0.48
	Without protective grate	51.0%	0.50	30.1%	0.46
	None	10.4%	0.31	6.4%	0.25
	Bathroom located inside	4.0%	0.20	21.3%	0.41
	Kitchen located inside	14.1%	0.35	38.2%	0.49

As a result of the small differences between the percentages of households complying with the various OBA criteria in the lowest and highest quintiles, while the largest proportion of those who received the OBA subsidy fell into the poorest per capita expenditure quintile (40%), notable percentages of the households in the two highest quintiles also received the subsidy (25% and 20%, respectively) (Figure S1).

Assuming that per capita expenditure is a good proxy for wealth, these differences suggest that the OBA criteria were indeed able to target a larger proportion of households in the poorest quintile; however, in terms of recipients of OBA subsidies, there also appear to be significant 'errors of inclusion' (households that were not intended to benefit from the subsidy who did receive it) and 'errors of exclusion' (households that were intended to benefit but did not receive it). It should be noted that sample sizes of newly connected households whose members provided a bill were small when analysed by quintile, and that the results should thus be taken cautiously.

THIS ARTICLE IS DISTRIBUTED UNDER THE TERMS OF THE CREATIVE COMMONS *ATTRIBUTION-NONCOMMERCIAL-SHAREALIKE* LICENSE WHICH PERMITS ANY NON COMMERCIAL USE, DISTRIBUTION, AND REPRODUCTION IN ANY MEDIUM, PROVIDED THE ORIGINAL AUTHOR(S) AND SOURCE ARE CREDITED. SEE [HTTPS://CREATIVECOMMONS.ORG/LICENSES/BY-NC-SA/3.0/FR/DEED.EN](https://creativecommons.org/licenses/by-nc-sa/3.0/fr/deed.en)

