Mobile Water Payment Innovations in Urban Africa

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Executive Summary

Africa's mobile revolution can help address one of its oldest challenges – sustainable water services. Mobile money is a key driver in this innovative landscape expanding access to financial services to the poor and unbanked. With an annual financing gap to meet the African water supply and sanitation Millennium Development Goal of USD 9 billion, mobile water payments present a promising new approach to improve financial performance for water service providers, offer time and cost savings to water users, and increase customer loyalty for mobile network operators.

This report examines the impacts and implications of mobile water payments from Kenya, Uganda, Tanzania and Zambia. Evidence from 20 urban water service providers serving over 12.5 million customers is evaluated against the deployment strategies of mobile network operators and the responses of national water service regulators. Three research objectives inform the study design: (a) evaluation of adoption levels and the associated motivations and barriers to uptake; (b) assessing the distribution of costs and benefits across water service providers, mobile network operators and urban water customers; and (c) exploring new mobile payment applications and design modifications that could better meet the needs of the urban poor.

Our findings reveal low mobile water payments adoption rates with only one water service provider achieving over 10 per cent uptake from its consumer base. Key barriers to adoption include delayed reconciliation of billing systems, limited customer awareness, lack of physical proof of payment, high transaction tariffs, and convenience of alternative pay points. All these barriers can be overcome as exemplified by one small and privately-run scheme in Kenya where 76 per cent of customers have adopted the mobile bill payment option. In this case, high time and cost savings were revealed as principal motivations for mobile water payment adoption, with women benefiting most from time savings. There was no evidence that levels of wealth, education or water service satisfaction are significant predictors of choosing to pay by mobile transaction. However, mobile water payers were more likely to be already paying their electricity bill via a mobile transaction or in full-time or self-employment, which reinforces time and cost saving benefits. Of note, scheme ownership, size and location illustrated important contextual factors influencing adoption in contrast to our wider sample.

Despite a compelling value proposition for a range of actors, technological, behavioural and structural constraints currently hinder greater customer uptake of mobile water payments throughout the region. Where these constraints are released mobile paying customers enjoy considerable savings in the time and money costs usually incurred when settling water bills at physical pay points. Water service providers strengthen their financial base through timelier bill payments, higher collection efficiencies and lower administrative costs. Finally, mobile network operators are rewarded with direct revenue and customer churn reduction. Key determinants which shape the distribution of these costs and benefits include transaction tariff structure, regulatory position, and competition amongst mobile money providers. We conclude by identifying mobile payment applications that could reach and benefit low-income and vulnerable groups in both urban and rural areas to help tackle ongoing service delivery challenges relating to public standpipes, pre-paid metering and rural water supplies.

Acronyms

DAWASCO	Dar es Salaam Water and Sewerage Corporation, Tanzania
EWURA	Energy and Water Utilities Regulatory Authority, Tanzania
KIWASCO	Kisumu Water and Sewerage Company, Kenya
KWT	Kiamumbi Water Trust, Kenya
LWSC	Lusaka Water and Sewerage Company, Zambia
MNO	Mobile Network Operator
NAWASCO	Nanyuki Water and Sewerage Company, Kenya
NCWSC	Nairobi City Water and Sewerage Company, Kenya
NWASCO	National Water and Sanitation Council, Zambia
NWSC	National Water and Sewerage Corporation, Uganda
USD	US Dollars
WSP	Water Service Provider

Exchange rates (October 2011)

USD	= 99 Kenyan Shillings (KSh)
	= 1634 Tanzanian Shillings (TSh)
	= 2814 Ugandan Shilling (USh)
	= 4747 Zambian Kwacha (Kwa)

Contents

1 Mobile payments: A financial innovation for water services in urban Africa

The revolution in Africa's mobile communications sector offers exciting opportunities to address many of the continent's enduring water service challenges. Over the past decade, mobile phone subscriptions in Africa have grown to over 620 million and analysts expect this figure to surpass 900 million by 2015 (GSMA/A.T. Kearney, 2011). This growth is catalysing innovations for economic and human development benefits in areas such as health, agriculture and financial inclusion. Mobile money is a key driver in this innovative landscape expanding access to financial services to the poor and unbanked. There are now more than 50 mobile money services operating in Africa with over 20 million users (GSMA 2011b).

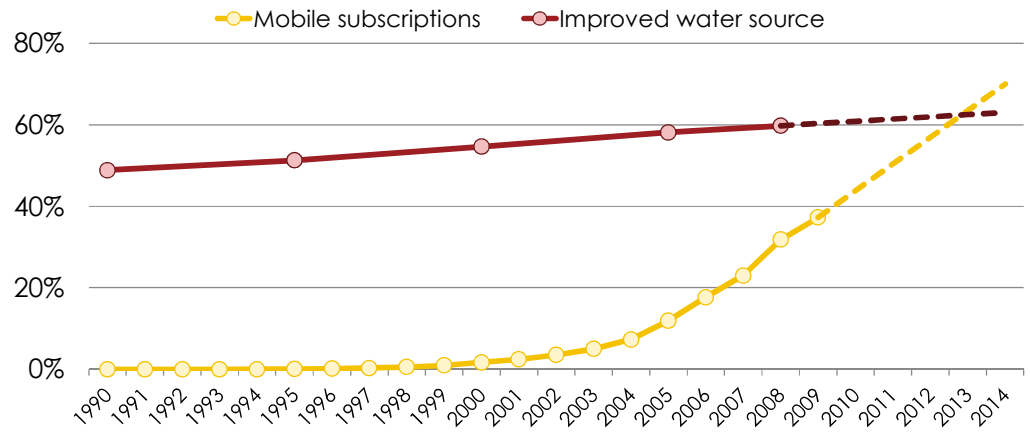
Juxtaposing the rapid rise of mobile communications universal access to safe and reliable water services remains a distant goal. The number of Africans without an improved water supply has climbed to 330 million by 2008, 67 million more than in 1990. Current annual investment in sub-Saharan Africa's water service sector is less than half of the US$16.5 billion required to meet the water access Millennium Development Goal (AICD 2010). In order to bridge this financing gap to maintain water supply infrastructure and accelerate access to the unserved, collecting water user fees is vital. Currently around one in five water bills in urban Africa is unpaid. High transaction costs incurred by customers and burdensome paper-based billing processes for water service providers are key obstacles to efficient and secure revenue collection. Improved revenue collection is one of several measures required to improve the operational performance of urban water utilities to achieve more sustainable and equitable approaches to serving the urban poor.

With the convergence of increased mobile network coverage, high mobile phone ownership and mobile payment platforms, Africa's mobile revolution can help address one its oldest challenges – reliable and safe water access. The transformative opportunity is characterised by more Africans having mobile phone subscriptions than access to improved water services by 2013 (Figure 1).

What is mobile money?

Mobile money is an electronic payment system that enables money transfers to and from an electronic account that can be accessed via an ordinary mobile phone. Each customer's account is linked to their mobile phone number by means of an in-built SIM-card application. Physical cash withdrawals and deposits are facilitated by a network of retail agents. While configurations vary across providers, the viability of mobile money is premised upon the cost base associated with an agent network, which is lower and more flexible than establishing 'bricks and mortar' bank branches. Mobile money can therefore profitably extend the reach of financial services to those who have traditionally been unbanked, such as low-income or remote households.

Figure 1. Mobile subscriptions will soon overtake safe water access in Africa

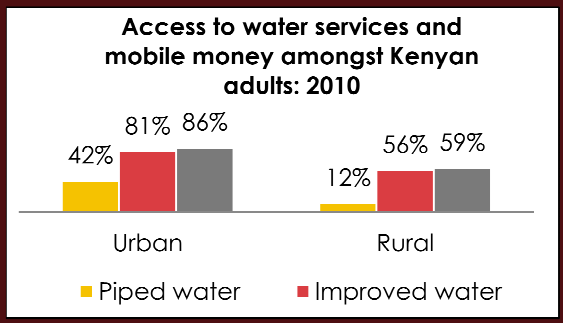


A key innovation at the intersection of mobile technology and water service delivery is the use of mobile money for water bill payments. Mobile water payments represent a secure, low-cost and increasingly accessible mechanism to support the financial and operational sustainability of urban water services. The ability to remotely pay for water bills offers customers both time and money savings. With this increased convenience, customers are more likely to be able to pay their bills in a timely manner. Consequently, utilities can boost their revenue collection while simultaneously reducing the administrative burden of bill processing. These gains could help WSPs strengthen their financial base. A stronger financial base will support WSP investments to maintain and improve access to safe and reliable water services for all segments of the population rather than the 35% currently served by individual piped water services in urban Africa.

Since 2009, at least a dozen WSPs across four African countries have introduced a mobile water payment service (Table 1).[1] Dar es Salaam Water and Sewerage Corporation (DAWASCO) was the first utility on the continent to introduce mobile water payments via agreements with Vodacom and Zain (now Airtel). WSPs in Kenya, Zambia, and Uganda have all launched similar services. In total, the water utilities offering the mobile payment option serve around 1 million connections – in Kenya the adopting WSPs account for more than half the nation's urban piped connections. Moreover, there are plans to deploy mobile water payments systems in Rwanda, and further expand services in Zambia and Tanzania, making the payment option available to an additional 300,000 connections.

M-PESA leading the way

The Kenyan MNO Safaricom is the global mobile money pioneer, having launched its M-PESA service in 2007. Less than five years on, M-PESA remains the industry vanguard with more than 14 million users, and 28,000 retail agents – a footprint that dwarfs that of Kenya's 1,030 bank branches. More Kenyan adults have an M-PESA account than access to safe water. Motivated by this success, an additional 51 mobile money services for Africa's unbanked have since been launched with global MNOs Orange, Airtel and MTN amongst the key players.



[1] This study focuses specifically on mobile money services that do not require users to possess a bank account

Table 1. Mobile water payment deployments in Urban Africa

Country	Water Service Provider	Served population	Piped water connections	Annual billing (USD m)	Collection efficiency	Mobile money partners
Kenya	Nairobi City	2,250,607	415,229	45.6	75%	Safaricom M-PESA Airtel Money
	Kisumu	181,512	15,493	2.8	94%	Safaricom M-PESA
	Nakuru	372,366	42,171	6.1	69%	Safaricom M-PESA
	Nanyuki	57,252	12,332	1.2	101%	Safaricom M-PESA
	Eldoret	220,198	47,110	2.8	91%	Safaricom M-PESA
	Nzoia	129,798	19817	1.4	87%	Safaricom M-PESA
	Kiamumbi Water Trust	2,922	661	0.1	97%	Safaricom M-PESA
	Grundfos LIFELINK	~2700	NA	0.03	100%	Safaricom M-PESA
Tanzania	Dar es Salaam	2,380,000	145,579	10.4	85%	Vodacom M-PESA Airtel Money Tigo**
	Morogoro	268,305	19,969	2.1	93%	Vodacom
	Mwanza	412,650	26,988	3.2	99%	Airtel Money Vodacom**
	Arusha	355,925	27,169	2.0	96%	Vodacom**
	Mbeya	277,085	22,849	1.4	86%	Vodacom**
Uganda	National	2,426,502	244,075	39.8	98%	MTN Mobile Money UTL M-Sente Airtel Money** Warid**
Zambia	Lusaka	1,285,270	76,749	32.7	75%	Standard Chartered* Zanaco* Airtel
	Nkana	600,199	45,983	13.0	83%	Standard Chartered* Zanaco* Airtel Money**
	Kafubu	545,196	48,807	12.8	67%	Airtel Money**
	Mulonga	385,914	43,330	13.3	94%	Airtel Money**
	North Western	153,398	7,661	2.0	101%	Airtel Money**
	Southern	292,638	31,535	4.8	100%	Airtel Money**
Sample estimates	n/a	12,597,737	1,293,507	198	90%	n/a

* = mobile banking requires a customer bank account; ** = planned deployment
Sources include WASREB (2011), EWURA (2010), NWASCO (2011)

2 A cross-country comparative assessment

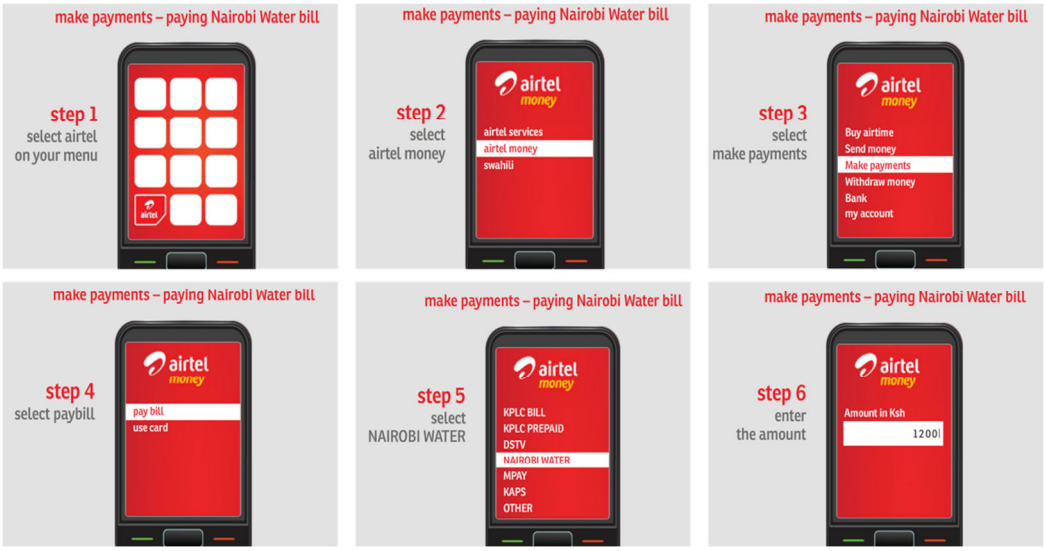
This study provides a comparative assessment of mobile water payments within different urban African contexts. Three thematic areas inform the study design: (a) evaluation of adoptions levels and the associated motivations and barriers to uptake; (b) assessing the distribution of costs and benefits across WSPs, MNOs and urban water customers; and (c) exploring new mobile payment applications and design modifications that could better meet the needs of the urban poor.

The research was undertaken in urban Kenya, Tanzania, Uganda and Zambia from May to October 2011. Interviews were held with (a) eight WSPs that are deploying, or plan to deploy, a mobile payment option; (b) major MNOs in each country that have partnered with WSPs to offer a payment option; and (c) water service regulators in three of the four focus countries. Primary data were collected from the WSPs and reliable secondary sources, such as the World Bank or national water regulators. In Kiamumbi, Kenya, where the adoption rate of mobile water payments is particularly high in a privately-operated scheme, a household survey provided data for quantitative analysis of customer benefits and drivers of adoption.

3 Models and status of mobile water payments

All deployments profiled in this study are premised on an MNO's mobile money platform, which enables water users to electronically transfer funds to their WSP using any mobile handset. Across all systems, customers follow a simple series of on-screen menus to execute the bill payment (Figure 2). There is, however, considerable variation in the design of mobile water payment models, objectives and motivations for launching the service, and ensuing customer adoption rates. Furthermore, models examined in the four study countries are accompanied by different institutional arrangements, transaction tariffs and structures, and functionalities. Mobile water payment services usually emerge from direct negotiation between MNOs and WSPs. The instigating parties do however vary – in some cases it is the MNO approaching the WSP, in other instances it is the WSP taking the initiative. In a number of cases, negotiations commenced at the behest of customers. Of those systems investigated, Dar es Salaam is an outlier in this respect – the partnerships between the WSP (here, DAWASCO) and the MNOs (Vodacom and Airtel) were forged by a third-party company that provides the necessary data integration service between the mobile money and water billing systems.

Figure 2. Process for paying water bills in Nairobi with Airtel Money



The MNO typically charges a fee for each mobile water bill payment, which is paid by either the customer, the WSP, or shared by both, depending on the negotiated agreement. There is no standard fee regime. Section 4 details the variation in both magnitude and structure of existing fees. In the case of Tanzania, the third party charges an additional commission for facilitating the transaction. Customers are never required to pay their bills using mobile money – in all cases examined physical pay points remain an alternative, whether via dedicated utility offices or partnering bank branches.

The systems examined offer varying service levels regarding both speed and price of transactions. Many of the utilities offer additional SMS services such as balance enquiries, billing notifications reminders, and payment receipts. Table 2 provides a comparison of these features across the utilities investigated, as well as the associated mobile payment adoption rates, which range from 1 percent to 76 percent of the WSP's customer base.

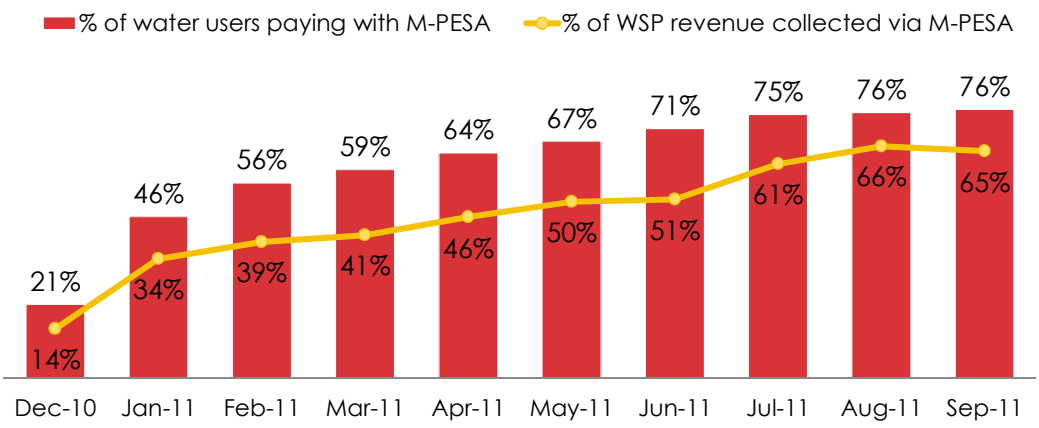
Table 2. Mobile billing system features and adoption rates

Country	WSP	Mobile money	Free transaction	Real time reconciliation	Confirmation SMS from Utility	SMS balance enquiries	Mobile payment adoption	Months since launch
Kenya	Nairobi City WSC	M-PESA				✓	4%	13
	Kisumu WASCO	M-PESA				✓	8%	-
	Nanyuki WSC	M-PESA				✓	1%	1
	Kiamumbi WT	M-PESA					76%	11
Tanzania	DAWASCO	Airtel		✓	✓	✓	1%	27
		M-PESA	✓	✓	✓	✓		
Uganda	NWSC	MTN		✓	✓	✓	10%	7
		UTL		✓	✓	✓		
Zambia	Lusaka WSC	Airtel	✓	✓	✓	✓	-	-

3.1 Status of mobile payments by country

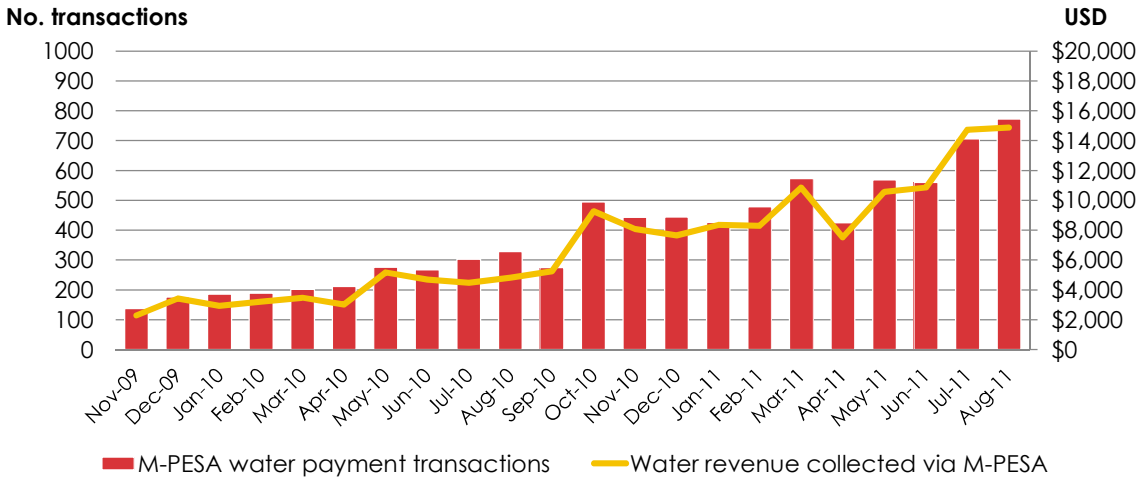
In **Kenya**, the seven WSPs offering mobile payments provide piped services to over 60 percent of the country's urban population with piped water access. Safaricom's M-PESA is the mobile payment service available in all cases. In Kiamumbi, 76 percent of bills are paid by mobile money, which is by far the highest uptake of all WSPs reviewed (Figure 3). In comparison, only 8 percent of water users in Kisumu pay bills with M-PESA, 4 percent in Nairobi, and 1 percent in Nanyuki. In addition to the WSPs examined in this report, mobile payments are also offered by utilities in Nakuru, Eldoret and Nzoia. Of all the WSPs accepting mobile payments, Nairobi City WSC drives the highest transaction volumes with more than USD 120,000 worth of water bills transferred via M-PESA every month. Airtel Money has recently launched a free mobile water payment service for Nairobi City WSC's customers – though it remains too early to assess the success of this free service or Safaricom's response to this competition.

Figure 3. More than three quarters of Kiamumbi water users pay bills with mobile money



In **Tanzania**, Vodacom Tanzania and Airtel (formerly Zain) have offered a mobile water payment service since early 2009. DAWASCO in Dar es Salaam is the major WSP accepting bill payments via mobile money, although the option is also now available in Morogoro and Moshi (not investigated within this study) with planned deployments in Mwanza, Arusha, and Mbeya. In Dar es Salaam, the use of mobile money platforms from Vodacom (M-PESA) and Airtel (Airtel Money) generate USD 15,000, or 1 percent, of monthly payments (Figure 4). However, over 800 GPRS-enabled points-of-sale offer a payment alternative which use mobile networks for communication, and bring in 11 percent of monthly bills. At GPRS pay points (located throughout cities in pharmacies, groceries, and foreign exchange bureaux) an attendant inputs customers' cash payments into a machine which transmits the payment information electronically over mobile networks. This allows for accounts to be credited in real-time and provides customers with paper-based receipts (unlike mobile money transfers). In Tanzania, over 1,500 GPRS-enabled pay points have been provided by Selcom Mobile, the same company which links DAWASCO's billing system with Airtel's and Vodacom's mobile money platforms.

Figure 4. Less than 1% of DAWASCO customers pay water bills with Vodacom's M-PESA



In **Uganda**, the National Water and Sewerage Corporation (NWSC) transitioned to a completely electronic system dubbed "e-water" in March 2011. Under this scheme, all NWSC payment offices across 23 cities and

towns were closed. Water users must now pay their water bills at bank branches or via mobile money platforms offered by the major telecoms MTN (MTN Mobile Money) and UTL (M-Sente). Within four months of the "e-water" launch, over 20,000 of NWSC's account holders had switched to the mobile money option, accounting for 10 percent of the total customer base (Figure 5). In excess of USD 300,000 worth of water bills are paid via mobile money channels every month, 80 percent of which derives from Kampala (Figure 6). MTN is the dominant player, accounting for 95 percent of water service revenue collected through mobile money channels.

Figure 5. More than 20,000 water users in Uganda switched to mobile bill payments within four months of launch

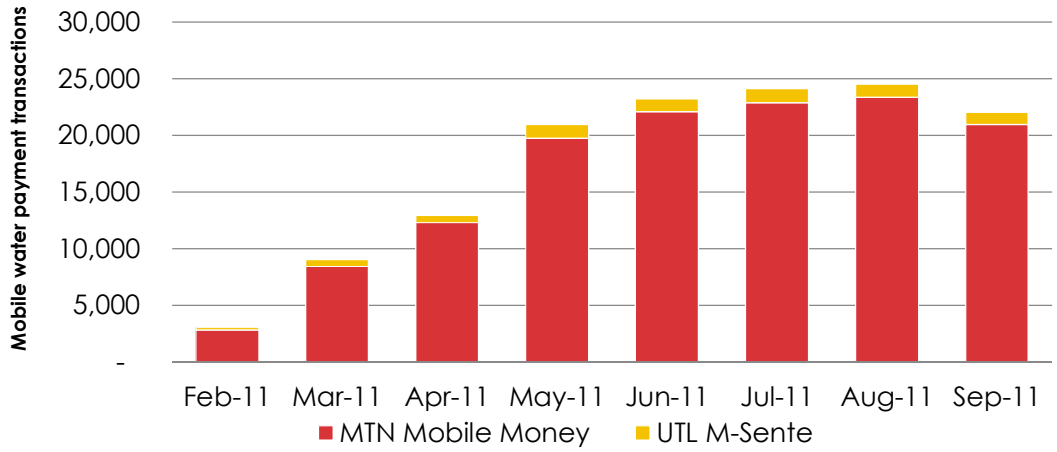
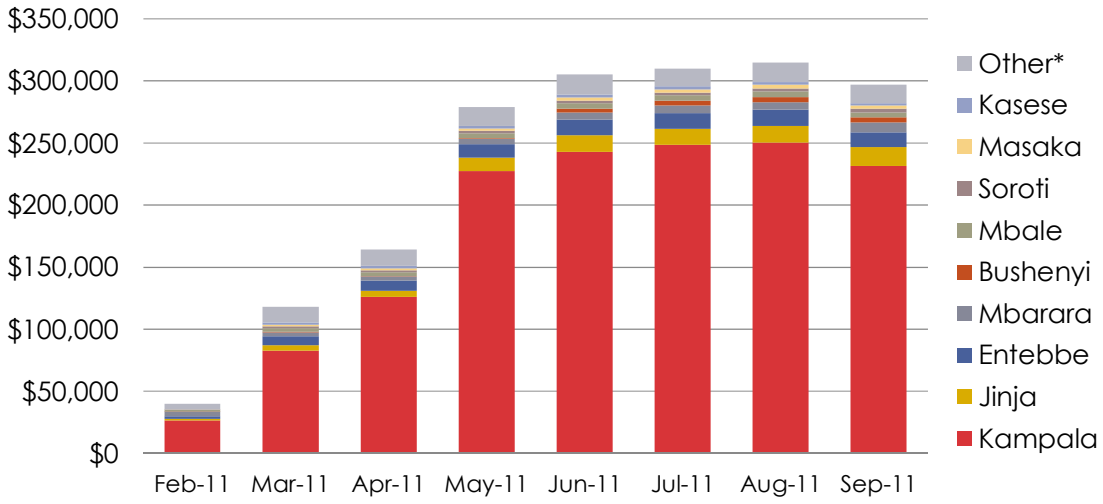


Figure 6. More than USD 300,000 collected via mobile money every month by NWSC in Uganda



*Other includes Lira, Mubende, Fort Portal, Tororo, Lugazi, Iganga, Masindi, Kabale, Gulu, Hoima, Arua

Across **Zambia**, Airtel has introduced a mobile water payment system in conjunction with Lusaka WSC. Plans are also underway to deploy similar systems with commercial utilities that operate in other urban centres. At the time of publication, the mobile payment option in Lusaka was still in its infancy and thus too early to gauge adoption levels. Uniquely, the Zambian water service regulator has prohibited MNOs and WSPs from passing transaction fees on to water users, as doing so would infringe on the terms of water service tariff approval. Though not investigated in this study, mobile banking options for those with

Standard Chartered and Zanaco bank accounts are also available for Lusaka WSC and Nkana WSC customers. However with only a small proportion of customers possessing bank accounts, these channels account for less than 1 percent of revenue collected.

The deployments reviewed generally reveal low levels of adoption, with the majority having achieved between 1 percent and 10 percent of customer usage. Bearing in mind that mobile bill payment volumes have tended to plateau four to eight months after their launch, it should be noted that the systems examined here have been in operation for varying durations, from one month in Nanyuki through to two years in Dar es Salaam. The exception to the modest adoption levels is the case of Kiamumbi, Kenya where three quarters of water users have made the transition to mobile payments in less than a year. Understanding factors that differentiate Kiamumbi's performance from the regional level may therefore guide wider uptake measures. In recognition of this opportunity, a detailed household analysis was conducted to measure customer benefits of mobile water payments and assess their motivations for switching to this option.

4 Customer benefits and drivers of adoption: The case of Kiamumbi

Kiamumbi Water Trust (KWT) is a privately operated, piped water scheme located 15km north of Nairobi, Kenya. Now serving nearly 700 households, Kiamumbi's water distribution system was completed in July 2009 with funds from a loan and Output Based Subsidy.[2] The mobile water payment option was introduced in December 2010 and uses M-PESA's basic bill pay function to transfer customer payments to the KWT business account. Bills are hand delivered and there are no SMS-based services (e.g. balance enquiries, payment reminders). Mobile payments offer KWT a particularly valuable revenue collection mechanism, as security issues prevent cash handling on the operator's premises. Prior to December 2010 bills could only be paid by bank deposit. As the nearest bank branch is 4 km away water users had to make a trip that takes time and costs money before December 2010 in order to pay their water bill.

In addition to interviews with the KWT committee and the WSP, including analysis of various metrics of operational and financial performance, a household survey was conducted during June 2011.[3] Of the 279 households surveyed, 193 households were connected to the piped supply, 69 percent of which paid their water bills with M-PESA. The survey was designed to explore a range of key issues: (a) the time and monetary cost savings generated by the mobile water payment option; (b) other indirect benefits flowing from use of the mobile water payment option; and (c) drivers and barriers to mobile water payments uptake. In order to model household mobile water payment adoption, a range of socio-economic indicators were also recorded.

4.1 Customer benefits

To enable quantification of the benefits of M-PESA water payments, respondents were asked a series of questions relating to time and monetary costs incurred when (a) visiting the bank to pay a water bill, and (b) when depositing cash with the closest M-PESA agent in order to pay a water bill. We report four dimensions of time costs: a) waiting time at the bank, b) return travel time to bank, c) waiting time at mobile agent to load mobile money to account and d) return trip time to mobile agent. Transport mode to the bank is primarily via bus or private vehicle, with a few people walking; in contrast most people walk to the mobile agent. The incremental cost (or benefit) is complicated by households' bundling activities, such as paying multiple bills in one bank or mobile money agent visit. Of our sample of households paying their

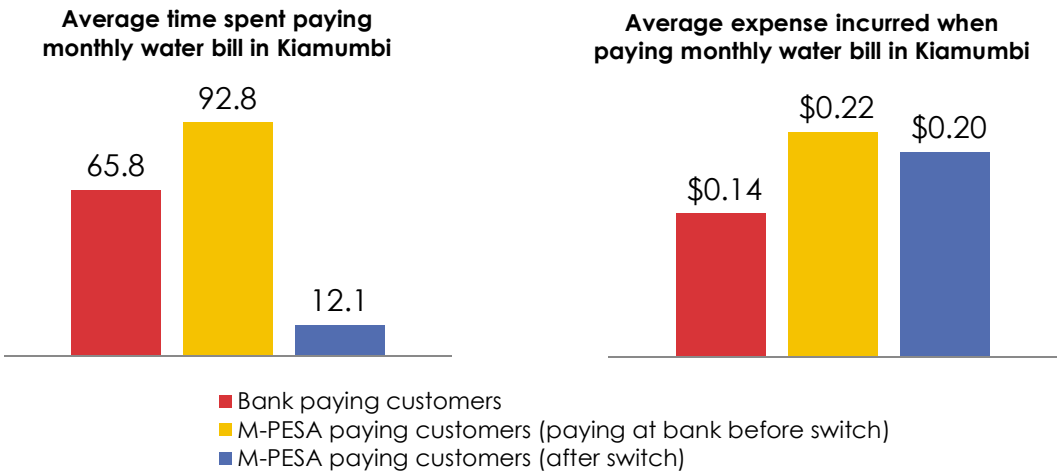
[2] For more information on this financing scheme, see http://www.wsp.org/wsp/sites/wsp.org/files/publications/WSP-Financing-Small-Water-Systems-Kenya.pdf

[3] For a detailed account of the survey approach taken, see Cohen (2011)

water bill at the bank, 52 percent 'bundle' payment activities compared to 32 percent who make a separate trip to pay the water bill. Where payments at the bank were conducted as part of another task, the travel times and costs were assumed to be zero. It was also assumed that those paying by mobile money would visit the agent to deposit cash for each monthly bill. Both of these assumptions aim to ensure that the analysis under-estimates rather than over-estimates the potential savings accruing from mobile water payments.

Results reveal that those paying their water bills with mobile money save a considerable amount of time and money relative to what they incurred prior to the switch, and also compared to their colleagues who continue to pay at the bank (Figure 7)[4]. For those who have carried on paying water bills at the bank, the combination of travel and queuing averages 65.8 minutes (median 60 minutes). This is more than five times the average 12.1 minutes (median 10 minutes) spent making a trip to the mobile money agent to deposit money for a mobile bill payment. Moreover those that have switched recalled waiting and travelling times for bank journeys that totalled 92.8 minutes (median 70 minutes).[5] Thus those paying with M-PESA spend 82 percent less time paying bills than those settling their bills at the bank, saving an average of 54 minutes. It should be noted that if a customer already has sufficient funds in their mobile money account to make the payment, an agent trip is unnecessary, making time savings even greater. Conversely, mobile water payment users incur an average of USD0.06 more in direct expenditure relative to their bank paying counterparts, as a result of the M-PESA tariff of USD0.20.

Figure 7. Time and cost implications of mobile water payments at Kiamumbi



Note: Bank trips undertaken in conjunction with other tasks considered to have monetary and time costs of zero. M-PESA users assumed to deposit cash with agent for each monthly bill payment.

These average figures may well underestimate the degree to which other water users might benefit throughout East Africa. A typical urban water user for example might not be able to 'bundle' tasks if they need to pay at a dedicated utility pay point. Moreover, public transport is more likely to be used in other urban areas – piped water customers in Kiamumbi are two and a half times more likely to own a car than

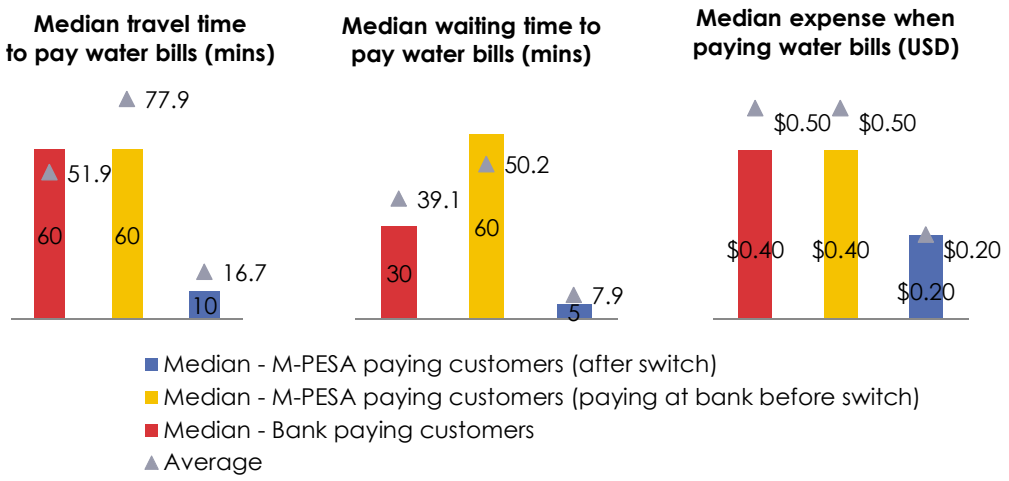
[4] A full table of calculations can be found in Appendix I.

[5] A number of other additional factors could account for the transaction cost differences between those currently paying at the bank and those formerly paying at the bank: 1) switchers may not have as accurate a recollection of bank trips since it was a long time ago, 2) other external factors may have since sped up the trip to the bank (e.g. more buses, more bank staff), and 3) a higher proportion of those that switched were taking the bus than those who stuck with the bank.

other urban Kenyans with a piped connection. Hence it is important to disaggregate estimates by those customers who have to make exclusive trips to the bank to pay their bill, and use public transport to do so.

As expected, the savings enjoyed by this sub-sample are even greater (Figure 8)[6]. Of households making a non-bundled trip to pay their water bill at the bank, 70 percent indicate that they travelled by public bus with a median return trip cost of USD0.40. Of households shifting to mobile water payments 84 percent stated they formerly took a public bus to pay at the bank, with the same travel cost. In comparison, the transaction fee charged to customers paying their water bill with M-PESA is USD0.20 – a direct saving of USD0.20 per month. Similarly, median travel times for mobile payers are one sixth of those faced by bank payers, and median wait time for mobile payers is 25 minutes less than that for bank payers. In sum, M-PESA users save an average 66 minutes per month compared to their bank paying colleagues who take public transport exclusively to pay their bills.

Figure 8. Indicative transaction costs for those taking a trip by public transport exclusively to pay their water bills

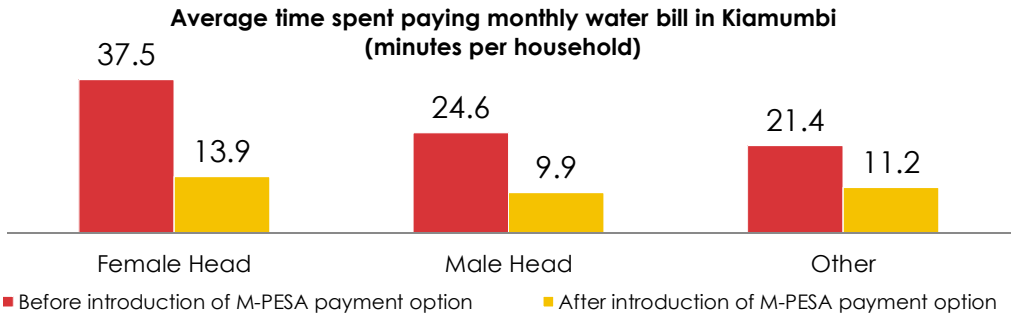


Note: M-PESA users assumed to deposit cash with agent for each monthly bill payment.

Results indicate it is women who have benefited most from the time savings. Bill payment responsibilities were fairly evenly split before the introduction of M-PESA payment. The female head of household paid water bills at the bank for 34% of households, compared to 40% of households whose bills were paid by the male head of household[7]. The big disparity however lies in the time taken to make the payment – the male payer on average took 62 minutes, and the female required 98 minutes.[8] Thus by reducing these times to 14 minutes and 10 minutes respectively, the mobile payment brings with it more significant time savings for women. When averaging across surveyed households (incorporating all payment methods), the introduction of mobile water payments in Kiamumbi saves women 23.6 minutes per household per month (Figure 9). When extrapolated to Kiamumbi's 700 connected households, this aggregates to around 3,300 women hours saved per year.

[6] A full table of calculations can be found in Appendix II.
[7] The remainder include other family members or non-family paying the household bill.
[8] This discrepancy is for two reasons. First, only 46% of trips to the bank undertaken by women are 'bundled', compared to 63% for men. Second, whereas all women making an exclusive trip to the bank take public transport, 50% of men making an exclusive trip take a private vehicle, which takes only half the time of public transport.

Figure 9. Women in Kiamumbi benefit most from time savings afforded by mobile bill payment option



Note: Bank trips undertaken in conjunction with other tasks considered to have monetary and time costs of zero. Calculations based on a sample of 151 respondents who provided both time and payment responsibility data.

Respondents opting for M-PESA payments also identified a range of other benefits. Fifty percent of users felt they were less likely to be disconnected since switching to mobile payments, and 27 percent believed they were better able to save money to pay the bill. Similarly, very few respondents had experienced any difficulties using the system. Seven months after its introduction, only eight percent had been affected by mobile network reliability issues, two percent had experienced difficulty knowing whether the payment had gone through, and two percent suggested they had made a payment that was never received by KWT. Given these positive perceptions, it is not surprising that households generally expressed a high level of satisfaction with the mobile bill payment service, and 98 percent of users claimed they would recommend the service to a neighbour.

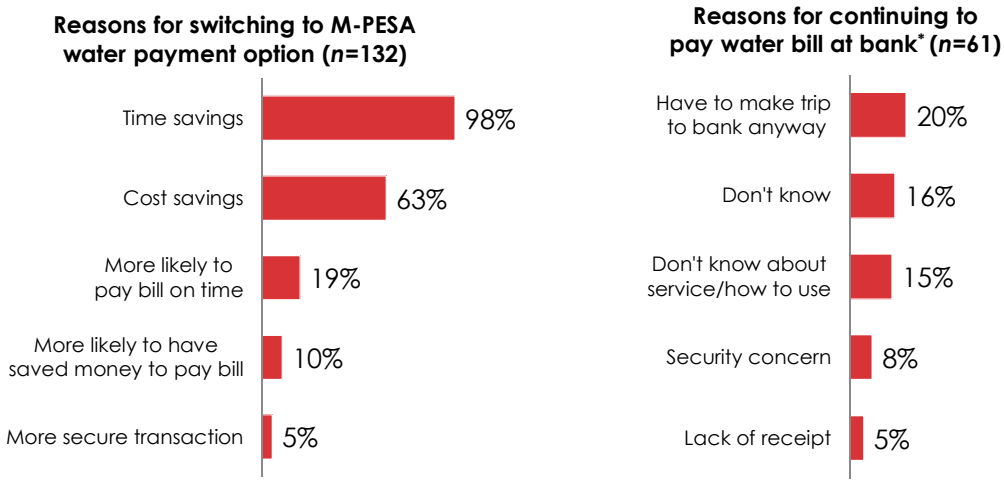
4.2 Motivations and barriers

Households were also questioned about the reasons why they may, or may not, have decided to switch to mobile bill payments.[9] Results reinforce the contention that time and cost savings are key drivers of mobile payment adoption (Figure 10). Respondents almost universally viewed time savings as a reason for transition to M-PESA payments, while direct monetary savings were cited by two-thirds of those surveyed. One in five households stated they now pay bills with M-PESA as they feel more likely to pay the bill on time, and one in ten claimed they switched as they find it easier to save the required funds.

Of those respondents who chose not to adopt mobile water payments, the need to make trips to the bank anyway was identified as the primary reason. Again, this highlights the importance of the transaction cost calculus undertaken by customers when deciding on their preferred payment method. Around one in six bank payers continued with manual payments due to their uncertainty about how mobile money worked or their awareness of its existence as a payment option. In contrast to the qualitative information gleaned from larger urban WSPs (see Section 4), transaction security (8%) and lack of paper-based receipts (5%) presented concerns for only a small minority of customers Kiamumbi.

[9] Survey questions included: (a)"Identify any reasons in your decision to use mobile payments for your water bill"; (b) "If you do not usually use mobile money for water bills, identify reasons why not".

Figure 10. Time and cost associated with bank trip are key drivers of mobile water payment adoption in Kiamumbi



* In addition, 2% of bank paying customers elected not to switch to M-PESA payments as they considered the transaction tariff too expensive, and 2% were unable to as they subscribed to an MNO other than Safaricom

4.3 Predictors of adoption

Household characteristics that predict mobile water payment adoption were examined using logistic regression analysis. Socio-demographic factors tested included educational attainment, household size and composition, time living in the community, and employment activities. Measures of wealth were tested across assets (televisions, fridges, computers, cars, motorbikes, sanitation access, livestock, land) as well as interval measures of adult equivalent expenditure and self-perception of being well-off.

The socio-economic profile of sample households decomposed by payment type indicates comparable and high education and employment levels across the sample (Table 3). The majority of households settled in the community in the eight years prior to the 2009 launch of the KWT piped water service. Each household has an average of just over four members with over two mobile handsets and three SIM cards. Safaricom is the dominant mobile network operator reflecting the national profile with over 80 percent market share. Adult expenditure on food, transport, clothing, health, school fees and electricity bills is on average USD2,000 per year across the sample. Mobile water paying households have both more upper expenditure quintile members and lower expenditure quintile members than households paying their water bill at the bank. Overall, there is limited evidence that mobile water payment households differ from households paying at the bank by socio-economic composition or mobile technology indicators.

Regression results indicate that individual indicators of wealth, education or assets are not significant predictors of adopting mobile water payments (Table 4). But employment (full-time or self-employed) does matter which likely embeds broader characteristics of household wealth, education and assets. The positive association with employment status supports the finding that time-savings are a key reason for adoption. This may reflect those working on a full time basis placing a higher value on the opportunity cost of manual bill payment as well as the convenience of paying bills outside of working hours.

We also tested if consumer satisfaction with piped water service influences a greater willingness to pay for services and therefore, willingness to adopt mobile payments. Based on metrics of household perceptions of water quality (by 'good' taste), household investment in water storage, satisfaction with water services and

water supply reliability (by days and hours by day), we found no significant relationship between a reliable and safe water supply and mobile payment adoption.

Determinants of current and past water bill payment method were also tested by the household member responsible for paying at the bank, waiting time at the bank, return travel time to the bank and wider experience with mobile money to pay for other services. The only positive and significant predictor of mobile water payment was paying the electricity bill by mobile money. If a woman was paying for electricity services by mobile money this increased the probability of the household paying for water by mobile money by 3.8 times, compared to 2.8 times for men. These findings point to the importance of a demonstration effect of mobile money as a factor in increasing the probability that a household will then adopt the technology for other services. However, it does not unravel what factors lead to the mobile electricity payers adopting in the first instance.

Table 3. Kiamumbi household characteristics by water billing mechanism

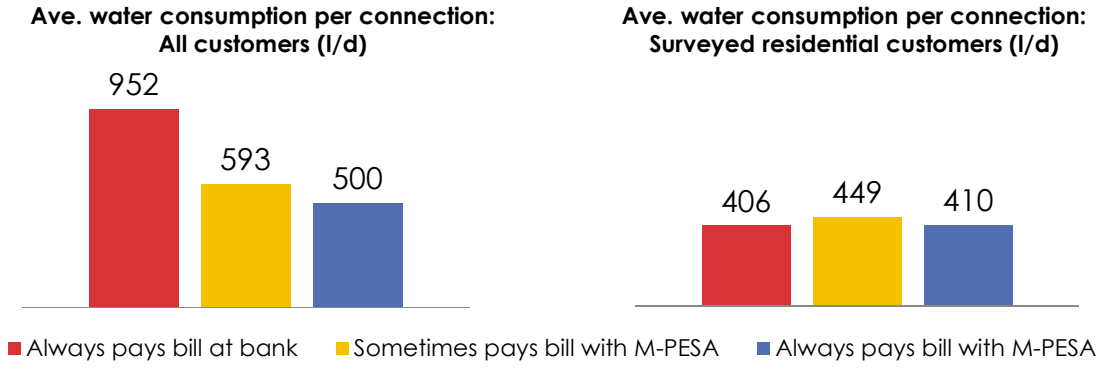
	Measure	Paying water bill with mobile money (n=132)	Paying water bill at bank (n=61)	All piped water households (n=193)
Socio-demographic	Average household size (st.dev)	4.4 (1.6)	4.4 (1.8)	4.4 (1.6)
	% of children to adults (dependency ratio)	31%	33%	32%
	% adults with secondary education	49%	45%	48%
	% adults with no education	6%	6%	6%
	% adults in full-time employment	39%	32%	37%
	% of self-employed adults	34%	32%	33%
	Average no. of years living in Kiamumbi (st.dev)	8.1 (7.0)	8.1 (6.6)	8.1 (6.9)
Technological	Average mobile handsets per household (st.dev)	2.7 (1.2)	2.9 (1.7)	2.7 (1.4)
	Average SIM cards per household (st.dev)	3.3 (1.5)	3.6 (1.9)	3.4 (1.6)
	Safaricom share of total SIMS owned (%)	84%	81%	83%
Wealth	Average adult equivalent expenditure (USD/yr)	2008 (1615)	1906 (1462)	1977 (1568)
	% of households in upper expenditure quintile	23%	20%	22%*
	% of households in lower expenditure quintile	16%	11%	15%*
Water service quality	Satisfaction with piped water services (%)	82%	82%	82%
	% of households with water 7 days per week	74%	66%	72%
	% of households rating water taste as 'good'	36%	34%	35%

Table 4. Significant predictors of mobile water payment adoption in Kiamumbi (n=193)

	B	std. error	Sig	Exp(B)
No of adults with university degree	-0.44	0.15	0.00	0.65
No of adults employed full-time	0.49	0.21	0.02	1.63
No of adults self-employed	0.42	0.22	0.06	1.52
Adult female pays electricity bill by mobile money	1.33	0.47	0.01	3.78
Adult male pays electricity bill by mobile money	1.02	0.38	0.01	2.78
Constant	-0.21	0.39	0.59	0.81
Observations	193			
Pseudo R^2	0.19			
Hosmer and Lemeshow test	0.65			

Likewise, household water use appears to have little bearing on mobile payment adoption in Kiamumbi. Though large water bills tend to be paid at the bank rather than by mobile money - the average daily water consumption for those paying by M-PESA is 0.5 m^3, compared to 0.95 m^3 for bank payers – we believe this discrepancy is due to the presence of apartment complexes and businesses. Though high consuming clients, these commercially oriented customers appear to favour paying bills in person. Possible explanations for this include the need for businesses to collect paper-based receipts, concerns about transferring larger sums of money via mobile money, and the higher transaction fee which payments over USD 100 attract. Indeed, the customers whose water bills attract the highest M-PESA fee of USD0.30 are four times less likely to use M-PESA than their counterparts paying a USD0.20 fee. However, when coupling the Kiamumbi billing data with the results of the household survey (which excluded commercial clients), a more nuanced understanding of the relationship between domestic water use and M-PESA payment emerges. The analysis reveals very little difference in per capita water consumption levels by bill payment method (Figure 11).

Figure 11. Customers paying bills with M-PESA consume less water on average, though relationship no longer holds for residential customers



4.4 Explaining Kiamumbi's success

Though the above analysis yields insights into drivers of water user payment decisions within Kiamumbi, it fails to explicate why this community has adoption rates more than seven times higher than any other urban setting investigated. This disparity is even more remarkable when considering the basic nature of KWT's mobile payment offering, which lacks the ability to conduct balance enquiries, provides no confirmation receipt via SMS, and is absent any automated, real-time reconciliation with the billing system. In order to explain Kiamumbi's outlier status, broader contextual aspects need to be considered.

Though an obvious starting point, the relative penetration of mobile handsets and use of M-PESA does not appear to be responsible. In Kiamumbi, 99 percent of households served by KWT own a mobile phone, and 95 percent are registered to use M-PESA. Though high, these figures are comparable with households throughout urban Kenya. In 2009, 93 percent of urban Kenyan households with piped water connections owned a mobile phone,[10] a figure that would certainly be higher in 2011. By December 2010, it was estimated that 86 percent of urban Kenyan adults used mobile money (World Bank 2010), again a figure which is likely to be higher for adults who also enjoy a piped connection. Hence mobile ownership and M-PESA use in Kiamumbi is broadly representative of urban Kenya.

There are six other interrelated factors that may explain Kiamumbi's unparalleled success:

[10] Based on analysis of data from the Kenyan 2009 Demographic and Health Survey.

Distance to pay point relative to mobile money agent. The 4 km distance to the nearest bank may make the mobile payment a more valuable service for Kiamumbi customers relative to water users in other urban centres, where alternative pay points are more proximate. This is compounded by the fact that the closest M-PESA agent is within walking distance for Kiamumbi residents.

High opportunity cost. The average Kiamumbi resident appears to be of a higher socio-economic status than the average urban Kenyan household with a piped water connection (see Appendix III). This may result in a higher value placed on the time costs associated with manual payment processes, thus increasing the likelihood of preferring to pay remotely via mobile phone.

Satisfaction with water service. Kiamumbi customers expressed a high degree of satisfaction with the water service provided by KWT. Of the households surveyed, 97 percent of customers were either satisfied (41%) or very satisfied (56%) with KWT service delivery. This is reinforced by the impressive operation and financial performance of the scheme, which is far superior to the indicators reported by WSPs across urban Kenya (see Appendix III). However, regression analysis suggests this relationship by different metrics of service delivery or stated satisfaction is not significant in predicting mobile payment adoption.

Size and ownership. Unlike the other WSPs examined in this study, Kiamumbi is a small and privately-owned scheme with 700 connections. With this comes the benefit of a more personal service. Billing issues can be resolved on the spot by dealing directly with the scheme manager. The personal nature of the KWT operations may therefore play a key role in alleviating customer concerns as to the security and integrity of the M-PESA payment option. This, in combination with the service reliability dimension, may explain why only 5 percent of bank payers identified security concerns as the reason why they had not transitioned to the mobile payment option.

The size of the community may also have facilitated greater awareness of the mobile payment option through word of mouth. Mobile water payment deployments elsewhere indicate lack of customer awareness to be a key hurdle (see Section 4). Though limited knowledge and awareness was also evident in the survey responses from Kiamumbi, it is perhaps less prevalent than one would expect given KWT undertook no advertising beyond a note at the bottom of bills.

High water service tariffs. KWT has set water tariffs that are considerably higher than the most urban WSPs in Kenya. The average price per cubic meter of water in Kiamumbi is almost double the urban average reported by Kenya's Water Service Regulatory Board. The reason behind this disparity is that Kiamumbi tariffs incorporate full O&M costs, plus 40 percent of the upfront capital costs including debt servicing. As a result, the M-PESA transaction tariff makes up a much smaller proportion of the overall monthly water bill in Kiamumbi compared to other Kenyan settings (see Figure 13). It may well be that this lower percentage increase encourages more customers to switch to the mobile payment option.

Taking these points into consideration, Kiamumbi still provides a relevant benchmark to which other mobile water payment deployments can aspire. It remains to be seen whether the larger service providers can replicate this success in more complex urban environments. Nonetheless, when viewed against the information garnered though stakeholder interviews, it is clear that a number of the success factors discussed above can assist WSPs to overcome the obstacles preventing broader uptake of mobile bill payments.

5 Broader barriers to adoption

The uptake of mobile payments for water services will clearly be dependent on mobile money penetration levels more generally. It is therefore important to note industry growth rates have not tracked at the levels many expected in the wake of M-PESA's initial success. Indeed the 86% of urban Kenyan adults using M-PESA far outweighs the equivalent numbers in Uganda, Tanzania and Zambia. Mobile money players will therefore need to continue tackling a range of systemic barriers to adoption, the reach of agent networks and the broader regulatory environment (Mas and Radcliffe 2010, Davidson and McCarty 2011, GSMA 2011). However, it is worth considering that mobile water payment solutions could help drive growth in mobile money adoption rather than be constrained by it.

However, even in Kenya, where mobile money has penetrated deeply, relatively low mobile water payment rates have been observed. This indicates that there are other obstacles specific to water bill payments that are hindering uptake. Based on interviews with WSPs and MNOs, five key barriers to the adoption of mobile water payments have thus been identified:

Alternative pay points. The uptake of mobile water payments varies with the relative ease with which customers can access a physical bill payment location, as compared to a mobile money agent. It is likely that if there are numerous pay points throughout a city, mobile water payment volumes will remain low because potential time savings become negligible. The spatial distribution of pay points for the examined WSPs vary greatly, from a single utility pay point in Kisumu to over 800 point-of-sale locations for GPRS-enabled payment in Dar es Salaam (Table 5). Most noteworthy is the move by the National Water and Sewerage Corporation (NWSC) in Uganda to forge partnerships with 15 major banks, so customers can settle their bills at hundreds of branches across the country. Similarly, in Nairobi, NCWSC estimates that all customers are within one kilometer of either a dedicated pay point or a partnering bank branch.

Table 5. Alternative pay points made available to customers

Country	WSP	Physical water bill pay points	Mobile money footprint
Tanzania	DAWASCO	• 14 DAWASCO offices • Partnerships with Barclays Bank, Bank of Africa, CRDB Bank and NMB Bank • 1500 Selcom point of sale devices (800 in Dar es Salaam)	Airtel Money: 3,500 agents TigoPesa: 6,000 agents M-PESA: 12,000 agents
Uganda	NWSC	• Partnerships with Bank of Africa, Centenary, PostBank, Crane, DFCU Bank, Standard Chartered, Barclays Bank, United Bank for Africa, Ecobank, National Bank of Commerce, Citibank, KCB, Equity, Diamond Trust and Global Trust Bank	MTN: 5,000 agents
Kenya	Nairobi City WSC	• 9 Nairobi City WSC offices • Any Nakumatt supermarket • Partnership with Equity Bank, Barclays Bank, Co-operative Bank, K-Rep Bank and Postal Corporation of Kenya	M-PESA: 28,000 agents
	Nanyuki WASCO	• 1 NAWASCO office • Nanyuki Branch of K-Rep Bank	
	Kisumu WASCO	• 1 KIWASCO office	
	Kiamumbi WT	• Bank branch in Zimmerman	
Zambia	Lusaka WSC	• 35 Lusaka WSC paypoints • Zanaco and Standard Chartered mobile and internet • Zanaco bank branches	Airtel Money: 2,000 agents
	Nkana WSC	• 8 Nkana WSC pay points • ~20 Celpay agents • Zanaco and Standard Chartered mobile and internet • Barclays Direct Debit • Rural Development Councils (RDCs)	

Delayed reconciliation. A number of deployments lack a mechanism for automatically updating the WSPs billing system immediately upon receipt of a mobile payment. Instead, there is a delay between the transaction and the reconciliation of the billing system, which in some cases is done manually. In certain

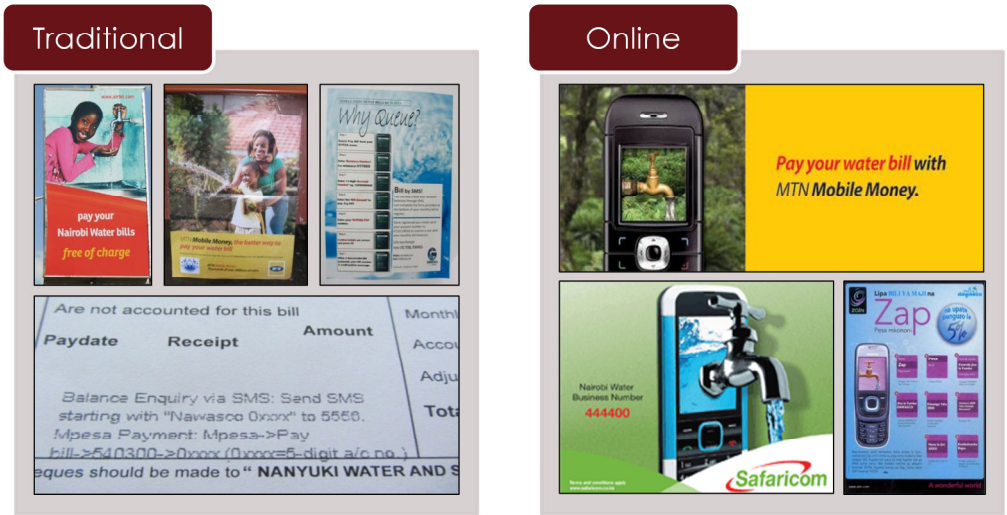
instances this delay has led to erroneous disconnections for last-minute payers, an outcome that has obvious ramifications for customers' faith in the integrity of the mobile payment system.

In Uganda, Tanzania, and Zambia, bespoke solutions have thus been developed to electronically link mobile money platforms with WSP billing databases to allow for automated and immediate reconciliation. In these cases, an SMS is sent to the customer from the WSP to confirm that the payment has been received. In Kenya, the mobile water payment systems have not been customised to enable this automated link. Hence, while the transaction itself takes place in real time, the payment information on the WSP side is generally updated in batches at the close of business or the following day. To cater for this delay and avoid erroneous disconnections, Kenyan WSPs have now had to build in a time buffer between payment deadlines and generation of disconnections lists.

Though integrated systems are clearly desirable, their development has proven to be a key implementation challenge in all four countries. From the MNO's perspective, the multitude of billing systems in place makes it difficult to produce an off-the-shelf solution. Yet many WSPs lack the IT capacity and record keeping systems to generate a solution themselves. In Tanzania, a third party provides the necessary data linkage services. In Uganda, NWSC and the mobile money providers worked together for two months to set up the required system. In Zambia, Airtel has taken the lead, aided by the fact the Commercial Utilities have in place similar billing systems. In Tanzania, the task was outsourced to a third party, Selcom Mobile. Paradoxically, it is in Kenya, where mobile water payments are most widely available, where integration of billing systems and mobile money platforms remains an unresolved challenge.

Limited awareness. Insufficient marketing and advertising of mobile water payment options have resulted in an overall lack of awareness in many of the study locations. In smaller population centres, such as Kisumu and Nanyuki, MNOs are unwilling to invest significantly in advertising water payments, while WSPs are constrained by limited budgets. In contrast, MNOs have been leading well-funded campaigns in Nairobi and across Uganda, where customers are high in number. For example, MTN in Uganda has taken on marketing responsibilities via a range of means (i.e. radio, newspapers, billboards). That NWSC has achieved the highest mobile payment adoption levels of all the large-scale deployments may in part be attributable to these efforts. Airtel has executed a similarly professional and visible promotion of their free bill payment service in Nairobi. Conversely, in Dar es Salaam there has been very limited marketing of mobile water payments by both MNOs and WSPs, which may account for the small number of customers who have made the switch.

Figure 12. Means of advertising the mobile water payment option



Physical proof of payment. As an inherently paperless system, mobile bill payment transactions lack the physical receipts that have traditionally presented an unambiguous proof of payment and defence against disconnection. The unease associated with conducting a transaction that provides no physical proof undoubtedly hinders wider uptake. This was cited by all WSPs, who pointed to both customer and WSP employee hesitancy to accept an SMS as proof of payment. Even for Kenyans, who are more familiar with mobile money, distrust in a paperless bill payment remains a barrier. All mobile money providers issue an electronic confirmation of the payment via SMS. What is needed however is an enforceable electronic receipt issued by the utility that will be accepted by staff in the event of a billing dispute. Unlike in Kenya, utility branded SMS receipts are issued by NWSC in Uganda and DAWASCO in Tanzania. However, even then, achieving widespread acceptability of paperless receipts will take time, especially where a more general distrust of a WSP prevails.

High transaction tariffs. Transaction tariffs levied by MNOs on customers varied from free payments in Dar es Salaam (M-PESA), Lusaka (Airtel) and Nairobi (Airtel), through to an average charge of USD0.30 in Nanyuki. Higher fees may prohibit adoption by low-income households who find it necessary to pay their bills in smaller instalments – a behaviour already being observed by some in Tanzania. In Kenya, the M-PESA charges are substantially higher, owing in part to the dominant market position enjoyed by Safaricom in that country. The cost of a mobile transaction must be measured against the cost of travelling to a payment office (USD0.40 in Kisumu and USD0.50 in Nanyuki for bus transport) and the opportunity cost of waiting in queues once a customer arrives there. This calculus is no doubt why only two percent of bank paying customers in Kiamumbi considered the USD0.20 M-PESA fee to be prohibitive. It is also important to note that pricing is constrained by an MNO's agent commission structure, which is designed to support a wide range of transaction types. As a result, it appears that some MNOs are achieving only slim profit margins on water bill payments (Table 6).

Measures can be taken to help WSPs and MNOs overcome the abovementioned obstacles and increase mobile payment volumes. First, a greater emphasis on marketing the mobile payment option will increase awareness of the option and allow customers to actively make a choice. Second, confirmation of payment SMS messages will help to improve trust in the service and may reduce hesitancy to adopt or trial the option. Third, real-time and automated reconciliation of payment with the WSP billing system appears to be essential for consumer confidence and widespread adoption. Finally, greater customer usage is likely to result where the WSP is prepared to foot the bulk of the MNO transaction fee, which could be justified on the grounds of their potential efficiency savings and uptick in collection rates.

6 Distributional impacts for users, providers and operators

Given the array of different institutional, pricing, and commercial landscapes across the study countries, it is difficult to generalise on the how the costs and benefits of mobile water payment are shared across water users, WSPs and MNOs. Nonetheless, the distribution of costs and benefits is influenced by several factors. Above all, the magnitude and structure of mobile water tariffs govern the distributional impacts. These tariff arrangements are in turn a function of the relative bargaining power of the WSP and MNO, and thus shaped by the degree of competition among MNOs and the relative size of the utility. Agent commission are an additional constraint from an MNO's perspective. Also important are the pre-existing bill payment methods and their relative transaction costs, which dictate the potential time and cost savings for customers, and efficiency savings for WSPs. Finally, the institutional reach of the water service regulator and its position on the mobile payment pricing arrangements also plays a role in how the benefits are distributed.

Tariff Structure. In all the study sites, the MNO draws revenue from charging a fee per bill payment transaction. Each fee agreement is borne out of negotiations between WSPs and MNOs. Despite the geographical proximity of the four focus countries, a multitude of tariff arrangements are in place (Table 6). These vary by (a) who pays the fee, and (b) how the fee is calculated. The MNO fee can be borne by the water user, by the WSP or shared between the two of them. The amount charged is calculated using three different formulae:

Fixed: A flat fee is charged on each mobile water payment regardless of the transaction value

Stepped: Fees are applied to tiered bands of bill payment values – fees are generally higher when larger values are transferred

Percentage-based: The fee paid is a fixed percentage of the transaction value

Table 6. Mobile payment tariff structures

Country	Water Service Provider	Mobile money option	Who pays MNO fee?	Fee paid by water users	Fee paid by WSPs
Kenya	Nairobi City WSC	M-PESA	Shared	Stepped	Stepped
	Kisumu WASCO	M-PESA	Shared	Stepped	Stepped
	Nanyuki WSC	M-PESA	Shared	Stepped	Stepped
	Kiamumbi WT	M-PESA	Shared	Stepped	Stepped
Tanzania	DAWASCO	Airtel Money	Shared	Fixed	Percentage-based
		M-PESA	WSP	-	Percentage-based
Uganda	NWSC	MTN Mobile Money	Water User	Stepped	-
		UTL M-Sente	Water User	Stepped	-
Zambia	Lusaka WSC	Airtel Money	WSP	-	Percentage-based

MNO Competition. Some WSP representatives cited competition amongst MNOs as a particularly effective tool to achieve the best pricing outcomes for both the utility and customer. Indeed, the more commanding the market share of an MNO, the less flexible they are likely to be in pricing negotiations. The dominant Safaricom, for example, allows WSPs to choose from a selection of three standardised tariff structures. These formulations are not specific to water service providers, and there is no room for tailoring the tariffs to specific contexts. As a result, the majority of water users pay USD0.20 for paying their water bills via M-PESA. Encouragingly, the emergence of new mobile money providers is now benefitting water users Nairobi. In attempt to capture more of the mobile money market, Airtel is now offering a free mobile water payment option. The role of competition is also evident in Dar es Salaam, where DAWASCO was able to arrive at unique terms with fierce competitors Airtel and Vodacom.

It is also important to recognise that, from a bill payment perspective, mobile money providers are in direct competition with banks and other physical pay points. For example, when vying for NWSC bill payments, the numerous bank branches at which Ugandans can settle water bills likely present more potent competition for MTN than mobile money rivals UTL. Similarly, when competing directly with utility pay points in Zambia, Airtel Money viewed it as important to offer free transactions for customers, particularly given the nascent mobile money landscape.

Regulator stance. Water service regulators and their perceptions of mobile water payments can influence how tariffs are structured and shared. Kenya's Water Services Regulatory Board (WASREB) and Tanzania's Energy and Water Utilities Regulatory Authority (EWURA) are interested observers but have chosen to not

intervene in the growth and use of this novel option. Conversely, in Zambia, the National Water and Sanitation Council (NWASCO) has expressly prohibited commercial utilities from directly passing mobile water payment charges onto customers.

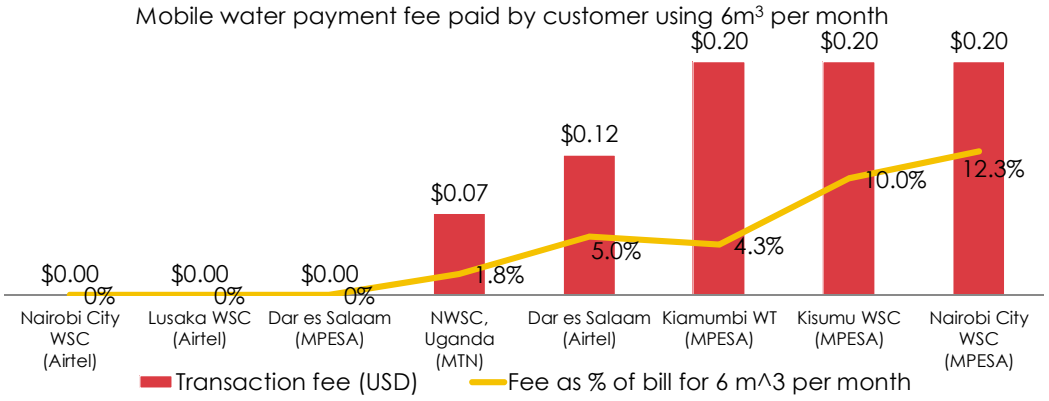
6.1 Water Users

As seen in Kiamumbi, time and cost savings are the two clear customer benefits arising from the use of mobile money for paying water bills. In terms of time savings, lengthy queues at water offices and banks appear to be a universal aspect of paying water bills in our study countries. Kisumu is perhaps the most extreme example - serving 180,000 people across the city, KIWASCO issues all bills with the same monthly deadline and accepts payments at only one location. In other contexts, it is the cost of travel to the payment location that is considered a more important factor. These costs can be particularly high in smaller urban areas such as Kisumu (USD0.40) and Nanyuki (USD0.50) where public transport is limited and pay points are geographically sparse. Time savings appear to be more important in larger urban areas such as Nairobi and Kampala, where bank partnerships and extensive public transport networks simplify the task of reaching a payment location.

The relative benefits of mobile water payments for low-income households remain unclear. Certainly in Kenya, the M-PESA fees do not cater for households with variable or low incomes and penalise those wishing to pay their bills in small but multiple instalments. Most stakeholders interviewed felt it was the wealthier and professional segments which are most likely to use this payment service. MTN Mobile Money purposively targets this segment with their mobile water payment marketing. The socio-economic profile of mobile water payment usage likely stems from a combination of factors. First, mobile phone and mobile money penetration remains higher amongst the wealthiest sections of the population. Second, the potential time savings associated with paying bills via mobile phone is likely to be less highly valued by low income households. Third, only 35 percent of urban Africans have an individual piped water connection and this is strongly correlated with household wealth (AICD, 2010). Nevertheless, the rise of free payments for water users in Tanzania and Zambia is promising, and may well lead to a more equitable distribution of benefits.

In most cases, the quid pro quo comes in the form of a transaction fee charged by the MNO. Averaging USD0.20 per bill payment, M-PESA users in Kenya are subject to the highest fees in the region (Figure 13). Juxtaposing this tariff are the free customer options offered by Vodacom in Dar es Salaam and Airtel in Lusaka and Nairobi. While the latter two deployments are still in their infancy, the free Vodacom service has attracted surprisingly few customers.

Figure 13. Kenyan customers paying water bills via mobile money incur the highest charges in the region



6.2 Water Service Providers

The use of mobile water payments promises two direct benefits to WSPs:

Cost savings related to handling/processing bills. When customers switch to mobile water payments, utilities can eliminate physical payment infrastructure, thereby reducing costs associated with rent, labor, security and insurance. These benefits are afforded different weighting in our study sites. In Zambia, WSPs emphasized the reduced rental and labour costs associated with collecting revenue at official pay points. In Kenya and Uganda, savings related to insurance and secure cash transportation were seen as paramount.

With limited empirical data, potential savings for WSPs remain speculative at best. At the launch of the mobile water payment service, NWSC in Uganda predicted that its annual savings in operations and maintenance costs would exceed USD420,000 per year as a result of closing its pay points.[11] In response to the addition of mobile-enabled payment options, Nkana WSC in Zambia also closed two of its pay points, at an annual saving of USD23,000. The modest nature of these estimates should however be noted, as in both cases the savings represent less than one percent of the respective cost bases for each utility. However, further savings may emerge from automated billing processes if they reduce accounting errors and the need to resolve customer complaints

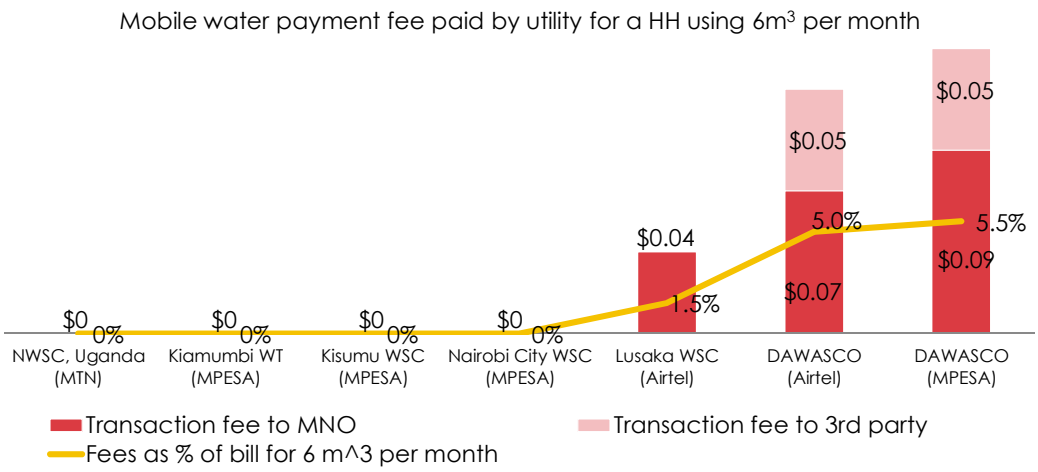
Increased revenue collection through timelier bill payments and improved collection efficiencies. Though it is premature to quantify changes in revenue collection, NWSC in Uganda reports that monthly revenues have increased an average of 33 percent since the advent of the e-water system.[12] DAWASCO in Tanzania also believes its collection rates have increased as a result of mobile water payments, though with less that 1 percent of users paying via mobile phone, it is more likely that any significant changes are derived from payments made at GPRS-enabled points-of-sale. In Kiamumbi, billing records show those paying via M-PESA are 10 percent more likely to pay their bills by the deadline. Initial data from Kiamumbi and Kisumu also suggest monthly disconnection numbers have declined since the M-PESA option was introduced. Though proving a causal connection is problematic, such findings align with prior research which suggests that more flexibility in paying water bills will result in a greater number of on-

[11] http://www.monitor.co.ug/Business/-/688322/1108256/-/3r115b/-/index.html
[12] http://www.newvision.co.ug/D/8/220/757067

time payments (Mugabi et al 2010). Revenue collection could be further bolstered by increased trust and security associated with an automated billing process that reduces the risk of human error, which in turn may lift customer confidence in the utility and willingness to pay for the service. Any such improvement in collection efficiencies could have a substantial impact – the WSPs currently offering mobile water payments have a weighted average collection efficiency of 85 percent, suggesting a total of USD16 million worth of bills go uncollected every year.

On the other side of the equation, any benefits need to be viewed alongside the mobile transaction fee paid by the WSP. With the exception of NWSC in Uganda, all WSPs are subject to tiered or variable pricing structures. Thus the degree to which WSPs share the cost depends on the size of the bill. For example, Kenyan WSPs avoid contributing any mobile payment fee for a household consuming six cubic meters per month (Figure 14). In contrast, DAWASCO pays between USD0.09 and USD0.12 depending on the mobile money provider, and Lusaka WSC pays USD0.04. As the transaction value rises, the Kenyan WSPs take more of the share, though in Kisumu this is not until the volume consumed hits 20 cubic meters per month or 25 cubic meters in Nairobi (see Appendix IV and V).

Figure 14. Water service providers in Tanzania and Zambia are paying a greater share of the mobile money fee



6.3 Mobile Network Operators

By offering water bill payments, MNOS enjoy dual benefits of revenue from transaction volumes and greater customer loyalty.

Direct revenue. The primary motivation for most MNOs offering the mobile water payment option is revenue generation. As a predictable monthly transaction, the water bill payment option is a natural fit within a mobile money provider's suite of products. The revenue generated by the mobile water payment option varies by agreement – for an average water bill paid via mobile money, MTN in Uganda would receive USD0.09, Vodacom would earn USD0.64 in Dar es Salaam, and Safaricom would take in USD 0.30 (Table 6). The involvement of cash-in/cash-out functions makes it difficult to calculate average MNO profit margins from each bill payment, but it is possible that some MNOs may lose money on mobile water payments that involve a single cash-in transaction solely for paying water bills (i.e. where the agent commission outweighs the bill payment transaction fee). Table 6 contains indicative estimates of profit margin ranges for Kiamumbi, Dar es Salaam and Uganda.

Table 7. Estimated MNO profit margin for average mobile water bill payment (USD)

	Kiamumbi (M-PESA)	DAWASCO (M-PESA)	NWSC (MTN)
Ave bill paid via mobile money	14.57	18.22	13.00
Mobile money fee paid by customer	0.20	-	0.09
Mobile money fee paid by utility	0.10	0.64	-
Third part data integration fee	-	-0.06	-
Max MNO profit margin	0.30	0.58	0.09
Agent commission if cash deposit	-0.10	-0.18	-0.09
Min MNO profit margin	**0.20**	**0.40**	**0.00**

The relatively modest size of the MNO revenue generated through the bill payment service should be highlighted. In Uganda, though around USD 300,000 worth of water bills are paid via MTN Mobile Money, this generates less than one percent of monthly revenue for the mobile money service, which itself accounts for less than five percent of MTN's total revenue in Uganda. Similarly in Tanzania, DAWASCO bill payments amount to less than one percent of both Airtel and Vodacom's monthly revenue

Churn reduction. Customer loyalty is also an important consideration, and for some MNOs it stands as the principal reason to offer a water bill payment service. Indeed, analysis undertaken by GSMA (2011a) suggests that 33 percent of revenue generated by MTN Mobile Money in Uganda was the result of a reduction in customer churn. In line with this, in Tanzania both Vodacom and Airtel view mobile water payments more as an opportunity to build customer loyalty rather than a means to directly drive revenue.

7 Implications for sustainable service provision

With the mutual benefits that mobile water payments afford, it is hoped this revenue collection mechanism can help provide the circuit-breaker that many African utilities seek to escape the vicious cycle of low cost recovery and poor operational performance. Efficient revenue collection is vital for WSPs to achieve cost recovery, which in turn is critical to the ongoing reliability of the service. Yet many urban water services in Africa are beset by decrepit and inadequately maintained infrastructure, intermittent water supplies, dissatisfied customers, poor collection efficiencies and a weak financial base. This downward spiral ultimately leads to an inability to sustain and expand services. Inadequate billing and revenue collection is a chief contributor to this spiral of decline and continues to harm the creditworthiness of many WSPs.

Hence mobile water payment innovations can help disrupt the loop of weak financial and operational performance in two key ways. First, by lowering transaction costs of water bill payments for customers, revenue collection is likely to improve in terms of volume and immediacy of transactions. Second, by lowering transaction costs for utilities, operational efficiencies can be extracted and more flexible payment arrangements can be offered, meaning serving the poor (and expanding the customer base) becomes a more commercially attractive proposition. In tandem, these important gains can contribute to sector wide efforts to shift WSPs from a vicious to virtuous cycle of operational and financial sustainability. Ultimately, it is hoped this will translate into more reliable water services for customers, and network expansions for the unserved. Promisingly, mobile bill payment systems are being driven by commercial interests which augurs well for their long term prospects. The challenge now is to tackle the obstacles which hamper wider uptake and effectiveness of the mobile payment option.

8 Future innovations

Household connections are generally limited to wealthier segments of urban Africa – approximately 65 percent of urban residents lack piped water supplies to the dwelling. Thus, in their current format, mobile water payments are likely to have only a limited impact on low-income households. If they are to benefit the poor, future mobile water payment advances will need to push technological and pricing boundaries. With technical and commercial innovations, mobile payment solutions could provide a tool to address water service challenges relating to prepaid metering, public standpipes, and rural water supplies.

Prepaid metering. WSPs are increasingly turning to prepaid water metering as a way to reduce the risks associated with serving low-income areas. Of the WSPs interviewed in this study, prepaid metering pilots are being planned or are underway in Nairobi, Nanyuki, Kisumu, Dar es Salaam, Kampala, Lusaka and Nkana. Varying 'top-up' technologies are being adopted but distributing credit remains a challenge. For example in Kisumu and Nanyuki prepaid customers can only purchase credit at the head office of the WSP during business hours, a trip that costs between USD0.40 and USD0.50. Given a pay-as-you-go approach will necessitate a high frequency of transactions, providing convenient and accessible channels for distributing credit will need to extend beyond the provision of a point-of-sale device in utility payment offices.

A mobile money top-up solution was endorsed by all WSPs interviewed as a low-cost means of distributing credit at any hour of the day. Moving in this direction, however, requires the integration of billing systems and overcoming the challenge of providing a reliable source of power for the meters. No companies were able to offer this capability for a recent prepaid metering project in Uganda. However, prepaid electricity meters are already being linked with mobile money systems in Tanzania and Uganda, and the strong demand for prepaid water meters indicates that the implementation of these systems is only a matter of time.

GPRS Points-of-sale

Though not specifically targeted at low-income users, GPRS-enabled devices are a low-cost solution being used to expand the footprint of physical pay points, particularly in urban areas in Tanzania and Rwanda. Paying water bills at these locations incurs no additional costs for the user and minimises travel time as they are often located within frequently visited locations. In contrast to mobile payments, this method allows face-to-face transactions with the machine attendant. This feature and the paper receipt for customers may be an important bridge in the "trust" challenge facing mobile payment adoption rates.

Mobile bill payment tariffs may also need to be reconsidered for pay-as-you-go water services. For example, the USD0.20 M-PESA fee for a bill payment in Kenya would clearly be unaffordable for a low income household topping up a meter on a daily or weekly basis. At the same time, MNOs are restricted by the commissions they need pay agents to facilitate cash deposits. Creative solutions will therefore need to negotiate a narrow pricing envelope that is both commercially attractive to an MNO and affordable for low income households. Given their commercially proven 'pay-as-you-go' track record, a more radical approach could exploit airtime units as water meter credits. Mobile money agents could therefore be supplanted by more expansive airtime reseller networks.

Public standpipes. Removing cash-based transactions at public standpipes by incorporating mobile money capabilities presents a significant opportunity to better meet the needs of low-income water users. Despite social tariffs being commonplace, standpipe supplies in Africa are on average 2 to 3 times more expensive than water piped to the home, due to unregulated mark-ups by middle men (AICD 2010). It is estimated that approximately USD635 million is pocketed by standpipe operators every year at the expense of the urban poor. New solutions must include fee collection so that financial incentives exist for utilities to

reliably serve the poor, yet they need to do so in a way that avoids the unregulated mark-ups which prevent social tariffs reaching low-income groups. Mobile payments could underpin such solutions by eliminating the need for third-party operators and enabling a secure, cashless system capable of price monitoring and regulation. Importantly, mobile phone ownership among urban households obtaining water from standpipes is in excess of 80 percent in many African countries.

Mobile money solutions for standpipes would need to address the same power and pricing issues that confront prepaid meters. Overcoming some of these obstacles is an off-grid variant of the standpipe concept that has been rolled out by Grundfos across 17 peri-urban communities in Kenya.[13] This 'LIFELINK' water point abstraction and dispensing scheme has enabled a cashless prepaid system which is remotely monitored and reduces the risk of mark-ups. Though the capital expenditure requirement may restrict the pace at which this particular off-grid configuration can be scaled-up, it demonstrates the potential for mobile-payments to open up new business models for public water points and reshape the commercial incentives for WSPs to expand standpipe coverage.

Rural water payments. Mobile payment solutions could help boost the financial and operational sustainability of rural water systems. Across Sub-Saharan Africa, it is estimated that at least one-third of rural water points are non-functional (RWSN 2009). Inadequate revenue generation is a key obstacle to the ongoing operability of water points managed at the community level (Harvey, 2007; Carter, et al., 2010). With banking services both distant and expensive, mobile money offers a secure, low-cost, and geographically accessible mechanism option for storing funds for future repairs of rural water points. By enabling the collection and storage of electronic funds across large administrative units, mobile money might also unlock innovative supra-community management models that could drive a step change in rural water sustainability.

9 Conclusion

Mobile water payment systems present a promising tool that can meet the needs of water users, WSPs and MNOs. Our findings indicate water users can benefit from time and financial savings. This secure, low-cost and customer-friendly revenue collection mechanism can also assist WSPs in their efforts to achieve their twin goals of financial and operational sustainability. At the same time, MNOs can further their commercial objectives by driving revenues and retaining subscribers. However, with the exception of a small and privately-operated scheme on the outskirts of Nairobi, this compelling value proposition has yet to be matched by mobile water payment adoption rates. Work is now needed to tackle the operational and behavioural constraints which have hindered large-scale uptake. Creative innovation is also required to unlock mobile money solutions that can directly benefit low-income, unconnected water users. Despite its significant potential, mobile money is only an instrument for transferring and storing money in a secure and low-cost fashion. Ultimately, any transformational change will depend upon the institutional, financial, operational and regulatory responses that put this tool to good effect.

[13] See www.grundfoslifelink.com

Appendices

Appendix I. Indicative transaction costs by bill payment method in Kiamumbi

Country	Activity*	Measure	Remained with bank payment (n=61)	Switched to mobile money (n=132)	
				Bank payment prior to switch	M-PESA payment after switch
Time costs (mins)	Waiting time	Median	30.0	45.0	5.0
		Mean (st. dev)	44.8 (45.1)	51.0 (32.0)	7.6 (6.8)
	Return trip	Median	0.0	10.0	0.0
		Mean (st. dev)	19.1 (31.0)	39.3 (50.6)	4.4 (9.1)
	Total	**Median**	**60.0**	**70.0**	**10.0**
		Mean (st. dev)	**65.8 (56.9)**	**92.8 (60.6)**	**12.1 (12.0)**
Financial Costs (USD)	Return trip	Median	0.00	0.00	0.00
		Mean (st. dev)	0.14 (0.31)	0.22 (0.31)	0.00
	Transaction fee	Flat fee	0.00	0.00	0.20
	Total	**Median**	**0.00**	**0.00**	**0.20**
		Mean (st. dev)	**0.14 (0.31)**	**0.22 (0.31)**	**0.20 (0.00)**

* For bank payers, activity relates to trip to local bank branch; for mobile money payers, activity relates to trip to mobile money agent. If bank trip forms part of another activity, travel time is assumed to be zero. If mode of travel was by private vehicle, financial cost of trip is assumed to be zero.

Appendix II. Indicative transaction costs for Kiamumbi customers taking a trip by public transport exclusively to pay their water bills

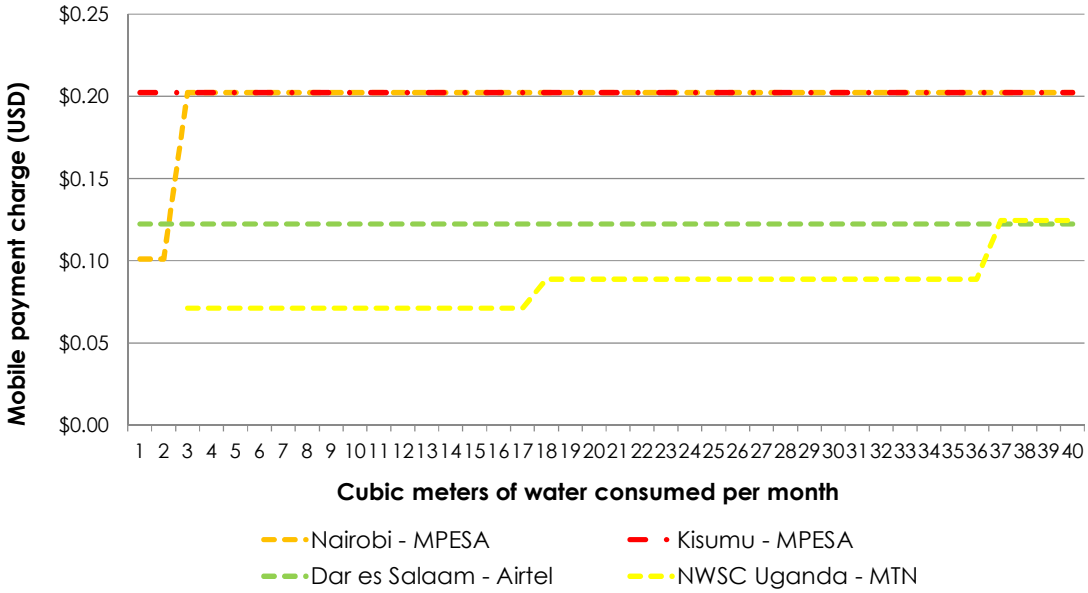
			Customers paying bills at bank	Customers switching to mobile payments
Time costs (minutes)	Waiting time at bank exclusively to pay water bill	Median	30.0	60.0
		Mean (st.dev)	39.1 (27.4)	50.2 (27.4)
	Return trip to bank by public transport	Median	60.0	60.0
		Mean (st.dev)	51.9 (31.0)	77.9 (45.4)
	Waiting time at mobile money agent	Median	n/a	5.0
		Mean (st.dev)	n/a	7.9 (6.4)
	Return trip time to mobile money agent (exclusive trip by foot)	Median	n/a	10.0
		Mean (st.dev)	n/a	16.7 (10.4)
Financial costs (USD)	Return trip to bank by public transport	Median	0.44	0.44
		Mean (st.dev)	0.55 (0.45)	0.55 (0.32)
	M-PESA fee for water bill payment	Flat fee	n/a	0.22

Appendix III. Comparison of asset ownership and water service indicators for households with piped water connections

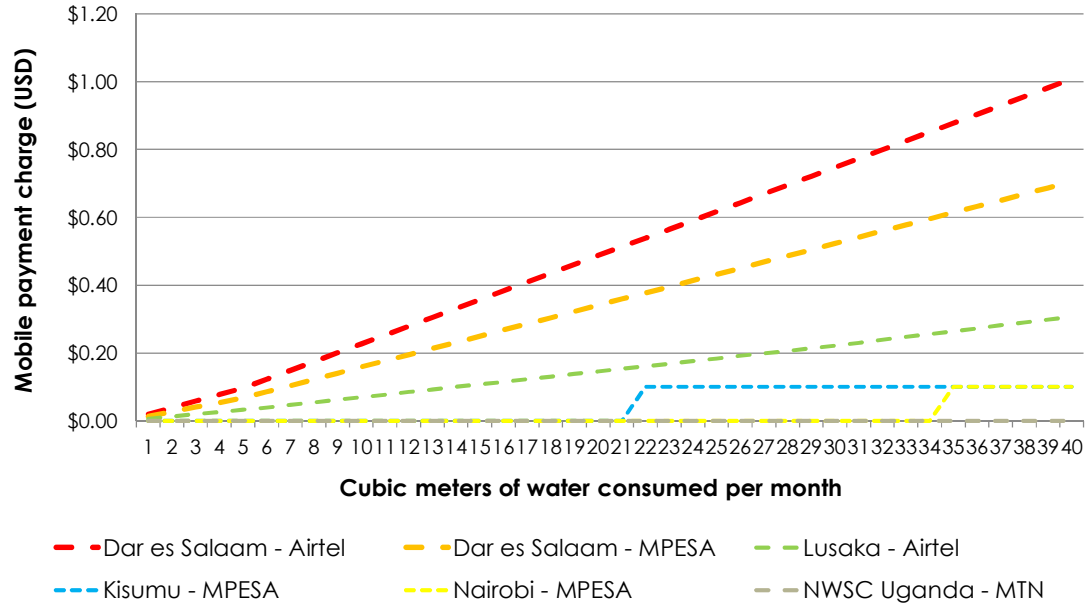
	Key metrics	Kiamumbi*	Urban Kenya**
Household ownership	Mobile phone	99%	93%
	Mobile money	95%	86%***
	Electricity	95%	81%
	Television	92%	69%
	Fridge	70%	32%
	Landline phone	8%	12%
	Solar panel	5%	4%
	Flush toilet	66%	69%
	Car	52%	21%
	Motorbike	2%	4%
Water service	Water use (l/c/d)	110	36
	Ave. tariff (Kshs/m3)	91	56
	Collection efficiency	98%	82%
	Non-revenue water	27%	45%
	O&M cost coverage	139%	109%

* Kiamumbi socio-economic data from June 2011 and KWT performance report (2011)
** Urban Kenya from DHS 2008/9 and WASREB (2011)
*** Figure taken from World Bank (2010) - refers to all urban Kenyans, regardless of piped water access

Appendix IV. Mobile payment charge paid by customer (by monthly household water consumption, for non-free services)



Appendix V. Mobile payment charge paid by water service provider (by monthly household water consumption)



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