WATER SUPPLY AND SANITATION SECTOR BOARD DISCUSSION PAPER SERIES

PAPER NO.5

JANUARY 2005

Water for the Urban Poor: Water Markets, Household Demand, and Service Preferences in Kenya

Sumila Gulyani, Debabrata Talukdar, and R. Mukami Kariuki

THE WORLD BANK GROUP

Water Supply & Sanitation Sector Board

ACKNOWLEDGMENTS

We are grateful to Alain Locussol for his advice on the study, Munguti Katui-Katua for leading the survey teams in the field, and Japheth Mbuvi for facilitating the fieldwork. We thank Catherine Revels, Vijay Jagannathan, Richard Verspyck, and Jonathan Halpern for their comments and Vimalanand Prabhu and Madhu Raghunath for providing research assistance. The views expressed here are neither attributable to, nor necessarily shared by, the World Bank.

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ABSTRACT

Compared with the non-poor, just how inadequately are the urban poor served by the public utilities and small-scale private water providers? Based on a survey of 674 households, this paper examines current water use and unit costs in three Kenyan cities and also tests the willingness of the unconnected to pay for piped water, yard connections, or an improved water kiosk (standpipe) service. By examining water-use behavior of poor and non-poor households, this study brings into question a long-standing notion in the literature—that the poor are underserved, use small quantities of water, and pay a higher unit price for it. It also indicates that the standard prescription to "price water and create water markets" is in itself insufficient to improve service delivery and that without appropriate institutional arrangements, technical solutions such as water kiosks may not succeed in delivering an affordable service to the poor.

Key words:
urban water supply, household demand, willingness to pay, urban poverty, Kenya, Africa

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1 INTRODUCTION

Access to safe water supply has been one of the top priorities in developing countries over the past three to four decades, and billions of dollars have been invested in pursuit of the goal of "universal service." And yet the general consensus at the 2002 United Nations World Summit on Sustainable Development was that the current reality—as well as the situation expected in the near future—are far from that goal (*The Economist* Sept. 7–13, 2002). In fact, recent reports emphasize that the world "is facing a serious water crisis" and that water access and service delivery in the developing world need to be improved dramatically and urgently, especially if we are to make gains in the fight against poverty, hunger, and disease (United Nations 2003). World leaders not only agree that water is an important part of the core development agenda but have also committed to ambitious targets for expanding access to water services. At the U.N. Millennium Summit in 2000 and subsequently at the Johannesburg Earth Summit in 2002, world leaders agreed to a set of time-bound and measurable development targets—widely known as the Millennium Development Goals for 2015—which include a commitment "to halve the proportion of people without access to safe drinking water" (Box 1).

Box 1: The Millennium Development Goals

These time-bound and measurable targets are aimed at reducing poverty, hunger, disease, illiteracy, environmental degradation, and discrimination against women. Although the target of reducing the proportion of people without access to safe water is technically included under the category of "environmental sustainability," it is widely acknowledged that many of the other goals—such as reduction of poverty and lowering of infant mortality rates—require improvements in water supply and sanitation (United Nations 2003 and http://www.un.org/millenniumgoals/).

Many experts seem to agree that poor access to water supply is often a result of poor policies and management practices; however, there is significant disagreement over the approach to addressing the problem. In direct opposition to lobbies demanding that water be treated as a human right, experts at agencies such as the United Nations and the World Bank argue that a first or crucial step toward improving the water situation and its management is to treat water as an economic good (for example, World Bank 2003a, United Nations 2003). *The Economist* is even more emphatic and specific—it concurs that water has been "ill-governed," but argues that the problem "above all, [is that] it has been colossally underpriced." It concludes that in meeting the ambitious water target of halving the proportion of people without access to clean water, " . . . money will play a part. But . . . greater reliance on pricing and markets are even more crucial" (*The Economist* July 19–25, 2003).

A review of the academic literature reveals both a more sophisticated diagnosis of the problem and a more detailed prescription for addressing it. The literature clearly shows that public utilities in developing countries often serve only a fraction of the urban population, with the vast majority relying on alternate sources. Microstudies in urban areas such as Port-au-Prince (Haiti), Jakarta (Indonesia), and Onitsha (Nigeria) show also that the urban poor are disproportionately underserved—poor households are almost never directly connected to the public utility, rely on vending systems, buy water by the bucket at very high unit prices, and hence consume very little water (Fass 1988, Whittington and others 1991, Crane 1994, World Bank 1994, 2003b). Poor households often pay vendors several times the unit price paid by connected non-poor households to the utility, and they use only a fraction of the amount of water used by the connected. In many areas, water vending is no longer a fringe activity, and vending systems account for a large proportion of total water revenues. In Onitsha, for example, the water vending system collects 24 times as much revenue as the public utility during the dry season (Fass 1988, Whittington and others 1991, Crane 1994, World Bank 1994, 2003b).

These findings strongly suggest that the widely used and well-intentioned public policy of keeping domestic water tariffs low is not working. According to the World Bank, this policy has resulted in massive and poorly targeted subsidization of service that has helped the rich (but not the poor), has hurt the financial viability of utilities, and has led to deterioration in service quality, and consequently to low willingness to pay by users—most communities are now caught in a low-price, low-quality equilibrium (World Bank Water Demand Research Team 1993).

To break out of this low-level equilibrium, World Bank experts contend, governments need to adopt a "demand-driven approach" in which utilities "deliver services that people want and for which they are willing to pay" (World Bank Water Demand Research Team 1993). There are two key ideas underlying the demand-driven approach (Gulyani 2001). First, utilities can and should charge full costs for water and use the revenues to improve service and expand coverage—that is, utilities should aim to move from a low-price, low-quality service for all households to a high-price, high-quality service for those who are willing to pay for it. Second, to do so, utilities and planners need to understand and respond to demand—quantity, price, and preferred service types and options—in every community they intend to serve because demand is highly location-specific. In other words, by pricing the water right, effecting demand, and then responding to effective demand for water, governments and planners are well on their way to solving the problem.

Designed as part of a larger inquiry into the problems and potential solutions for the water sector in Kenya,[1] this study examines household demand for water in three urban centers—Nairobi, Mombasa, and Kakamega. Drawing on detailed household surveys, we take a closer look at service access, water use, and prices and disaggregate the data by welfare level to examine the following question: Compared with the non-poor, how inadequately are the urban poor served by the public utilities and private water providers? We also compare the level of service provided by different systems and the level of user satisfaction with each. Finally, to help design and tailor interventions for serving unconnected households in these Kenyan cities, we examine which, if any, of three differently priced improvement options they would choose and why.

Using the term "water service" in its broadest sense to include water supplied by both the public utility and private providers (formal and informal), we find that neither the poor nor the non-poor are being well served. The clearest evidence of poor service comes from the two most basic and important service variables—price and quantity. In direct contrast to the literature, we find that both the poor and non-poor are using little water and paying a lot for it. Dissatisfaction levels are high across the board, and all households rate improvements in water supply as their top development priority. This does seem to be a case of water mismanagement, but one where the problem is anything but underpricing (either by the utility or by private providers) or lack of markets.

Overall, this study makes three contributions. First, it provides new policy-relevant empirical data on the situation in terms of water use and costs in these Kenyan urban centers. In addition, using

1 The "larger inquiry" refers to a joint review of the water and sanitation sector in Kenya by several bilateral and multilateral agencies, including the Agence Française de Développement (AFD), KfW Bankengruppe (KfW), Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, UK Department for International Development (DfID), and the World Bank. This study on household demand was one of several analyses and background papers commissioned for the review.

multivariate statistical analyses and discrete choice models, it identifies the key socioeconomic factors that influence households' decisions on whether to pay for an improved system. Unlike most previous studies that focus on either the households' current water supply situation or their willingness to pay for hypothesized future improvements, this study does both. This allows us to investigate whether households' stated willingness to pay is backed by an ability to pay and how it is linked to their current water supply situation.

Second, it shows that in some urban centers, the poor may not be the only ones suffering from an inadequate water supply service.

Third, it finds that tariffs are, in themselves, a limited and partial tool for influencing service delivery. This is a case where utilities charge cost-recovery-level tariffs, but these have not automatically translated into financially solvent utilities that deliver a good service. And although utilities deliver water at a highly subsidized tariff to kiosks used by the poor, this has not translated into low purchase prices for the poor. While these observations regarding the limited potential of tariffs may seem obvious, much of the current discourse on service and utility reform continues to place an extraordinary amount of faith in the power of "correct" prices (*The Economist* July 19–25, 2003).

The paper is organized as follows. Section 2 outlines water supply arrangements, performance issues at the utility level, and the reform agenda. Section 3 delineates the study design and data collected. Section 4 presents the stated development priorities of the households surveyed. Sections 5 and 6 analyze the actual water situation at the household level in terms of water-use levels, prices, and other service variables—broken down by household income level (Section 5) and by type of water source (Section 6). Section 7 investigates households' stated preferences and willingness to pay for improvements in their water system. Section 8 summarizes and discusses policy implications.

2 SUPPLY ARRANGEMENTS, PERFORMANCE OF URBAN UTILITIES, AND THE REFORM AGENDA

Water supply and sanitation services in Kenya are delivered under several different institutional arrangements. The Ministry of Water Resources Management and Development (MWRMD), the publicly owned but corporatized National Water Conservation and Pipeline Corporation (NWCPC), and local authorities are responsible for the supply of water or sewerage services or both in various urban and rural areas. MWRMD and NWCPC typically do not operate wastewater facilities, leaving these (where they exist) to local authorities. Ten "gazetted" local authorities,[2] including Nairobi, operate their own water and sewerage systems. "Self-help" groups (registered with the Ministry of Gender, Sports, Culture, and Social Services) operate piped water systems in some urban and rural areas. Private water vending by small-scale independent providers has also grown, owing to the deterioration of public piped water systems.

In 2003, urban areas were home to 36 percent of Kenya's total population of 32 million (World Bank 2004a). Of the 201 urban centers in the country, 109 have piped water systems—73 are managed by MWRMD, 26 by NWCPC, and 10 (including Nairobi) by local authorities. Known

2 A gazette was a periodical publication giving an account of current events; "to be gazetted" meant to be the subject of an announcement in the official gazette; to be named in the gazette as appointed to a command, etc. (*Source*: Oxford English Dictionary).

facts regarding the water supply situation and utility performance in Nairobi, Mombasa, and Kakamega, as reported by the World Bank (2001, 2004b), are presented below.

In Nairobi, the capital city with a population of about 2.3 million in 2003, service is provided by the Water and Sewerage Department of the Nairobi City Council. Nairobi has an installed production capacity of 420,000 cubic meters per day and 182,295 legal connections, of which 164,000 are domestic connections; often, water from a single connection is shared by multiple households. Although the production capacity is large and theoretically sufficient to meet demand, total water available for actual sale and use is significantly lower—unaccounted-for water (UFW) in the system is estimated to be about 50 percent. The UFW is attributable to both technical losses (leakages, especially in older pipes) and commercial losses (unbilled and uncollected revenues and theft). Both bulk- and client-level metering are highly inadequate, and the data on water use and losses are unreliable. For households, bills are based on presumed consumption. The billings system is poor, collection efficiency (or revenues collected as a proportion of total billed) is 65 percent, and accounts receivable stand at more than two years of billings.

Water service in Mombasa, an urban center of about 715,000 residents, is managed by the NWCPC's Coastal Region Operations office as part of a larger system that also covers four smaller towns (Voi, Malindi, Kilifi, and Kwale). The Coastal Region's integrated water supply system has a combined source capacity of about 160,000 cubic meters per day, but the total transmission capacity is only about 120,000 cubic meters per day. All of the 57,500 connections (53,000 domestic connections) are metered, but about one-third of these meters do not work. UFW is estimated at 40 percent. Billing efficiency is 62 percent, collection efficiency is 67 percent, and accounts receivable represent more than 15 months of billings. In Kakamega, an urban centerwith about 61,000 residents, the water utility has 4,000 connections, and this is also managed by the NWCPC. (Additional utility-level data on Kakamega's system are currently not available to us.)

According to the World Bank (2001, 2004b), urban centers such as Nairobi and Mombasa are caught in a cycle of declining investment, quality of service, and financial returns, characterized by (a) low coverage and unreliable service, (b) high levels of UFW and unpaid bills, (c) poor financial management, (d) revenues insufficient to cover operations and maintenance costs, and (e) inadequate commercial management. This has translated into inadequate service to the population, including to the informal settlements, where the vast majority of the urban poor reside.

To improve the urban water situation in Kenya, a sector review carried out by the World Bank in 2001 recommended (a) an overhaul of the institutional arrangements for water service delivery, especially to change the incentives facing utilities (for example, by enhancing their autonomy, ring-fencing revenues); (b) rehabilitation and increase in transmission capacity to enable full utilization of current production capacity; (c) rehabilitation, expansion, and metering of the distribution network and reduction of UFW; and (d) demand-based service delivery, where consumers' actual use levels and their preferences and willingness to pay are used as the basis for expanding the distribution network, developing service options, and deciding on tariff adjustments.

The Government of Kenya has placed water sector reforms high on its agenda, and implementation of the Water Act of 2002, which will include major institutional reforms, is underway. However—as is evident from the observations regarding limited utility coverage and the acknowledged lack of adequate metering—there are currently no reliable data on the demand side (neither on actual water use nor on household preferences and willingness to pay); these data are required to help establish a baseline, facilitate design of interventions, and adjust policies and plans. This paper is an attempt to fill that gap.

3 THE DATA

3.1 Urban Areas Surveyed: Nairobi, Mombasa, and Kakamega

The data were collected from a household-level survey conducted in November 2000 in Nairobi, Mombasa, and Kakamega. The three urban centers selected to participate in the survey differ in various ways, including size, population, geographical situation, socioeconomic status of household, nature of water supply, and range of water sources. In this paper, we present the results for the three-city sample as a whole, except in cases where we find statistically significant differences across the three urban centers or to allow for comparisons with available secondary data from earlier studies conducted in these urban centers.

3.2 Sample Design and Characteristics

In each of the three urban centers, surveys were conducted in seven or eight residential sites to ensure inclusion of a wide range of settlement and housing types, as well as diversity in the households' socioeconomic status and access to services. Within each site, the households were randomly selected. In Nairobi, 300 households were sampled in 8 residential sites. In Mombasa, 199 households were selected in 7 sites, and in Kakamega, 175 households were surveyed in 7 sites. Thus a total of 674 households were interviewed in 22 sites in the three urban areas. Out of these, 311 households (46 percent of the sample) that do not have private piped connections were also asked which, if any, of three improvement options they would choose if they had to pay for it. Specifically, each household in this part of the survey was given the following options regarding the water supply system: (1) private piped connection; (2) yard tap connection; (3) improved kiosk services; and (4) status quo, or "no change" to the current system. Overall, this is a stratified random sample, and we believe that it is reasonably representative of urban households in these three urban centers.

3.3 The Average Respondent and the "Poor" in the Sample

Table 1 shows the summary statistics of key socioeconomic variables for the participating 674 households in our survey. On average, the respondent was 35 years of age, had a family size of 5, and had lived in his or her current residence for 8 years. The majority (86 percent) had at least primary-level education, and about 35 percent owned their home. Exactly half of the respondents were female.

We used self-reported total monthly household income as the measure of welfare to classify households as "poor" versus "non-poor."[3] Specifically, households that reported total monthly household incomes equal to, or less than, the threshold level for that city—10,000 Kenya shillings (Ksh10,000) in Nairobi and Mombasa and Ksh5,000 in Kakamega—are designated as "poor," and the rest are "non-poor." The poverty threshold for Kakamega was set lower than for Nairobi

3 To reduce survey response bias in income reporting, we relied on a technique that is well tested and commonly used in the marketing and management literature (for example, Ratchford, Lee, and Talukdar 2003). Instead of asking for a precise income figure, households were asked to indicate which of the following nine income brackets they were in: less than and equal to Ksh5,000; Ksh5,001–10,000; Ksh10,001–15,000; Ksh15,001–20,000; Ksh20,001–25,000; Ksh25,001–30,000; Ksh30,001–35,000; Ksh35,001–40,000; more than Ksh40,000.

Table 1: Key Summary Statistics of the Household Sample for

Variable	Sample Value
Total number of household respondents	674
Percentage of female respondents	50.3
Average age (in years) of the respondents	35.2
Percentage of respondents with at least primary education	86
Mean household size	4.9
Mean number of years in current residence	8.3
Mean number of rooms in current residence	3.9
Percentage of households owning their current residences	35
Percentage of households identified as "poor"[a]	38

a. "Poor" is defined in terms of *total monthly household income* of Ksh10,000 and less for Nairobi and Mombasa; and of Ksh5,000 and less for Kakamega. (See Section 2.3 for further details.)
Source: World Bank Economic Sector Work 2000 survey.

and Mombasa to reflect the lower levels of income and expenditure and the lower cost of living in this small city.[4] The sample proportion of poor households, as defined by our welfare measure, is 37 percent.

Given that households tend to underreport income relative to expenditure, this poverty threshold is broadly consistent with the 1997 official poverty line for urban Kenya, which is set at a monthly *expenditure* of Ksh2,648 per adult equivalent per month (Government of Kenya 1999).[5] Further, those defined as poor (using our welfare measure) display characteristics that are consistent with expectations and the findings from previous surveys. First, statistical analysis of social and demographic characteristics of poor versus non-poor households (as defined by our welfare measure) show that, compared with non-poor households, poor households in our sample are more likely to live in densely populated neighborhoods (informal or peri-urban settlements), not own their homes, earn their living in daily wages, and have household heads who are less educated and younger. Second, the neighborhood-specific sample proportion of poor households is also found to be consistent with a priori expectations—for example, neighborhoods that are known to be poor have a high proportion of poor households (as defined by our welfare measure), and vice versa.

4 DEVELOPMENT PRIORITIES OF POOR AND NON-POOR URBAN HOUSEHOLDS

Our survey confirmed that in these cities, households' access to various basic infrastructure and social services is highly inadequate. More than 25 percent of the 674 sample households reported that they do not have access to *any* of the following four basic services: (a) private piped water supply; (b) private toilet, defined as one that is not shared with another household; (c) organized public or private collection of garbage; and (d) electricity. Only 1 percent of the sample households have access to all four of these services. Given that their current access to various

4 We tested the sensitivity of the primary findings reported in this study with respect to (a) using a common poverty threshold of Ksh10,000 for all three urban centers and (b) excluding Kakamega from our sample altogether. In either case, the substantive findings were quite similar to the findings reported here.

5 The urban food poverty line was estimated at Ksh1,254 per adult equivalent per month. To calculate adult equivalency, the Government of Kenya report (1999) reweighted household size as follows: 0.24 for age groups 0–4; 0.65 for age groups 5–14; and 1.00 for adults (15 and above). For example, for a family of two adults and three children in the 5–14 age group, the adult equivalent would be 3.89, and the poverty threshold would be monthly expenditures of Ksh10,300 (3.89 x Ksh2,648).

basic services is highly inadequate and the government's budget constraints are unlikely to allow for simultaneous improvements in all, we asked the households what their development priorities were (that is, toward which services they would like to see resources directed). Specifically, the households were asked to rank nine services, including health and education, in order of priority. Table 2 presents the results in the form of frequency distributions for the entire sample and by household welfare level.

Table 2: Development Priorities of Households: All Three Urban Centers Combined

Development Priority	First Most Important	Second Most Important	Total[a] All	Total[a] Poor	Total[a] Non-poor
Water supply	56%	13%	35%	39%	32%
Electricity	11%	20%	15%	16%	14%
Sanitation/sewerage system	9%	10%	9%	9%	10%
Health services	5%	12%	8%	8%	8%
Solid waste	5%	10%	8%	7%	8%
Roads	5%	11%	8%	8%	9%
Schools	4%	8%	6%	8%	5%
Street lighting	3%	10%	6%	3%	9%
Water drainage	2%	6%	4%	2%	5%
Total	100%	100%	100%	100%	100%
Sample size	666	654	1,320	452	765

a. "Total" here refers to frequency with which a particular priority was mentioned as either first or second most important.

Note: Numbers in columns may not add up to 100% because of rounding.

Source: World Bank Economic Sector Work 2000 survey.

Because the frequency distributions of development priorities across the three urban centers are very similar, we focus our discussion here on the values for the entire sample. The results indicate that development of a water supply system is by far the top priority for the households in the sample as a whole. Surprisingly, this finding holds even when the data are disaggregated by welfare level (that is, both the poor and non-poor rate water supply as their top development priority).[6] Electricity and a sanitation or sewerage system appear to be the next two priorities for both groups. The rest of this paper focuses on the water supply situation and starts to show why households accord such a high priority to water issues.

5 UNDERSTANDING THE WATER SITUATION AT THE HOUSEHOLD LEVEL

5.1 Primary Water Sources

Households surveyed in the three urban centers use a wide array of primary water sources to meet their needs. Private in-house piped connections are the most important, with just under half (46 percent) of the sample households using them as their primary source. An additional 15 percent of the households use yard taps as their primary source. In other words, 61 percent of the

6 Given that the focus areas for the survey were water and sanitation, one could argue that this introduced a bias toward reporting water supply as a high priority. However, the significantly high importance placed on water supply relative to any other development area and the relative stability of the rank order for the top three development priorities across cities make it difficult to dismiss the finding as merely a result of such bias. Further, this question was administered at the start of the survey and before the detailed questions pertaining to water use were asked.

households in the three urban centers have access to piped water supply, either in their house or in their yard.

Water kiosks[7] are, by far, the most prevalent “alternative” to piped supplies, with 19 percent of the households using them as their primary source. Ground and natural sources serve as the primary source for 10 percent of the households, the overwhelming majority (94 percent) of whom are in Kakamega. About 5 percent of the households rely primarily on vendors, 2 percent have their “own source” (such as a well or borehole), another 2 percent rely on neighbors, and the remaining 1 percent report “other” sources (including bottled water).

Utility coverage, or the proportion of households with access to piped water supply, in Nairobi—and even in Mombasa and Kakamega—appears to be higher than that in many of the other capital cities in Africa (Table 3). Specifically, we find that 71 percent of the households in Nairobi, 50 percent in Mombasa, and 56 percent in Kakamega have access to piped water supply, either through a private in-house connection or a yard tap. By comparison, a study of water supply and independent providers in 10 African capital cities (including Nairobi) estimates that in six of these cities, only 27–49 percent of the households have access to piped supplies, with the rest of the households relying on independent providers or traditional sources.[8] In the other four capital cities, coverage is estimated to be higher: 72–85 percent of the households have access to piped supplies (Collignon and Vézina 2000). In other words, Mombasa and even Kakamega, a small city, have a better utility coverage than 6 of the 10 African capital cities examined in the above study.

Although a significant proportion of households in Nairobi, Mombasa, and Kakamega have access to piped supplies, the service that they receive is often substandard. As one would expect, the level of service provided by alternative sources such as kiosks is also very low. The evidence

Table 3: Proportion of Households with Access to Piped Supplies in Urban Africa

	Ten-Cities Study										Our (2000) Survey		
	Abidjan (Cote d'Ivoire)	Nairobi (Kenya)	Dakar (Senegal)	Kampala (Uganda)	Dar es Salaam (Tanzania)	Conakry (Guinea)	Nouakchott (Mauritania)	Cotonou (Benin)	Ouagadougou (Burkina Faso)	Bamako (Mali)	Nairobi (Kenya)	Mombasa (Kenya)	Kakamega (Kenya)
Piped	78	72	85	41	31	32	49	27	72	36	71	50	56
Independent providers, traditional sources, and other	22	27	15	59	69	68	51	73	28	64	29	50	44

Note: “Piped” includes in-home connection, yard tap, or standpipe with collection by household. Numbers in columns may not add up to 100% because of rounding.
Source: Ten-cities data are from Collignon and Vézina (2000), and data for three Kenyan cities are from our 2000 survey.

7 In Kenya, a water kiosk or standpipe is often managed by private individuals or nongovernmental organizations, rather than the public utility.
8 In this 10-city study, the households were categorized as (a) those with an in-home connection; (b) those that collect water themselves from standpipes; and (c) those that depend on independent providers (trucks, vendors, kiosks, and so forth) or traditional sources. For our purposes, the first two groups can be reclassified as those that have access to piped supply in-house or through standpipes or yard taps.

for substandard service—and the argument that service is universally bad—emerges from the analysis presented in the rest of this section and the one that follows. Given that level of service is a function of several variables, we will first examine the three most basic ones: price, quantity, and time spent in collection (Sections 5.2–5.4). We will then examine additional service indicators, such as hours of service, quantities available from the primary source, and satisfaction rates (Sections 5.5 and 6).

Per Capita Water Use

For the aggregate sample, we find that water use averages about 40 liters per capita per day (40 lcd) (Table 4). For households that have access to piped supply—either a private connection or a yard tap—average water use is 44 lcd, compared with 35 lcd in unpiped households. Median water use is 33 lcd among households with piped supplies and 27 lcd among unpiped households. These water-use levels are rather low, given that planners often design water systems based on average water use of about 100–200 lcd. Average water use in these centers as estimated at 40 lcd is the amount of water dispensed in a 4.2-minute shower using an environmentally friendly reduced-flow shower head available in the United States.

Table 4: Per Capita Water Use in Eastern Africa

	All Households		Piped Households		Unpiped Households		Non-Poor Households		Poor Households	
	N	Mean (Median)	N	Mean (Median)	N	Mean (Median)	N	Mean (Median)	N	Mean (Median)
Results from our Study										
Kenya – all 3 cities	581	40.0 (30.0)	299	44.3 (33.3)	248	35.3 (28.6)	324	43.8 (33.3)	213	33.1 (26.7)
Nairobi	248	37.3 (30.0)	155	37.2 (30.0)	83	35.5 (26.7)	136	41.3 (33.3)	96	32.1 (24.0)
Mombasa	178	49.8 (37.5)	81	61.6 (42.9)	96	39.9 (33.3)	87	58.5 (40.0)	65	36.5 (33.3)
Kakamega	155	33.0 (25.0)	63	39.7 (30.0)	69	28.6 (22.5)	101	34.6 (24.0)	52	30.3 (26.3)
		Mean		Mean		Mean				
Results from DOW II										
Kenya – urban sites		45.2		47.4		27.7				
Tanzania – urban sites		70.5		76.5		25.1				
Uganda – urban sites		47.0		64.7		23.5				

Note: Numbers in table represent liters per capita per day (lcd).
Source: Our 2000 survey; also Thompson and others 2000.

These figures immediately raise questions about whether the data are credible, especially because the water-use levels are self-reported by households, rather than measured by a surveyor or a meter. Reassuringly, our estimate of average water use is remarkably similar to that reported in the Drawers of Water II (DOW II) study. The DOW II study uses the original Drawers of Water study conducted in 1967 as the baseline and examines changes in water use in 16 sites in Eastern Africa between 1967 and 1997 (Thompson and others 2000b). Based on information collected from household surveys (in which interviewers spent an entire day with each household observing[9] water use), DOW II reports that average urban water use in Kenya is 45 lcd, with 47 lcd in piped households and 28 lcd in unpiped households (Table 4). Our estimate of average water use is

9 This showerhead dispenses water at 2.5 gallons per minute (or 9.46 liters per minute) and is rated by its manufacturer as a "reduced flow" showerhead.

somewhat lower than that in DOW II; there are at least two possible explanations. First, there was a water shortage in Nairobi at the time of the survey in November 2000. If we assume that the shortage in Nairobi reduced water use in that city by as much as 25 percent, the three-city average increases by 10 percent to 44 lcd.[10] Second, our survey was conducted three years after the DOW II survey, and it is possible that water-use levels had fallen from the levels reported in 1997.

Despite minor differences in the results, our study and DOW II together provide strong empirical evidence that average per capita water use in urban households in Kenya is only about 40–45 lcd. Comparisons with other countries reveal the following. Although water use in urban Kenya is only marginally lower than the 47 lcd estimated for urban Uganda in the DOW II study, it is 60–70 percent lower than in neighboring Tanzania, where average water use in urban areas is about 71 lcd. And it is even lower when compared with water-use levels reported for several non-African cities in the developing world (Table 5). For example, using metered consumption data, Yepes and Dianderas (1996) find per capita water use in eight Latin American cities to be in the range of 143–237 lcd. Similarly, water use in 13 Asian cities was found to be in the range of 91–209 lcd (Asian Development Bank 1997).

Table 5: Per Capita Water Use in Asian and Latin American Cities

Asian Cities	Water Use (lcd)	Year	Latin American Cities	Water Use Metered (lcd)	Year
Kathmandu, Nepal	91	1995–96	Sta. Catarina, Brazil	143	1990
Dhaka, Bangladesh	95	1995–96	Minas, Brazil	154	1990
Beijing, China	96	1995	Bogotà, Colombia	167	1992
Mandalay, Myanmar	110	1995–96	Santiago, Chile	204	1994
Hong Kong, China	112	1996	Costa Rica	208	1991
Suva, Fiji	135	1995	Brasilia, Brazil	211	1989
Shanghai, China	143	1995	São Paulo, Brazil	237	1988
Colombo, Sri Lanka	165	1995			
Singapore	183	1995			
Kuala Lumpur, Malaysia	200	1996			
Manila, Philippines	202	1995			
Seoul, Republic of Korea	209	1995			
Delhi, India	209	1995–96			

Sources: Asian Development Bank (1997) and Yepes and Dianderas (1996).

The current level of per capita water use in Kenya is low not only when compared with that of other countries but also when compared with earlier consumption and use levels in Kenya itself. Using baseline data from 1967, authors of DOW II argue that there has been a dramatic decline in domestic water use in urban Kenya: it has fallen from 105 lcd in 1967 to 45 lcd in 1997 (and to 40 lcd in 2000, according to our study). This decline occurred even though unpiped households increased their water use from 11 lcd in 1967 to 28 lcd in 1997 (and to 35 lcd in 2000,

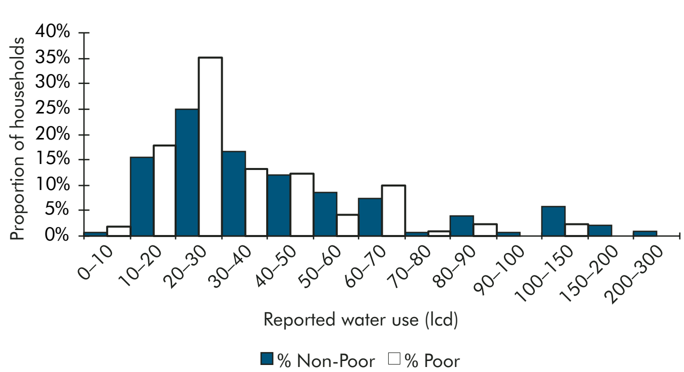
10 To investigate the extent of potential "bias" that could have been introduced into our findings because of the drought-induced shortage in Nairobi during our survey, we computed both the average water-usage level and unit price paid for the aggregate sample in Nairobi under the following scenarios: (a) without shortage, each Nairobi city household would have been using 10–25 percent more than that reported in our survey and (b) without shortage, each Nairobi city household would have been paying 10–25 percent less than that reported in our survey.

according to our study). It is attributable entirely to the sharp reduction in water use by piped households, which fell from 117 lcd in 1967 to 47 lcd in 1997 (and to 44 lcd in 2000, according to our study). Thompson and others (2000b) suggest that piped households have been forced to cut back because of failing municipal supplies, an argument that our data (presented in Section 6) support. As we will subsequently show, however, the reduction in water use is due not just to reduction in quantity supplied or available but also to a combination of price and quantity factors.

Water Use by Poor and Non-Poor Households

The literature describes images of the rich and connected households using—often wasting—water liberally for gardening, washing of cars, and water for swimming pools. The poor, by contrast, are not connected, have to buy water by the bucket, and pay exorbitant prices (for example, Fass 1988, Whittington and others 1991, World Bank Water Demand Research Team 1993, Crane 1994). The outcome, as mentioned earlier, is that the poor consume far less and pay far more per unit of water relative to their rich and connected counterparts. Previous studies in Jakarta and Port-au-Prince, for example, find that the non-poor use 2–14 times as much water as the poor. Specifically, in Port-au-Prince, Fass (1988) estimates that households with connections (mostly the rich) use 156 lcd, compared with the 11 lcd used by poor households that rely on the vending system. The poor buy from vendors at prices ranging from US$1.1 to US$5.5 per cubic meter (m^3) and thereby pay, according to Fass, "some of the highest urban [water] prices in the world." For Jakarta, Crane (1994) reports that households with private connections use 62.2 lcd, as compared with 27.5 lcd used by those relying on hydrants and 14.6 lcd for those relying on vendors. Crane also notes that vendors in Jakarta charge up to $2.6 per cubic meter, which he estimates is about 30 times the rate charged by the public utility; a different study finds the typical (as opposed to the maximum) multiple to be about 7 (Shugart 1991).

Figure 1: Self-Reported Water Use (Poor and Non-poor Households)



Source: World Bank Economic Sector Work 2000 survey.

In Kenya, we find that poor households do use less water than the non-poor, but the difference is nowhere near as large as the literature and conventional wisdom would suggest. Specifically, the poor use an average of 33 lcd, compared with 44 lcd by non-poor households in these three Kenyan cities—that is, the non-poor use about 1.33 times (33 percent) more water than the poor. Figure 1 shows the sample distribution of per capita water use by household welfare level. As one would expect, the sample distribution for poor households is more skewed to the left (lower usage level) than that of non-poor households. While this may have been influenced by the water shortage, it is more likely the result of the substandard water supply situation in these urban centers.

5.2 The Unit Cost of Water

The unit cost of water was computed for each household in the sample by dividing the reported total expenditure on water by the total water use.[11] Households are spending on an average Ksh260/m^3 (US$3.5/$m^3$) for the water that they use (Table 6 below).

11 Although "unit cost" usually refers to the costs of production, in this paper we use the term to indicate the costs incurred by households per unit of water that they use.

Table 6: Unit price of water in Kenya (US $/m^3)

	All Households		Piped Households		Unpiped Households		Non-Poor Households		Poor Households	
	N	Mean (Median)	N	Mean (Median)	N	Mean (Median)	N	Mean (Median)	N	Mean (Median)
Results from our Study										
Kenya - all 3 towns	374	3.45 (2.11)	172	3.71 (1.80)	184	3.32 (2.59)	192	3.73 (2.00)	153	3.07 (2.40)
Nairobi	164	4.68 (3.33)	83	5.00 (2.21)	77	4.51 (3.33)	81	5.24 (2.37)	76	4.01 (3.33)
Mombasa	142	2.39 (1.67)	50	2.12 (1.21)	91	2.50 (1.77)	58	2.51 (1.40)	62	2.19 (1.67)
Kakamega	68	2.71 (1.75)	39	2.93 (2.00)	16	2.15 (1.17)	53	2.88 (1.77)	15	2.12 (1.67)

Source: Our 2000 survey (Conversion Rate: $1.0 = Ksh. 75).

The median cost is Ksh156/m^3 (US$2.1/m^3); that is, exactly half of the sample households are incurring unit costs that are higher. If we assume that the price inflation for vended water in Nairobi was about 25 percent because of the water shortage at the time and recalculate the figures for a "no shortage" scenario, we get an average unit cost of US$2.93/m^3, which is about 16 percent lower. Even after the adjustment, these costs are remarkably high, both in relative and absolute terms. They are high, for example, relative to prevailing utility tariffs (see below). They are also high in absolute terms, given estimates by the World Bank that full cost recovery of current water systems can be achieved at a fraction of these unit costs.

To be specific, utilities in most Kenyan cities and towns, including Mombasa and Kakamega, follow a standardized increasing block tariff that ranges from Ksh20–100 per cubic meters (US$0.27–1.33/m^3) depending on total use (World Bank 2001). In Nairobi, the tariffs for domestic use are somewhat lower and range from Ksh12–60 per cubic meter (US$0.16–0.80/m^3). According to the World Bank (2001), the average tariff charged by Kenyan water utilities, from all categories of customers combined, is US$0.4/m^3. The same Bank study also estimates that these current tariffs levels are in themselves sufficient to cover capital plus operations and maintenance costs in Kenya if the water utilities are run efficiently.

The main reason behind the high unit cost of water reported by households is that many of them, including those with private connections, are buying water from expensive sources such as kiosks and vendors. Households in our sample are paying, on average, Ksh4.1 per 20-liter jerrican (Ksh205/m^3 or US$2.7/m^3) for water from kiosks, and Ksh12.6 per 20-liter jerrican (Ksh630/m^3 or US$8.4/m^3) for water from vendors who deliver at home (including tankers of 8-m^3 capacity). These prices for vended water are similar to those reported for Nairobi by Collignon and Vézina (2000) in their study of African cities; their data also show that vended water costs more in Nairobi than in most of the other capital cities included in their 10-country sample.[12]

It is important to note that the average cost of water from kiosks is remarkably high, given that utilities in Kenya usually supply water to kiosks at a "social" or bulk rate of about Ksh11/m^3 (US$0.15/m^3). In other words, the kiosk owners are charging 18 times the price that they pay for the water. Even after taking into account that kiosk owners have to incur initial costs for

12 For Nairobi, Collignon and Vezina (2000) report that the cost of water from standpipes ranges (min-max) from US$1.00–2.50/m^3. For water delivered to homes, the range of prices in the 10 cities is US$2–8/m^3, with that in Nairobi being US$6–8/m^3.

installation of kiosks, as well as some recurrent overhead costs (including illegal payments), the difference between the price paid to the utility and the price charged for water by kiosk owners is large. In fact, Collignon and Vézina (2000) calculate the minimum gross profit margin of "standpipe operators" (kiosks) in Nairobi to be 80 percent and the maximum to be 90 percent—these profit margins were the highest among their 10-country sample.[13] This suggests that much of the subsidy provided by the utility is not accruing to the poor for whom it is intended; rather, these subsidies are negated by the high costs of installing and running kiosks, or they accrue to kiosk owners, those collecting illegal payments from them, or both.

In contrast to data available on the price of water from a given vending source (a variable that has been examined in several studies), it is hard to find comparable data for the average unit cost borne by households for the water that they use from all sources combined. The DOW II study is one of few that calculates an average unit cost, but whereas we calculate only the monetary costs, the authors calculate the "social cost of obtaining water," in which they include not just monetary expenditures on water but also a cash value for the amount of energy used by each (unpiped) household to fetch water.[14] While estimates of social cost are important for public policy, we find that it is important at the household level to separate monetary and nonmonetary costs, especially in trying to understanding household decisionmaking. As we will see in Section 7, some households in our sample chose to trade off time savings in exchange for low monetary costs—contrary to expectations, unconnected households with long collection times were more likely to opt for the status quo, rather than pay for an improvement in their water service.

Unit Cost of Water for Poor and Non-Poor Households

We find that poor and non-poor households are, on average, paying very similar unit costs for their water. We do not find any statistical difference (at 5 percent significance level) in average unit cost for water by welfare level. The median cost for the non-poor is US$2.0/m^3, as compared with US$2.50/m^3 for the poor and US$2.10/m^3 for the sample as a whole. Although the difference in the median cost borne by the poor and non-poor is statistically significant, the difference is again not as large as one might expect.

At least three factors help explain the convergence in average unit costs borne by the poor and non-poor in our study. First, the failing municipal water supply system does not provide adequate water to the connected non-poor households, forcing them to buy from vendors and tankers at prices that are significantly higher than the municipal tariff. This raises their average unit cost for water. In theory, the connected non-poor do have access to water at the low and often subsidized utility tariff, but in practice they have to supplement this with water purchased from more expensive sources.

Second, some of the non-poor (35 percent of our sample) do not have access to a private utility connection and rely on privately installed household or neighborhood boreholes, and this also raises the average cost borne by the non-poor as a group.

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13 A detailed study of 650 kiosks in Kibera, Nairobi, found that in some cases, this "profit margin" is consumed by unofficial charges and unexpected costs (repairing vandalized pipes) accrued by kiosk owners.

14 DOW II reports an average unit cost of water of US$1.02/m^3 for piped supplies and US$1.40/m^3 for unpiped supplies. These estimates are significantly lower than ours and appear to reflect different assumptions—for example, they appear to be assuming that the piped households are able to buy *all* of their water at the relatively low utility rates, an assumption that our study directly refutes. Despite the differences in our results, our cost data, combined with that from the DOW II study, provide a basis for future discussion and debate on the appropriate methodology for calculating the private cost of water and help establish some sort of a baseline for future analyses.

Third, the poor—especially in small cities such as Kakamega—can and do still use water from natural sources such as streams and wells and do not incur monetary costs for it; this lowers the average unit cost of the water that they use.

Although the average unit costs borne by poor and non-poor households are about the same, the costs borne by poor households are more "concentrated" around this average value than the costs borne by the non-poor. This is evident from the standard deviation in the unit costs that they bear—we do find statistical difference (s.d.), at 5 percent significance level, between non-poor (s.d. = 0.50) and poor households (s.d. = 0.18). As the high value of the standard deviation would suggest, we find a significant proportion of non-poor households falling in the two tails of the distribution. In other words, non-poor households are more likely to bear the least as well as the highest unit cost for water. This is because non-poor households are likely to use both private piped connections (low unit price) and tankers and bottled water (high unit prices).

Per Capita Water Expenditure

Households in the sample spend an average of Ksh9.06 (US$0.12) per capita per day. The average daily per capita expenditure on water by non-poor households is Ksh10.35 (US$0.14), in contrast to Ksh7.63 (US$0.11) per capita per day by poor households. Although the per capita expenditure by the poor is lower in absolute terms compared with that of the non-poor, it represents a significantly higher proportion of their income.

Price Perception and Demand Elasticity

While the unit costs currently borne for water provide an important insight into households' ability to pay for future improvements, policymakers are likely to be interested in knowing what tariff levels would be acceptable or politically feasible. To get the households' notion of a feasible or fair tariff, we asked them whether they perceived the current unit costs that they were bearing to be "high," "fair," or "low." Then we compared each household's current unit cost (reported in a separate section of the questionnaire) with the household's perception of its fairness. Table 7 presents the findings of this analysis for the aggregate sample and also by welfare level.

Table 7: Households' Perception of Price Currently Paid for Water

	Reported Price Currently Paid for Water Used					
	All Households		Non-Poor Households		Poor Households	
	Mean (Ksh/m^3)	Sample Size	Mean (Ksh/m^3)	Sample Size	Mean (Ksh/m^3)	Sample Size
High	305	162	380	67	257	88
Fair	209	111	218	70	210	32
Low	163	45	129	23	161	15

Note: Tests for statistical significance (at 10 percent level or less) for difference in means above show: (a) difference between non-poor and poor households is not significant for each of the three perceived levels of price; (b) differences across the three perceived levels of price are significant for each group of households: all, non-poor, and poor households (this implies that households, whether poor or not, have distinct price levels for each level of perception—high, fair, low).
Source: World Bank Economic Sector Work 2000 survey.

As Table 7 indicates, households appear to have some distinct cost level corresponding to what they perceive as fair. Typically, a cost of about Ksh200/m^3 is perceived by households as a fair unit cost for water, and interestingly, it is similar for non-poor and poor households (although they do differ in their perception of low and high). This estimate of fair cost can be thought of as a "proxy" measure for acceptability or feasibility and has some policy implications.

Another important policy question that arises, especially when tariff changes are being contemplated, is the price sensitivity of households and the extent to which it differs for the poor and non-poor. For example, if the tariff were to be increased by 10 percent and one could enforce payment, would this have a differential impact on water use by the poor and the non-poor? To get insights into this issue, the data collected in the survey were used to estimate household demand based on the prevailing water supply situation. We estimated a linear demand function, with total household water use as a function of unit cost incurred, household income level, household size, current city of residence, and current primary water source. (A description of the demand function and estimation results is presented in the Appendix.)

The estimated multivariate linear demand model greatly increases our confidence in the data because it confirms that households' demand for water responds to key variables exactly in the manner predicted by economic theory. The quantity consumed is negatively correlated with price (to be more specific, unit cost) and positively correlated with income and household size—all with a high degree of statistical significance (at 5 percent level or less). In terms of demand elasticity, the estimation results indicate that household demand for water is relatively inelastic over the (realistic) price range of Ksh100–300 per m^3 (US\$1.33–4.00 per m^3). For example, using our sample means for the prevailing household water-use level and unit price, the estimated point price elasticities are –0.12 for the sample as a whole, –0.16 for poor households, and –0.10 for non-poor households.[15] It should be noted that while the *absolute* level of price sensitivity of all households is quite low, the results indicate that poor households are still *relatively* much more sensitive than the non-poor households.

It is also important to note that our demand function analysis here is based on demand for water from *all* sources. It is thus expected to yield inherently lower price elasticity than in a source-specific (for example, piped water) analysis (as is the case with typical existing studies), because the latter analysis can capture the expected intersource demand substitution in response to any price change. Further, the results of any household water demand analysis using households' actual (as opposed to "desired") water consumption data are implicitly contingent on supply-side constraints. The relatively low price elasticity of demand in the current analysis is thus reflective of, and consistent with, the prevailing water supply situation. With average use for a basic necessity like water already at a low absolute level and faced with limited availability and access to water, the households have very little flexibility in terms of changing their current use levels—either downward in response to a price increase or upward in response to a price decrease.

5.3 Collection Time

On the whole, households are spending an average of 30 minutes a day in collecting water. The poor spend an average of 42 minutes, or three times as long as the non-poor, who spend 15

15 Because price enters in linear form in the estimated demand function, price elasticity of demand is not constant over the function, but rather depends on the "point" of the demand function at which it is computed. The point price elasticity of demand at price P and corresponding demand Q can be expressed as $\beta P/Q$, where β is the estimated demand function coefficient for price. The sample mean household water-use levels (in liters per day) are 186.4, 118.9, and 226.0 for "all," poor, and non-poor households, respectively. The sample mean unit costs incurred (in Ksh per liter) are 0.26, 0.23, and 0.28 for all, poor, and non-poor households, respectively.

minutes (Table 8). As expected, collection time varies significantly by the primary source that households use. While those with private connections spend only about 5 minutes on water collection daily, those relying on yard taps spend about 15 minutes, and those using kiosks spend about 55 minutes per day on this task (Table 9). Households that rely on other alternatives, including own source and natural sources, spend an average of 37 minutes daily in collecting water.

Table 8: Current Water Use and Expenditure Patterns

	Aggregate		Poor		Non-Poor	
	N	**Mean**	**N**	**Mean**	**N**	**Mean**
Daily per capita water use (in liters)[a]	581	39.97	213	33.01	324	43.81
Unit cost of water used or procured:						
– From all sources (in Ksh per liter)[a]	374	0.26	153	0.23	192	0.28
– From kiosk service (in Ksh per jerrican)[b]	156	4.07	111	4.35	36	3.28
– From vendor service (in Ksh per jerrican)[b]	132	12.59	77	12.26	44	13.02
Time spent in collecting water (minutes per day)[b]	458	26.62	181	42.41	249	14.83
Per capita expenditure on water in Ksh per day[a]	409	9.06	155	7.63	220	10.35
Water storage capacity (liters)[b]	598	1,058.00	205	377.00	347	1,443.00
Investment in storage system (Ksh)[b]	549	5,399.00	188	508.00	323	8,519.00
Household size (persons)[b]	669	4.92	227	4.17	389	5.25
	N	**Percent**	**N**	**Percent**	**N**	**Percent**
Households dissatisfied with primary source	592	49.80	203	58.13	343	43.15
Households who get all their water from a single source	610	65.90	201	55.20	357	73.40

Note: Differences in means across poor versus non-poor households are statistically significant (at a 10 percent level or less) for all the variables except two: unit prices for water used or procured from all sources and from vendor service.

a. Based on *computed* values derived *for each household* as follows: (a) daily per capita water use is daily household water use divided by household size, (b) daily per capita expenditure on water is daily household expenditure on water divided by household size, and (c) unit cost of water used or procured from all sources is daily household expenditure on water divided by daily household water use.

b. Based on direct responses of survey participants.

Source: World Bank Economic Sector Work 2000 survey.

5.4 Summarizing the Water Situation of Poor and Non-Poor Households

Overall, the results show that water-use levels are low and both monetary costs and time spent on collection are high for the sample households. When disaggregated by welfare level, the data on these three level-of-service indicators—water use, unit cost, and collection time—show, as expected, that the non-poor are better off than the poor. Specifically, the differences in mean values for the poor and non-poor are statistically significant for all except two of the variables: the unit cost of water used from all sources and from vendor service. Although the differences are statistically significant, many of these differences among the poor and non-poor are far smaller than previous studies suggest. In particular, the finding that the non-poor use (only) about 33

Table 9: Comparison of Households Currently with and without Piped Water Service

Primary Source	Pvt. Conn. N	Pvt. Conn. Mean	Yard Tap N	Yard Tap Mean	Kiosk N	Kiosk Mean	Alt. Sources[b] N	Alt. Sources[b] Mean
Daily per capita water use (in liters)[a]	208	49.29	91	33.07	124	35.10	124	35.60
Cost in Ksh per liter for water used from all sources[a]	124	0.26	48	0.31	119	0.24	65	0.26
Cost in Ksh per jerrican from kiosk service	3	2.33	15	5.87	119	3.92	18	3.97
Cost in Ksh per jerrican from vendor service	22	12.45	22	13.63	44	13.39	43	11.53
Time spent on collection from primary source – minutes per day	166	5.30	65	14.50	122	54.70	99	37.40
Per capita expenditure on water in Ksh per day[a]	155	8.87	48	9.02	119	9.26	68	9.92
Water storage capacity in liters	251	1825	82	777	122	322	109	588
Investment in storage system (Ksh)	234	8,994	80	1,070	113	801	98	6,883
Household size	275	5.50	100	4.40	125	4.20	134	5.10
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
% of households who are "poor"	247	4.5	94	50.0	119	76.5	125	51.2
% of households dissatisfied with service from primary source	269	44.0	77	45.0	123	63.0	123	53.0
% of households stating "water" as top priority	271	45.4	99	51.5	125	62.4	135	74.8
% of households rating water from primary source as high quality	267	53.9	80	50.0	123	49.6	125	34.4
% of households receiving less than 8 hours of service per day	239	35.0	77	44.0	119	32.0	n.a.	n.a.
% of households who get all their water from a single water source	271	76.0	86	60.5	122	51.6	124	62.1

Notes: (1) Differences in means across the three groups of households are statistically significant (at 10 percent level or less) for all the variables except two: unit prices for water used or procured from all sources and from vendor service.

(2) The mean refers to values for the subset of households using a given primary source (and not, for example, to the cost or use of water from that source).

a. Based on *computed* values derived *for each household* as follows: (a) daily per capita water use is daily household water use divided by household size, (b) daily per capita expenditure on water is daily household expenditure on water divided by household size, and (c) unit cost of water used or procured from all sources is daily household expenditure on water divided by daily household water use.

b. "Alt. Sources" cover use of vendors, neighbors, own source (well, borehole), ground/natural sources, and other miscellaneous sources (including bottled water) as primary water sources.

Source: World Bank Economic Sector Work 2000 survey.

percent more water than the poor, combined with the finding that the two groups bear similar unit costs for their water, suggests that both the poor and the non-poor—with the possible exception of the richest 7–10 percent of the population—are suffering under the current water supply system in urban Kenya.

To further explore the differences in the water situation of the poor and non-poor, we examined data on additional variables on type and level of service, such cost of water from different sources, reliability of the primary source, and satisfaction rates. These results, summarized in Table

8, show, for example, that 58 percent of the poor are dissatisfied with their primary source compared with 43 percent of the non-poor. Compared with the non-poor, a lower proportion of the poor get their water from a single source, and they get a smaller proportion of their water from their primary source (Table 8). These data provide additional evidence that the non-poor are better off than the poor, but not dramatically so.

6 COMPARING THE LEVEL OF SERVICE FROM DIFFERENT SYSTEMS

In this section, we analyze the level of service provided by the three most-used primary sources of water—private connections, yard taps, and kiosks—and that from all "other alternative sources" (for example, vendors, neighbors, wells, and natural sources) combined. The level of service provided by a water system is a function of the price, quantity, quality, reliability, and convenience that it provides to the user. Data on some of these level-of-service indicators are summarized in Table 9, and the findings regarding the water availability and customer satisfaction with various systems are discussed in detail below. Also presented is a profile of households that these systems serve. Overall, this section shows that all households receive water for only a few hours a day from their primary source, as many as 42–44 percent are forced to rely on multiple sources, and water storage is ubiquitous. As a result, half of all households—piped and unpiped, poor and non-poor—are dissatisfied with their current water supply situation.

6.1 Which Systems Serve the Poor?

About 50 percent of the households using yard taps and 77 percent of those using kiosks are poor. Similarly, 52 percent of the households relying on other alternative sources are also poor. By contrast, poor households account for a mere 5 percent of those with private piped connections. Although almost all of the households with private connections are non-poor, many of the non-poor are not connected and have to rely on private boreholes, tankers, and other sources, including (to some extent) kiosks or door-to-door vendors who buy from kiosks.

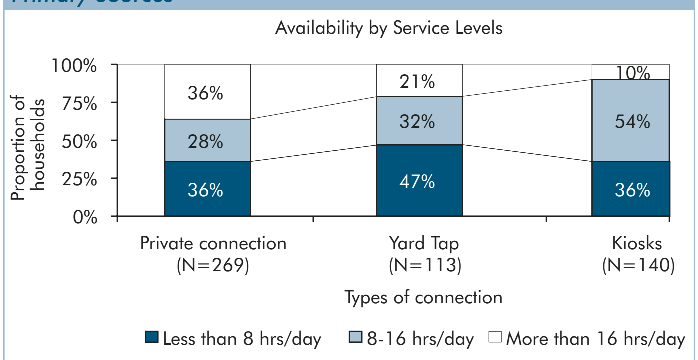
6.2 Water Availability by Source

Previous studies of water use in Kenya report that households tend to rely on one source to meet most of their water needs, but reliance on additional sources has increased (for example, Thompson and others 2000a). In our sample, households report that their primary source accounts, on average, for 66 percent of their total water use. At the same time, as many as 42 percent of the households in our sample report that they use two or more sources to meet their water needs. As one would expect, the non-poor households get a higher percentage of their total water needs from the primary source than poor households do. Households need to use multiple sources because their primary source is not fully reliable and does not provide the level of service that they require.

One indicator of the water availability and level of service of a system is the proportion of households that rely exclusively on that system to meet their water needs. We find that 76 percent of households with private piped connections, 61 percent of those with yard connections, 62 percent of those that rely on alternative sources, and 52 percent of those using kiosks get their water exclusively from their primary source (Table 9). In relative terms, then, the piped connection provides better service than that from a yard connection and that from all other sources combined. However, neither the "gap" between the private and yard connections nor that between the yard tap and alternative sources is as large as one might expect.

Another indicator of service level is the number of hours that water is available from a given system. Figure 2 shows that 36 percent of the households with private connections, 36 percent of those relying on kiosks, and 47 percent of those with yard taps report that water is available for *less than 8 hours per day.* Only about one-third of households that have private connections usually get water for more than 16 hours a day. Taken together, limited water availability and the highly curtailed hours of service offer one explanation for why overall water use, by poor and non-poor alike, has fallen and is at surprisingly low levels. In addition to cutting water use, households are coping with the intermittent water supply by storing water. Indeed, almost all households report that they store water. The average capacity of a private water storage system is about 1,058 liters, and the average investment for such a system is about Ksh5,399 (US$72). As one would expect, storage capacity and investment vary by income and type of storage system—the poor rely on portable, low-cost, and low-capacity storage options such as jerricans, whereas the non-poor use higher-cost options such as overhead tanks.

Figure 2: Availability of Water from the Three Most-Used Primary Sources



6.3 Customer Satisfaction

Our survey shows that half of the households are dissatisfied with their current primary water source. The groups dissatisfied include 44 percent of those using piped water as their primary source, 45 percent of yard tap users, 53 percent of those depending on alternative sources, and 63 percent of those relying on kiosks (Table 9). Disaggregating the data by welfare level shows, as mentioned earlier, that about 58 percent of the poor and 43 percent of the non-poor are dissatisfied (Table 8). That service and availability, apart from easy access, strongly influence household satisfaction is evident from the 56 percent satisfaction level for private piped connections, in contrast to the 100 percent satisfaction for own sources. It is not surprising then that in Section 4.2, both the poor and non-poor households are found to overwhelmingly rate "improvement in water supply" as their top development priority. The highest levels of household dissatisfaction are associated with water kiosks and vendor services—although people are forced to rely on them, they do not like them as options for their water supply.

7 HOUSEHOLD PREFERENCES AND WILLINGNESS TO PAY FOR IMPROVEMENTS

As noted earlier, 311 of the total of 674 sample households that did not have private piped connections were asked additional questions on their preferred option for improving their current water supply system. This section reports the findings from these 311 responses (Nairobi 117, Mombasa 91, and Kakamega 103). About 65 percent of these households are "poor," based on our welfare measure discussed in Section 3. In this part of the survey, each participating household was given the following options regarding the water supply system: (a) private piped connection, (b) yard tap connection, (c) improved kiosk services, and (d) status quo, or no change to the current system.

The improvement offered in the kiosk service entailed building additional kiosks so that households would have access to a kiosk within 50 meters from their residence. The unit price for this improved kiosk service was set at Ksh250/m^3 for all households surveyed. For the private piped and yard tap connection options, different tariff structures, based on deposit fee and unit price, were used across households. Specifically, each household surveyed was offered one of the following eight tariff combinations of an upfront deposit (Ksh) and unit price (Ksh/m^3): (2,500; 50); (2,500; 75); (2,500; 100); (2,500; 125); (5,000; 50); (5,000; 75); (5,000; 100); (5,000; 125).

Many willingness-to-pay studies use a very wide range of prices to allow an estimation of the limits of the demand function. In this survey, we chose a range of "pragmatic" tariffs around a level estimated to allow cost recovery. A team of water experts had estimated that a price of approximately Ksh75 or US$1 per cubic meter, combined with an upfront deposit of Ksh5,000 or US$67 would be sufficient to recover costs for a system such as Nairobi's—indeed, at such a price, private providers would be willing to enter the market (World Bank 2001; also, personal communication with Bank staff). These experts also noted that the unit tariff would need to be somewhat higher in Mombasa, given the higher cost of supply in that city. Accordingly, we offered the respondents one of two deposit fees (Ksh2,500 or Ksh5,000) and unit prices ranging from Ksh50–125/m^3. For each household, based on its size, we estimated the monthly bill associated with the offered price for each of the three options. Based on these prices and its preferences, each unconnected household chose the improvement option, if any, for which it was willing to pay.

From the analysis presented in earlier sections of this paper, we now know—in hindsight—that the prices offered are lower than the average and median unit costs (Ksh260/m^3 and Ksh156/m^3, respectively) that households are currently bearing (Section 5). Indeed, the prices are also lower than the Ksh200/m^3 cost that the households deem as fair (Table 7). The result, not surprisingly, is that the majority (76 percent) of the unconnected households chose to pay cost-recovery-level prices for one of the three improvements, rather than maintain their current water system.

In its simplest form, the result above is no different from what many other studies have found in the now vast literature on the willingness to pay for water—that households want improved water service and that they are willing to pay a lot for these improvements. One difference, perhaps, is that we can show that the households' willingness to pay is backed by an ability to pay and that they consider these prices to be fair.

In the next two sections, we use our data to go beyond these broad conclusions and examine the following questions: Which households opted for the status quo versus an improved system, and why? Of those opting for an improvement, which households are likely to select a private connection versus a yard tap versus kiosks, and why? To answer these questions and to identify the key variables influencing demand and preferences among sample households in these three Kenyan cities, we first look at cross-tabulation-based descriptive statistics to draw initial insights about the various socioeconomic factors that seem to influence households' preferences. We then use multivariate analysis to test the statistical significance of those initial insights. The results are discussed in the following sections.

7.1 Demand for Change versus No Change

Of the 311 households responding to the contingent valuation questions, 72 (23 percent) opted for the "no change" or status quo option, rather than pay for improvement options, and 4 households (1 percent) remained unsure. All of the rest—235 households (76 percent)—opted to pay for change, indicating that there is quite a bit of "latent" demand for some type of improvement in the current water system.

Of the 72 households opting for the status quo, 36 (or half) are those who currently rely on kiosks. One could infer that these households opted for the status quo because they are satisfied with the service that they receive from the kiosks. However, our analysis suggests that such an inference is unlikely to hold true. Specifically, from Table 10, we find that the households preferring the status quo option are also likely to be least satisfied with their current primary water sources. They are also likely to be poor, to pay a lower unit cost for water consumed, to have lower per capita expenditures on water, and to spend more time collecting water than those households who opted for change in their current water supply conditions. The lower-income level and the relatively long time spent daily in collecting water by these households suggest they have low opportunity cost of time, which is likely to be the result of both low wage rates of earning members and the presence of nonearning members in households. In their source selection, then, they appear to be trading off their time in exchange for low monetary expenditures on water.

We asked these 72 households their reasons for not choosing any of the proposed three improvement options. The 70 households who responded gave the following reasons: 53 (76

Table 10: Profile of Households Selecting a Particular Option (by Option)

	Pvt. Conn.		Yard Tap		Kiosk		Status Quo	
Option Preferred	**N**	**Mean**	**N**	**Mean**	**N**	**Mean**	**N**	**Mean**
Household water use in liters per day	94	139	80	128	49	93	70	119
Daily per capita water use (in liters)[a]	93	34.9	80	34.2	49	27.9	69	30.9
Cost in Ksh per liter for water used or procured from all sources[a]	59	0.27	66	0.25	28	0.24	51	0.21
Time spent on collection from the primary source in minutes per day	77	35.4	68	38.3	47	26.9	66	61.4
Household expenditure on water in Ksh per day	61	31.4	66	28.7	28	29.4	51	27.0
Per capita expenditure on water in Ksh per day[a]	60	10.5	66	8.6	28	7.0	51	6.6
Number of rooms in current residence	102	2.5	80	1.9	51	1.7	71	1.9
Household size	101	4.7	81	4.3	52	4.2	71	4.5
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
% of households who are "poor"	98	46.9	57	73.1	48	75.0	69	75.4
% of male respondents	102	46.1	81	45.7	52	36.5	72	40.3
% of respondents with at least primary-level education	102	50.0	80	36.3	51	31.4	72	43.1
% of households who own their current residence	95	34.7	79	17.7	52	17.3	64	23.4
% of households traveling more than 200 m. to primary source	89	34.8	72	33.3	45	8.9	69	40.6
% of households not satisfied with service from primary source	97	51.6	76	61.8	49	51.0	70	64.3
% of households very satisfied with service from primary source	97	5.2	76	0.0	49	4.1	70	1.4

a. Based on *computed* values derived *for each household*, as follows: (a) daily per capita water use is daily household water use divided by household size, (b) daily per capita expenditure on water is daily household expenditure on water divided by household size, and (c) unit cost of water used or procured from all sources is daily household expenditure on water divided by daily household water use.
Source: World Bank Economic Sector Work 2000 survey.

percent) households cited financial reasons—that is, the unit price or deposit fee (or both) for the proposed improvement options was high; 8 (11 percent) gave both financial and "physical" ("no room in house") reasons; and 9 (13 percent) of the households said that they were satisfied with their current supply system.

These findings suggest that most of these households prefer to maintain the status quo not because they are satisfied with their current water sources, but rather because either they see little economic benefit (combination of monetary costs and opportunity cost of time) in switching from current sources or that is the best they can get—given their current housing circumstances (for example, tenants who rent a room)—or afford, even if it entails a long collection time and an unsatisfactory service experience.

While the findings in Table 10 and the analysis of stated reasons are helpful, they have the same limitations as any other descriptive, univariate analysis—that is, the statistical significance of the findings is not tested. Further, such a univariate analysis also does not simultaneously control for the effects of all the potential factors and thus cannot separate out the effect of one factor from other potential factors in explaining households' preference for change versus no change. Therefore, we conducted a multivariate statistical analysis in the form of a binomial logistic regression model to test which of the multiple potential factors are truly the "drivers" behind households' preference for change versus no change.

The literature suggests that there are a multitude of socioeconomic factors that can influence a household's decision regarding change versus no change (for example, World Bank Water Demand Research Team 1993). In our binomial logistic regression model, we analyzed the following variables drawn from the literature: household size, income level, gender of respondent, education level of household respondent, home ownership, number of rooms in current residence, current primary water source, time spent daily in collecting water, overall satisfaction level with the primary source, current unit cost for water, and per capita water-use level. In our analysis, we also controlled for the city of residence and the tariff for private and yard improvement options used in the survey for each household. Results of the analysis are presented in Table 11.

The results show that when controlling for all the potential socioeconomic factors simultaneously, only three factors exhibit a statistically significant (at 5 percent level or less) influence on a household's preference for change versus no change in its current water supply situation. These are (a) current unit cost for water, (b) current per capita water use, and (c) time spent daily in collecting water. We find that a household is *more* likely to maintain its current water supply status, the *lower* the unit cost it bears for water, the *lower* is its per capita water-use level, or the *longer* the time it spends daily on collecting water. The negative relationship between the preference for the status quo and the first two variables is easy to understand—a household that currently bears a low unit cost for water or has a low per capita water-use level will see little economic incentive in switching from its current water system.

Regarding collection time, a priori, we would expect that households spending a lot of time in getting their water would be more (not less) likely to opt for a change. In this case, however, there is a positive relationship between daily time spent by a household on water collection and its preference for the status quo. As mentioned earlier, one possible explanation is that these households place a very low value on the opportunity cost of their time, reflecting perhaps low wage rates or availability of nonworking members who can collect the water. A low opportunity cost of time, combined with the indication that they have financial concerns or constraints,

Table 11: Results of Binomial Logistic Regression Analysis

Dependent variable: Probability of opting for "*change*" relative to "*no change*"

Independent Variable	**Coefficient Estimate**	***t*-Statistic**
Intercept	–0.45365	–0.26
Option characteristics:		
Connection fee for private or yard tap options	0.00003	0.30
Unit price for private or yard tap options	0.00090	0.12
Household characteristics:		
Male respondent	–0.07932	–0.15
Education level of respondent	–0.87327	–1.67
Poor household	–0.65677	–1.52
Household size	0.00873	0.07
Per capita daily water use	0.01767 c	2.38
Unit price currently paid for water	5.87584 c	3.70
Own residence	–0.95518	–1.72
Number of rooms in residence	0.23416	1.13
Time spent daily in collecting water	–0.00868 c	–2.75
Overall satisfaction level with primary water source	0.30604	0.60
City of residence:[a]		
Mombasa	–0.06182	–0.19
Kakamega	0.46857	0.24
Current primary water source:[b]		
Yard tap	0.04937	0.05
Own source (well, borehole)	–2.30138	–1.86
Kiosk	0.27770	0.21
Ground and natural sources	0.08514	0.68
Adj. R^2	0.37	
Log-likelihood	–74.9	
Number of observations	221	

a. "Nairobi" is used as the base or comparison level.
b. "Neighbors/vendors/others" is used as the base or comparison level.
c. Coefficient is statistically significant at 0.05 level or less.
Source: World Bank Economic Sector Work 2000 survey.

suggests that these households perceive the economic incentives of switching from their current sources to be low, despite the longer collection time.

We find that all other potential factors used in our analysis reveal *no* statistically significant (at 5 percent level or less) influence on a household's preference for change versus no change in its current water supply situation. The statistically insignificant factors, many of which other studies find to be relevant, include household size, welfare category, gender and education level of respondent, home ownership, current primary water source, overall satisfaction level with the primary source, the city of residence, and the tariff for the private and yard improvement options used in the survey.

Overall, our results indicate that within the subset of the unconnected, neither current economic welfare category (poor versus non-poor) nor its stated dissatisfaction with its current source plays a decisive role in a household's decision to change its current water system. What really decides whether a household is likely to prefer and agree to pay for a proposed improvement option is whether it expects the switch to result in tangible economic benefits—implicitly defined by respondents themselves as some combination of just three factors: cost, quantity, and collection time. For instance, a poor household with a high level of satisfaction with its current water supply situation can still prefer a proposed improvement option, as long it sees economic benefit in such a switch. Conversely, a non-poor household with a low level of satisfaction with its current water system can still prefer the status quo over all of the proposed improvement options if it sees no economic benefit (in terms of either direct monetary savings or indirect savings associated with time reduction) from such a switch.

The results suggest that these urban households in Kenya use an implicit economic cost-benefit framework to guide their decision on change versus no change in their current water system. Coupled with the finding that 76 percent of sampled households prefer one of the three proposed improvement options, this study indicates that the majority of Kenyan urban households are paying for services and are more likely to be willing to pay for the proposed improvements if they perceive a clear economic benefit. The policy implication is that the economic and financial viability of future improvements is high. The key constraints to the introduction and success of improved water services are, hence, more likely to be political and institutional. (We return to this point in the concluding section.)

7.2 Demand for Types of Change

Of the 76 percent (235 households) who opted to pay for a change, 33 percent selected private connections (51 percent of non-poor and 24 percent of poor), 26 percent selected yard connections (21 percent of non-poor and 30 percent of poor), and 17 percent opted for improved kiosk services (12 percent of non-poor and 19 percent of poor). Kiosks were the least preferred improvement option among both the non-poor and the poor. This result is consistent with our earlier finding that the dissatisfaction rate of households who *currently* use kiosk services is high (Section 4). In other words, many poor urban consumers are currently unhappy with the service they currently receive from kiosks, but are limited in their choice of options and must therefore continue to rely on kiosks for the foreseeable future (we return to this point in Section 7.3).

To separate out the effect of one factor from other potential factors, we again use multivariate analysis to identify the genuine “drivers” or determinants of households’ preferences across multiple improvement options. We use the McFadden discrete choice model for our multivariate analysis because, in our survey, the households choose among three improvement options and one option characteristic (the tariff structure) varies across households (Mu and others 1990). The improvement option characteristics used in the analysis are the proposed connection fee and unit price. The socioeconomic variables included are the same as those used in the analysis of “change versus no change” in the last section. Estimation results of the McFadden discrete choice model are presented in Table 12.

The results show that, when controlling for all the potential household and option characteristics simultaneously, only three variables are statistically significant (at 5 percent significance level) in explaining households’ preferences among the three options: (a) current unit cost of water, (b) current per capita water-use level, and (c) number of rooms in current residence. We find that a household is *more* likely to prefer the private piped connection option (as compared with the improved kiosk option), the *higher* the unit cost it currently incurs for water, the *higher* its current per capita water-use level, or the *larger* the number of rooms it has in its current residence. These three statistically significant factors suggest that non-poor households are more likely to have

Table 12: Estimation Results of the McFadden Discrete Choice Model for Household Preferences Options

Independent Variables	Coefficient Estimate	t-Statistic	Relative to the "improved kiosk service" option, probability of opting for: Private Connection Coefficient Estimate	t-Statistic	Yard Tap Coefficient Estimate	t-Statistic
Intercept			2.82979	0.67	2.97466	0.71
Option characteristics:						
Connection fee	–0.00016	–0.69				
Unit price	2.25893	0.19				
Household characteristics:						
Male respondent			0.33352	0.49	0.57949	0.89
Education level of respondent			0.90920	1.19	–0.01566	–0.02
Poor household			–0.96432	–1.25	–0.61993	–0.81
Household size			–0.10386	–0.64	–0.18524	–1.16
Per capita daily water consumption			0.02523[c]	2.41	0.01719[c]	2.32
Unit price currently paid for water			0.99265[c]	1.97	3.10373[c]	1.99
Own residence			–0.50863	–0.38	–1.21824	–0.92
Number of rooms in residence			1.47847[c]	1.98	1.46556[c]	1.98
Time spent daily in collecting water			0.00869	0.86	0.01261	1.30
Overall satisfaction with primary water source			–0.58083	–0.82	0.02283	0.03
City of residence:[a]						
Mombasa			–0.81608	–0.50	0.96586	0.57
Kakamega			–1.64079	–0.93	–1.49329	–0.84
Current primary water source:[b]						
Yard tap			–2.18028	–1.29	–2.77830	–1.69
Own source (well, borehole)			–12.58227	0.00	26.04710	0.00
Kiosk			–1.29486	–0.92	–1.83151	–1.32
Ground and natural sources			–1.12005	–0.50	–2.04493	–0.94
Adj. R^2			0.31			
Log-likelihood			–97.6			
Number of observations			221			

a. "Nairobi" is used as the base/comparison level.
b. "Neighbors/vendors/others" is used as the base/comparison level.
c. Coefficient is statistically significant at 0.05 level or less.
Source: World Bank Economic Sector Work 2000 survey.

higher preference for private piped connections, and support the descriptive results in Table 10. The strong influence of the size of a household's current residence on its preference for the type of improvement option suggests that housing (and by extension, settlement) characteristics play an important role in determining household preferences.

7.3 Kiosks as a Strategy for Serving the Poor?

Many water sector experts note that well-managed kiosks are an appropriate and financially sustainable solution for providing water to poor households (for example, Whittington and others 1990, Collignon and Vézina 2000, Water Utilities Partnership 2003). These experts argue that private connections are often inaccessible to the poor. First, for those within reach of the network, connection costs tend to be unaffordable. Second, the poor often cannot pay lump-sum bills monthly or quarterly, especially because their income tends to be irregular. The result is high disconnection rates or large arrears or both, and both the utility and poor consumers are left worse off. In addition, many poor households may live in areas that are inaccessible (for legal or technical reasons) to utilities, or they may be tenants—renting rooms—and not have a choice in service level. For these households, alternatives to the utility may include small-scale private service providers and self-provisioning.

Where access to a private or yard connection is limited, kiosks or public standpipes may be an appropriate option for the poor. Specifically, kiosks (a) allow users to buy in quantities and at times that they can pay; (b) entail lower capital costs per household served, compared with private and yard connections (allowing, among other things, coverage rates to be increased significantly and faster and presumably lowering the unit cost to the user); and (c) permit (better) cost recovery by the utilities because the kiosk operators ensure that the users pay for the water. In other words, kiosks provide a flexible, desirable, and "good" service to the poor by allowing them to purchase in (small) quantities, as and when they have money (as opposed, for example, to a lump-sum monthly bill that is due on a fixed date each month). The poor get a service that they can afford, and the utility recovers most of the costs of providing such a service. Further, given that almost all of the customers of kiosks tend to be poor, any subsidies directed to the kiosk system are better targeted.

In these three urban centers in Kenya, this well-intentioned approach is not working well. Although kiosks do seem to have improved access for thousands of unconnected and poor households, they are neither providing the quality of service desired by users nor achieving the utilities' objective of subsidizing costs to poor households. From our price analysis in Section 5, we know that kiosk owners charge, on average, a price that is 18 times higher than the subsidized prices at which they receive water from the utility. That is, the utility provides a subsidy on every unit of water it supplies to kiosks, but this does not reach users, the majority of whom are indeed poor. As mentioned earlier, while noting that kiosk operators in Nairobi have gross profit margins of about 80–90 percent, studies conducted by Collignon and Vézina (2000) and the Water and Sanitation Program (1998) suggest that these apparently high margins reflect the hidden costs of connecting to distant water trunk lines or making unofficial payments to gatekeepers in informal settlements. In contrast with other countries in which kiosk services exist, the high cost of risks associated with developing and running a kiosk service in these Kenyan cities has essentially overridden the subsidy provided by the utility.

In this case, the extent to which the kiosk system does or does not result in extraordinary net profits (that is, monopoly rents) and who benefits require further research. It is clear, however, that the kiosk system and the design of the subsidy are not working as intended in these Kenyan cities. The significant gap between purchase and sale prices of kiosk water also provides evidence for the argument that subsidizing tariffs to kiosks is in itself a limited tool for targeting or influencing service delivery for poor households and that the intermediating institutional arrangements are crucial for determining the outcome.

What is the practical implication of these findings? A key priority—a pragmatic and optimistic one—is to try to fix the problem and the options for doing so by (a) bringing trunk infrastructure closer to low-income areas and ensuring continuity of supply; (b) increasing private, yard, and kiosk connections in these areas, perhaps by subsidizing connections, but not the water itself; and (c) increasing competition and introducing performance measures for kiosks to put downward pressure on the price charged by other kiosks—there is evidence, for example, that nongovernmental organization-run kiosks in Nairobi charging lower prices have helped lower water prices in their area. At the same time, there is a need to focus more squarely on the underlying reasons for the low quality and high costs of kiosk services by gaining a better understanding of the impact of broader issues such as land and housing tenure on water supply and by resolving land-use planning, security of tenure, and other issues to expand the range of options available to poor households.

8 CONCLUSIONS

This study finds that the current water supply situation in Nairobi, Mombasa, and Kakamega is dismal. Although about half of the sampled households have access to private piped water connections, only 5 percent of those connected are poor. The poor households are thus overwhelmingly dependent on alternative water sources and end up spending an average of 42 minutes in collecting water (compared with 15 minutes spent by non-poor households). These findings are not surprising. Indeed, stories of underserved poor households are legion in the literature, which shows that the urban poor are not likely to have a private water connection, are likely to be paying high unit prices for water that they purchase, and are spending a significant amount of time in collecting water.

The non-poor in the sample are not that much better off. The mean per capita daily water use is 33 and 44 liters for poor and non-poor households, respectively, and the median water-use values for both groups are lower in absolute terms. When compared with baseline data from earlier studies, this represents a sharp decline in usage by the connected non-poor households. In addition, the unit costs incurred by both the poor and the non-poor are very high, and there is no statistically significant difference in the mean unit costs that they incur for their water. On average, the households are spending Ksh260/m^3 (US$3.5/$m^3$), and the median unit cost for the sample is Ksh156/m^3 (US$2.1/$m^3$). As a result of declining utility services, both the poor and non-poor are consuming little water and incurring high unit costs for it. The result is that half of the households sampled—piped and unpiped, poor and non-poor—are dissatisfied with their current water supply situation, and the majority rate improvement in water systems as their top development priority. In other words, across the board, the quality of water supply is generally substandard.

When presented with improvement options and associated tariffs, the majority (76 percent) of the 311 unconnected households opted to pay for an improvement—kiosk, yard tap, or a private connection—rather than maintain the status quo. Of these, 43 percent opted for private connections, 35 percent for yard connections, and 22 percent for improved kiosk service. Using multivariate statistical analysis, we examined variables that influence household preference for and choice of option. The results show that only three variables are statistically significant in explaining households' preferences among the three options: (a) current unit cost of water, (b) current per capita water-use level, and (c) number of rooms in current residence. We find, for example, that a household is more likely to prefer the private piped connection option, the higher the unit cost it incurs for water, the higher its per capita water-use level, and the larger the number of rooms it has in its current residence.

Regarding the household decision on whether to opt and pay for a change from its current system, three variables have a statistically significant influence: (a) its current unit cost of water, (b) current per capita water-use level, and (c) time spent daily in collecting water. We find that a household is more likely to maintain its current water supply status, the lower its unit cost for water, the lower its per capita water-use level, or the longer the time it spends daily on collecting water.

The results indicate that households in these urban areas are acting largely as informed and rational economic decisionmakers, that there is a well-established private market for water, and that it is similar in nature to the market for a consumption good—it works on price and quantity, all else being equal. Survey respondents—poor and non-poor, educated and uneducated, male and female—understand the value of water, treat it as an economic good, and have moved away from any erstwhile notions that it will be available from a public source at low or no cost.

In contrast to some of the earlier studies on demand (which focus on rural demand),[16] it is clear that in urban areas, economic factors such as price and quantity, rather than socioeconomic variables such as education level and gender, help explain much of the variation in households' decision on whether to connect and which option to choose. One possible explanation is that a failing public supply, combined with the emergence of a poorly functioning and unregulated market for water, has transformed basic user perceptions regarding water and its availability, price, and options for supply. In cities of comparable nature—such as Lagos—the demand for improvements in water supply and households' willingness to pay for them are likely to be very high.

And while kiosks may be an appropriate, affordable, and desirable strategy for serving the poor, in the three urban centers in Kenya, we find that kiosks are the least preferred "improvement" option among the unconnected urban households. Our data also suggest that current users of kiosks continue to use them only because they have no choice or no ability to pay for a better alternative. Households report that kiosks do not offer adequate convenience (for example, long travel distance and queuing times); are more expensive than other options—at the time of the study, an average of Ksh4.1 per 20-liter jerrican or US$2.7/m^3, even though the utility "social" tariff was US$0.15/m^3. Thus, the subsidies intended for the customers of these kiosks—77 percent of whom are poor—are not actually reaching them. This finding highlights the limitations of using tariffs as a targeting tool and the importance of getting the subsidy targeting mechanism to work. We speculate that this particular failure seen in the Kenyan kiosk system is not unique—that is, it is likely that utilities in several other countries are also failing to recover costs from kiosks, even though they have provided a subsidized tariff and users are paying cost-recovery-level prices for water from these systems. This contention needs to be tested through additional empirical research. Further, it is worth conducting research on the scale, scope, and functioning of the parallel water industry in these Kenyan cities and also, perhaps, on whether the private water providers—who often deliver a valuable and desirable service—are indeed extracting extraordinary profits.

What are the broader implications of this study for the water sector in Kenya? The study indicates that there is broad constituency for reform in the water sector in urban Kenya—a constituency that includes—unlike perhaps in many Asian and Latin American cities—both poor and non-poor

16 Several studies on demand for water in rural areas, published in the early 1990s, suggest that socioeconomic factors such as education levels and the gender of the respondent have a large role to play in determining the demand for water and the source choice (for example, Briscoe and others 1990, World Bank Water Demand Research Team 1993).

consumers. The high level of access to a utility connection has at least one positive implication: that the objective of scaling up water supply to respond to demand and meet the Millennium Goals is within reasonable reach. Despite low water use, households' willingness to pay for improvements is backed by an ability to pay. In other words, this is a situation where user support for, and the financial and economic viability of, an improvement program are high. There are no major supply constraints, although improvements and expansions in the transmission and distribution networks are required. We also know that the utilities are losing money and that service provision is deteriorating, even though the tariffs are technically sufficient to allow cost recovery (World Bank 2001). This means that the low-level equilibrium cannot be attributed to low tariffs, and hence the standard prescription of "raising prices and using the increased revenues to improve service" has little impact in this situation. The key challenges appear to be political and institutional. They include the political will to build broad support for implementation of the government's reform program, thereby improving institutional and governance arrangements for service delivery, enhancing incentives for performance, and designing means of improving the efficiency and cost-effectiveness of alternative providers, such as kiosks.

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APPENDIX
ESTIMATION OF HOUSEHOLD DEMAND FUNCTION FOR WATER USE

To gain insights into sample households' price elasticity of demand for water, we used regression analysis to estimate a linear demand function of total household water use (in liters per day) in terms of unit water price paid (Ksh per liter), household income level (Ksh per month), household size (number of persons currently in residence), current city of residence (indicator variable with Nairobi as the "base or comparison" level), and current primary source of water (indicator variable with private piped connection as the "base or comparison" level). It should be noted that the objective of our demand model analysis is not to develop a predictive model of household water use, but to test for any systematic empirical relationship between the use level and unit price paid across households. This makes the inherent problem of "missing variables" in any reduced-form empirical model analysis, as is the case with our demand function model estimation here, less of an issue.

The model was estimated using GLM (Generalized Linear Model) regression analysis with robust standard errors clustered on neighborhood sites (which was used as the stratifying unit for our survey data collection) to account for possible lack of independence across individual household observations within these clusters. The GLM estimation technique thus relaxes the two critical assumptions (namely, equal variance and independent random errors across observations) underlying the usual OLS (Ordinary Least Square) regression analysis and should lead to more appropriate significance tests for the model coefficients. (The estimation results are shown below in Table A1.)

Table A1: Estimation Results for the Linear Demand Function

Dependent variable: Household water use (liters per day)

Independent Variables	**Coefficient Estimate**	***t*-Statistic**
Intercept	32.23310	0.78
Unit price paid (Ksh per liter)	–83.28066[c]	–2.24
Household income (Ksh per month)	0.00281[c]	3.70
Household size (number of persons)	31.52073[c]	4.34
Current city of residence:[a]		
Mombasa	87.30729[c]	3.18
Kakamega	–27.44817	–1.14
Current primary source of water:[b]		
Yard tap	–60.70484[c]	–2.48
Own source (well, borehole)	91.36908	0.45
Water kiosk	–78.06063[c]	–3.07
Water vendors	–80.13046[c]	–2.20
Neighbors	–67.69434[c]	–2.12
Ground and natural sources	–59.11138	–1.81
Others (including bottled water)	–126.6406[c]	–4.94
Adj. R^2	0.34	
Number of observations	340	

a. "Nairobi" is used as the base or comparison level.
b. "Private piped connection" is used as the base or comparison level.
c. Coefficient is statistically significant at 0.05 level or less.
Source: World Bank Economic Sector Work 2000 survey.

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