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WATER SYSTEM UNRELIABILITY, AVERTING BEHAVIORS, AND HOUSEHOLD PREFERENCES

William F. Vásquez

Abstract

Concern continues to grow over the unreliability of water services in many developing countries. The poor are particularly affected by financial and health implications of water service interruptions. This summary of my research reviews some of the behaviors that households adopt to cope with unreliable water services, and analyzes household preferences for improved services in Guatemala, Mexico, and Nicaragua. Findings indicate that many households are willing to pay for improved water services. In addition to providing guidance for policies aimed to improve water services, this summary is intended to motivate researchers to study the causes and effects of unreliable water services in developing countries.

Keywords: Water System Unreliability – Water Service Interruptions – Averting Behaviors – Water Storage – Water Treatment – Willingness to Pay – Household Preferences

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◆ INTRODUCTION

By ratifying the United Nations Millennium Declaration in 2000, 189 countries committed to halve, by 2015, the proportion of the population without sustainable access to safe drinking water, among other objectives. The percentage of the global population with access to improved drinking water increased from 76% in 1990 to 91% in 2015. Of the 2.6 billion people who have gained access to improved water sources since 1990, 1.9 billion gained access to piped water. By 2015, approximately 58% of the global population had access to piped water (United Nations 2015). These figures are encouraging given the multiple benefits of having access to safe drinking water, particularly in terms of the health of the population. Recently, in the framework of the Sustainable Development Goals (SDGs), the United Nations has proposed to reach universal provision of safe drinking water by 2030. Pursuing this noble objective will require considerable investments in water infrastructure.

It is unquestionable that drinking water infrastructure has been expended worldwide in the last years, and with it comes the need for resources to maintain and repair water systems. Regardless of the type of water utility, water services seem to be frequently interrupted, in a large extent due to inappropriate maintenance and operation of water systems (Katuwal and Bohara 2011; Majuru et al. 2016; Vásquez 2013; 2016). Kumpel and Nelson (2016) estimate that more than 300 million people

[*] PhD - Associate Professor - Department of Economics - Fairfield University - 1073 North Benson Rd, Fairfield - CT 06824- USA - Email: wvasquez@fairfield.edu

around the world often experience water service interruptions. As a result, those households adopt a variety of coping strategies that impose a heavy burden on the poor (Baisa et al. 2010; Pattanayak et al. 2005; Vásquez 2012). Moreover, it has been demonstrated that water service interruptions negate the potential of piped water access to reduce morbidity (deWilde et al. 2008; Hunter et al. 2009; Jeandron et al. 2015; Majuru et al. 2011). The behaviors that households adopt to cope with unreliable water systems (e.g. in-home water storage and treatment) are a demonstration of a latent demand for improved water services.

When questioned about the reasons for frequent interruptions of water services, government officials often indicate that they lack the resources required to maintain water systems and provide better services, primarily because households do not comply with water services (Vásquez 2011). In their view, households are unwilling to pay for improved services. However, there is ample evidence that many households are indeed willing to pay for reliable water services (Abramson et al. 2011; Arouna and Dabbert 2012; Vásquez 2014; Vásquez and Franceschi 2013; Vásquez et al. 2009, 2012). Existing studies of household preferences have also provided relevant insights regarding the preferred form of water service governance, which is strongly related to the willingness to pay for those services.

The objective of this summary is to review some of the behaviors that households adopt to cope with unreliable water services, and improve our understanding of household preferences for improved services in developing countries. This summary is far from being a comprehensive literature review; instead the discussion of household behaviors and preferences regarding improved water services is based on research projects that I have conducted in Guatemala, Mexico, and Nicaragua. In addition to providing guidance for policies aimed to improve water services, this summary of my research is intended to motivate researchers to study the causes and effects of unreliable water services in other developing countries, and thus contribute to achieving the SDG of universal provision of drinking water.

◆ AVERTING BEHAVIORS

Water service interruptions represent a challenge for many households worldwide. To cope with unreliable services, households adopt a variety of measures

including storing water at home. For example, based on survey data from the second largest city in Nicaragua, León, Vásquez (2012) found that almost 80% of sampled respondents had at least one water storage device at home on which they expended approximately 0.87% of their average monthly household income. Interestingly, sampled households reported to have water services for an average of almost 20 hours per day. Pattanayak et al. (2005) reported similar levels of household expenditures on averting measures including water storing (about 1% of the average household income) in Kathmandu, Nepal. While most studies on in-home water storage have been conducted in large cities, Vásquez (2016) looked into this averting behavior using a sample of households located in a small, poor municipality of Guatemala, San Lorenzo. On average, sampled households experienced water service interruptions for two to three days per week. The average household had invested an amount equivalent to about 23% of the average monthly household income on a variety of storage devices (e.g. buckets, barrels, roof tanks, and cisterns). This suggests that averting measures can impose a heavy burden on poor households that are served by unreliable water systems.

Vásquez (2012) estimated instrumental variables Tobit models to investigate factors associated with water storage expenditures at the household level in León, Nicaragua. His estimation results show that household perceptions of water system reliability are the main factor driving household expenditures on storage devices, followed by home ownership and household income. Moreover, Vásquez showed that perceptions of water system reliability are primarily related to the average number of daily hours with water supply reported by respondents. Vásquez (2016) investigated determinants of the household choice of purchasing different storage devices, which he classified as small devices (e.g. casks and buckets), barrels, and large devices (e.g. roof tanks and cisterns). Several households used a mix of those storage devices. Using seemingly-unrelated probit models, Vásquez (2016) demonstrated that small devices and barrels are used in a complementary fashion. In contrast, large devices (i.e. cisterns and roof tanks) seem to be considered as substitutes for both barrels and small devices. Estimation results also showed that small devices and barrels are considered to be inferior (i.e., their use decreases with household income), while roof tanks and cisterns are considered as normal goods (i.e., their use increases with household income). This suggests that poor households would rely on barrels and small devices to store water at home, and more affluent households would do so using roof tanks and cisterns.

The selection of storage devices may have some health implications and, given that the poor are constrained to use barrels and other small devices, their health could

be at risk. Storage devices that are not covered, such as barrels and buckets, may allow for water recontamination, which has been repeatedly linked to diarrheal disease (Gunther and Schipper 2013; Roberts et al. 2001; Wolf et al. 2014). Those devices may also promote growth of disease vectors such as the mosquito carrier of dengue (Majuru et al. 2016; Thompson et al. 2000). Additionally, compared to roof tanks and cisterns, barrels and other small devices have a lower storage capacity. Without enough water, households may reduce water usage for personal and home hygiene such as bathing, handwashing, laundry, dishwashing, and washing floors (Evans et al. 2013; Majuru et al 2016; Wolf et al. 2014). Hygiene interventions, handwashing in particular, reduce the incidence of diarrhea (Aiello et al. 2008; Curtis and Cairncross 2003; Ejemot-Nwadiaro et al. 2015; Esrey et al. 1991; Thompson et al. 2000; Waddington et al. 2009). Consequently, water system unreliability may jeopardize the health of the population, particularly for the poor who cannot afford improved water storage devices.

Vásquez et al. (2015) found that water service interruptions may also affect household perceptions of tap water quality, which in turn influences household choices of consuming bottled water (as an alternative to drinking tap water) and treating tap water at home for drinking purposes. That is, in the absence of real water quality data (e.g., actual test results), system reliability serves as a quality perception proxy for the decision to spend scarce time or money on averting measures. In-home water treatment may be desirable when water services are frequently interrupted because the water quality can be compromised by contaminants introduced during periods of low pressure or supply interruption (Majuru et al. 2016; Wolf et al. 2014). However, water quality and service interruptions are not perfectly correlated and, consequently, water quality perceptions may be inconsistent with the (unobservable) quality of tap water. Inconsistencies between perceived and actual water quality may put households at significant risk in areas with poor water quality or may result in overspending on averting measures when water quality is acceptable for drinking (Um et al. 2002; Vásquez 2015).

Bottled water could be a temporary source of safe drinking water in areas where households are exposed to health risks due to the lack or unreliability of public water systems. However, as Gleick (2004) has argued, it is difficult to consider bottled water as a permanent solution to mitigate health risks, primarily because bottled water is considerably more expensive than publicly-provided tap water. Due to the exorbitant price of bottled water, it would be difficult for the poor to purchase and consume

bottled water in the event of extended water service interruptions. In general, the unreliability of water systems represents a considerable risk for population health (Jeandron et al. 2015; Majuru et al. 2011), as well as a financial burden particularly for impoverished households.

◆ HOUSEHOLD PREFERENCES FOR IMPROVED WATER SERVICES

Policymakers often argue that the public demand for improved water services is too low to cover investments in and operation costs of reliable systems. However, households already spend a considerable amount of resources to cope with unreliable services in the form of in-home water storage, in-home water treatment, bottled water consumption, and water purchases from water vendors (e.g. water trucks). As argued in the previous section, those averting measures are a demonstration of a latent demand for improved water services. Supportive evidence for this latent demand for improved water services is provided by several studies on household preferences for improved water services that have found households are willing to pay for continuous water supply (i.e. no service interruptions) and water quality improvements.

Using a referendum-format contingent valuation approach, Vásquez et al. (2009) investigated households' willingness to pay for improved water services in the city of Hidalgo del Parral, Mexico. In this city, water services are frequently interrupted and the quality of tap water is compromised by chemical residuals from past intense mining. Sampled respondents were asked to vote for or against a project under one of following two hypothetical scenarios. The first scenario would improve the quality of tap water to make it safe to drink according to internationally-accepted standards. The second scenario would improve the reliability of the water distribution system to ensure continuous provision of safe drinking water (i.e. no service interruptions). Conservative estimates indicate that the median household would be willing to pay at least 0.75% of its income for improved quality of tap water (i.e. scenario 1), and at least 1.8% of its income for continuous provision of safe drinking water (i.e. scenario 2).

The city of León, Nicaragua, experiences similar issues of water service interruptions (Vásquez and Franceschi 2013). While information about tap water quality does not exist, León's inhabitants perceived tap water to be relatively safe to drink. Vásquez and Franceschi (2013) estimated the median household's willingness to pay for

continuous supply of safe drinking water under two forms of management: 1) the current national water utility (known in Nicaragua as ENACAL), and 2) a hypothetical decentralization to the municipal level. They found a significant willingness to pay for service reliability, but an insignificant willingness to pay for improvements of tap water quality. Interestingly, they also found considerable variations in the willingness to pay for improved services across the proposed forms of management. Households are willing to pay a premium equivalent to 3.3% of their income if the improved system is administered by the current centralized water utility.

Vásquez (2014) also found different levels of willingness to pay for improved water services between municipal and community-managed systems in San Lorenzo, a small town in the western highlands of Guatemala. His findings indicate that households served by the municipal government were willing to pay about 1.5% of their income for system improvements that would guarantee continuous supply of safe drinking water. In contrast, households connected to a community-managed system would not pay for continuous supply of safe drinking water even though the service interruptions they experienced were more frequent and longer than interruptions of municipal services. Given that San Lorenzo's inhabitants are relatively poor, there was a concern that they would not be able to pay for improved water services. Therefore, Vásquez (2014) also estimated the willingness to work for improved water services as any household can contribute some labor to manage, operate, and maintain the water system. Households served by the municipal system were willing to work an average of 19 hours in a month for continuous supply of safe drinking water. Again, households served by the community-managed system were not willing to pay for improved water services. These results suggest that the willingness to pay for reliable water services is context-dependent, and that the type of service management is part of that context.

◆ CONCLUSIONS

In many developing countries, households experience negative consequences from water system unreliability. Households adopt a variety of measures to cope with unreliable services according to their ability to pay. Affluent households may afford adopting measures that will ensure water quality and availability. In contrast, poor households may be financially constrained having to adopt inferior alternatives that can compromise the amount and quality of stored water. Therefore, water service unreliability jeopardizes the health of the population and imposes a considerable financial burden particularly on the poor.

Averting behaviors are a demonstration of the households' latent demand for improved water services, and household expenditures on those measures can be considered a lower bound of the household's willingness to pay for improved water services. Prior studies on averting behaviors have shown that many households are willing to pay for reliable water services. Similarly, analyses of household preferences for improved services indicate that many households would pay (or work) for better water services, although there also are some households that are not willing to pay for such improvements. That is, the willingness to pay for reliable water services is context dependent. It is worth noting that the type of service management is part of the context that determines household preferences for improved water services.

More research is needed to improve our understanding of contextual effects on household preferences for improved water services, beyond service characteristics. As Vásquez (2014) and Vásquez and Francheschi (2013) have shown, household preferences can vary across different forms of service management. Yet, more evidence is needed to identify the attributes of management approaches that determine the level of support (or rejection) for improvements of water services. Other contextual factors such as social capital and supplier-user relations can influence household preferences as well. Future studies should investigate those contextual factors.

There also exists the potential for scholarly contributions to the literature on averting behaviors. For instance, it is common to observe households treating water at home in places where the quality of the tap water has been shown to be acceptable for drinking purposes (Um et al 2002). On the other hand, there are households that drink tap water in places where water quality is dubious and information on water quality is lacking. Another example is in-home water storage, a practice that is often implemented

even in areas where water services are rarely interrupted. Inconsistencies between water quality and averting behaviors certainly deserve more attention.

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