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Understanding Water Affordability in the United States

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Abstract

Access and affordability to clean water in households are primarily considered third world issues – which is why there seems to be limited research on water affordability focused on the first world. However, rising water prices over time have become a growing concern even in the developed world, especially for the low-income population. Therefore, this paper takes a deep dive into the literature available on water affordability in the United States to explain what water affordability means; the equity and efficiency concerns around it; how it is measured; the critiques to the standard affordability threshold being used; the possible alternative criteria that can be considered instead; and the policy responses to the current water affordability challenges. The analysis presented indicates the need to understand water affordability from an equity standpoint, though it does not suggest a decrease in prices across the board or making water services free. This research can serve as a baseline for future studies related to water affordability within different regions in the United States and other developed countries.

Keywords: Water affordability, Water pricing, Water access, Water scarcity, Water equity, EPA affordability threshold

Introduction

Access to clean water is globally recognized as a fundamental human right. The United Nations General Assembly and the Human Rights Council formally recognized human right to safe drinking water as part of the binding international law in 2010 (UN General Assembly, 2010). Though there has been considerable progress in increasing availability of safe drinking water to the world population, affordable access remains a concern. This is because access to water is not just limited to the provision of water supply infrastructure but also about households having sufficient purchasing power to afford the available water services (García-Valiñas, Martínez-Espiñeira, & González-Gómez, 2010). Hence, water affordability is integral to ensuring that people can enjoy their right to clean water.

Water affordability is largely considered a third world issue, which is why there seems to be limited scholarship around the subject in developed countries (Mack & Wrase, 2017). However, in the recent past, concerns have been shared about rising water rates and how

they can impact affordability in the developed world, including the United States (Layne, 2019; Picchi, 2017). Analysis of the literature reveals that many low-income families across the globe are struggling to pay their water bills, which makes a significant proportion of their low incomes (García-Valiñas, Martínez-Espiñeira, & González-Gómez, 2010). According to a study, at least 11.9 percent of people find their water bills unaffordable in the United States when the EPA affordability threshold[1] is used (Mack & Wrase, 2017). As many as 19,500 households (representing more than 100,000 people) in Detroit, Michigan, had their water shut off on March 1, 2014, as they could not pay their bills (Wilder & Ingram, 2018). Hence, water affordability is an important issue for both developing and developed countries (García-Valiñas, Martínez-Espiñeira, & González-Gómez, 2010; Sebri, 2015).

This paper aims to dig deeper into water affordability as a growing problem and review the literature around it. The focus is specifically on potable water used in households for which sewer costs may or may not be combined. The paper is divided into sections that discuss water affordability issues emerging after a close review of the available literature. These include increasing water rates, water equity and efficiency, meaning and measurement of water affordability, assessment of water affordability criteria, and response to affordability challenges. The analysis presented here can serve as a baseline for future studies related to water affordability within different regions in the United States.

Increasing water rates amidst scarcity concerns

One of the significant findings in the literature around water affordability is that water rates (i.e., prices of water supply to households) have been on the rise. Costs of water provision are increasing in the U.S. due to the aging infrastructure, growing demand for water, and need for compliance with federal standards – all of which translate directly into rising water rates over time (Beecher, 1994). This increase has been more than the rise in the Consumer Price Index (CPI), while at the same time, real incomes of the poor households have decreased (Pontius, 2008). An example is Pennsylvania's case where water rates increased faster than incomes, proving to be burdensome for the lower-income households, many of whom were paying more than the affordability threshold of 2 percent (Rubin, 1994). The following graph shows the water rates trend compared to electricity and CPI from 2000 to 2016 (BPC, 2017).

[1] Explained in section 4

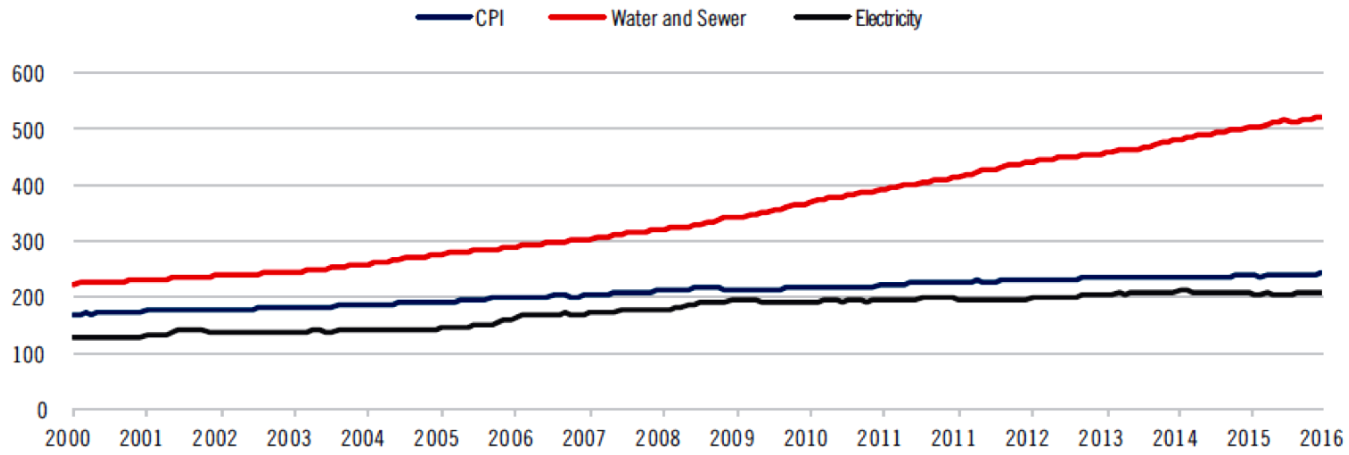

Figure 1: Trends in U.S. Consumer Prices (1982 – 84 = 100) (Source: Bipartisan Policy Center, 2017; Original Source: Bureau of Labor Statistics)

The increase in water rates is accompanied by growing concerns over a decrease in the water supply. Though freshwater is a renewable resource, population growth, human intervention, and climate change are causing a steady reduction in the world's clean water supply (Devi, Joseph, Karunakaran, Anurdha, & Devi, 2009). Already a scarce resource, water is expected to get scarcer even in the United States, especially in the arid and semi-arid regions, as the water-intensive economic activities have grown substantially (Whiteley, Ingram, & Perry, 2008). Given the current trend and scarcity concerns, water cost is expected to increase even more in the future. If this trend continues for the next five years, the percentage of people that find water unaffordable in the U.S could grow five times the current level of 11.9 percent (Mack & Wrase, 2017). Therefore, pricing policies need to be more sensitive to the principles of equity (García-Valiñas, Martínez-Espiñeira, & González-Gómez, 2010). The next section shares more about equity and what it means for water distribution and affordability.

Water equity and efficiency

Equity has been associated with the *benefit principle* and *ability to pay principle*. The former means different users pay the same for a certain quality and quantity supplied, while the latter implies linking the water payments inversely with incomes (García-Valiñas, Martínez-Espiñeira, & González-Gómez, 2010). The benefit principle seems to be more prevalent and deemed sufficient for determining water rates. However, the latter is more socially just.

The distinction between these two principles can also be understood in terms of equality and equity, two seemingly related concepts with different implications. *"Equal water distribution assumes uniform needs and rights to water. By contrast, equitable water distribution is based on fairness in terms of local histories, norms, and beliefs rather than equal allocations alone."* (Wutich, Brewis, Sigurdsson, Stotts, & York, 2013, p.221). In addition, water equity is considered aspirational, contextual, and relational. It is aspirational since it aims to accomplish better outcomes and contextual because it can be achieved in specific places and contexts. It is also participatory and inclusive. Moreover, it depends on the relationship between different governance actors and the relationship between humans and the environment, making it relational (Wilder & Ingram, 2018). Hence, the goal of

attaining water equity is not as simple as ensuring equal access to water for all. It is also about having an inclusive process and looking at the community's benefits overall (Whiteley, Ingram, & Perry, 2008).

Sebri (2015) describes that social equity, concerning water, has four primary dimensions. The first is the proportionality principle, according to which consumers must pay the water's cost as per the quantity they consume. The second is equality, which implies each person gets an equal amount of water. The third principle is an allocation based on need, which means that availability is not dependent on the ability to pay. The fourth is intergenerational equity, which implies environmental sustainability, i.e., making sure that today's consumption does not impact the water availability for future generations.

Unfortunately, the focus of current water distribution is not on equity or equality. The emphasis of reforms for the past thirty years has been on efficiency. This approach treats water as a commodity and assumes that markets are more efficient water allocators than public enterprises (Wutich, et al., 2017). A focus on efficiency that has no equity considerations ignores the needs of the many to serve a few (Wilder & Ingram, 2018). There are clear trade-offs between equity and efficiency (García-Valiñas, Martínez-Espiñeira, & González-Gómez, 2010), and this trade-off is politically sensitive (Beecher, 1994). Though economic maximization of water is essential, and efficiency helps achieve that goal, it is just one of the values that can be achieved when considering water distribution. A focus on efficiency alone can miss critical practical considerations, e.g., environmental concerns regarding water provision. (Whiteley, Ingram, & Perry, 2008).

None of the principles or approaches are mutually exclusive and may be interrelated. However, what is important is the kind of principle prioritized when making water policies and designing water prices because that directly impacts affordability, especially for low-income households. The next section describes what we can learn about water affordability from the literature.

Understanding water affordability

Economists often use the contingent valuation (CV) method to capture *willingness to pay* for water. CV surveys capture the maximum amount that a person is (hypothetically) willing to pay for a proposed improvement in water services, assuming that the households are free to allocate their financial resources. (Devi, Joseph, Karunakaran, Anurdha, & Devi, 2009). Though the method is useful and has its merits, especially when we do not have sufficient market data to determine the appropriate cost, it is often inappropriately associated with affordability. *Willingness to pay* implies a choice that cannot capture affordability accurately. On the other hand, the *ability to pay* is about what customers *can* pay – which is why it can be a better indicator of affordability (EPA, 1998).

Several factors come into play when understanding affordability, especially for low-income households. Five of these factors have been described by Sebri (2015). First, water and sewage bills represent a larger proportion of income for low-income families. Non-discretionary obligations, e.g., rent, taxes, utilities, take up a larger proportion of income for low-income households (Beecher & Shanaghan, 1998). Second, poor quality housing and inefficient appliances add to the costs of clean water supply (Beecher, 1994). Third, some households have different needs, e.g., larger households or families with younger children may need more water. Fourth, water pricing structure can impact households disproportionately, e.g., if the structure has a higher fixed cost with increasing prices, the smaller families may end up paying disproportionately more than larger families consuming more. This implies a regressive impact of utility bills for low-income families

(Beecher & Shanaghan, 1998). Finally, location can be a significant factor as getting water to people in remote areas entails more cost and can mean higher water charges. Therefore, it is vital to consider the *ability to pay* when discussing affordability.

In contrast to efficiency – which only looks at costs – affordability focuses on prices. Affordability is a function of both the price of water and consumers' ability to pay for it. This means looking at the *ability to pay* instead of just the *willingness to pay*. While *willingness to pay* is dependent on the price elasticity of demand, the *ability to pay* is dependent on the income elasticity of demand. Income, in turn, is a function of employment, which is impacted by the socioeconomic conditions of the community (Beecher & Shanaghan, 1998). Hence, affordability is not only dependent on household circumstances but also on the conditions of the community. Figure 2 shows the relationship of water prices to household ability-to-pay. Table 1 shows the framework for affordability analysis that gives all the factors that contribute to affordability at each level, i.e., within the household and the water system and higher up till the service territory.

Water Prices

Household Ability-to-Pay		*Selected factors that can raise water prices* •Compliance costs •Infrastructure improvement costs •Demand growth costs •Debt costs •Correction of historic underpricing	*Selected factors that can lower water prices* •Economies of scale •Affordable technologies •Low-cost loans •Grants •Subsidies
Selected factors that lower ability-to-pay	•Low income levels •Unemployment •Nondiscretionary obligations •No income or payment assistance •Regressive rate structures	High prices and low ability-to-pay	Low prices and low ability-to-pay
Selected factors that raise ability-to-pay	•High income levels •Employment •Discretionary expenditures •Income or payment assistance •Progressive rate structures	High prices and high ability-to-pay	Low prices and high ability-to-pay

Figure 2: Relationship of Water Prices to Household Ability to Pay [Source: (EPA, 1998)]

Given the interdependency of factors shown in Table 1, water system affordability and household affordability are sometimes not so different. For example, the ability to get external finances for the water system may depend on the community's financial health, which helps in household affordability. Water systems in the U.S. may also be eligible for the Drinking Water State Revolving Fund (DWRF) if they cannot comply with the Safe Drinking Water Act's standards due to cost considerations. Affordability concerns can also arise when states have to meet requirements of the Clean Water Act; the Asbestos Hazard Emergency Response Act; the Comprehensive Environmental Response, Compensation, and Liability Act; and the Resource Conservation and Recovery Act (Beecher & Shanaghan, 1998).

An important consideration here is that even though desolate community conditions can impact households' affordability, the opposite may not be true. Not all households living in well off neighborhoods can afford water prices. In fact, it has been found that some families within counties face unaffordability even though the region overall is doing better. This is why some people's inability to pay in the community can impact services for the whole area (Mack & Wrase, 2017).

It is also important to note here that not all low-income renters must pay their water bills directly since these costs may be included in their rents. However, higher water prices owning to location or pricing mechanism, or any other factor may be reflected in higher rents (Beecher & Shanaghan, 1998; BPC, 2017). Given that rents are already a high burden, where renters end up paying more than half of their incomes, increasing water prices can exacerbate the situation (BPC, 2017).

Table 1: Framework for Affordability Analysis [Source: (EPA, 1998)]

Category	Focus	Level of Analysis	Selected Indicators
Household affordability	Rate impact on the capacity of water users (particularly residential users) to support the full cost of water service (including debt repayment) through user charges.	Households	• Ratio of user charges to income • Ratio of user charges to income relative to income levels • Percentage rate increase (rate shock)
Financial capacity	The financial structure of the water system including internal sources of capital, key financial ratios, and business planning capability.	Water system	• Ratio of revenues to expenditures • Ratio of net income to revenues • Ratio of assets to liabilities • Debt-service coverage • Composite indicators of financial health • Market test for goods and services (noncommunity systems)
Access to private capital	Ability of the water system to arrange financing (such as a bank loan) through private sector equity and debt markets.	System (or parent entity) and private capital markets	• Credit and bond ratings • Debt and debt capacity • Market test
Eligibility for public capital	Ability of the water system to secure financing (grants or loans) from local (community) or nonlocal (SRF and other programs) public sources.	System (or parent entity) and public capital markets	• Credit and bond ratings • Priority rankings • Eligibility test
Fiscal conditions	Fiscal stress on the community in terms of the condition of local government finances and competing demands for capital and operating expenditures.	Relevant local government	• Debt as a percentage of market property value • Tax revenues as a percentage of market property values • Property tax collection or delinquency rate • Local expenditures per resident • Opportunity costs associated with water system expenditures
Socio-economic conditions	General socioeconomic conditions related to household affordability, priority for public funding, and fiscal distress.	Service territory	• Median household income • Percent below the poverty level • Percent unemployment • Composite indicators of distressed communities

Measuring water affordability

Though there is a general understanding of affordability, measuring affordability is complex and dependent on several factors. Mainly, there are two approaches to quantifying affordability, i.e., an income-based approach or an expenditure-based approach. Both have their pros and cons, e.g., it is easier to measure expenditure than total income since revenue could be from different sources. However, the expenditure approach may give a false impression of being water-poor if a family with an above-average income uses abundant water for non-essential purposes. Similarly, affordability thresholds are also different for different measures (Mack & Wrase, 2017).

The Environmental Protection Agency (EPA) in the U.S. uses the income-based approach to calculate affordability, i.e., the ratio of the annual user charges (AUC) as a percentage of median household income (MHI). MHI may be available in the census data for a state, county, or place – not necessarily corresponding to the boundary of the water system's customer base. The threshold is set to be 2.5 percent (4.5 percent for water and sewage combined), which means that if the annual water charges are more than 2.5 percent of the median household income, the costs are considered unaffordable. However, it should be noted that this is the maximum threshold and does not automatically imply that 2.5 percent of the MHI will be automatically affordable for everyone in the community. If the socioeconomic conditions do not allow for charges as high as 2.5 percent, states can use a lower threshold (EPA, 1998).

Ensuring household affordability is the first step and can be referred to as the Residential Indicator (RI), similar to household affordability in Table 1. The second step is looking at the water system's financial capability in terms of how well it can comply with the standards and still provide water at affordable levels. This is called the Financial Capability Indicator (FCI). Both RI and FCI contribute to the EPA's financial assessment to determine overall affordability (Raucher, Rothstein, & Mastracchio, 2019).

Since EPA requires that water systems ensure compliance with SDWA, it has set an affordability criterion for determining whether affordable compliance technology exists for small systems. The criterion depends on the household affordability threshold (Devi, Joseph, Karunakaran, Anurdha, & Devi, 2009). Decisions to fund these small systems or allowing for variances are based on the criteria established by the EPA (EPA, 1998; Scharfenaker, 2006; Pontius, 2008). Details about the EPA criteria for water systems to allow for variances are not part of this paper's scope.

While the EPA affordability criterion is commonly used as a standard across the U.S., it is not without its flaws. Several studies have criticized the measures used by the EPA and proposed alternatives. The next section dives into these critiques and alternative paradigms.

Criticism on affordability criteria and proposed alternatives

Using any affordability criterion can be problematic because of its binary nature and the fact that some costs will always remain excluded. Wutich et al. (2017) explain this as follows:

> *"Specifically, the binary nature of these conventional approaches—either 'affordable' or 'unaffordable'—is problematic because affordability is rarely a strictly either/or phenomenon; water is affordable relative to the costs of other things and the household's total economic resources (cash and noncash). Simple income percentage-based metrics are not sensitive to other essential household costs (e.g., food, housing, medicine, home energy, taxes), and so income percentage standards can lead to overestimates or underestimates of affordability. More accurate and comprehensive*

> *(but seldom used) affordability metrics account not only for the direct service costs households pay through water bills, but also direct capital costs (e.g., connection fees, water tanks, or on-site purification technology) and the opportunity costs associated with water acquisition, including time spent traveling to and from water sources. But even the broadest cost measures still exclude costs such as the physical impacts of hauling water and missed opportunities for work or school due to water carriage, although these are issues at times taken up in qualitative and critical water security studies."* (Wutich et al., 2017, p.3)

Though this critique is important, it does not necessarily invalidate the use of some criterion for determining affordability as a practical need for devising policy. It serves as a good explanation to understand limitations when using any standard metric.

The affordability criterion set by EPA has mostly been criticized due to the use of MHI (Teodoro, 2018; Christian-Smith, Balazs, Heberger, & Longley, 2013). Some of the challenges of using MHI, as explained by Eskaf (2013), are as follows:

1. The MHI estimate is for the state, county, or place, and not the customer base of the water or wastewater utility itself.
2. MHI estimates are different across the three versions of the ACS (1-year, 3-year, and 5-year), even for the same year.
3. The latest MHI estimates are usually more than a year old
4. MHI estimates for a community can significantly change from one year to the next.
5. The Median Household Income is not a single number (anymore).
6. MHI does not provide a complete picture of the income distribution of households.

Though these challenges exist, Eskaf (2013) does not entirely discredit the use of MHI, though he underscores the need for understanding the implications while using it.

On the other hand, Teodoro (2018) gives several reasons why the EPA's overall standard is misleading, especially since it uses MHI. First, applying average utilization instead of essential use can inflate the actual water needed. It can include consumption to water lawns or filling up pools, especially in summers. Second, using MHI means calculating affordability as a function of the whole community, which can be seriously skewed. The use of median income can leave low-income and poor households unrepresented. Third, costs need to be inclusive of other essential items like food and energy as these costs can impact a household's financial flexibility. Moreover, these essential items might be a lesser proportion of the income but are usually a high proportion of the disposable income, hence the need to include other essential costs. Finally, the ratio is arbitrary, and its binary nature can be problematic, as has also been shared by Wutich et al. (2017).

Given these issues, the study proposes using a different method that considers household affordability (instead of financial capability), basic water needs (instead of average consumption), and low-income households (instead of median-income customers). It also accounts for other essential costs apart from water and sewage. The method involves two complementary metrics, i.e., the Affordability Ratio (AR) and basic costs expressed as hours of labor at minimum wage (HM). Using AR and HM for the top 25 cities in the U.S. shows strikingly different results if EPA criterion was used. For example, the conventional metric of water rates for Dallas is only 1.8 percent of MHI – well under the affordability criterion. However, the AR and HM come out as 8.7 and 8.3, respectively, which shows that the water cost burden is higher than perceived. Though the use of AR and HM has limitations, an important take-away is that the kind of methodology used can lead to different results. However, the variables used should be based on some

realistic understanding of household-level affordability, which seems to be lacking in the EPA methodology.

The National Academy of Public Administration (2017) shares the deficiencies about the use of RI and FCI for financial assessment by EPA. It gives recommendations about how these can be improved, e.g., by focusing on low-income users instead of median income households and including all costs related to water provision with an overall focus on 'integrated planning'. Based on these reservations, an alternate measure of affordability has been proposed by Raucher et al. (2019). It entails using the *Household Burden Index (HBI)* and *Poverty Prevalence Indicator (PPI)* instead of RI and continued use of FCI to understand the community's circumstances. The HBI includes the combined water service costs as a percentage of the 20th percentile household income. This means that it measures the economic burden faced by the relatively low-income households in the community when paying their water bills. On the other hand, the PPI is the percentage of community households at or below 200 percent of the federal poverty level, i.e., the degree to which poverty is prevalent in the community. Hence, both the metrics combined give a snapshot of the household level burden and the prevalence of challenges due to the community's water sector costs.

Though these alternative measures provide better reasoning for using the said variables, the practicality of their use is yet to be seen. When any standard is used across the country, the ease with which it can be utilized and implemented at the lowest level is one of the major factors. Hence, while complicated formulae may seem more accurate, they may be almost impossible to implement, e.g., the use of AR proposed by Teodoro (2018).

Response to affordability challenges

In response to the affordability issues, some organizations have identified the problems associated with affordability to propose recommendations for programs that can help. UCLA Luskin Center for Innovation has published a report about affordability concerns in Los Angeles County in light of the law passed in 2012, which recognized water as a human right for all Californians (Pierce & Gmoser-Daskalakis, 2020). The UCLA Luskin Center for Innovation (as partners with California Environmental Protection Agency) also offers an analysis of the "Low-income Water Rate Assistance Program" in California to present recommendations for effective implementation (Pierce, et al., 2020). Moreover, Pacific Institute has published a brief about some programs that can help with water affordability in California (Pacific Institute and the Community Water Center, 2012). These efforts contribute to addressing the issues surrounding water affordability in the U.S.

The Tiered Assistance Program (TAP) by the City of Philadelphia is another example of a program where the government responds to the growing issues of water affordability (City of Philadelphia, 2019). The Water Center at the University of Michigan has analyzed this program and how it helps people struggling to pay their water bills (Water Center, University of Michigan, 2018). Several reports share policy recommendations and strategies that can help with affordability, e.g., using discount programs (BPC, 2017; National Consumer Law Center, 2014). However, it should be noted that these programs are scarce and not being practiced nationwide to help with water affordability.

Conclusion

This paper uses the available literature to provide a general understanding of water affordability, its link to equity, and the kind of variables that need to be considered – especially for low-income households – when an affordability metric is being used. The

paper sheds light on the implications and limitations of using the EPA affordability criterion and shares the critiques and possible alternatives shared by different scholars.

While the analysis indicates the need to understand water affordability from an equity standpoint, it should be noted that it does not suggest a decrease in prices across the board or making water services free. Water needs to be priced, especially because the growing challenges of climate change can threaten future water availability if we remain careless about its use. However, that pricing mechanism and affordability threshold should not be the same for low-income and relatively affluent households.

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