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Unequal Access to Water and Its Affordability for Households in Mexico

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ABSTRACT



Mexico reported an access rate to piped water of 93.7% and an affordability rate of 0.9%. According to the Millennium Development Objectives, these values suggest that the government is complying with this policy. Nevertheless, this article shows that when grouping households by income level, the results contradict the evaluation. Households in the three poorest deciles have a water access rate of 87.4% and an affordability rate of 4.74%. With the given water policy, households that are not covered, or have deficient coverage, rely on strategies for substituting piped water, which require an investment of time and additional monetary expenses.

KEYWORDS

Accessibility; affordability; drinking water; inequity; poverty

Introduction

The human right to drinking water and sanitation was explicitly recognized in July 2010 by United Nations General Assembly resolution 64/292 (Kooy et al., 2018). The regulatory aspect of the right to water and sanitation must be determined according to the criteria of availability, quality, accessibility, and affordability (Cook et al., 2016). Considerations of accessibility and affordability -the latter understood as the relative ability to pay or the portion of income spent on a particular service by any household in a population (Galster & Lee, 2021; Hutton, 2012)- are key to broadening water and sanitation services and ensuring that everyone can benefit regardless of income, age, gender, race, or other factors (Mack & Wrase, 2017; García-Valiñas et al., 2010a). In fact, over recent years various international and regional declarations have recognized not only accessibility but also affordability, which was included in the formulation of Objective #7 of the Millennium Development Objectives (MDO) related to access to water and sanitation (García-Valiñas et al., 2010a, 2010b).

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It is not enough to have a connection to quality piped water. In addition, its cost should not be disproportionately higher than a person's resources (Arbués & Barberán, 2012; Kessides et al., 2009). On average, the literature on this topic indicates that for middle-income households, affordability tends to be around 1% in developed or emerging countries, and roughly 2.0% to 2.5% in developing countries (Mack & Wrase, 2017; García-Valiñas et al., 2010). Nevertheless, other studies indicate that this affordability index also needs to include additional expenses that households incur in order to access water using means other than piped water, when the main supply is deficient (García-Valiñas et al., 2010a; Mack & Wrase, 2017; Sebri, 2015).

In Mexico, which is considered to be a developed or emerging country, the degree of coverage and the number of residents who have access to piped water services has been rising over recent decades (CONAGUA, Comisión Nacional del Agua, 2016). In 1990, total coverage on the national level was 75.4% (61.2 million people), with 87.0% for the urban population and 46.5% for the rural population. In 2015, that coverage reached 93.7% nationally (112 million people), with 97.2% for urban areas and 85% for rural areas. While there is evidence that the service's coverage has increased considerably over the years, this figure overlooks problems that are related to the continuity of service and the quality of the water delivered to households. Lack of continuity is a large problem for piped water services in Mexico. According to the National Survey of Household Income and Expenses (ENIGH in Spanish) (INEGI, Instituto Nacional de Estadística y Geografía, 2016), roughly 67% of the nation's households receive water daily, while the rest receive it only two or three times per week.

Whether due to a lack of access to piped water, inadequate continuity, or poor quality services, households in Mexico look for other sources of water, such as rainwater collection systems, well water, rivers and streams, cisterns, bottled water, and soda. Given concerns about access and quality, residents in various localities or municipalities depend on cisterns and bottled water for drinking, which adds a considerable additional financial expense for those who often live in the poorest areas and who have the lowest incomes.

On the international level, there are no recognized standards that define the price at which piped water becomes unaffordable. Nevertheless, some references do exist, including 1.5% stipulated by the United Nations Development Programme (UNDP), 3 to 4% set forth by the Organization for Economic Cooperation and Development (OECD), and 4 to 5% stipulated by the Asian Development Bank (ADP) (Hutton, 2012). Over recent years, a series of countries have officially adopted affordable index values in order to adapt their water pricing policies to the population's ability to pay (García-Valiñas et al., 2010). It is worth noting that governments have chosen roughly 1 to 3% as the amount to use for adjusting water prices to the society's ability to pay, primarily for low-income groups, while not compromising the financial

capacity and viability of the water service (Hutton, 2012; Kayser et al., 2013; Kooy et al., 2018; Revollo-Fernández et al., 2019a; Wareg, 2017).

Therefore, the objective of this study was to review Mexico's water supply policy in terms of rates of access to water and its affordability for households based on grouping households by income level (deciles). The results are compared with global indicators of the same variables reported by the government at the global level.

Accessibility and affordability measurements

The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) define piped water as water that is used for domestic purposes, personal hygiene, drinking, and cooking (Morales-Novelo & Rodríguez-Tapia, 2007). They also indicate that a household has access to piped water when the source of that water is less than 1 km from where it is used, most preferably inside the home or on the property where the activities are carried out, and if each household member can reliably obtain at least 20 liters/day to meet their basic needs (Revollo-Fernández et al., 2019a).

Meanwhile, as indicated by Kessides et al. (2009), affordability is quantified by the percentage of income that is spent on a particular service, such as access to piped water, by any household in a population. The literature provides a variety of indicators for measuring this, each one of which has its advantages and disadvantages (Table 1) (García-Valiñas et al., 2010; Arbués & Barberán, 2012). These include: i) measuring household members' perception of the affordability of water and sanitation services; ii) unit prices for water and sanitation services; iii) financial cost, as a percentage of household income, for the minimal water and sanitation services needed to comply with the human right to water; iv) financial cost of water and sanitation services as a percentage of household income; and v) the elasticity of water demand. Of these, the indicators that are most commonly used are the unit price for accessing public services, the elasticity of demand associated with changes in the price of services, and financial costs.

Three indicators were used for this study: total financial cost of accessing piped water (FCAP), total financial cost of accessing water from other sources (bottled water and water tanks paid by households) (FCOS), and total economic (non-financial) cost of accessing water (water tanks received as help from a third party and hauled water) (ECA). These were calculated based on household income deciles in Mexico. With regard to ECA, it is necessarily to recalculate that 89.3% of the country's households that receive water from water tanks pays for the water they consume from this service, while the rest receive it as a donation from a third party. Similarly, the National Survey of Household Income and Expenses (ENIGH) (INEGI, Instituto Nacional de Estadística y Geografía, 2016) reported the number of hours per week that

Table 1. Indicators for measuring affordability.

Indicator	Advantages	Disadvantages
i) Household members' perception of the affordability of water and sanitation.	This type of information can be used when lacking secondary census or survey data.	Perception could be subjective, and responses could be biased. Need for human and financial resources in order to collect the information.
ii) Unit prices for water and sanitation services	Information available for analysis.	The actual level of payment cannot be determined since there is no comparisons with household income or expenses.
iii) Subset of the financial cost to households for water services as a percentage of total income or total expenses	To-date, the dominant affordability indicator has been used, which is easy to understand and is the most widely accepted. Measurable based on survey data available in most countries. Reflects financial costs for households without access to water.	Excludes some key recurring financial costs (water treatment in the home, treatment without a network, hygiene). Excludes non-monetary costs, especially time required to access water. Depending on the pricing policies by the provider of the water network service, this indicator may exclude the capital costs for the services.
iv) Total financial household costs for water services as a percentage of total income or total expenses	Reflects overall financial costs for households, including the cost of accessing other water sources not paid by households and access time, which is an obstacle for many poor households. This is a comprehensive measurement of "actual" affordability for households. Most of the public data is easy to access. The surveys required have been performed in most countries.	Financial costs are not very easy to understand or to follow as a policy objective. Modeling and assumptions involve uncertainty. Some components of the costs require data from other research studies or assumptions. It is difficult to obtain broad agreement over the value of the time spent accessing the services. The data from different surveys must be combined, for example, household income-expense surveys and demographics from population censuses.
v) Elasticity of demand with respect to price or income	A measurement that enables comparing different groups or situations.	More information is needed than other indicators in order to calculate this

Elaborated by the authors

households spend hauling water home from a well, lake, stream, or other water source, and presuming that those hours could be spent on other economic activities (opportunity cost), they were converted to US dollars and calculated in terms of the national minimum salary. The indicators were calculated based on information from the ENIGH, which was developed by the National Institute for Statistics and Geography (INEGI, Instituto Nacional de Estadística y Geografía, 2016). The ENIGH is aimed at providing a statistical panorama of the behavior of household income and expenses in terms of amount, source, and distribution. This survey is nationally representative, and representative of the 32 states and 33,462,598 households.

$$FCAP_i = (\text{Total household cost for accessing public, piped water service}_i / \text{total household income}_i) * 100 \quad (1)$$

$$FCOS_i = (\text{Total household cost for accessing water from other sources}_i / \text{total household income}_i) * 100 \quad (2)$$

$$ECA_i = (\text{Total economic household cost for accessing water}_i / \text{total household income}_i) * 100 \quad (3)$$

Where “i” refers to the decile group.

The FCAP indicator compares the quarterly household financial cost of piped water with total quarterly income. This is the main indicator that has been used to-date to evaluate affordability in many countries (García-Valiñas et al., 2010; Arbués & Barberán, 2012). The option of using FCOS and ECA indicators expands the FCAP financial costs to include expenditures on water that are generally not captured, such as a household’s access to water from other sources, which includes the cost of bottled water, water tanks, and hauling water.

Results

Accessibility by income level

While nearly 93.7% of households in Mexico have access to piped water, this percentage changes considerably when dividing households into income deciles, and when analyzing according to households with and without continuous access to water. In 2016, a total of 2,010,000 households did not have access, representing roughly 8 million people in Mexico’s 32 states. When analyzing according to deciles, only 82% of the first decile (the lowest income) had access to piped water, and roughly 538,000 households in this decile did not have access to this service. Meanwhile, for the tenth decile, nearly 99% had access and only 44,000 households did not (Figure 1).

According to ENIGH (INEGI, Instituto Nacional de Estadística y Geografía, 2016), 67% of the households in the country receive water daily, 14% receive it every third day, 5.1% two times per week, 3.9% once per week, and the rest receive water once in a while. According to stipulations by the WHO and UNICEF, households have access to piped water when they receive it inside the home or on their property, and can obtain it every day for their activities (Morales-Novelo & Rodríguez-Tapia, 2007). The coverage of access in Mexico presents a different panorama. When including households that only receive water every third day to the 6.3% of households that do not have access to piped water, then 20.8% of households would not have good coverage. And when adding to this group the households that receive it two times per week, once per week, and once in a while, the percentage of households that lack good access to water increases to 33.3%

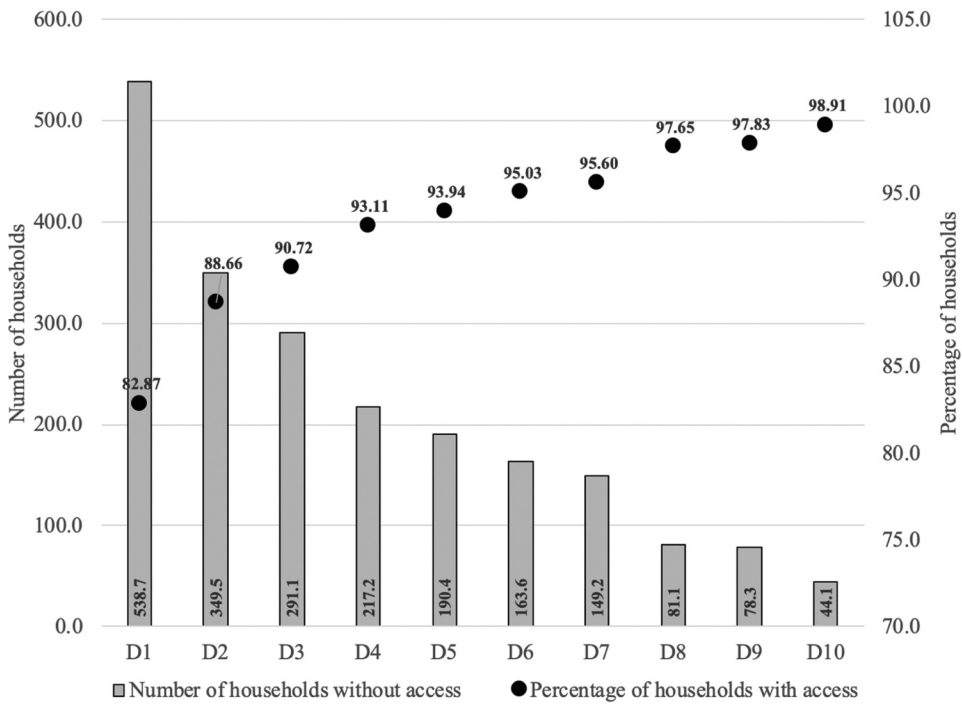


Figure 1. Households nationwide with access to drinking water. Source: Based on ENIGH, 2016. Elaborated by the authors

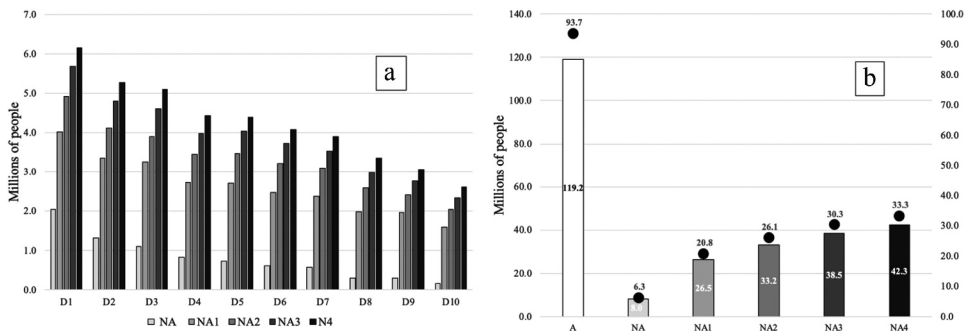


Figure 2. Access and frequency with which the piped water that comes from the public network reaches the house. A: Access/NA: No Access/NA1: No Access + Every third day/NA2: No Access + Every third day + Biweekly/NA3: No Access + Every third day + Biweekly + Once a week/NA4: No Access + Every third day + Biweekly + Once a week + Occasionally. Source: Based on ENIGH, 2016. Elaborated by the authors

(Figure 2b). This shows that access to water is not only about whether or not there is access, but it also depends on the continuity of the service. The wellbeing of the group without access plus the group without daily access is greatly affected by their need to dedicate financial resources to covering their daily water needs (Figure 2b). And when analyzing the problem of access

along with the problem of insufficient frequency, the most vulnerable groups are the low-income deciles, which also indicates a problem of inequity in access to the service (Figure 2a).

Affordability by income level

Reports show that, nationally, 36% of total household expenses is spent on the food, drink, and tobacco group. And 18.6% of the total amount spent on alcoholic and nonalcoholic beverages is spent on bottled water. This high percentage is understandable given that Mexico is the largest consumer of this type of product worldwide. When analyzing the total cost of the different sources of water, households spend approximately US\$ 299 million on packaged juices, US\$ 728 million on bottled water, US\$ 1,713 million on piped water, and US\$ 2,226 million on cola and flavored sodas.

When analyzing these expenses according to different income deciles, in general, the first decile is accountable for 3 to 5% of the country's total household expenditure on access to some source of water, while the tenth decile is accountable for 20 to 22%. Although this indicates that the higher-income deciles contribute a larger monetary amount to the total annual expenditure (Table 2), the situation is reversed when analyzing household expenses as a percentage of total income (Table 3). When analyzing that indicator only in terms of the cost of piped drinking water (FCAP), then households spend 0.9% of their income on water, on average. In terms of deciles, the first decile spends 1.5% of its income and the tenth decile spends only 0.4%. That is, at the national level, the decile with less income spends three times more of its income on access to piped water than higher income deciles. Furthermore, it is of interest to recalculate the indicator taking into account not only household expenditures on access to piped water but also on bottled water and cisterns, since those are significant alternative sources of access for households that do not have adequate access to the main source. The indicator of the financial cost of other sources (FCOS) for all households nationwide is 2.1%. When analyzing this according to household income decile, the indicator for the first decile (5.1%) is 5 times greater than that of the tenth decile (0.9%). Lastly, the indicator of the economic cost of water (ECA) for all households nationwide is 2.5%. And when analyzing the first six income deciles – that is, from the lowest (6.9%) up to the sixth lowest income decile (2.1%) – these are the deciles that present affordability problems (Table 3). Similarly, for this indicator, the difference between the first and last decile is roughly seven-fold. Therefore, it can be said that the more alternative water sources that are used by households, the greater the inequality in terms of affordability.

Lastly, as can be seen when analyzing affordability for the group of households that has access to piped water, those that are most negatively affected are

Table 2. Total annual monetary current expenditure by expenditure items (millions of USD).

Item	Decil of household income									
	1	2	3	4	5	6	7	8	9	10
Total	\$4,675	\$6,239	\$7,704	\$8,955	\$10,469	\$12,362	\$14,930	\$17,778	\$23,704	\$48,230
Monetary current expenditure	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Food, drinks and tobacco	\$2,354	\$2,996	\$3,490	\$3,868	\$4,412	\$4,955	\$5,695	\$6,486	\$7,852	\$12,461
Alcoholic and nonalcoholic beverages	\$168	\$214	\$252	\$272	\$337	\$365	\$431	\$461	\$551	\$729
Bottled water	\$706	\$39	\$47	\$54	\$64	\$66	\$72	\$85	\$102	\$152
Cola and flavored soft drinks	\$109	\$134	\$152	\$166	\$199	\$229	\$265	\$278	\$311	\$316
Packaged juices and nectars	\$12	\$15	\$20	\$21	\$24	\$28	\$34	\$35	\$42	\$69
Piped water	\$60	\$79	\$96	\$120	\$127	\$155	\$179	\$204	\$278	\$382
	3.60%	4.70%	5.70%	7.10%	7.60%	9.20%	10.70%	12.10%	16.60%	22.70%

Based on ENIGH, 2016. Elaborated by the authors

Table 3. Affordability indicators (Percentage).

Indicator	Total	Decil of household income									
		1*	2*	3*	4	5	6	7	8*	9*	10*
Piped water	0.91	1.51	1.14	1.02	1.03	0.91	0.87	0.81	0.72	0.71	0.46
Bottled water	1.14	3.25	2.03	1.63	1.41	1.23	1.01	0.88	0.78	0.65	0.45
Water tanks paid by households	0.12	0.35	0.26	0.21	0.15	0.11	0.08	0.05	0.03	0.02	0.00
Water tanks not paid by households	0.01	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.00	0.00	0.00
Hauled water	0.31	1.83	0.57	0.34	0.2	0.13	0.09	0.06	0.02	0.01	0.01
Indicator Affordability:											
Total financial cost of accessing piped water (FCAP)	0.91	1.51	1.14	1.02	1.03	0.91	0.87	0.81	0.72	0.71	0.46
Total financial cost of accessing water from other sources (bottled water and water tanks paid by households) (FCOS)	2.17	5.11	3.43	2.86	2.59	2.25	1.96	1.74	1.53	1.38	0.91
Total economic (non-financial) cost of accessing water (water tanks received as help from a third party and hauled water) (ECA)	2.49	6.98	4.03	3.22	2.81	2.39	2.06	1.81	1.55	1.39	0.92

* To analyze if the difference in value between the lowest deciles (1, 2 and 3) and the highest deciles (8, 9 and 10) is statistically significant, a means test was performed. This test confirmed the difference for most indicators. Based on ENIGH, 2016. Elaborated by the authors

those that do not have daily access to water. That is, of all the groups nationwide, households that have access to piped water every day spend 0.9% of their income on water and 1.1% on bottled water, while households that have access to piped water only once per week spend 0.7% on piped water and 1.4% on bottled water. This is compounded when analyzing by income decile (Table 4). Therefore, it can be said that not only is it important to have access to piped water, but the percentage of household income that is spent is also relevant. Another crucial factor is that households that do not have access to piped water, or that have access but do not have a regular supply, need to spend their income on other water sources such as bottled water, which results in spending more of their income on water than if they had access to piped water.

Table 4. Affordability indicators taking into account the frequency with which the piped water reaches the house (Percentage).

Decil	Piped water					Bottled water				
	D*	ETD*	TW*	OW*	O*	D*	ETD*	TW*	OW*	O*
All	0.99	0.94	0.89	0.75	0.62	1.05	1.27	1.33	1.39	1.49
1*	1.9	1.8	1.96	1.22	0.97	3.12	3.45	3.16	3.82	3.76
2*	1.38	1.19	1.06	0.89	0.66	2.08	2.03	1.93	1.8	1.88
3*	1.27	0.86	0.9	0.83	0.61	1.6	1.76	1.75	1.64	1.43
4	1.15	0.98	1.1	0.94	0.63	1.42	1.29	1.47	1.56	1.28
5	1.03	0.92	0.73	0.55	0.46	1.22	1.3	1.22	1.23	1.43
6	1.03	0.66	0.63	0.46	0.64	0.99	1.03	0.98	0.93	1.12
7	0.94	0.62	0.48	0.57	0.5	0.88	0.96	0.9	0.87	0.93
8*	0.81	0.54	0.49	0.61	0.45	0.77	0.78	0.87	0.73	0.71
9*	0.75	0.61	0.54	0.54	0.9	0.65	0.63	0.71	0.69	0.59
10*	0.47	0.62	0.43	0.29	0.26	0.45	0.48	0.57	0.5	0.51

* D: Daily/ETD: Every Third Day/TW: Twice a Week/OW: Once a Week/O: Occasionally

* To analyze if the difference in value between the lowest deciles (1, 2 and 3) and the highest deciles (8, 9 and 10) is statistically significant, a means test was performed. This test confirmed the difference for most indicators. Based on ENIGH, 2016. Elaborated by the authors

Discussion

In the case of Mexico, records show that only 6.3% of the country's households does not have access to piped water. Nonetheless, that percentage increases considerably, to 33.3%, when taking into account not only households without access but also those with access but not on a daily basis. It is not only important to solve this lack of access, or lack of continuity in the service, but also the inequity that is found when analyzing the information by income deciles. Roughly 6.2 million people in the first income decile have problems with no access or with inadequate continuity in the service, as opposed to 3.9 million people in the tenth decile.

In addition to considering accessibility from the point of view of both use and frequency, public policies must consider the affordability of household consumption of piped water. There is no international consensus on the percentage that would guarantee that the cost of water would not pose a risk to the consumption of other goods and services that are vitally important to households. Nevertheless, international organizations, such as the United Nations Development Programme (UNDP), suggest that the cost not exceed 1.5% to 2.0% of household income. In the case of Mexico, the percentage of household income spent on piped water consumption is estimated at 0.9%, which increases to 2.2% when including the cost of bottled and cistern water, and to 2.5% when including time spent hauling water, in terms of the opportunity cost in monetary terms, given that not all households have access to water, or if they have access they lack a continuous supply. For comparison purposes, international studies on affordability that have been conducted in various countries report 2% in Lithuania, 3% in Northern Ireland, 3% in Argentina, 3% in Venezuela, 3% in Chile, and 4% in the United States, among others (Hutton, 2012; Kayser et al., 2013; Kooy et al., 2018; Wareg, 2017). In comparison, overall affordability in Mexico has not yet become a serious problem. Nonetheless, these affordability values increase greatly and become more inequitable when taking into account household income deciles, a situation studied very little by international studies but important to the design of public policies on water resources.

So what can be done to make water more accessible and affordable for households? At the international level, governments can: a) subsidize domestic water, b) ease the burden of smaller consumers (for example, by increasing prices for large consumers and non-domestic consumers), and c) support programs that improve economic efficiency in the water sector and that reduce the level of household consumption. For example, some governments have also introduced social welfare measures (for example, increased aid to households) as well as specific measures to make water more accessible and affordable for households, particularly for low-income households, including: a) providing assistance for repairing leaks and reducing wasteful usage, b)

helping users access different social support systems so that they can pay their various bills, including water, and c) reducing water fees for low-income households and/or providing specific assistance that has that effect.

On the other hand, in order for piped drinking water supply services to be sustainable, they must be financially balanced while also providing the desirable subsidies or aid, primarily to the most vulnerable sectors (Arbués & Barberán, 2012). For example, one way to facilitate access to water would be to provide a fixed allotment per household, or per person, at no cost or at a low price. Another approach is to offer low-income groups a reduced fee or assistance to help them pay their water bills up to a certain volume (García-Valiñas et al., 2010). The approach of a limited volume requires good prior identification of the beneficiaries and of how to recuperate the cost. The identification of beneficiaries is easier in countries that already have an established social benefits system (García-Valiñas et al., 2010; Farolfi & Gallego-Ayala, 2013). When information about households is lacking, simpler criteria can be used in order to determine who is eligible for special fees, such as type of household or area. Likewise, it is essential to create awareness or design mechanisms so that households that have access to piped drinking water pay for the cost of the infrastructure required for the services to reach their homes (Farolfi & Gallego-Ayala, 2013). In the case of Mexico, roughly 26% of the households that have access to piped drinking water do not pay for the service. Of those 8 million households that do not pay for the service, 36% belong to the three highest income deciles (Table 5). There is a need to consider political policies that offer assistance to low-income sectors that cannot pay for the services, and/or identify economic or regulatory incentives so that high-income households pay for the services. For example, assistance for households could be in the form of direct help for individuals (such as a coupon or a water check) or reduction in fees (reduced bill). If there are no individual meters, a coupon could be distributed for an amount equal to a water allotment. Centralized, district, or municipal water authorities can use social policies (subsidies covered by taxpayers) to guarantee financial aid

Table 5. Households that have access to piped drinking water and do not pay for the service.

Decil	Access and not pay		Access and pay		Total		
All	8,227,326	100.00%	31,359,424	23,132,098	100.00%	31,359,424	
1	1,063,205	12.90%	3.40%	1,543,307	6.70%	4.90%	
2	956,157	11.60%	3.00%	1,776,331	7.70%	5.70%	
3	932,963	11.30%	3.00%	1,913,408	8.30%	6.10%	
4	878,993	10.70%	2.80%	2,054,049	8.90%	6.60%	
5	819,973	10.00%	2.60%	2,132,218	9.20%	6.80%	
6	830,406	10.10%	2.60%	2,299,312	9.90%	7.30%	
7	819,264	10.00%	2.60%	2,424,775	10.50%	7.70%	
8	711,365	8.60%	2.30%	2,655,628	11.50%	8.50%	
9	637,341	7.70%	2.00%	2,896,088	12.50%	9.20%	
10	577,659	7.00%	1.80%	3,436,982	14.90%	11.00%	
			26.20%			73.80%	100.00%

Based on ENIGH, 2016. Elaborated by the authors

to low-income groups, or this could be subsidized by solidarity policies (cross subsidies), through large users, companies, or households in high income deciles.

The cost of social measures vary depending on the number of beneficiaries. For example, organizations that are responsible for supplying water to households (in Mexico known as Water Management Organizations (OOA in Spanish)) fail to collect approximately US\$ 457 million per year from households that do not pay for their piped water consumption. Forty percent of households in the first decile who have access to piped water do not pay for what they consume, which is similar to the second, third, and fourth deciles (35%, 32%, and 30%, respectively). Nationally, US\$ 124 million is lost in unpaid bills due to these first four deciles not being able to pay for the piped water that they consume, while US\$ 200 million in bills go unpaid by the households in the last four deciles, that is, those with higher incomes (Figure 3). In other words, the four highest income deciles fail to pay 1.8 times more than what the first four deciles fail to pay. Therefore, a cross-subsidization strategy could be used in which regulatory incentives encourage higher income deciles to pay for their services, and a percentage of what is collected is designated to lower-income deciles. This can be complemented by financing from large users as well as a strategy for lower-income households to

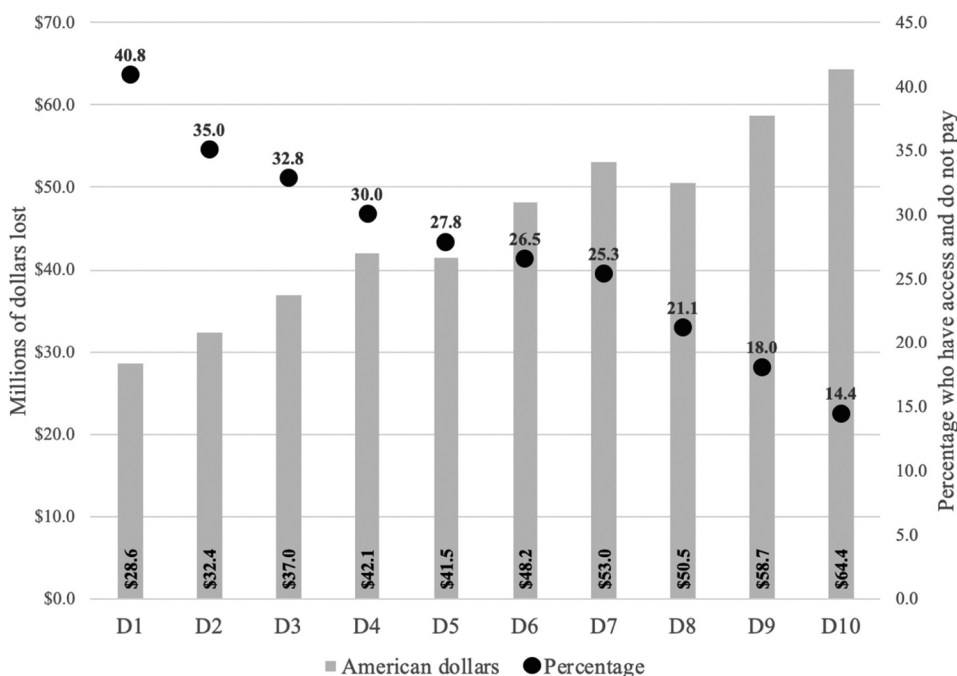


Figure 3. Percentage of households, in each decile, that have access to piped drinking water and that do not pay the consumption and economic income that the operating agencies no longer receive. Source: Based on ENIGH, 2016. Elaborated by the authors

not consumer more than what they need. Or the cross subsidy could be applied only to a certain consumption level (scaled fee structure). This type of aid is less costly to finance since it generally entails fewer people or smaller groups. Establishing social measures does not necessarily mean increasing the final price of water for domestic users (Farolfi & Gallego-Ayala, 2013).

Conclusions

Access to piped drinking water has undeniably increased for households in Mexico, reaching 93.7% in the year 2015, which represents service to 112 million people. Along with this increase, the frequency of the supply of water to households has generally decreased, and in the extreme case, this could be considered as equivalent to not having access. In this respect, when including households without have access to water because it is not supplied daily, the 6.3% of households that do not have access to piped water nationally rises to 33.3%. And when analyzed by deciles, this lack of access to the water supply, or lack of continuity in the service, primarily affects lower-income households, demonstrating a serious problem of inequity. Approximately 6.2 million people in the poorest decile deal with the problem of not having access or having insufficient continuity, while only 3.9 million of the wealthiest decile are faced with this problem.

While overall measurements of the affordability of piped water in Mexico indicate that it is acceptable, since it is less than the 1.0 to 2.0% that the literature considers to be a serious problem, a more detailed approach indicates that there is a good deal of inequality in access and affordability among household groups. In terms of consuming drinking water from a public network or from other sources of water, the inequity among income levels is very notable when analyzing both access and affordability for households. Most of the households without access to piped water services or with problems related to the frequency of receiving the service generally belong to low-income groups. In addition, the relationship between expenditures on sources of access to water and family income is high. In absolute terms, higher-income households spend more on piped and bottled water than the poorest families. Nonetheless, the percentage of household income spent on water is much higher for the latter group, thereby compounding the inequity in the human right to this resource. While the coverage of access to piped drinking water has increased over recent years in Mexico, this could seem somewhat misleading when taking into account the frequency with which households receive the service. Furthermore, this problem with unequal access to piped water and/or to other sources of access (as well as frequency) goes hand in hand with the problem of affordability, understood as the percentage of monthly income that households spend on accessing either piped water and/or water from other sources.

The results of this investigation convincingly demonstrate that Mexico's water policy is characterized by large inequalities in water access and affordability among household groups. A lack of attention to the water needs of very poor households in the country is evident. The water policy should identify the localities, groups, and sectors of the population whose right to water has become vulnerable, and address the causes of the deprivation of this right, in order solve this problem.

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