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The impact of bottled water on household expenditures in Mexico: is it a public policy problem?

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ABSTRACT

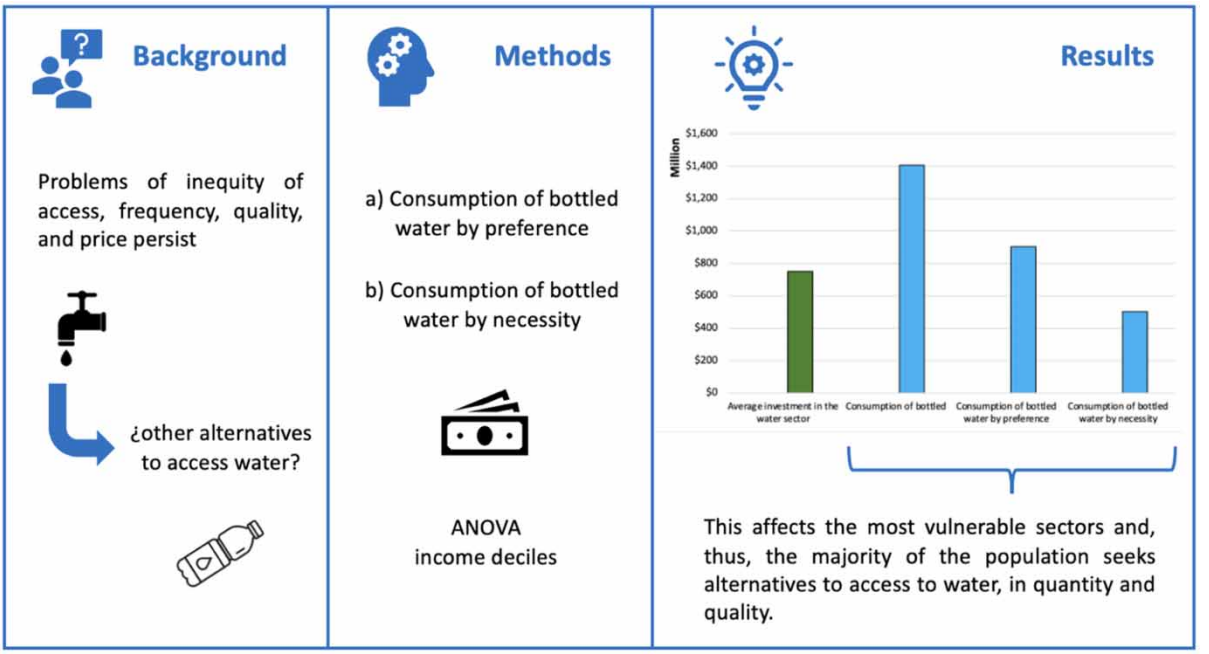
The right to sufficient, affordable, and high-quality water is internationally recognized by various resolutions. Despite global progress, there is still a long way to go to achieve this objective, especially for vulnerable households. This lack of compliance leads households to seek alternative sources, such as bottled water. Through statistical analysis and means tests, this study estimated that bottled water consumption in Mexican households amounts to approximately USD 1,405 million per year: 19.9% by the first three deciles and 42.3% by the last three deciles. Similarly, the study shows that households without daily access to piped water spend a total of USD 503 million on bottled water out of necessity. Households with daily access to piped water spend USD 902 million on bottled water, consuming it for pleasure or due to mistrust of the quality of piped water. Thus, there is a need for hydric policies to consider vulnerable groups more, through efficient investment allocation and improved piped water quality, as well as accurate information about the quality of this resource, to incentivize its consumption.

Key words: Bottled water, Decil, Expenditure, Piped water

HIGHLIGHTS

- Water problems include unequal distribution, overexploitation, and contamination of water resources, among others.
- These conditions are the reason that households look for other alternatives to access water, either due to problems of access to piped water (quality and quantity) or due to their preference.
- These other forms of access to water, for example bottled water, can affect groups of households to different extents.

GRAPHICAL ABSTRACT



1. INTRODUCTION

Water is a relatively scarce natural resource due to environmental, natural, socioeconomic, and cultural factors. In July 2010, the United Nations General Assembly explicitly recognized the human right to drinking water and sanitation in Resolution N°64/292 (Kooy *et al*. 2018). The normative content of water and sanitation rights is determined by the criteria of availability, quality, accessibility, and affordability (Cook *et al*. 2016). These criteria are essential for expanding water and sanitation services and ensuring that everyone can benefit regardless of their income, age, gender, race, and other factors (Mack & Wrase 2017). In fact, affordability has been recognized in recent years in several worldwide and regional declarations on water. The adoption of these declarations was considered in the formulation of Goal 7 of the Millennium Development Goals, which addresses access to water and sanitation (García-Valiñas *et al*. 2010a, b). Having a connection to piped water is not enough; the frequency of use must also be considered, as well as the quality of the water, and the cost must not be disproportionately high compared with household income (Kessides *et al*. 2009).

Generally, emerging or developing countries, such as Mexico, currently face significant problems and challenges, particularly those related to water. These issues include unequal distribution, improper sanitation, insufficient innovation and maintenance of the hydric system, and the overexploitation and pollution of hydric resources. Other issues include high subsidies for water, waste, and frequent leaks (Kooy *et al*. 2018). The provision of piped water and sanitation is among the most important services due to its strong relationship with the health, growth, and welfare of the population (Revollo-Fernández *et al.* 2019). In Mexico, national coverage of piped water is nearly 93% (Revollo-Fernández *et al.* 2020). Urban zones have 97% coverage, while rural areas (localities with fewer than 2,500 inhabitants) have 84.8% coverage due to population dispersion in complex physiographic conditions and technical and financial difficulties in developing piped water systems. Although 94% of the population has access to the public piped water service, this percentage could decrease when considering the

water's quality and how frequently it reaches households. These situations first and most drastically affect households with lower incomes or those most socially deprived (Revollo-Fernández *et al.* 2019). These conditions cause households in Mexico to seek other water access alternatives, either due to problems with access to piped water (quality and quantity) or due to preference. For example, some households have chosen to consume bottled water (Pacheco-Vega 2020).

On the other hand, global bottled water consumption reached approximately 455 billion liters in recent years, surpassing any other liquid in the same format by far. It is valued at around 287 billion dollars per year. Additionally, Mexico has become the world's largest consumer of bottled water per capita, with an average of 274–286 liters consumed per person per year, which is five times the global average (Statista 2023).

In this context, the objective of this work is to analyze and quantify the monetary expenditure of households in Mexico on bottled water, considering whether this consumption is due to necessity (lack of access to piped water and/or inconsistent service) or preference (when they have access to piped water but do not use it). The analysis is divided into deciles based on income. The goal is to make recommendations for public policies that benefit society, especially the most vulnerable sectors. This document is structured as follows: Section 2: A review of the literature on the consumption of bottled water in Mexico, Section 3: Materials and methods, Section 4: Results, and Section 5: Discussion and conclusions.

2. LITERATURE ON THE CONSUMPTION OF BOTTLED WATER IN MEXICO

The literature reviewed for the case of Mexico reports significant increases in bottled water consumption. We considered research that analyzed cases involving a university campus in Mexico City, cities, regions, and the entire country. Based on the review, bottled water consumption can be classified into two categories that reflect different consumer motivations. The first category is defined as consuming bottled water to meet basic needs, while the second category is consuming bottled water due to a preference for this product. In the first case, consumption of bottled water in Mexico is significantly driven by the perception that tap water is of poor quality. According to Silva (2023), consumers in Mexico City (CDMX) perceive negative organoleptic characteristics in tap water, leading them to prefer bottled water. This perception is exacerbated by historical events such as the 1985 earthquake and the 1991 cholera outbreak, which undermined trust in the safety of tap water (Greene 2018; Silva 2023). McCulligh *et al.* (2020) highlighted that in the Mexican state of Jalisco, the perception of low water quality from the distribution network has led to high bottled water consumption. Similarly, Vázquez-García (2021) observed that, in the Sonora River basin, chemical pollution and cuts in the water supply forced residents to depend on bottled water. Vega Amaya *et al.* (2020) pointed out that in Hermosillo, Mexico, the lack of appropriate regulations and pollution of water sources has reinforced the perception of poor tap water quality.

Mistrust in the state's ability to provide safe drinking water is also a key factor. Parag & Roberts (2009) argue that consumers opt for bottled water due to their perception of the state's incompetence in protecting public health. Pacheco-Vega (2019) analyzed how hydric insecurity in drought-stricken and infrastructure-damaged communities in Mexico has led to the perception that bottled water is a necessary solution to guarantee the right to water.

In the second category, marketing strategies played a crucial role in transforming the value of bottled water in Mexico. Arriaga-Medina & Piedra-Miranda (2021) pointed out that marketing strategies have altered the perception of bottled water in Mexico City, particularly on university campuses, turning it from a basic product into one associated with lifestyle and social status. Both Euromonitor (2024) and Williams & Marshall Strategy (2024) analyzed how aggressive marketing campaigns by large corporations have influenced the preference for premium brands and private labels throughout Mexico. These campaigns promote not only the quality of bottled water but also health and wellness trends. Greene (2018) discusses how big companies entered the bottled water market in

Mexico, noting how these corporations capitalized on mistrust of tap water quality by promoting bottled water as a safer, healthier option.

In short, according to the literature, the factors that prompt people to buy bottled water to cover their basic necessities are the perception of low-quality tap water, issues with the supply and quality of public water, and mistrust of the government's ability to provide sufficient, high-quality water to households. On the other hand, the second category brings together other factors that influence the purchase of bottled water, reflecting consumers' preferences in a product selection scenario. Some factors that affect consumer preferences include aggressive marketing strategies and the entry of big corporations that transform the value of water, creating a market for pleasure consumption.

3. MATERIALS AND METHODS

3.1. Method

First, we created a decile variable based on economic income to categorize Mexican households into deciles D1 to D10. D1 represents the lowest-income households, and D10 represents the highest-income households. Second, we identified households with and without access to piped water. Among those with piped water, we estimated the number of households with 24/7 water service and those without. Third, we calculated the yearly expenditure for the consumption of both piped and bottled water for each household, considering both households with and without access to piped water. Fourth, we estimated the mean and total expenditure on bottled water for all households in Mexico, considering both those with and without access to piped water. For households with access, we considered the number with uninterrupted access as well as those without. This led us to separate the households into two groups: those that consume bottled water out of necessity (due to lack of access or infrequent access to piped water) and those that consume bottled water for pleasure or due to mistrust of the quality of piped water (Table 1). Finally, in the fifth step, we compared mean expenditures among different groups of households regarding the decile variable of income. We performed an ANOVA test to determine whether there is a statistical difference in household expenditures.

3.2. Data

Data were extracted from the 2022 National Survey of Household Incomes and Expenditures (ENIGH by its Spanish acronym), developed by the National Institute of Geography and Statistics (INEGI by its Spanish acronym) (INEGI 2022). The survey aims to provide a statistical overview of household income and expenditure behavior in Mexico regarding amount, source, and distribution. It also offers information about the occupational and sociodemographic characteristics of household inhabitants, as well as their access to food, and the characteristics and equipment of the household. The survey considers national coverage, including urban and rural areas. For this research specifically, we considered data on the sources and frequency of access to piped and bottled water, expenditures, and household income levels at the national, urban, and rural levels.

Table 1 | The type of household that consumes bottled water is based on its access to piped water.

Household type by bottled water consumption type	Availability of piped water	Access to piped water 7 days a day, 24 hours a day
Consumption of bottled water by preference	Yes	Yes
Consumption of bottled water by necessity	No	No

4. RESULTS

4.1. Situation of piped water in Mexico

In Mexico, the use, supply, and treatment of water are regulated by the Political Constitution of the United Mexican States (Constitución Política de los Estados Unidos Mexicanos, or CPEUM). Specifically, Article 27 establishes that national waters are the property of the nation, and Article 115 indicates that: 'City councils shall be in charge of the following functions and public services: Drinking water, drainage, the sewerage system, and the treatment and disposal of sewage'. Additionally, state and municipal water regulations ensure that the entire population has access to this resource. These legal instruments establish guidelines for water use and conservation, as well as the rights and obligations of water utilities (OOAs). OOAs are economic units that administer and operate systems and provide water, sewage, and sanitation services in urban and rural areas. OOAs have diverse structural and organizational characteristics and are generally attached to municipal governments. They are represented in the water and sanitation direction and commission boards, or in decentralized water systems. OOAs also operate as local boards and committees of water users and, less frequently, as private concessionary companies.

Regarding water investments, the National Water Commission (CONAGUA) coordinates with state and municipal governments and the private sector to make investments through different programs. These programs are regulated by operational rules and comply with provisions issued by the federal expenditure budget for each fiscal year or its own guidelines. The main programs in recent years are the Drinking Water, Sewage, and Treatment Program (PROAGUA), the Duty Drawback Program (PRODDER), and the Drinking Water Supply and Sanitation Program in the Mexico Valley, among others. The goal of these programs is to provide drinking water, sewage, and sanitation services to more people in rural and urban areas. By 2022, investments in this sector totaled approximately USD 1.773 billion, 77.2% of which was allocated to drinking water (CONAGUA 2022, 2024a).

In this sense, the level of coverage and the number of people with access to a piped water service have increased in Mexico in recent decades. By 1990, it is estimated that 75.4% of households nationwide had access to piped water service (approximately 61.2 million people). Among urban households, 87.1% had access to this service, compared with 46.5% of rural households. By 2022, national coverage had increased to 93.1% (approximately 115.5 million people), with 96.4 and 81.9% of urban and rural households having access, respectively (INEGI 2022; Figure 1). While there has been a significant increase in access to the service over the years, this data could mask issues regarding service descontinuity, water quality, and access to alternative water sources, such as bottled water (Revollo-Fernández 2023; Revollo-Fernández *et al*. 2023a).

Regarding continuity, according to the ENIGH survey (INEGI 2022), approximately 66.5% of households with access to piped water at the national level received water daily in 2022. The rest received water one, two, or three times a week, usually for only a few hours. In urban and rural areas, these percentages were 69.4 and 55.3%, respectively (Figure 1).

On the other hand, regarding the quality of water delivered to households, although there are no national-level data or government-supported studies, there are two sources for analysis. The first is the Source Quality Monitoring Network (RMCF), which extracts surface and groundwater at the national level. This network is managed by CONAGUA (CONAGUA 2024a, 2024b). The second source is the National Survey of Government Quality and Impact (ENCIG), which is conducted every two years by the INEGI (INEGI 2023). The ENCIG survey aims to collect information about the population's experiences and perceptions of various government-provided services, including public security and justice services, which contribute to public policy decision-making.

In the case of the RMCF, the quality analysis of surface water in 2022 was constituted by 1,723 sites, and it considered eight indicative parameters: (i) five days biochemical oxygen demand (DBO5), (ii) chemical oxygen demand (DQO), (iii) total suspended solids (SST), (iv) fecal coliforms (CF), (v) *Escherichia coli* (E_COLI), (vi)

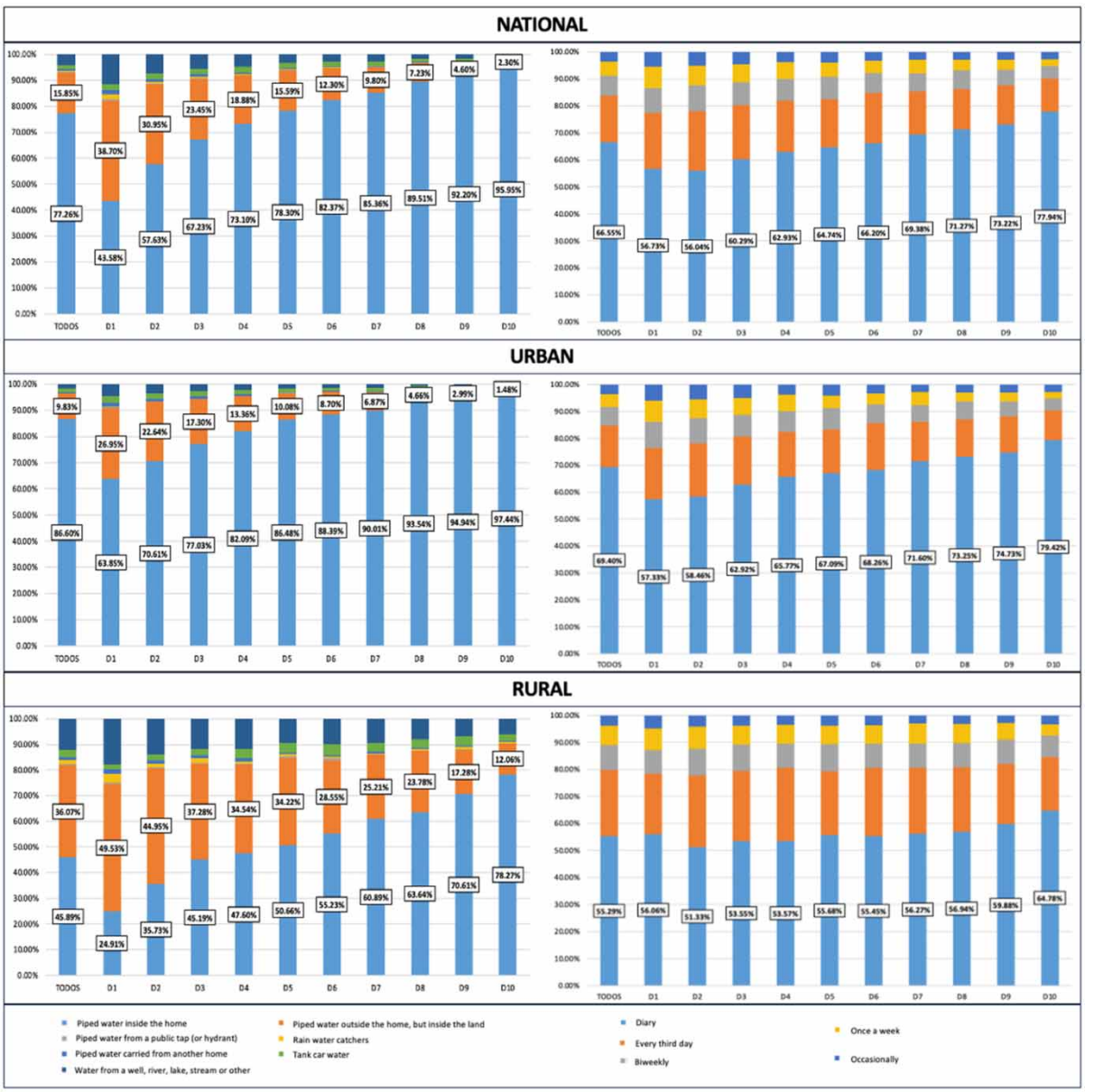


Fig. 1 | Access to water in Mexico by decile levels.

fecal enterococci (ENTEROC_FEC), (vii) percentage of saturation of dissolved oxygen (OD%), and (viii) acute toxicity (TOX). The CONAGUA uses a traffic light rating for the quality of surface water that considers three colors: green when there is compliance with the eight indicators; yellow when at least one of the following parameters is not complied: E_COLI, CF, SST, and OD%; and red when at least one of the following parameters is not complied: DBO5, DQO, TOX, and ENTEROC_FEC. In this manner, 26.1% of the sites were assigned to the green group, 45.2% were included in the yellow group, and 28.7% of the sites were classified in the red group. In

the case of the analysis of groundwater quality, CONAGUA recoursed to 775 sites at the national level, and it considered 14 physicochemical and microbiologic indicator parameters: (i) fluorides (Fluo), (ii) fecal coliforms (CF), (iii) nitrates' nitrogen (N_NO3), (iv) total arsenic (As_Tot), (v) total cadmium (Cd_Tot), (vi) total chromium (Cr_Tot), (vii) total mercury (Hg_Tot), (viii) total lead (Pb_Tot), (ix) alkalinity (Alc_Tot), (x) electric conductivity (Cond_elec), (xi) total hardness (Dur_Tot), (xii) total dissolved solids (SDT), (xiii) total iron (Fe_Tot), and (xiv) total manganese (Mn_Tot). Based on these parameters, it was decided whether the compliance or non-compliance with the quality of water destined for drinking. For this, a traffic light rating was established to assess the quality of groundwater: green, when there is compliance with the 14 indicator parameters; yellow, when at least one of the parameters from (ix) to (xiv) is not complied (total alkalinity, electric conductivity, total hardness, total dissolved solids, total iron, and total manganese); and red, when at least one of the following parameters is not complied: fluorides, fecal coliforms, nitrates' nitrogen, total arsenic, total cadmium, total chromium, total mercury, and total lead. Based on this, in 2022, 42.5% of the sites were classified in green, 18.6% in yellow, and 39% in red. In this sense, it is shown that, for both surface and groundwater, there is an important percentage of sites in yellow or red. The situation with wastewater treatment plants (WWTPs) in Mexico is complex. Although many WWTPs are in operation, a significant percentage is not operating optimally or is out of service. Of the 2,642 WWTPs in the country with considerable installed capacity, only 57% are operating optimally, and the actual treated flow is less than the installed capacity (Revollo-Fernández *et al.* 2023a).

According to the ENCIG, only 20.9% of households nationwide consider the water delivered to their homes through the public network to be drinkable as of 2023 (Figure 2). The situation varies by state, ranging from 49.1% in Tlaxcala to 1.9% in Tabasco. Although this is a perception of water quality, it demonstrates households' concern about this issue and the various alternatives they consider for accessing water, such as consuming bottled water.

Similarly, the problem of not having access to piped water, lack of continuity, and poor water quality principally affects households with higher levels of poverty and marginalization due to geographic, technical, and/or socioeconomic conditions. In Mexico, 93.1% of households have access to piped water. However, this percentage is 82.3% for D1 and 98.3% for D10, showing a significant difference ($p < 0.01$) (Figure 1). For urban and rural areas, these percentages are 90.8 and 74.4% for D1 and 98.9 and 90.3% for D10, respectively ($p < 0.01$). These values decrease drastically when considering only households with access to water all week. At the national level, the percentage drops from 93.1 to 66.5%, with only 56.7% of households in D1 and 77.9% of households in D10 having daily access to water ($p < 0.01$). The difference in access between households with daily service is more evident in urban areas, where 57.3% of households in D1 and 79.4% of households in D10 have this condition. In other words, when shifting the focus from total access to water to daily access, either urban or rural, and by decile levels, significant differences emerge.

Due to a lack of access to water services, service interruptions, and the perception of low water quality, many households in Mexico rely on alternative sources such as rainwater harvesting systems, wells, rivers, streams, cisterns, and bottled water (Figure 1). In several municipalities, inhabitants depend on cisterns and bottled water for drinking due to concerns about access and quality. This adds a considerable financial burden for those in the poorest areas and zones with the lowest incomes. These results confirm that Mexico has the highest per capita bottled water consumption in the world (274–285 liters per year), indicating mistrust of the quality of piped water, a total lack of access to the service, infrequent access, or a preference for this type of beverage.

4.2. Bottled water consumption in Mexico

According to the ENIGH 2022 survey, approximately 17.8 million Mexican households consumed bottled water in 2022, representing nearly half of all households. When analyzed by deciles, it is evident that nearly 42.6% of

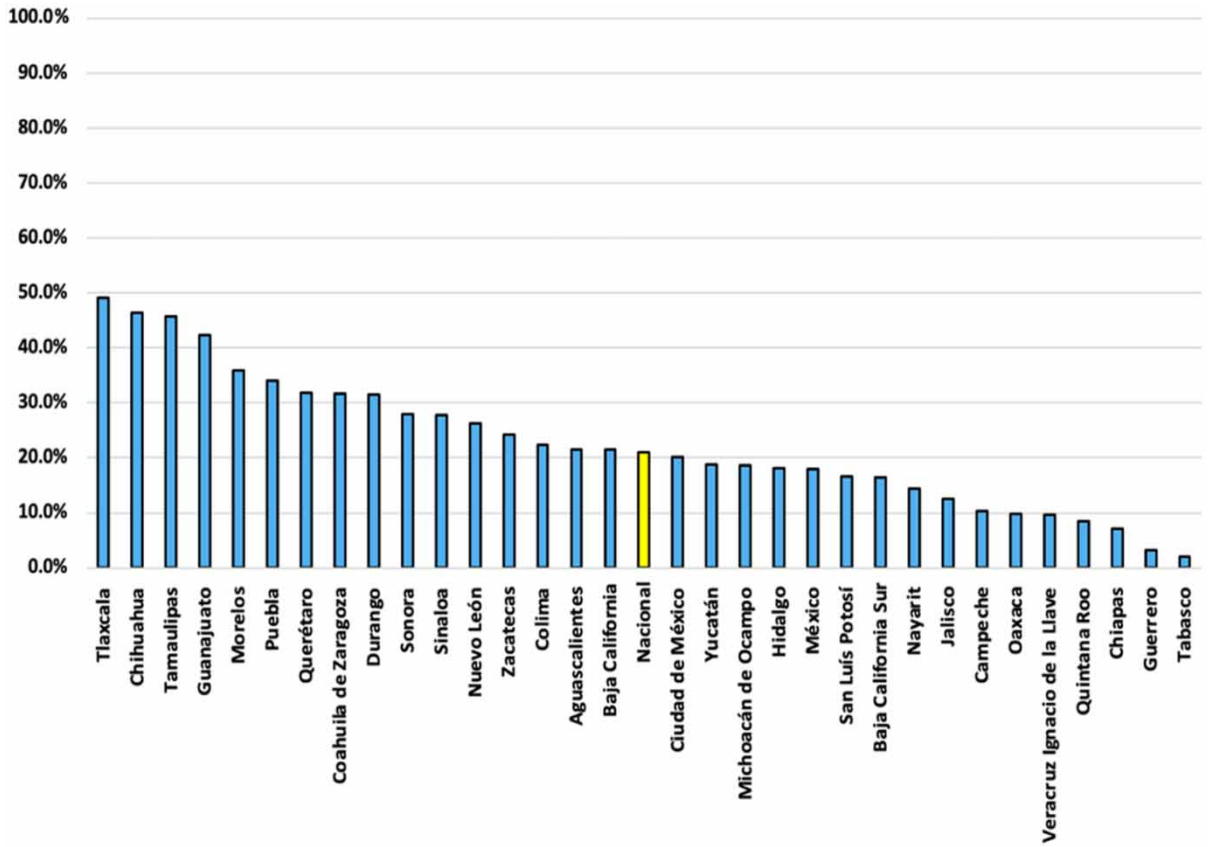


Fig. 2 | Is the water that comes to your home through the public network drinkable without fear of getting sick?

households in the lowest decile (D1) consume bottled water, compared with nearly 48.7% of households in the highest decile (D10). This represents a significant percentage difference of nearly 5.0% ($p < 0.1$) (Table 2). Of the 17.8 million households, up to 95.0% have access to piped water. Nevertheless, it is significant that nearly 1.052 million households nationwide do not have access to piped water and rely on bottled water as their primary source.

Additionally, the ENIGH data shows that 48.8% of households with access to piped water consume bottled water, compared with 41.3% of households without access to piped water. In other words, about one out of two households consumes bottled water. When analyzed by decile level, 46.2% of households with access to piped water in D1 consume bottled water, compared with 48.9% in D10, which is not a significant difference. Conversely, among households without access to piped water, 33.6% of those in D1 and 44.8% of those in D10 consume bottled water. This represents a significant statistical difference ($p < 0.1$). These percentages change significantly when considering households with and without daily access to water. Of the total households with daily access to piped water, 47.9% consume bottled water, compared with 50.5% of households without daily access. Important differences are evident between the first and last income deciles when analyzing both houses with and without daily access to water ($p < 0.1$).

Table 2 | Availability of access to piped water and consumption of bottled water by households in Mexico by 2022.

Number of households (thousands)		ALL	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
Total households in Mexico		36,968	3,385	3,512	3,529	3,646	3,680	3,692	3,807	3,808	3,847	4,057
Availability of piped water		34,422	2,785	3,111	3,200	3,353	3,456	3,496	3,623	3,684	3,724	3,986
		93.1%	82.3%	88.6%	90.7%	92.0%	93.9%	94.7%	95.2%	96.7%	96.8%	98.2%
Non-availability of piped water		2,546	599	401	329	292	224	196	184	124	123	71
Availability of water every day for those who have piped water		22,907	1,580	1,743	1,929	2,110	2,237	2,314	2,513	2,625	2,727	3,124
		66.5%	56.7%	56.0%	60.3%	62.9%	64.7%	66.2%	69.4%	71.3%	73.2%	78.4%
Non-availability of water every day for those who have piped water		11,515	1,205	1,367	1,271	1,243	1,218	1,181	1,109	1,058	997	862
They drink bottled water		17,840	1,488	1,689	1,666	1,782	1,805	1,807	1,904	1,849	1,865	1,981
They drink bottled water	They have water availability	16,787	1,286	1,529	1,516	1,669	1,702	1,704	1,829	1,792	1,808	1,949
		48.8%	46.2%	49.1%	47.4%	49.8%	49.3%	48.8%	50.5%	48.7%	48.6%	48.9%
	They do not have water availability	1,052	201	159	150	113	102	103	75	57	56	31
		41.3%	33.6%	39.8%	45.8%	38.9%	45.7%	52.6%	40.8%	46.3%	45.9%	44.8%
They drink bottled water and have water availability	They have water every day	10,976	688	874	893	1,034	1,109	1,114	1,251	1,258	1,272	1,478
		47.9%	43.5%	50.1%	46.3%	49.0%	49.6%	48.2%	49.8%	48.0%	46.7%	47.3%
	They don't have water every day	5,811	598	654	622	634	592	589	577	533	536	470
		50.5%	49.7%	47.9%	49.0%	51.0%	48.7%	49.9%	52.0%	50.4%	53.8%	54.6%

Comparison between deciles: Yellow: Significant difference at 99%. Orange: Significant difference at 99%. Green: Significant difference at 95%. Blue: Significant difference at 90%.

Therefore, we conclude that households with high and low incomes both consume bottled water. However, consumption increases when considering whether households have access to piped water and whether they have daily access to it. The most affected households are those in the lower deciles (Table 2).

Similarly, the ENIGH showed that, in 2022, Mexican households spent approximately USD 3,021 million on piped water. Of this amount, 14.2% was spent by households in deciles D1–D3, and 49.3% was spent by households in deciles D8–D10 (Table 3).

Households spent approximately USD 1,405 million on bottled water. The first three deciles spent 19.9% of this amount, while the last three deciles spent 42.3% (Table 3). On average, for each dollar spent on piped water, households spend 46 cents on bottled water. Conversely, when analyzing bottled water expenditures, it is evident that nearly 5% corresponds to households without access to piped water (USD 71.8 million), with the highest expenditures being made by households with lower incomes (D1) (USD 10.8 million). Households with access to piped water spent USD 1,333 million on bottled water, 18.3% of which came from households with the highest incomes (D10). Additionally, analyzing households with daily access to piped water reveals that they spend USD 902.7 million on bottled water, 20.5% of which comes from households in D10. In contrast, households with non-daily access to piped water spend USD 431.2 million on bottled water.

Based on this information, it is estimated that households without daily access to piped water spend a total of USD 503 million on bottled water. These households consume bottled water out of necessity. Households with daily access to piped water spend up to USD 902 million on bottled water, which they consume for pleasure or due to mistrust of the quality of piped water. When these results are analyzed by decile, it is evident that all deciles in the group that consumes bottled water for necessity have an almost equal participation in the total expenditure, ranging between 8.4 and 12.7%. For households that consume bottled water for pleasure or better quality, participation is higher in the higher deciles (12.5–20.5%) than in the lower deciles (4.1–6.4%) (Table 3).

5. DISCUSSION

In Mexico, the investment in the water sector has tended to increase over the years (Figure 3). In 1999, CONAGUA allocated approximately USD 293 million for investments in drinking water, sewage, sanitation, efficiency improvements, and other projects, 63.3% of which went to drinking water projects. In 2022, this investment increased significantly compared with previous years, reaching approximately USD 1.773 billion, 77.2% of which was allocated to drinking water, the highest percentage in decades.

The average increase in investments over the last 24 years has, to a certain extent, achieved the goal of improving societal welfare by ensuring access to water. However, despite this significant progress in public investment, there is still an inequality problem regarding access to this resource, particularly among the most vulnerable populations (Revollo-Fernández 2023). Additionally, households with lower incomes generally spend a higher percentage of their income on piped water and other water sources, including bottled water (Revollo-Fernández & Rodríguez-Tapia 2023). Therefore, public policies and investments must identify groups or sectors of the population whose right to water has been violated, paying special attention to the causes that lead to the deprivation of this right in order to find solutions (Suárez-Varela & Dinar 2017; Aguilar-Benitez 2024). For example, in Mexico, only 6.3% of households lack access to piped water. However, this figure rises to 33.3% when considering households with no access or non-daily access to this resource. Despite being an important problem to solve, this lack of access or continuity in the service becomes even more inequitable when analyzed by income deciles. When designing public policies regarding the consumption of piped water by households, it is imperative to consider not only accessibility and use frequency, but also affordability. In Mexico, it is estimated that households spend between 0.9 and 1.3% of their income on piped water. This value increases to 2.1% when expenditures

Table 3 | Expenditure on access to piped water and consumption of bottled water by households in Mexico for the year 2022.

Expenditure		ALL	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
		AMERICAN DOLLARS (thousands of USD)										
Piped water		3,021,581	98,965	153,425	175,489	208,993	254,692	306,344	333,594	384,516	453,895	651,664
		100.0%	3.3%	5.1%	5.8%	6.9%	8.4%	10.1%	11.0%	12.7%	15.0%	21.6%
Bottled water		1,405,792	79,392	97,059	104,256	115,442	123,199	138,314	153,189	162,100	183,971	248,866
		100.0%	5.6%	6.9%	7.4%	8.2%	8.8%	9.8%	10.9%	11.5%	13.1%	17.7%
Bottled water	They have water availability	1,333,960	68,567	87,832	94,327	108,163	116,206	130,494	147,872	157,039	178,947	244,508
		100.0%	5.1%	6.6%	7.1%	8.1%	8.7%	9.8%	11.1%	11.8%	13.4%	18.3%
	They do not have water availability	71,831	10,824	9,227	9,929	7,278	6,993	7,819	5,317	5,060	5,023	4,357
		100.0%	15.1%	12.8%	13.8%	10.1%	9.7%	10.9%	7.4%	7.0%	7.0%	6.1%
They drink bottled water and have water availability	They have water every day	902,721	36,911	52,550	57,423	68,000	77,328	86,151	101,445	112,512	125,350	185,047
		100.0%	4.1%	5.8%	6.4%	7.5%	8.6%	9.5%	11.2%	12.5%	13.9%	20.5%
		431,238	31,656	35,282	36,903	40,163	38,878	44,343	46,427	44,526	53,596	59,461
	They don't have water every day	100.0%	7.3%	8.2%	8.6%	9.3%	9.0%	10.3%	10.8%	10.3%	12.4%	13.8%
They consume bottled water for pleasure (they have access to piped water and have piped water every day)		902,721	36,911	52,550	57,423	68,000	77,328	86,151	101,445	112,512	125,350	185,047
		100.0%	4.1%	5.8%	6.4%	7.5%	8.6%	9.5%	11.2%	12.5%	13.9%	20.5%
		64.2%	46.5%	54.1%	55.1%	58.9%	62.8%	62.3%	66.2%	69.4%	68.1%	74.4%
They consume bottled water out of necessity (they do not have access to piped water or do not have piped water every day)		503,070	42,480	44,509	46,832	47,441	45,871	52,162	51,744	49,587	58,620	63,819
		100.0%	8.4%	8.8%	9.3%	9.4%	9.1%	10.4%	10.3%	9.9%	11.7%	12.7%
		35.8%	53.5%	45.9%	44.9%	41.1%	37.2%	37.7%	33.8%	30.6%	31.9%	25.6%
		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Comparison between deciles: Yellow: Significant difference at 99%. Orange: Significant difference at 99%. Green: Significant difference at 95%. Blue: Significant difference at 90%.

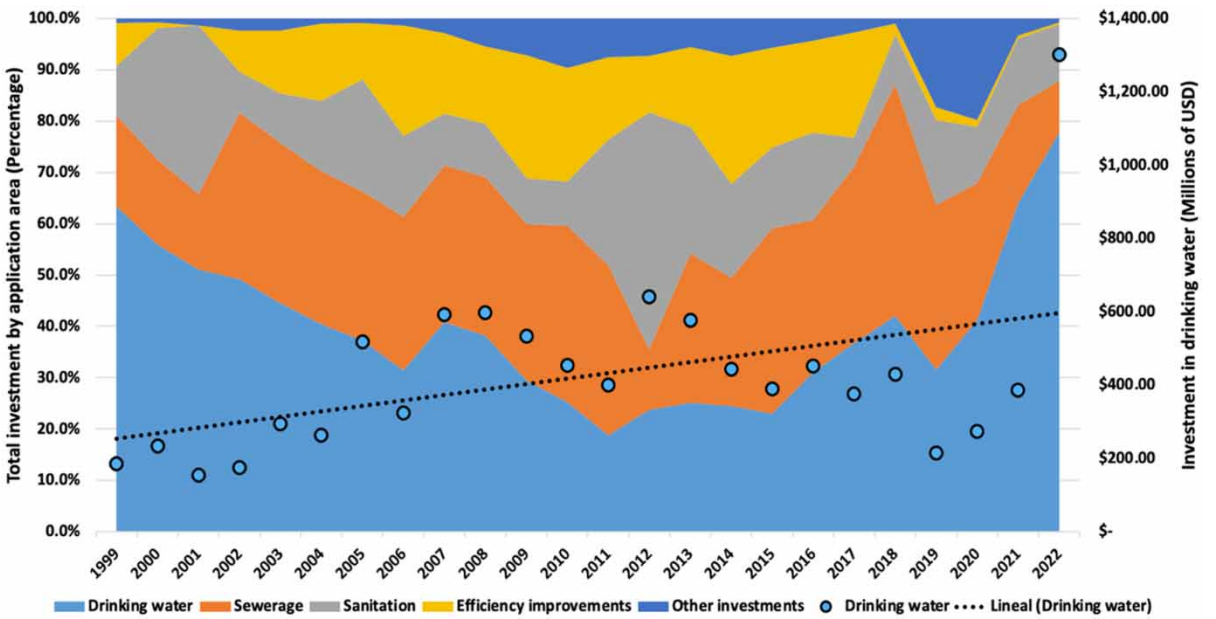


Fig. 3 | Investments by application area made through the National Water Commission in Mexico from 1999 to 2022 (2022 prices).

on bottled and cistern water are included, considering that up to 33% of households nationwide do not have access to piped water or receive it less than daily, making other water sources real and frequent alternatives (Revollo-Fernández *et al*. 2023a). These affordability values increase and become more inequitable when analyzed by income decile. The economic impact of not having piped water or having it less frequently leads households to spend approximately USD 503 million per year on bottled water. Meanwhile, households that consume bottled water despite having frequent access to piped water spend an additional USD 902 million, possibly due to mistrust of the quality of piped water or for personal preference. In 2022, the total amount spent on bottled water was USD 1.4 billion, almost half of what households spent on piped water. Therefore, greater focus and efficiency in investments in this sector would motivate households to consume piped water instead of bottled water. For example, investments could guarantee the quality of piped water and/or offer a more frequent supply. Households would then use the money they saved on bottled water for other goods or services of greater importance (Revollo-Fernández *et al*. 2023b).

In this sense, countries with high bottled water consumption, including this one, must improve access for the most vulnerable households through hydric policies. These policies should focus not only on access but also on ensuring daily access to quality water at affordable prices relative to household income.

In Mexico, the quality of piped water is currently regulated by the 1994 Mexican Official Standard 'Environmental Health, Water for Human Use and Consumption – Allowed Limits of Quality and Treatments to Make Water Potable', reformed in 2000 (NOM-127 SSA1-1994/2000). The National Waters Law, enacted in 1992 and reformed in March 2016, regulates the distribution and control of this resource. However, this legislation is obsolete and is hardly ever complied with. Therefore, it is of the utmost importance to generate new, current, and modern legislation on hydric matters at the national and state levels that aims to reduce or eliminate problems for the benefit of society as a whole, especially the most vulnerable groups.

6. CONCLUSIONS

Although access to piped water in Mexican households has increased significantly in recent years, problems of inequitable access, frequency, quality, and price persist. These issues disproportionately affect vulnerable populations, prompting the majority of the population to seek alternative ways to access water in terms of quantity and quality. In this sense, future water policies in the country must consider these groups more, through efficient investment allocation and improved water quality provided by utilities to households, as well as a permanent national campaign implemented by the state to demonstrate the quality of water received by households and encourage consumption, always with the objective of increasing societal well-being.

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DATA AVAILABILITY STATEMENT

Data cannot be made publicly available; readers should contact the corresponding author for details.

CONFLICT OF INTEREST

The authors declare there is no conflict.

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