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RESEARCH ARTICLE

Getting citizens to conserve water: A comparison of crisis responses in Bogota and Mexico City

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How can global megacities respond to increased threats from natural hazards? Looking at hazard events that produced drinking water crises in Bogota, Colombia, and Mexico City, Mexico, we compare these cities' efforts to decrease potable water consumption. We ask how and why the socioeconomic and biophysical contexts shape city policymakers' responses to water crises and consider the immediate and lasting impacts of technical and behavioral interventions. Leveraging our 2 case studies in Latin America, we identify how the unique policy contexts affected the interventions used and helped determine their outcomes. Four factors are identified as particularly relevant as follows: the differential roles of scientific and technical perspectives in each context, the role of ideology, the complexity of the environmental policy problems in each setting, and the varied roles of policy entrepreneurs in Bogota and Mexico City.

Keywords: Megacities, Urbanization, Water crises, Policy, Potable water

Around the world, megacities are struggling to keep populations hydrated. Even when plentiful in areas surrounding megacities, access to potable water can be poor due to infrastructural problems, pollution, unequal distribution among population residents, and other factors. Two striking examples of cities with abundant access to freshwater resources that have faced significant water crises are Bogota, Colombia, and Mexico City, Mexico. In this article, we study the reaction of these major cities to potable water infrastructure crises that threatened the cities' ability to provide sufficient water to their populations and the divergent outcomes—prolonged water use reduction in Bogota, and a short period of drastic reduction that plateaued in Mexico City—in each city that resulted from their different policy responses.

We ask how global megacities facing significant pressure for potable water can drastically decrease potable water consumption when confronted with crises. We also ask how and why the socioeconomic and biophysical contexts shape city policymakers' responses to water crises. Why did Bogota choose behavioral interventions, even before such approaches were common in public policy? How has this decision fared over time? Why did Mexico City rely on technical and economic solutions to water crises, and why does it continue to do so?

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Social psychology and prior studies of the Bogota water crisis of 1997 suggest that behavioral interventions may be particularly useful in decreasing potable water consumption and keeping it low over time. While we agree that behavioral interventions can be effective tools, we also argue that the social and political contexts matter for these to be successful—behavioral interventions are not inherently superior to other intervention types. Drawing on interviews with relevant policymakers and existing studies of Mexico City's and Bogota's water crises, we identify 4 ways the unique policy contexts affected the design of interventions in Mexico City and Bogota and helped determine their outcomes: (1) the differential roles of scientific and technical perspectives in each context, (2) the role of ideology, (3) the complexity of the environmental policy problems in each setting, and (4) the varied roles of policy entrepreneurs in Bogota and Mexico City.

Although the Bogota case is well discussed in the literature on behavioral policy interventions (e.g., see World Bank, 2015), the factors explaining how behavioral interventions came to be used and accepted by the population are less understood. We draw on several existing studies of the Bogota 1997 water crisis and the response of Bogota's then-mayor, Antanas Mockus, and his administration. Their response was grounded in what the Mockus' administration termed "Citizen Culture," an effort to enhance and empower citizen participation in public affairs. Mexico City's water crises are less well-known, so we draw on government reports, newspaper articles, and expert interviews to understand the city's water crises and subsequent policy responses.

The goal of this article is to conduct a comparative analysis of 2 megacities' policy responses to hazard events

that threaten people's equitable access to potable water. While we do examine both cities over time, our primary interest is on moments in time in each city when innovative policy decisions were made that altered the cities' water usage. For Bogota, our primary focus is therefore on the mid-1990s in response to the collapse of the Chingaza tunnel. For Mexico City, our focus is on the city's response over time to a common and looming crisis faced by many of the world's megacities: increasing water scarcity and climate change. The lasting impacts of Bogota's behavioral policy intervention and Mexico City's long-term focus on infrastructure repair, technical solutions, and demand management, including a more recent and radical investment in system repairs despite civilian protests, represent crucial policy choices that warrant further examination. We highlight these different points in time due to the notable lessons that can be drawn from each location when these crises are examined.

We find that Mexico City's approach is characterized by a top-down emphasis on technical solutions and limited interest in or follow-up of behavioral interventions. Although Mexico City emphasizes technical solutions, this should not be confused with evidence-based policy making (EBPM), which neither city seems to strongly embrace. Bogota's behavioral intervention in the late 1990s had a lasting impact, but eventually the city also resorted to tariff manipulations and now requires significant infrastructural repairs in the face of increasing water stress. A combined strategy of innovative behavioral interventions and consistent infrastructural repairs would likely benefit both cities. To cultivate the appropriate context for public policy innovations, active citizen participation in public policy should be encouraged. The lessons drawn apply not only to the cities in the study but also to numerous megacities worldwide facing potable water crises.

Why Bogota and Mexico City?

The decision to compare Mexico City and Bogota was based on the similarities between the 2 crises—Bogota's 1997 tunnel collapses and Mexico City's (and to some extent, Bogota's) response to prolonged water stress and repeat droughts in the late 2010s—across multiple dimensions and their divergent outcomes in potable water consumption. Both are capitals and megacities that contain the highest population concentration in their respective countries. Bogota and Mexico City are also the locations where most of their country's gross domestic products are produced. Both also began to grow exponentially in the 1950s due partly to abundant freshwater resources. Likewise, successful mayors of each city frequently move on to the national political stage. Over time, both cities have faced significant water strain due to population growth and repeated natural hazard events leading to acute drinking water shortages. Furthermore, levels of inequality and poverty are similar in the 2 cities, and both have also relied on *pipa* trucks and communal piping to deliver water to neighborhoods that lack household connections.

Although the graphs in **Figures 1** and **2** provide some data prior to the start of our analyses in each city, we begin our analysis prior to Bogota's 1997 water crisis and follow it with an examination of Mexico City's increasing water stress and crises in the late 2010s. Supplementary discussion of prior and later crises in both cities is included, which helps to clarify overall patterns of behavior in the 2 cities. The objective is not a strict comparison between both cities; rather, we use each city to illustrate policy choices made in the face of water stress and overall lessons that can be drawn from their experiences.

As seen in **Table 1**, Mexico City and Bogota share hydrological similarities that make their comparison natural. Both cities are in hydrologically well-endowed areas but away from the coast. The rainfall level in each city is comparable, with an average rainfall of 749 mm/year in Mexico City and 818 mm/year in Bogota. Temperatures in each city are also comparable, at 13.5°C on average in Bogota and 15.7°C on average in Mexico City. Similar rainfall and climate are likely due in part to the mountainous location well above sea level of each city, with a mean altitude of 2,240 m in Mexico City and 2,625 m in Bogota. The cities also share a similar geographic extension of 1,485 km^2 in Mexico City and 1,637 km^2 in Bogota (de Mola et al., 2017). Mexico City's population is significantly larger than Bogota's, however.

Despite the aforementioned similarities between Mexico City and Bogota, the 2 cities differ substantially in their reactions to their respective water crises. Bogota experienced a 37.33% decrease in water consumption between 1990 and 2004, while Mexico City's water use decreased by 20% between 1998 and 2018 (Ortega Vazquez, 2021). In Bogota, incorporating innovative behavioral strategies that mostly predated social psychology's influence on public policy led to massive drops in water consumption in the mid-1990s with long-lasting effects. Infrastructure expansion and repair are ongoing in the city and Bogota has experienced conflict surrounding water concurrent with a plateau in recent usage. In Mexico City, reliance on technology and sometimes technocratic solutions resulted in significant changes in the population's potable water consumption without changing user behavior significantly. The city's water infrastructure is still undergoing significant repairs and expansion of the system is still needed. One interviewee argued that the city has relied too much on "band-aid" solutions and an engineering-driven approach that neglects the importance of the overall ecosystem and the users who affect and are affected by potable water provision in Mexico City (Mexico City interviewee 1 2023). Despite significant progress in infrastructure, social conflicts exist with surrounding communities over the city's water usage and the targeting of user behavior has not traditionally been a core component of the city's water use reduction efforts.

The majority of laws governing drinking water in Colombia are at the national level, with the exception of the 1,953 decree creating the Empresa de Acueducto de Bogota; Bogota's water utility. Although the law itself is national in character, it created an independent water utility at the state level. In Mexico, however, key legislation is at national and state levels, although there was no

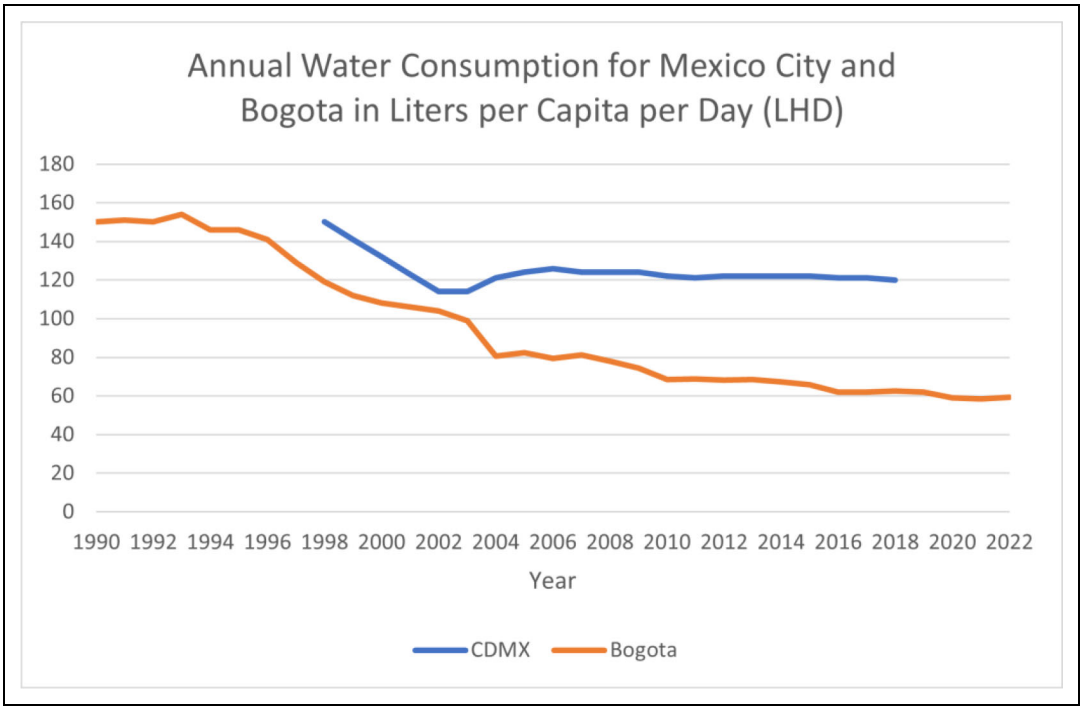

Figure 1. Liters of water consumed per inhabitant per day (LHD) in Bogota and Mexico City. A similar drop in water consumption is apparent in both cities in the early 2000s, but Mexico City experienced a rebound in use and plateaued. Prior data on Mexico City's water use is not available to the best of the author's knowledge. Bogota's decrease in water consumption continued. Data for Bogota are estimated from the *Empresa de Acueducto y Alcantarillado de Bogotá's* Documento Técnico de Soporte Plan Maestro de Acueducto y Alcantarillado de Bogotá D.C. (2006), sourced from the Observatorio Ambiental de la ciudad de Bogota (2023). Data for Mexico City are from CONAGUA (2020) as cited in Ortega Vazquez (2021).

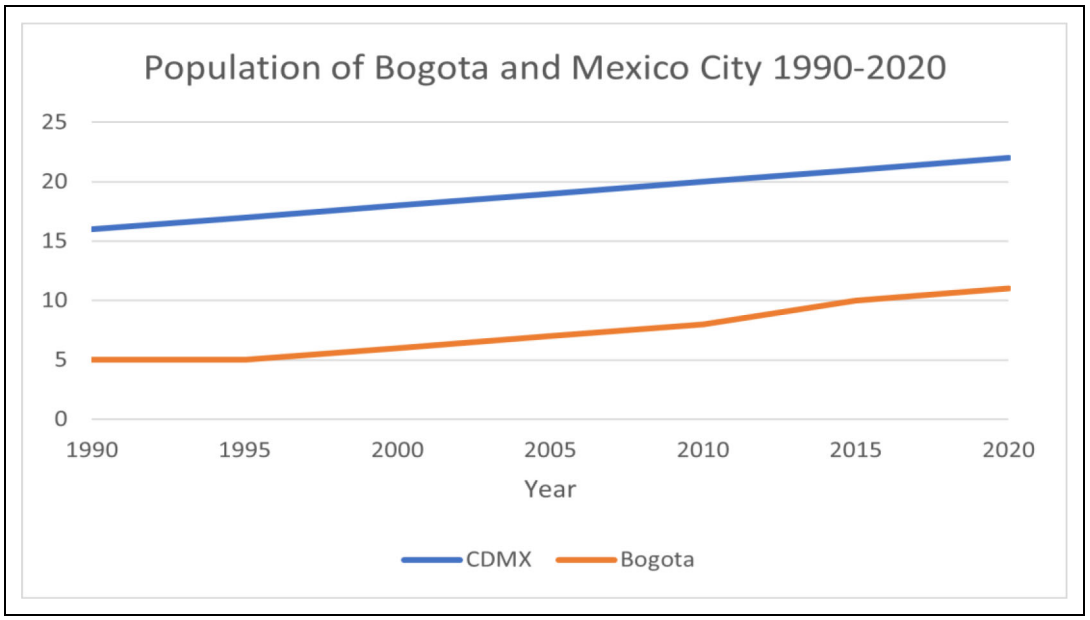

Figure 2. Population (in millions) per year in Bogota and Mexico City metropolitan agglomeration for the periods covered by the study. A similar population growth trend is apparent in both cities. Data sourced from the United Nations World Population Prospects (prospective estimates removed). Measurements in the original data were reported at 5-year intervals.

independent water authority for Mexico City until the 2003 creation of SACMEX. Much of the legislation providing free and equitable access to potable water was passed earlier in Bogota—likely as a result of Mexico City's lack of autonomy in water policy, although the relevant national legislation also passed later than in Colombia.

Table 1. Key statistics for Mexico City and Bogota

	Bogota	Mexico City
Mean altitude (m)	2,625	2,240
Extension (km^2)	1,637	1,485
Population of metro area as share of overall population (2005)	17.1	17.1
Population of metro area as share of overall population (2020)	17.9	16.2
Mean precipitation per year (mm)	818	749
Mean temperature per year (Celsius)	13.5	15.7
GDP per capita income (2005)	15,604	22,716
GDP per capita income (2018)	21,318	25,924
Year constitutional human right to water recognized	1,991	2,012

Source: de Mola et al. (2017) and Mexican and Colombian constitutions of 2012 and 1991, respectively.

GDP = gross domestic product.

Mexican national laws created governing potable water during the period of study include the regulation of water tariffs and requirements for the city to supervise water quality, preserve water and ecological equilibrium, be transparent in water data, and in the penal code, the criminalization of damage to aquifers (considered as environmental damage). Constitutional recognition and state guarantee of the right to water and access, sanitation, and disposal of water for personal consumption that is sufficient, healthy, and acceptable was granted in 2012.

In Bogota, the key laws governing potable water that were created during the period of study are at the national level and require the state to preserve the ecological equilibrium while providing potable water as a social priority. Water is recognized as a human right in the 1991 constitution, and free provision of water is required in case of disconnection or extraordinary circumstances. The Colombian state is further required to be transparent with water data, to conserve water, and to provide free water access in public fountains. Furthermore, damage to water sources is considered damages against consumers, the state, and/or the environment in Colombian penal law.[1]

The national political contexts

At the national level, and replicated at the city level, the conception of the role of the citizen is also important. A nationwide survey in 2012 examining political participation in Mexico demonstrated that a significant majority of the general public perceived citizens as having little to no influence on politics in the country (Encuesta Nacional sobre Cultura Política y Prácticas Ciudadanas, 2012 as cited in CAF, 2015). In Colombia, although the majority of citizens surveyed in 2011 for the Political Culture Survey (Departamento Administrativo Nacional de Estadística, 2020) reported knowing of at least 1 location where they could participate in policymaking or politics, only 7% had done so in the preceding 12 months (CAF, 2015).

The political culture and history of Mexico directly impacted the perception of the population's role in public policy and political life. Colonial and early postcolonial rulers viewed Mexico's citizens as passive subjects to be ruled rather than as part of an active citizenry. Under autocratic rule, this perception continued although not without critique and protest from the public. Despite a transition to democracy in the 1990s, much of the public remains disillusioned, has a limited perception of their role in policy and political life, and does not view the citizen as being particularly influential in political processes. In short, the public feels strongly excluded from public policy in Mexico despite the existence of numerous civil society organizations (Reyes García, 2013; Serrano Rodríguez, 2015).

In Colombia, the concept of "citizen" has fluctuated over time, and with it, the expectations and understandings of the role of the individual in public policy. Unlike Mexico, Colombia wavered between liberal and republican conceptualizations of the citizenry, settling initially on a concept of citizen that was communitarian in nature. The violence in Colombia also directly contributed to defining the role of citizens. In 1991, the new constitution of Colombia was drafted with the specific intent of fomenting participative democracy. Special initiatives targeting youth participation in public policy began shortly before the new constitution was implemented and continue today, aiming to create politically and socially active future generations of Colombians (Peralta Duque, 2010). Despite the emphasis on participative democracy in Colombia, confidence in the ability of an individual to affect political life via participation in Colombia remains relatively low (CAF, 2015).

In general, Mexico tends to score lower than Colombia on measures of participatory democracy and civil society participation, as shown in **Figures 3** and **4**. The governance structure of each state over time likely plays a key role in determining how effective civil society participation is in each context, as discussed in the preceding section. The difference at the national level as shown in **Figure 3** should not be confused as directly representative of the context within Bogota and Mexico City, however.

City-level political differences

In the preceding section, some background information on the national contexts and political participation was provided. At the city level, we see the differences in political participation echoed from the national level.

Bogota was the first Latin American city to create a program directly seeking citizen feedback (Bogota Como Vamos) in 1998. Many Colombian cities followed suit. Although a Mexico Como Vamos initiative exists, the focus is at national and state levels as opposed to at the city

1. See the Supplemenal Appendix for tables comparing the administrations in both cities, major laws and regulations made during the period of study, and major laws governing potable water in both cities.

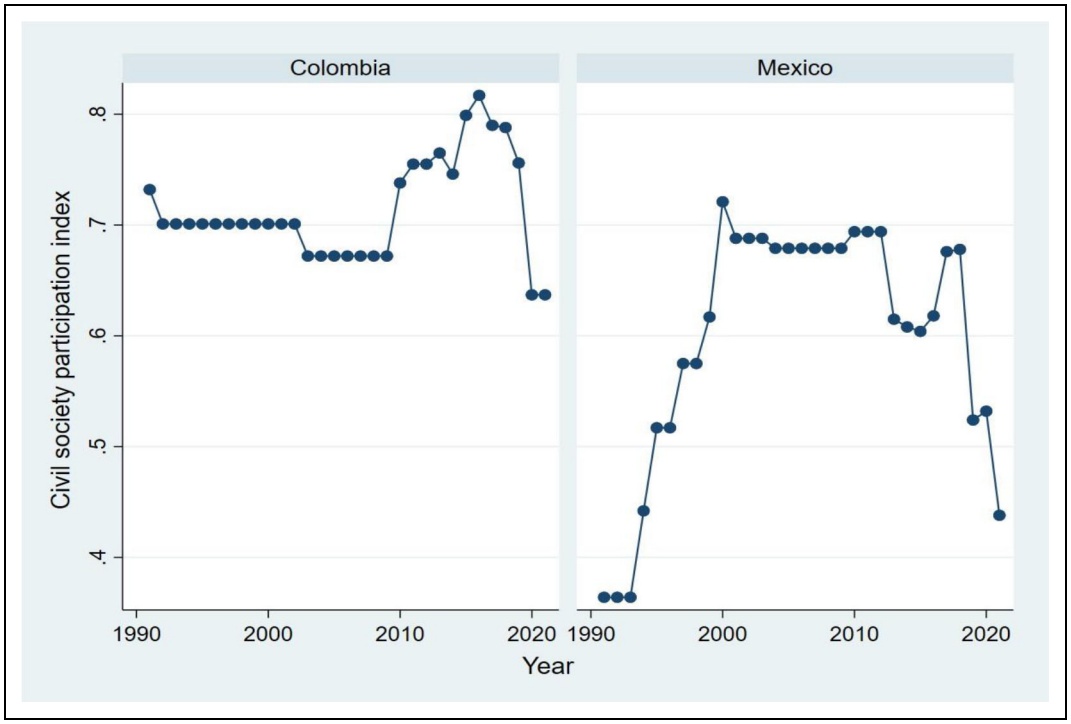

Figure 3. Civil society participation from 1991 to 2021 in Mexico and Colombia. Source: Coppedge et al. (2023) and Pemstein et al. (2023).

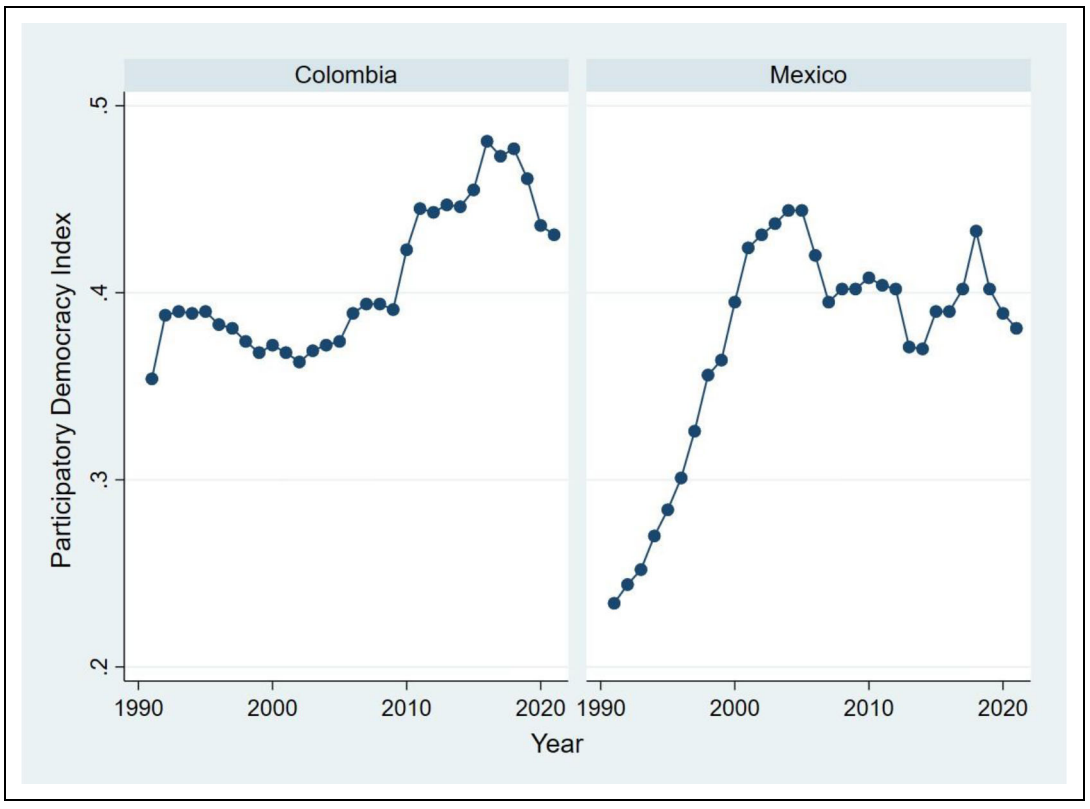

Figure 4. Participatory democracy in Mexico and Colombia, 1991–2021. Source: Coppedge et al. (2023) and Pemstein et al. (2023).

level (Mexico Como Vamos, 2023). Citizen participation in city-level politics is common and desired in Bogota.

City-level politics are relatively new in Mexico, where the Institutional Revolutionary Party (PRI) dominated politics as an autocratic government for several decades and municipal affairs—such as the management of water resources—were only turned over to city governments in the late 1990s. Notably, despite the relative recency of

municipal water control being turned over to the city, Mexico City has numerous civil society organizations addressing water issues. That said, they tend to be concentrated around specific issues, reactionary and defensive of potable water access, and have not been effective in resolving water issues faced by the city in its entirety (Mexico City Academic 2 interview 2023; Mexico City Academic 3 interview 2022).

Bogota's 1997 water crisis

Often touted in international reports as an exemplary use of behavioral interventions in response to water shortages or a key example of Mockus' "citizen culture" model in action, Bogota's 1997 water crisis began with the near-complete collapse of the Chingaza potable water tunnel. The tunnel's collapse led to an immediate risk of significant water shortage for the city. Bogota's poor were most vulnerable to the shortage and already faced limited water access, depending on *pipa* trucks and communal water taps for water. The Chingaza water system had drastically improved potable water access for the city following its construction. Still, it was plagued by partial collapses due to its location in soft and porous rock as well as poor maintenance. Before the 1997 collapse, the tunnel provided approximately 70% of Bogota's potable water. A reserve reservoir held enough water to last the city for a few weeks but was not designed for constant or consistent use.

When the extent of blockage was first known, the national government of Colombia declared a water emergency. The national government preferred a top-down approach that focused on regulating demand through controlled supply flow and water rationing, with the possibility of water-service cuts to some areas if supply was insufficient. Water rationing implies that each household would need to reduce consumption by a certain percentage. Such an aggressive, top-down policy intervention can disproportionately hurt the poorer segments of the population since they already live dangerously close to a minimum water consumption threshold. Bogota already had experience with this type of response, and following a 1,994 tunnel collapse, consumption was already down 16% using this approach. As a result, there was widespread perception among Bogota officials that there was little wiggle room to reduce water use further. The national government, nevertheless, intervened to introduce a variant of this traditional top-down approach, but it quickly backfired.

Most of Bogota's population's per capita water consumption was already relatively low when the tunnel collapsed, and further across-the-board cuts would have been difficult to achieve, especially among poorer water users. The problem was that a small number of extremely high-volume water users consumed a large proportion of the available water. Treating everyone the same and introducing across the board, forced water cuts for everyone would likely be seen as unfair. Such an approach could also cause a health crisis due to the resulting water shortages in poor neighborhoods. On the other hand, private corporations play a significant role in Bogota's local economy, employing tens of thousands of citizens. Reducing their access to water could also create adverse ripple effects throughout the economy.

Mayor Mockus and his city government administration had rejected the idea of water rationing and cuts outright, appealing to the national government for a chance to pursue the citizen-culture-focused strategy that characterized the Mockus administration's general policy strategy. A more aggressive top-down policy would also have been very unpopular among Bogota's regular citizens, whose support Mockus would prefer to retain in his impending bid for President. The challenge for Mockus was to identify a new policy solution that would be perceived as effective, fair, and not unnecessarily invasive, especially among the poorer segments of Bogota's population.

1997 was the third year of Antanas Mockus' first term as mayor. He was skeptical of invasive, top-down impositions on citizens and preferred a less invasive approach. His focus on a citizen-centered, pedagogic approach led to significant changes in how the city's administration interacted with the citizenry. Mockus' approach to public policy was characterized by a belief in the inherent desire of the population to do the right thing when informed. He employed unconventional interventions based on Mockus' ideology and pedagogical practices as a university professor. His administration's approach had become quite popular during his first 2 years in office, promoting the Citizenship Culture policy program. This program emphasized the moral duty of all citizens to do their part in the self-governance of their households, neighborhoods, and the city overall. Mockus relied on an unconventional mix of actors to achieve his policy goals, including mime actors, clergy, and youth volunteers. This city-wide strategy, however, ran directly counter to the policy preferences of the national government during the 1997 water crisis.

Using a combination of mass media and telephone messaging, graduated sanctions, and the creation of a youth civic group with 4,000+ participants, as well as workshops and incentives for autoregulation, the efforts resulted in a drastic drop in citizen water use. Remarkably, Mockus' interventions are classifiable as "behavioral instruments" but were implemented before researchers in social psychology and behavioral economics published studies (e.g., Nudge, peer-comparison utility bills, etc.) showing the effectiveness of such interventions. The recommendations Mockus' administration put forward for the population were simple and straightforward:

1. Use the least amount of water possible to wash clothes.
2. In the shower, use half the usual amount of water for half the time.
3. Flush the toilet only when necessary.
4. Turn the water off when soaping one's hands while washing hands (Mockus, 2001).

Both the city's and Mockus' ideas of addressing the water crisis required infrastructure repairs. The immediacy of the water crisis made the implementation of stand-alone

infrastructure repairs untenable as a policy response to the crisis. Efforts to improve and increase the capacity of Bogota's potable water infrastructure are ongoing.

Recent water crises in Mexico City

Like Bogota, Mexico City is no stranger to water crises. The city's water infrastructure has required multiple repairs. In Mexico City, the causes of infrastructure damage have not been complete tunnel collapses as in Bogota. Still, much of the city's potable water is lost each year due to infrastructure leaks and earthquakes, algae infiltration, prolonged heat waves, and droughts. The city has repeatedly faced drought-like conditions in the Cutzamala system, one of the world's largest potable water transport megaprojects. According to local officials, the conditions are not the result of meteorological drought; they are more likely caused by excessive water use for cleaning and hand washing during the coronavirus pandemic (SACMEX, 2018; MVS Noticias, 2022). However, the city's current mayor, Claudia Sheinbaum, has expressed concerns that climate change-induced drought is not something the city's water infrastructure can handle and does pose a significant, long-term threat to the city (El Heraldo de Mexico, 2021).

Several major water crises recently challenged Mexico City's already strained potable water infrastructure. First, on September 19, 2017, an earthquake struck the city and left several neighborhoods without water due to leaks. The impacts were concentrated in densely populated and poorer areas of the city, and the city's response was to initiate repairs to the system. Second, in October 2018, the Cutzamala system's only potable water plant, *El Berro*, underwent emergency repairs that led to water shortages and cuts in 13 out of 16 counties of Mexico City over several days. The city water utility, SACMEX, asked water users to "not wash clothing, cars, patios, water gardens; use the minimum number of kitchen utensils, avoid showering, and reuse water to flush toilets" during the planned cuts (SACMEX, 2023). Starting in June 2021, Mexico City faced a drought that depleted the Cutzamala system's reserves. The city's current mayor stated in 2018 that the city is infrastructurally unprepared for droughts, and she began implementing significant repairs to the city's potable water infrastructure to minimize leaks and water loss in the system. More recently, decreased rainfall in 2022 led the city's water authorities to voice concerns over the drought's impacts on aquifer recharge and the long-term sustainability of the potable water system (Congreso de la CDMX, 2023).

Across the board, as demonstrated by the aforementioned crises, Mexico City's response to water crises has been a top-down approach focused on technical solutions with sparse involvement from the population apart from requests to ration and conserve water.

A potent example is one of Mexico City's outreach campaigns: posters produced for *El Decalogo del Agua*. The posters were produced to encourage water use reduction. They include recommendations to not waste water, don't leave water running, take short showers, and make sure taps are closed, along with other similarly vague recommendations. In contrast to similar campaigns launched under Mockus in Bogota, the recommendations for users in Mexico City are less specific and do not rely on social cues from influential members of society (e.g., clergy, actors, athletes). Users are given general areas to focus on or reuse water for, but directions on how to go about completing the action are not present. Recall how some of Mockus' administration's recommendations asked users to shower for "*half their usual time*" and that they "*turn off the water when soaping one's hands*" (Mockus, 2001). The recommendation of specific actions in Bogota may have reduced the cognitive load for water users, making it easier for them to comply.

Mexico City has made other, limited attempts to change water culture. The 2 "Culture of Water" initiatives that remain active on the SACMEX website target children. One is a roughly 7-min educational video titled "Inspector SACMEX" and the other is an English-titled, slow-loading computer game, *Water Town* (SACMEX, 2022).

Notably, beginning in 1992, Mexico's National Water Commission (CONAGUA) attempted to use behavioral campaigns to reduce water consumption nationwide. Some of these campaigns won international recognition and public communications prizes. In fact, between 2004 and 2016 alone, more than 25 campaigns were attempted by federal authorities. Unfortunately, little attempt was made to analyze the impact of the campaigns and they are generally recognized as exerting low impact (Carabias and Landa, 2005; Ortega-Gaucin and Peña-García, 2016).

A detailed analysis of CONAGUA's campaigns during this time period attributed their failure to 4 main factors: (1) a national focus that fails to address differences in the population, (2) their orientation toward publicity for CONAGUA rather than a change in the culture of water, (3) the promotion of a very narrow aspect of Mexico's potable water problems, and limited coordination between government agencies managing public campaigns, and (4) a deficit in resources for campaigns not run by CONAGUA (Ortega-Gaucin and Peña-García, 2016).

Federal campaigns run by the Mexican Institute of Water Technology (IMTA) began in the 1990s are directed toward children and educators. Additionally, IMTA and CONAGUA collaborated with the Secretary for Public Education (SEP), but little communication regarding the implementation of the programs existed between these authorities as of 2016 and as of 2005 formal education had failed to instill a culture of water in the population (Carabias and Landa, 2005; Ortega-Gaucin and Peña-García, 2016). As Ortega-Gaucin and Peña-García (2016) conclude that:

> *It is clear that the greatest challenge in favor of a better relationship between society and water involves a broader understanding of what water culture is, and is not limited solely to a drinking water/urban user relationship in which guidelines*

imposed unilaterally by the State or the private sector on the care of the resource are dictated.[2]

Data collection and analysis

Mexico City and Bogota exhibit disparate responses to major water crises. To understand why and what impact their approaches had on the outcomes to these crises, we employ a comparative case study analysis with a structured comparative lens. Following the recommendations of Flyvbjerg (2006) and George and Bennett (2005), we ask a consistent set of questions about each case and structure our inquiry using 4 proposed factors we view as relevant to the divergent outcomes of the Bogota and Mexico City cases. Although less familiar to many social scientists than some qualitative methods, comparative case studies are well suited to examining multiple cases, making the method appropriate for our goals (Ruffa, 2020). Additionally, comparative case studies can make use of process tracing—a method we take advantage of in this text (Bennett et al., 2019). We opted to conduct the case studies sequentially, with Bogota first and Mexico City second.

To compare the crises in Bogota and Mexico City, we began by collecting existing studies of the Bogota case and identifying key data points missing from the literature. Next, we conducted a total of 4 semi-structured interviews and 1 unstructured interview with 3 academics with significant experience in Mexican water policy, economics, and ecosystem dynamics and 2 members of Bogota city administration who worked with Antanas Mockus during his term as mayor and went on to hold other public office roles after Mockus' terms as mayor. We initially reached out to former members of Mockus' administration and conducted interviews in December 2021 and January 2022. We studied several documents written by Mockus and his team regarding their program on "culture of citizenship" and the Bogota water crisis of 1997. During our first interview with one of Mockus' former administration members, we learned that our interviewee had shared insights from the Bogota crisis with Mexico City policymakers and political leaders in Mexico (Mockus Administration Official 2 interview 2021). We anonymized the names of our Mexican academic interviewees, although 2 of the 3 were comfortable sharing their identities. Our 2 Colombian interviewees were comfortable sharing their identities and are thus mentioned by name in the text. The interviews ranged from approximately 45 min to 1.5 h and the questions we asked during the semi-structured interviews are provided in the Supplemenal Appendix.

We began the study with the theory that the behavioral interventions in Bogota were successful due to the unique context of the Bogota case but hoped to identify what specific contextual factors enabled the success we observed in Bogota. Leveraging Mexico City, a case with a strongly divergent approach to water management despite numerous contextual similarities, allowed us to closely examine the mechanisms responsible for the differences between the 2 cities' policy choices and why Mexico City's consumption decrease plateaued when Bogota's continued, although at a decreased rate, over time.

Following the data collection for Bogota, we compiled primary and secondary source data for Mexico City. Few studies of the city's policy responses to water crises exist outside of newspaper articles and government reports, so our data collection efforts largely turned to these resources. Additionally, we reached out to interview city officials working for the municipal water utility, SACMEX, as well as experts at the IMTA about the federal government's role and reached out to officials in the State of Mexico (Edomex) and the municipal water council for the Valley of Mexico. According to Perlo-Cohen and Gonzalez Reynoso (2009), the government of the city, Edomex, and the federal government all play crucial roles in potable water management for the Mexico City Metropolitan Area. They must coordinate their actions to manage the city's potable water storage and wastewater expulsion.

Before delving into why each city pursued the strategies they did in response to their respective water crises, we provide a brief background of the access to and consumption of potable water in Bogota and Mexico City.

Potable water in Bogota

The city of Bogota was founded on the edge of the Andean mountains, where multiple sources of freshwater and a nearby indigenous settlement made the location a prime pick for Spanish settlers (Gallini et al., 2014). The rivers that flowed into and across the city were, at different times, considered sources of pleasure and relaxation or of filth and contagion (Gallini et al., 2014). Despite sitting in a prime location for access to freshwater, concerns about the available quantity and quality of water access plagued the city from the mid-1800s forward. They increased sharply with the exponential population growth the city experienced beginning in 1945. Bogota went from a small city of roughly half a million individuals in 1945 to a bustling major metropolis with approximately 8.2 million people today (Gallini et al., 2014; Nature Conservancy, 2021).

Throughout its history, Bogota struggled to maintain sufficient water infrastructure to support its growing population. The urban periphery and many of the city's poorer neighborhoods do not have direct access to piped, potable water at home, despite attempts by the municipal utility to provide access (Japanese International Cooperation Agency [JICA], 2009; Gallini et al., 2014). Thus, water is, and always has been, a major issue for the city's public affairs.

In the 1960s, Bogota, along with much of Colombia, implemented a stratified system of water tariffs. The six-tier system incorporated a cross-subsidy structure by which the richest segments of the population subsidized the water consumption of the poorest segments. The tariff system is of debatable efficacy as a tool for decreasing

2. Ortega-Gaucin and Peña-García argue strongly in favor of a conceptualization of the culture of water that extends beyond and yet encompasses urban potable water consumption. While we agree that a more holistic view of the problem is necessary, our discussion focuses on potable water for this article.

consumption in the top 3 strata but can encourage water use by the lower economic strata (Gil Mateus, 2011; Vargas et al., 2018).

In the 1970s and 1980s, the city was characterized by poor urban planning, absent leadership, and the takeover of public space by private individuals and actors (Berney, 2010). However, a massive overhaul of the potable water system was undertaken during this period. The Chingaza tunnel project began in the early 1970s. It was completed in 1982 after a massive tunnel was carved through 38 km of soft sedimentary rock and shale to bring fresh, potable water to Bogota (Broch, 2010).

The water utility corporation, *Empresa de Acueducto y Alcantarillado de Bogotá* (EAAB), provides water to Bogota and the surrounding municipalities. In the 1990s, water use was predominantly residential (77%), followed by commercial and industrial use (13%), and municipal service use (6%) (EAAB, 2000 as reported in Ramirez, 2002). However, a Chingaza tunnel collapse in 1994 spurred a 16% reduction in per capita water consumption. A consumer education campaign to reduce water use was launched, and Bogota's residents were encouraged to replace their older toilets with new, water-saving toilet models. Industrial water recycling was also encouraged during that earlier water shortage (Ramirez, 2002).

The 1994 Chingaza tunnel collapse was one of many suffered along with that particular tunnel, likely due to a combination of decreased rock strength resulting from the flow of water through the tunnel and porous shotcrete lining that allowed water to continue to make contact with the soft materials surrounding the tunnel (Brattli and Broch, 1995; Broch, 2010).

Several of Bogota's reservoirs were connected via a system of water tunnels to a water treatment plant near the city. An emergency water reservoir nearby the reservoir system held enough water to provide a few weeks of drinking water to Bogota in the event of a crisis. However, the tunnel collapse in 1997 would not be repaired quickly, necessitating several months of work. The population's water consumption was unsustainable and needed to drop rapidly and sharply to ensure enough water would be available to provide for the population's basic needs and prevent a major water crisis and water service cuts across the city.

Poverty in Bogota posed a significant complication; the Colombian federal government classified 80% of Bogota's residents as lower middle class or below. Additionally, population density in the city is very high, with 80 residents per acre compounded by massive population influxes leading to the creation of housing invasions and informal (pirated) housing settlements (Berney, 2010).

The 1997 water crisis in Bogota occurred in a city already familiar with water stress and with a sustained decrease of 16% in water consumption after the 1994 tunnel collapse. Initial attempts to encourage further water conservation failed miserably. After the national government declared the situation a state of emergency, many people panicked and started stockpiling water. For concerned citizens who wanted to conserve water, there was little clarity on what additional actions citizens could take to save even more water than the measures they had already implemented since 1994.

Due to the innovative behavioral approach incorporated by the Mockus administration, the public of Bogota managed to achieve an additional, strong decrease of roughly 23% in per capita water consumption a few months after the 1997 crisis. The administration and the Penalosa administration, which followed Mockus' administration, set in motion longer-term infrastructural reforms and repairs in the Chingaza portion of the potable water system. As infrastructure repairs finalized, the position of water as a human right entered public discourse and the tariff system was modified in 2009 to provide a minimum vital water allotment for free to all residential water users (Acevedo Guerrero et al., 2016).

Despite the allotment of a free allotment of water necessary for life, the reduction in consumption has persisted over time, remaining much lower than comparable cities. For example, Bogota's per capita per day water consumption in cubic meters was 0.16 in 2012, compared to 0.20 in Santiago, Chile and 0.21 in Brasilia, Brazil (Plappally and Leinhard, 2012). However, the infrastructure repairs have now become insufficient to address Bogota's current situation. Potentially necessary changes to the system include amplification of groundwater withdrawals, repairs to water transport infrastructure, and expansion of the city's water storage capacity (JICA, 2009). The city is constantly on the verge of water stress, with little left for individual consumers to do.

The city of Bogota's increasing population is putting significant strain on the potable water infrastructure and questions of informal construction and settlement are complicating the issue. An estimated 20,000 of the city's residents[3] currently do not receive regular water service (Medina, 2022). Recently, Bogota experienced protests and violence related to water service interruptions. The current city government has responded by implementing service cuts to conduct water infrastructure repairs (El Tiempo, 2022; Infobae, 2022; Acueducto, 2023). Some scholars have argued for the implementation of rainfall capture in the face of water stress, but no citywide program making use of rainfall has been implemented to date. Rainfall capture could be particularly fruitful for Bogota due to its year-round and relatively consistent precipitation levels (Ramírez-Escobar and Buriticá-Arboleda, 2021).

Potable water in Mexico City

Once known as the "Venice of the New World," Mexico City was founded in the lake-filled, mountain-ringed Valley of Mexico (Davids, 2016). The city's roots are ancient, dating back to the pre-Colombian city of Tenochtitlan. Under the Aztec empire, aqueducts brought freshwater into the city from higher elevations. The city was founded on land in Lake Texcoco, a predominantly saltwater-filled

3. These residents do not receive services because the areas they live in are not legally recognized settlements and EAAB (Acueducto) asserted that it can only deliver services to legally recognized settlements (El Tiempo, 2022; Infobae, 2022).

lake. Spanish settlement expanded on the Aztec efforts to tame the lake and rivers that fed into Mexico City and take advantage of groundwater deposits below the former lake (National Research Council, 1995; Jimenez and Birrichaga, 2019). Despite the significant use of freshwater resources in the Mexican capital, only the Rio Magdalena remains partially un-intubated, albeit heavily polluted within the city (Forsyth, 2017). Many of the city's other 45, now intubated, rivers are used to carry wastewater out of the metropolis despite proposals to restore them (Sanchez Inzuna, 2016). The city itself is now 540 times the size of its predecessor, Tenochtitlan (Jimenez and Birrichaga, 2019).

The city sits nearly 2,200–2,240 m above sea level and has a climate that fluctuates between wet and dry years. The surrounding mountains tower up to 5,000 m above sea level (Tortajada, 2006; Romero Lankao, 2010). From 1450 to the present, the city experienced at least 142 periods of drought but has also been subject to frequent and intense flooding due to alternating wet and dry years and the majority of the city's location in the massive basin of the Valley of Mexico. The past century also saw the city's median temperature rise by 1.6°C (Romero Lankao, 2010). The city's hydrological cycle had maintained a delicate ecosystemic equilibrium, which is threatened by climate change, overexploitation of the aquifer, and changes in land use from mixed lakes and forests to rapid and intense urbanization (Romero Lankao, 2010).

Mexico City's population began to boom in the mid-1900s, swelling from a modest 345,000 in the Mexico City Metropolitan Area in 1900 to 9,209,944 in the city itself in 2020 (Camposortega Cruz, 1991; National Institute of Statistics and Geography, 2021). Millions more live in the surrounding urban zone. The year 1900 marked the end of the construction of the Grand Canal, which drained much of the city's remaining lake water. As the population boomed, the city's rivers were intubated, and the lakes drained, and the demand for potable water increased. In 1970, a complex underground drainage system was completed to alleviate seasonal flooding. Together with the deforestation of the city and the prevalence of concrete and asphalt, there is little chance for the aquifer below the city to replenish itself (Davids, 2016). Yet, the aquifer provides much of the city's potable water. As a result, Mexico City has long struggled to provide sufficient potable water to its inhabitants. This despite ample yearly rainfall totaling 749–1,059 mm on average, nearby glaciers,[4] rivers, and its geological past as a massive valley lake (National Research Council, 1995; Davids, 2016; de Mola et al., 2017; Climate-Data.org, 2022). Like Bogota, problems with pollution, contaminated local rivers, and climate change pose a significant and prolonged problem for the city.

In the early 1990s, daily per capita water use averaged 364 liters per day for the 8.6 million residents of Mexico City, not including the population or water consumption of the surrounding metropolitan area. As some local activists have remarked, the city is abundant in water resources but water scarcity results from the urban design (Wattenbarger, n.d.). A 2001 assessment conducted by the National Hydraulic Program categorized Mexico City and the surrounding Valley of Mexico not as hydrologically water scarce—which it is not—but as suffering from 8 specific problems (Carabias and Landa, 2005):

1. Deficiency in drinking water and sewage supply
2. Overexploitation of aquifers
3. Poor handling of sewage
4. Pollution
5. Low-efficiency irrigation
6. High competition between water users
7. Free and overly cheap water tariffs
8. Dependency on imported water

Primary water consumers were domestic users, making up 67% of water use, with 17% used by industrial consumers and 16% by commercial and urban service providers (National Research Council, 1995). According to Jimenez and Birrichaga (2019, p. 542),

> *Considering the Mexico City population, the 62 m^3/s that are distributed through the network, represent a water supply of 255 liters per inhabitant per day [LHD].*[5] *However, due to water network leaks that amount to 40% of the total, each person receives on average 153 liters per day, a value that falls within the range of 150–170 LHD recommended by the WHO . . . The upper class, representing less that 5% of the total population, uses nearly 600 LHD while the lower classes, comprising 76.5% of the population uses 129 LHD.*

Bottled water consumption in Mexico, much of which is bottled domestically, is also among the highest in the world (Pacheco-Vega, 2019). Thus, although overall consumption has decreased in the city, inequality of water consumption appears to have increased.

Like Bogota, Mexico City has a stratified water tariff system. Created in 1992 during the internationally recommended privatization of various aspects of the city's water services in the "New water strategy for Mexico City," one of several water reforms undertaken by the Salinas regime. Salinas' water reforms were initially beneficial to the PRI party, which was struggling to maintain its autocratic rule (Haggarty et al., 2001; Marañon-Pimentel, 2003). The tariffs were part of a larger initiative on the part of the PRI political party to attract votes from citizens in lower socioeconomic brackets and regain support in rapidly urbanizing areas of Mexico. It was preceded by national-level participatory programs such as PRONASOL, which focused 40% of its budget on water and sewage and a failed city-level program led by then-mayor Manuel Camacho Solis—who was directly appointed by Salinas—, the Programa de

4. One of which, the Ayoloco, was declared extinct in 2021 (Mexico News Daily, 2021).

5. Quotes have been edited to clarify the meaning of technical abbreviations referring to liters per day and liters per inhabitant or per capita per day (LHD).

Uso Eficiente del Agua (PUEDA), which began in 1986 under Ramon Aguirre Velazquez[6] (Haggarty et al., 2001). The tariff system was designed to allow for cross-strata subsidization as used in Bogota (Romero Lankao, 2011). Despite its design, the tariff structure has largely benefitted wealthy users. The top quintile of water users in Mexico City consume 42% of the potable water, while the lowest tiers receive less subsidies and receive lower quality water. Subsidies have been a part of the water policy in Mexico City for decades but are not based on need—rather, subsidization of potable water is related to consumption (Morales-Novelo et al., 2018). Furthermore, overuse of water simply results in a higher fee, but the fee is low enough that wealthier users do not have an incentive to decrease their consumption (Carabias and Landa, 2005). The current tariff structure is, in the estimation of local economists, deficient and fails to accomplish the goal of decreasing excessive water use (Mexico City Academic 3 interview 2023).

Groundwater exploitation in Mexico City creates and exacerbates freshwater access problems by provoking flooding in some city regions through soil subsidence. The result is a confirmed average 7.5 m of sinking between 1895 and 1995 (National Research Council, 1995), and the city continues to sink. Some areas are more greatly affected by the process of subsidence than others, with the most extreme sinking observed in areas characterized by softer soils. Additional subsidence of 60–150 m is possible as the upper, softer soils consolidate. The specific depth is contested, as geotechnical maps of the city suggest consolidation would be forced to stop at a maximum depth of 80 m (see Santoyo Villa et al., 2005 for a detailed geotechnical discussion of the basin of the valley of Mexico). Regardless of the maximum depth of consolidation, groundwater recharge is not expected to reverse this process and as it continues, contaminants and salts from the upper clay soils will likely contaminate the city's main aquifer, decreasing water quality (Santoyo Villa et al., 2005; Chaussard et al., 2021). Deep pumping of water from the aquifer at depths of up to 80 m results in sinking of roughly 1.3 m^3/100 m^3 of water extracted (Santoyo Villa et al., 2005). The city holds and is projected to maintain a negative hydrological balance, with a water deficit compared to aquifer and surface recharge (World Bank, 2013).

Some estimates suggest Mexico City remains the highest consumer of potable water globally, averaging 360 liters per day as of 2018 (Ordoñez, 2019). This, even though (as of 2011) 89% of the city's population reported they did not drink tap water despite paying nearly double to consume bottled water than they would to consume water from the tap, potentially as a norm established after the 1985 earthquake (Montero-Contreras, 2016; Pacheco-Vega, 2019). An estimated 40% of the city's water consumption is neither commercial, industrial, municipal, agricultural, or residential. Instead, it is lost through leaks in the potable water infrastructure, which resulted from neglect, earthquake damages, and subsidence from the city's sinking (National Research Council, 1995; Avila, 2018; Milenio, 2019).

One of the major water sources for the city—the massive Cutzamala tunnel system—brings in 9 m^3/s of potable water per second (SACMEX, 2018). Approximately 25% of Mexico City's metropolitan zone's water is provided by the Cutzamala system (CONAGUA, 2023). Other major water sources for the city include the Lerma system—providing roughly 4 m^3/s—and wells in the city which provide approximately 14 m^3/s. The Barrientos and Chiconautla systems provide a much smaller portion of the city's water, as do springs, rivers, and the Caldera Plant (SACMEX, 2018).

The Cutzamala system has been completely and partially stopped for repairs on multiple occasions. In 2013, an announced pause of water delivery for 72 h extended to 90 h due to technical problems. The system had an announced pause in February 2016, and an emergency pause in services in April of the same year. Nearly half of the city's residents depend on water from the Cutzamala and Lerma systems (SACMEX, 2018).

The city loses between 35% and 42% of the water it receives in leaks. According to the Director of the Detection of Leaks at SACMEX, in 2022 the city dealt with 11,600 leaks—40 to 50 per day on average—due to numerous causes including varied rates of sinking, tree root penetration of pipes, and excessive pressure (Congreso de la CDMX, 2023). Analysis of potable water loss through leaks in Mexico City revealed that the city's reliance on groundwater is unsustainable, as economic activity threatens recharge zones for the aquifers the city relies on. However, leak control from the existing system is likely to be considerably more affordable than replacing groundwater extraction (López-Morales and Mesa-Jurado, 2017).

In addition to the tariffs discussed above, a few demand management approaches have been tried in the city. In the late 1980s, a toilet replacement program targeted a few thousand households and provided toilets with decreased water use per flush. This program had some success in alleviating water scarcity at the time, combined with water tariffs but was slow to implement and eventually canceled (Haggarty et al., 2001; Adler, 2011). In 2009, the program was tried again for a few million toilets in the city, with the goal of saving 7,000 liters/second of water. A "green seal" of approval for reduced water consumption. Some of the city's delegations have also enacted limited demand management policies (Adler, 2011).

During 2009 the city was forced to implement service cuts during a particularly severe water crisis (Adler, 2011). In 2018, a report on SACMEX's successes and failures indicated that 17% of users were subject to decent water pressure and guaranteed access for only 8 h/day, 9% only received water between 1 and 3 days/week, 4% received too little water in general, and an additional 14% received water but service delivery was unsustainable (SACMEX, 2018). The frequent service interruptions (intermittent water service [IWS]) which characterize water delivery for many of the city's residents can also lead to infrastructure

6. Not to be confused with the former head of CONAGUA, Ramon Aguirre Diaz.

degradation, decreased water quality, and higher levels of microbial infiltration, among other issues (Bautista-de los Santos et al., 2019).

Further complicating potable water problems in Mexico City are the impacts of seasonal flooding, water tariffs, contamination, and scarcity, which have been tied to instances of conflict between the population and the government (Cabestany Ruiz, 2017; Mandujano Tovar, 2017; Processo, 2017; Secretaria de Seguridad Ciudadana [SSC], 2020; Azteca Noticias, 2022; Garlem, 2022; Wattenbarger, n.d.). Although most of the disputes have been nonviolent and peaceful, it is essential to note that geographic differences more than socioeconomic ones have led to more protest-based mobilization in the peri-urban zone due to a lack of feedback mechanisms such as citizen hotlines or public meetings that the population can reliably use (Cabestany Ruiz, 2017). In general, reforms aimed to reduce water consumption in the city have been criticized for overlooking the impact behavioral and educational campaigns could have on reducing consumption (e.g., see Marañon-Pimentel, 2003; Romero Lankao, 2011).

Mexico City has significant interest from civil society in the use of rainfall capture. The city has a few programs currently in place—some led by civil society organizations, and at least one led by the city itself—but there is significantly more that can be done to expand the use of this technology. A recent study from the National Autonomous University of Mexico argues that families using pipas could avoid between 4 and 7 months of pipa delivery if they were to make use of rainwater (Arroyo-Zambrano et al., 2016). However, the same study also noted that filter cleaning and proper use of the systems that have been installed has created obstacles for many current users. The city's existing rainfall capture program, *Cosecha de Lluvia*, received 1,218 million pesos in operating budget between 2019 and 2023 for the installation and maintenance of 59,000 rainfall capture systems in 9 of the city's municipalities, as well as for user training. The program has the stated goal of installing 10,000 systems per year, targeting the lowest socioeconomic sectors first (SEDEMA, 2023).

Proposed factors explaining the divergent outcomes in Bogota and Mexico City

We propose an empirically grounded explanation as to why the policy responses observed in Bogota and Mexico City were so different. Based on the data collected about the 2 cities, especially our interviews with the key-informants, we identified 4 factors that help explain the divergent policy responses and subsequent water conservation outcomes. While previous work has focused mostly on biophysical and socioeconomic factors shaping water conservation outcomes, our analytical focus here is on the collective choice and policy processes in the 2 cities. We are particularly interested in factors that facilitated policy innovation. We propose that the following 4 factors shaped the policy processes and subsequent outcomes in the 2 cities: (1) the differential roles of scientific and technical perspectives in each context, (2) the role of ideology, (3) the complexities of the environmental policy problems in each setting, and (4) the varied roles of policy entrepreneurs. In the following sections, we detail each of these factors.

The chart in **Table 2** briefly addresses the relevant factors across the period of study, with emphasis on the periods of aforementioned crisis. The list is the result of the analysis of the contextual factors that help explain the variation observed between the 2 cases. In the following sections, we explain in further detail how each factor relates to the policy choices of each city in the face of potable water crises. The sections following the chart dive deeper into how each factor relates to the responses by the cities' responses to the crises they faced.

Proposed factor 1: Science-led or evidence-based reforms do not drive all innovative interventions

EBPM is a catchphrase frequently employed but little understood, even by those who use it. Advocates of this approach claim that scientific evidence should guide policymaking as much as possible. As Cairney (2016) points out, the term is often aspirational and interpreted at 2 extremes: as something impossible to achieve or as a direct path between scientific research and policy decisions and outcomes. As Cairney (2016) rightly notes, EBPM is neither. We recognize the lack of direct pathway between scientific research and policy implementation but also argue that, as shown in the Bogota case, EBPM does not always play a role in the creation of innovative, effective solutions to environmental policy problems. Furthermore, overreliance on technical solutions may inadvertently lead to less-than-optimal outcomes.

Following an initial, failed top-down approach, solutions proposed in Bogota were based on Mockus' Citizen Culture program (ideological, pedagogical, and political will), not on scientific insights or reports. However, Mockus' interventions were still informed daily by reports from the water utility on how much water was being consumed and how much remained in the emergency reservoir. The Mockus administration also conducted ongoing surveys with a representative sample of households during the crises to monitor how they responded to the various intervention strategies and messaging campaigns. In fact, it was by using these surveys that the administration learned about citizens' stockpiling and lack of effective water conservation strategies during the first days of the 1997 crisis.

What others have called a "behavioral intervention" in Bogota happened before the advent of Nudge (Thaler and Sunstein, 2008) or the Haifa childcare experiment (Gneezy and Rustichini, 2000) (i.e., pre-social psychology's major influence on public policy analysis). The solutions, when proposed, seemed detached from the common wisdom and practice of the time, which emphasized coercive, top-down, technocratic interventions. However, since the implementation of Mockus' unique intervention approaches in Bogota, per capita consumption of water has remained low despite increasing population pressure. Despite the lack of reliance on EBPM, the fast-thinking behavior that characterized Bogota's water crisis of 1997 were addressed effectively with significant and remarkable results.

Table 2. Chart comparing Bogota and Mexico City across 4 identified factors

	Bogota—Mid-1990s tunnel collapse. Infrastructure and water stress-related strains on the potable water system over the past decade	***Mexico City—drought, infrastructure problems, and increasing population and climate-related stress on potable water system over the past decade***
Science-led or evidence-based reforms do not drive all innovative interventions	Massive water sector reforms at the national level took place under Trujillo for 4 main reasons: the new 1991 constitution, Trujillo's personal convictions to reform, financial crisis in the electric sector, and the collapse of Colombia's water sector utilities (Velez Alvarez, 2010). Following an initial, failed top-down approach, solutions proposed to the crisis in Bogota were based on Citizen Culture program (ideological, pedagogical, and political will).	Policy focus is (and has historically been) almost exclusively on infrastructure repair, wastewater recycling,[a] and rationing. Water cuts and rationing used during times of water crisis led to water stockpiling and some incidents of unrest and violence in Mexico City. Behavioral interventions largely absent at present and previously demonstrated poor follow through.
Ideology matters (the perceived role of public policy)	Post-1991 emphasis on participative democracy encourages public consultation and multiple forms of engagement with the policy process. Trujillo's commitment to reform led to many changes in water sector in the early 1990s. Only one leader of Bogota (and only for 4 months) was an engineer. The majority of the city's leaders have been economists or lawyers. Mockus' administration relied on behavioral interventions and awareness campaigns. These were based on pedagogical ideas of teaching as a facilitation process that seeks to develop self-help skills and empowerment among students. Mockus was a university professor, as was his successor.	General approach by the city's leaders has been technically rooted and top down (water rationing, rate hikes, limited classroom education). City leaders from same party, included several engineers and environmentalists. While citizen feedback is received within the city, the peri-urban areas do not have reliable means of communication with the government, leading to protests.
Complexity of environmental problems can inspire creativity and innovation	National government's preferred measures were top down, "blueprint" solutions despite constitutional reforms. Mockus' administration rejected this approach and argued that people were trying to save water and behavioral interventions could work. Behavioral approaches were employed after top-down measures backfired. Push for rainfall capture in Colombia led by academic research and private actors in face of climate change. Private actors deliver water by truck and sell bottled water and water filtration systems, although less than in Mexico City.	Creation of Mexico City itself and subsequent reforms determined by environmental constraints (creation of chinampas, flood walls, entubation of rivers, megaprojects to bring water to, and remove it from the city) across centuries. Recently, individual entrepreneurship has led to creative solutions in Mexico City, but not in the policy sphere. Flooding is common in city, leading to civil society interest in local rainfall capture. Local NGOs engage in projects to provide rainfall capture systems. Many entrepreneurs sell potable and distilled water and home filter systems, deliver water by bicycle or truck, or otherwise engage in water provision where consistent state service is absent.
Policy entrepreneurs play a key role in policy innovation	Trujillo's commitment to reform in early 1990s. Interviews with members of Mockus' administration emphasize the importance of his individual charisma, emphasis on citizen culture, and pedagogical approach to public policy interventions.	**National—Salinas**. Late 1980s/early 1990s, water sector privatization and introduction of tariffs. Mayors of Mexico City have been slow to embrace innovative policy solutions, with some notable exceptions:

(continued)

Table 2. *(continued)*

	Bogota—Mid-1990s tunnel collapse. Infrastructure and water stress-related strains on the potable water system over the past decade	***Mexico City—drought, infrastructure problems, and increasing population and climate-related stress on potable water system over the past decade***
		AMLO. 2003, SACMEX formed under the Secretary of the Environment by fusing 2 prior city departments (DGCOH and CADF).
		Ebrard. 2009, sustainable water initiative.
		Questions from Bogota and Mexico City structured interviews:
		Sheinbaum. 2018, dedication of $370 million US in additional yearly funds to the city's water utility, doubling prior budget. Cosecha de Lluvia program.

[a]Wastewater recycling is used across the city for recreation, irrigation, car washing, environmental restoration, and industrial purposes. As of 2009, it accounted for 7.7 m^3/s of the water use in the Mexico City metropolitan area (Jimenez, 2009). As of 2013, 13.6% of Mexico City's water was recycled (CONAGUA, 2013). The use of recycled water was codified into Mexico City's law in 2003, modified in October of 2008, and expanded to further delineate the reuse of water in 2019 (Congreso de la Ciudad de Mexico, 2020). As translated from the law, "all parks, public gardens, and sports fields are required to use recycled water." Additionally, "all new buildings [constructed after 2003] are required to water garden and green areas [such as living walls] with recycled water and car washes, bathrooms and other uses not requiring potable water are to use the recycled water network of the city. In the absence of connections to the recycled water network, users are to reuse water internally and to capture rainwater for uses not requiring potability" (Congreso de la Ciudad de Mexico, 2020). As of 2011, roughly 9% of the city's water was recycled and untreated water likely contaminates the aquifer and subsoil (Romero Lankao, 2010).

In Mexico City, policy focus is—and has historically been—predominantly on infrastructure repair, limited wastewater recycling, and rationing. Additionally, other demand management strategies such as toilet retrofitting have been used. The same measures were used in Bogota before the 1997 water crisis. In Mexico City, water cuts and rationing used during times of water crisis led to water stockpiling, and some incidents of unrest and violence as citizens in severely water-strained areas of the city fought for access to potable water. In many parts of the city, residents have protested, water trucks are stolen, and violence has occurred in response to water shortages (Cabestany Ruiz, 2017; Mandujano Tovar, 2017; Processo, 2017; SSC, 2020; Azteca Noticias, 2022; Garlem, 2022; Wattenbarger, n.d.). Thus, despite evidence that top-down approaches may have detrimental social impacts in Mexico City, the city's leaders continue to rely on these traditional policy responses to recurring water shortages. Additionally, social conflicts over water provision from outside the Valley of Mexico erupted from the creation of the Cutzamala system and have placed indigenous communities in conflict with the Mexican federal government (Weaver, 2011).

Interestingly, an analysis of the desired solutions to water issues in Mexico City identified differences between officials, residents, and public administrators. Many citizens of the city wanted more access repair and creation (via rainfall capture) measures, increased public sector investment in water supply and storage infrastructure, and improved information and a better "culture of water," as well as new political leadership. Public officials also sought an increased "culture of care," additional gray water recycling, and enhanced collaboration across sectors of governance. Public administrators preferred infrastructure solutions and conservation measures (Eakin et al., 2019). The difference between public official and administrator preferences may impact the ability of policy innovation to occur in this space. Despite the apparent receptivity of the city's public to more behavioral measures, administrators' preference for other solutions may limit the creation and incorporation of such programs.

Different from the Bogota context, Mexico was an early adopter of the Integrated Water Resources Management (IWRM) model. IWRM was officially adopted in 2003 during the administration of Andres Manuel Lopez Obrador (Congreso de la Ciudad de Mexico, 2020). In Mexico City, there are several water working groups that have official standing and together with and comprised of stakeholders, the federal government's national water commission (CONAGUA), nearby states, the city government, and local officials, these water working groups seek to resolve Mexico City's water issues. Although a watershed approach was initially used, the city's water working groups are now divided along jurisdictional lines, with groups in 8 of the 16 counties that comprise the city. The creation of decentralized, water working groups is recent and ongoing, with the latest created in March 2022 in the Gustavo A. Madero neighborhood of the city. The model may be beneficial, as leaks are being addressed by these bodies (*Jefatura del Gobierno*, 2022). Despite promising policy IWRM on paper, however, many officials and academics studying the city's IWRM complain of poor

communication between member government bodies (Ortega-Gaucin and Peña-García, 2016; Mexico City Academic 3 interview 2023).

Neither Bogota nor Mexico City seems to rely heavily on EBPM in addressing water crises. Furthermore, despite reliance on commonly employed, technological and economic solutions to water crises that appear to have a stronger grounding in EBPM, Mexico City's water crises have not improved over time—although per capita use has decreased, the city has faced repeat crises with little evidence that the environmental policy problems driving water crises are being resolved. As Rafael Carmona, head of SACMEX (Mexico City's water authority) stated in an interview with the Thompson Reuters Foundation, climate change is affecting the city's potable water supply. "Climate change has definitely changed rainfall patterns . . . We have to prepare ourselves in lots of ways to be able to cope with these variations in climate conditions" (Murray, 2020). Notably, however, the city's current mayor is an energy engineer and environmentalist who invested heavily at the start of her term in repairing the leaks in the city's water system and promising to decrease the overexploitation of the aquifer by 2.5 m/s (Forbes Staff, 2019; Mexico City Academic 3 interview 2023).

Proposed factor 2: Ideology and the conceptualization of citizen matter

Mockus' administration's behavioral interventions and awareness campaigns in Bogota were mainly driven by his ideological beliefs and a policymaking perspective grounded in a pedagogy that incorporated citizen agency, incentives for "good" behavior, and punishments and public shaming for "bad" behavior. His administration arose in a policy context where top-down solutions to water crises had already been tried with some success but little room for additional improvement. Mockus' previous successes and the federal government's lack of success following the declared water emergency likely combined to make the national government capitulate to Mockus' administration's request to shift away from service cuts and rationing to more unconventional interventions (Chiappe interview, 2022).

Mockus' approach of "*Cultura Ciudadana*" was based on an idea of pedagogy as extending beyond the classroom and including workshops to define city council and administration responsibilities. The approach his administration used was based on the hypothesis that a division between the 3 governing forces of human society (legal, moral, and cultural) of Bogota's society drove the city's problems. Mockus' administration focused on rebuilding Bogota by creating a more civil culture in which peaceful conflict resolution and increased compliance with rules and regulations would be the norm (Mockus, 1999, 2012; Suarez Cardona and Ramirez Brouchoud, 2021).

The influence of pedagogy and ideology on the Mockus administration's decisions surrounding how to handle the water crisis of 1997 is apparent. However, pedagogy and ideology can inform public policy in other innovative ways. Ideological contexts can either enrich or constrain the ability of policy innovations to emerge, alter the willingness of actors to accept novel solutions, and sometimes affect the continuity of policies across administrations.

In contrast to Bogota, the general approach preferred by Mexico City's leaders has been technically rooted and top down (e.g., toilet retrofitting, water rationing, rate hikes, and some classroom education).

Mexico City's leaders tend to view the role of public policy as interventions that set and enforce standards among citizen water users. As explained earlier, the city has largely worked in tandem with the national government to confront water crises, which may partially explain the reliance on top-down solutions. Although attempts to create a "culture of water" are codified into the city's law, many academics and local policymakers are skeptical of their ability to have an impact (Mexico City Academic 3 interview 2023). Additionally, who the city's leaders have been over the past several decades likely also matters.

From 1997 to 2018, Mexico City's leaders were from the same political party, the leftist *Partido de la Revolución Democrático* (PRD). Additionally, the city's past and current mayors include engineers, physicists, and environmentalists, whose knowledge of the infrastructural aspects of environmental policy problems may have made them more inclined to rely on top-down, technical solutions. The technocratic approach—despite criticism for applying band-aid solutions to ecosystemic problems—has allowed the city to navigate long-term water stress but may benefit from a more holistic approach (Mexico City Academic 3 interview 2023). The PRD party has an ideological preference for state-run solutions (as opposed to voluntary agreements or market-based instruments) that may also contribute to the reliance on technical and top-down practices.

In Mexico City, the environmental commitment of Marcelo Ebrard, the technical engineering expertise of Cuauhtémoc Cardenas, and the combined experience as an environmentalist, scientist, and engineer of Claudia Sheinbaum likely exerted direct influence on the choices of these city leaders. Furthermore, these leaders shared a common ideological perspective that favored top-down, state-led solutions. These ideological leanings placed constraints on the actors involved in decision-making, limiting the policy space available for innovative solutions to emerge.

Proposed factor 3: Complexity of environmental problems can inspire creativity and innovation

Water crises have complex causes. In Mexico City and Bogota, infrastructure damage and neglect, unequal and inequitable potable water access, and immediate crises compounded over time to create water crises these megacities struggled to navigate. Depending on the available policy space, the complexity of environmental problems can drive innovation and inspire creativity.

The complexity of water crises is clear in both cases discussed in this study and is not unique to water crises. Environmental policy problems are often multifaceted and there may be multiple policy problems present in a single context, necessitating the use of multifaceted

solutions. The complexity of environmental policy problems and the complex systems in which they arise likely explains, to some degree, why "blueprint thinking" is often ineffective and may even backfire. However, path dependence on the part of policymakers can make it difficult to convince them to embrace novel solutions.

In Mexico City, a pattern of reliance on top-down, "blueprint" solutions to water crises has addressed the underlying infrastructure issues but not altered the behavior or significantly involved the average citizen. In Bogota, however, despite the Colombian national government's preferred measures (i.e., top down, "blueprint" solutions), the Mockus' administration had sufficient independence from the federal government to argue and implement interventions, which showed that people were trying to save water and novel solutions could work.

Although there is insufficient policy space for innovation and creativity to prevail in Mexico City, individual entrepreneurship has led to small-scale creative solutions to water crises. An estimated 89% of the city's population receives water from direct connections, but at least 1.15 million people receive their water via weekly or biweekly public *pipa* truck deliveries (Jimenez and Birrichaga, 2019). Private *pipa* trucks with water that is cleaner than city trucks provide paid services to poorer areas of the city and much of the population now relies on bottled water in *garrafones*[7] rather than tap water for drinking and cooking. Private citizens have also taken an active interest in resolving the city's persistent water crises. For example, flooding is common in city, leading to civil society interest in local rainfall capture.

National-level factors also likely influence the space for public policy innovation. As noted earlier, Mexico City did not have autonomy over water policy until 2003. For the first 13 years of our period of study, the city was dependent on national-level decisions to address potable water issues. Additionally, the position of water as a right occurred later in Mexico City than in Bogota, as the Colombian constitution recognized the right to potable water in 1991 but Mexico only recognized this right in 2012. Public policy entrepreneurs may therefore have found the policy space more welcoming for innovation in Bogota. Notably, the lack of public policy space left an opening for private enterprise in Mexico City, where efforts at privatization were attempted in the 1990s and early 2000s to help alleviate the city's water stress.

The immediacy of significant consequences from water crises may also have played a key role in allowing policy innovation. In the face of immediate threats affecting a large portion of the population requiring effective solutions, such as the water crisis in Bogota, there may be more room for public policy innovation. In contrast, slowly evolving natural hazard problems, such as climate change-related drought, may make it more difficult for Mexico City policymakers to embrace novel solutions. Thus, the magnitude, novelty, and immediacy of threats may impact policymakers' willingness to experiment with innovative solutions to environmental policy problems.

Proposed factor 4: Policy entrepreneurs and leader characteristics play a key role in policy innovation

Our interviews with former and current Bogota government officials who worked with Mockus' administration emphasize the importance of his individual charisma, emphasis on citizen culture, and pedagogical approach to public policy interventions. Mockus' administration followed shortly after Colombia's new constitution was created and during a political moment when both the population and at least 2 presidential administrations craved change that included more active and equal political participation for the general public. The characteristics of the national leadership, the Colombian public's hunger for change, and Mockus' unique approach as mayor of Bogota combined to create lasting change.

While the national context was undeniably important, Mockus' personality was a key factor in the creation of a truly innovative policy response to water crisis. Asked to identify factors responsible for the city's success in dealing with the water crisis of 1997, one former member of Mockus' administration and current city government official mentioned the mayor's ability to inspire confidence in people he worked with and in citizens at large, his novel use of media and communication, the hope he inspired, his pedagogical approach and use of artistic and playful approaches to policy, and his avoidance of punishment in favor of rewards, recognition, and support, as well as a strong belief in active citizen participation and deliberation. He further noted that "Mockus was one of the first to impart this type of vision" (Mockus administration official 1 interview 2022). Clearly, Mockus' role as a policy entrepreneur left the impression on this official that the mayor, as an individual, played a crucial role in resolving Bogota's water crisis.

Mockus selected an administration of individuals with similar faith in citizens and focus on teaching citizen culture as a means of making lasting change. Juan Luis Villaveces, who served as the Secretary of Education under the Mockus administration, involved schools in competitions to reduce domestic water consumption and having students track their family's water consumption. Children were taught how to read water meters at home and identified actions that could save more water, and independently dedicated themselves to taking these actions (Suarez Cardona and Ramirez Brouchoud, 2021).

Mayors of Mexico City have been slow to embrace innovative policy solutions, with some notable exceptions. For example, SACMEX is the public water utility for Mexico City. It was formed under Andres Manuel Lopez Obrador in 2002, under the Secretary of the Environment, by fusing 2 prior city departments (DGCOH and CADF). In 2009, Marcelo Ebrard created a sustainable water initiative. Also notably, in 2018, newly elected mayor Claudia Sheinbaum dedicated hundreds of millions (in US dollars) in additional yearly funds to the city's water utility, increasing its

7. *Garrafones* are large bottles of potable water, commonly containing 10 or more liters of water. See the Supplemenal Appendix for photos of various sizes of *garrafones* and signs offering them for sale (with prices in Mexican pesos).

prior budget from 45,472,663,305 MXN pesos to 57,296,269,915 MXN pesos (Stettin, 2022). Despite these efforts, the city's water utility does not operate independently. Rather, there is significant federal involvement in Mexico City's water management that constrains the policy choices available to the city government. Many city water initiatives are conducted in tandem with or subordinate to initiatives run by the federal government. Additionally, private actors such as real estate developers may play a role in determining how acceptable policies may be perceived to be by the public and which options may make it to policymaking agendas (Mexico Academic 1 interview 2022, Mexico City Academic 3 interview 2023).

Not all policy entrepreneurs play a beneficial role. In some cases, their involvement may be detrimental. In Mexico City, for example, some environmental and policy scholars suspect that the city's water zoning laws have led to a lack of desire for practical reforms that would limit excessive potable water consumption (Mexico Academic 1 interview 2022; Mexico City Academic 2 interview 2023). Real estate developers in Mexico City face high incentives to build apartments in the city due to pressure for urban housing. At the same time, zoning laws are largely absent. There is little to no regulatory incentive to reduce water use as new apartment construction takes advantage of the absence of zoning laws that allows for excessive water consumption (Mexico City Academic 1 interview 2022).

The individual personalities of policymakers can strongly impact the interventions used to address environmental policy problems such as water crises. Our interviews with members of Mockus' administration demonstrate the influence his charisma, dedication to citizen culture, and pedagogical approach had on the resolution of Bogota's water crisis. Beyond Mockus, policy entrepreneurs likely play a key role in calling attention and designing and implementing solutions to environmental policy problems. In Mexico City, civil society leaders and environmentalists have called for attention to innovative and novel solutions to the city's water crisis. Although many, such as the idea of reopening the city's rivers, have not resulted in policy action, awareness raising plays a crucial role in keeping potable water at the forefront of political discourse in the city. As 2 of the academics we interviewed indicated, some initiatives, such as rainfall capture, do eventually get adopted but the process is slow moving (Mexico City Academic 2 interview 2023; Mexico City Academic 3 interview 2023).

Broader lessons and conclusions

Using the cases of Mexico City and Bogota, we asked how global megacities facing significant pressure for potable water could drastically decrease potable water consumption when confronted with crises. We also examined the impact of biophysical, socioeconomic, political, and ideational differences affected the responses of city leaders to such crises. In specific, we inquired why Bogota chose behavioral interventions in the face of crisis and why Mexico City relied (and still relies) on technical and economic solutions to water crises. Our goal was to illustrate moments of crucial decision-making in each city that provide lessons for other global megacities facing severe potable water issues, not to identify a city which performed categorically "better" in the face of such crises.

The comparison of the 2 cities allowed us to illustrate how the behavioral innovations applied in Bogota played a crucial role in decreasing water consumption while also illustrating some of the negative ramifications of not using such interventions (e.g., violence, protests, theft of water trucks) in Mexico City and—decades after the Mockus administration's intervention—in Bogota. However, we also observe that both cities were able to substantially decrease water use, although Mexico City's reduction plateaued while Bogota's continued for roughly 2 decades.

There are many striking differences between the ways that Bogota and Mexico City navigated their respective water crises. Notably, although members of Mockus' administration brought knowledge of the Bogota case to Mexico City, behavioral reforms have not been widely adopted within the Mexican capital (Mockus Administration official 2 interview 2022). A technical approach focused on extensive infrastructure repair and expansion with limited introduction of low-flow toilets and shower heads dominates the city's response to water crises, and despite resulting in occasional incidents of violence, water cuts and rationing are used to reduce the population's water consumption. Although the city has made significant infrastructure repairs and expansions, there are conflicts with surrounding populations regarding the supply sources and disposal of the capital's water. Behavioral interventions have not traditionally been a focus of the city's efforts to reduce water use.

Mexico City's water utility has little independence from its federal counterparts, constraining its actions tightly. Additionally, despite repeat and significant investment into the city's potable water infrastructure and some privatization, there is little evidence of increased reductions in water consumption. Contrastingly, Bogota would benefit from a more comprehensive overhaul of the potable water provision system. Although much more costly than the repairs and renovations the system did undergo, this may have provided a more sustainable solution. However, the utility is constrained in its actions in part by the need to be self-sustaining despite its status as a government-run utility and in part due to the technical constraints surrounding infrastructure expansion, repair, and maintenance. In short, the 2 cities face nearly opposite policy constraints, and both could benefit from lessons learned in the other. Both cities were able, however, to significantly reduce potable water consumption in the face of water crises.

Mexico City shares numerous contextual factors with Bogota. The city suffers from resource pressure caused by rapid urbanization. Freshwater is drawn from nearby mountains and was once abundant and clean. The valley was filled with a lake and numerous rivers, which provided clean water for residents and trans-coursed the city, leading it to be described in the 1950s as the Venice of the Americas. The rivers are intubated, and the city's lake has

been largely drained and filled. Only the contaminated Rio Magdalena remains exposed (Forsyth, 2017).

Water connections and tariff structures in Mexico City could be improved significantly to benefit the city's poor, and across the city the reliance on bottled water consumption and truck-delivered water is high. Mexico City has also faced multiple water infrastructure tunnel collapses. Unlike Bogota, however, the city has not successfully implemented behavioral strategies such as those employed by Mockus' administration. Instead, Mexico City has been touted as an example of demand management strategies focusing on involuntary strategies such as retrofitting apartment buildings with low-flow toilets, water tariffs, and water rationing. Some public education and information campaigns exist, but the impact of these campaigns is not always clear, and the public may be oversaturated with public campaigns on various issues (National Research Council, 1995).

The solutions implemented in Mexico City have led to water hoarding, protests, and water rationing. A similar reaction was seen in Bogota when the population was afraid of cuts and rationing at the start of the 1997 water crisis. When water shortages are imminent and announced, people often fill *tinacos*, *garrafones*, and so on to prepare and stockpile extra water just in case. Neighborhoods with prolonged decreased access to water tend to be poorer and have less access to begin with. Thus, the population has responded with protests and reports exist of some local violence. *Pipa* trucks deliver water to neighborhoods without connections, often among the city's poorest and most densely populated, such as Iztapalapa (Watts, 2015).

The crucial absence of voluntary and innovative behavioral interventions has led Mexico City's residents to adapt to water shortages in a counter-productive fashion that, given the right circumstances, could result in a crisis such as the one which Mayor Mockus worked to prevent in Bogota. Given the dual nature of water infrastructure problems as both short-term behavioral problems and long-term infrastructure-related hazard problems, Mexico City's strategy would likely benefit from applying behavioral interventions in the short-term coupled with long-term infrastructural repairs, expansions, and modifications. As noted earlier in this article, although some behavioral interventions have been tried, follow through and clear communication between relevant actors was lacking.

Communication played a key role in the success of Mockus' efforts in Bogota. In contrast to the federal government's initial, top-down efforts, Mockus employed clear, direct, and concise messaging. The federal government had declared a water emergency and asked the public to save water, but their messaging failed due to vague and unclear goals. Mockus was able to communicate clearly with the public in part due to his ideological approach to public policy more broadly—he placed trust in the public first, something not all policymakers are willing to do. Within his administration, relevant officials also communicated clearly and often, and coordinated their actions.

Mockus' administration leveraged another crucial aspect of pedagogy that is underexplored but worthy of further examination. Research in pedagogy has demonstrated that humor and emotion can increase retention (Cavanagh, 2016). Many of Mockus' unconventional interventions inherently included aspects of humor or emotion and his efforts to resolve the water crisis are no exception. From showering on public television with his wife to involving local clergy in encouraging water conservation and using positive reinforcement to praise water conservation efforts while avoiding shaming excessive use, Mockus made expert use of human emotion in his interventions. This likely made it easier for the public to remember the need to conserve water and associated water conservation with positive emotions.

There are several lessons we can learn from Bogota's experience in 1997 that hold regardless of the root cause of a city's water crisis. Water crises are dynamic, requiring adaptability and, depending on the nature of the problem, may necessitate multifaceted solutions. An abundance of nearby freshwater is not a good predictor of a city's likelihood to face water stress and crises. For example, Bogota has ample nearby fresh, potable water but poor infrastructure upkeep and high population pressure placed the city in water crisis.

Following the 1997 water crisis, Bogota has repeatedly faced significant water strain despite having decreased water consumption drastically. The city desperately requires improvements, repairs, and the sustainable expansion of water infrastructure. As its population continues to increase along with the size of the surrounding metro area, Bogota is less able to rely on the clean water coming through the Chingaza system, which requires little purification. Gradually, because of cattle and potato farming, coal mining, and population growth, the city may turn to the highly polluted Bogota River for additional water and less able to rely on the surrounding *páramos*' natural purification (Sherriff, 2018). This would be particularly risky for the city, whose vulnerability to interruptions was demonstrated in May of 2021 when violent protests prevented the delivery of lime and aluminum sulfate needed for the river water purification process (Newbery, 2021).

The rapid urbanization of both Mexico City and Bogota has placed significant strain on their surrounding ecosystems since the mid-1900s. Although behavioral interventions in such contexts can be highly beneficial, the population in both cities continues to rise and the threat of water stress and recurrent crises remains high without addressing underlying infrastructure and supply issues. The 2 cities' circumstances are not unique. In many developing countries, rapid urbanization and significant resource pressure put strain on existing water infrastructure. Policy decisions can be affected by corruption and necessity, ignored for long periods, or addressed with inappropriate or ill-suited solutions.

The long-term reductions in potable water use in Bogota are impressive, but the city did implement a tariff strategy in the mid-2010s as usage began to plateau. Additionally, repairs and expansions to the system are ongoing but less intensive than those that Mexico City has engaged

in. Without regular maintenance and continual repair, water infrastructure can enter a downward spiral within which the intermittent provision of water encourages the growth of biofilms and changing flow rates shorten the lifespan of crucial infrastructure. This can place populations at risk for public health issues while also increasing the amount cities must dedicate to infrastructure repair. Furthermore, populations with ample access to potable water may see less need to conserve it or may begin to use potable water for novel tasks. This pattern was observed in studies of SCALL users in Mexico City. Hence, neither behavioral innovations nor infrastructure repair can independently address the entire issue of potable water use reduction.

When tackling environmental policy problems, behavioral interventions can have lasting impacts if executed with clear goals in mind. Mockus' interventions predated social psychology's major contributions to public policy and were inspired not by psychology theories but by practical lessons from pedagogy and personal ideology. This pushes us to ask what other lessons we can learn about pedagogy's potential impacts on public policy. Future research should examine the ways that pedagogy and public policy can better inform one another.

Data accessibility statement

The data for this article are available from the corresponding author, CB, upon request.

Supplemental files

The supplemental files for this article can be found as follows:

Supplemental_Material.docx
Supplemental Appendix.docx

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Author contributions

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