Expressions of collective grievance as a feedback in multi-actor adaptation to water risks in Mexico City

Hallie Eakin1 · Rebecca Shelton1 · Andrés Baeza1 · Luis A. Bojórquez-Tapia2 · Shalae Flores1 · Jagadish Parajuli1 · Ileana Grave2 · Alejandra Estrada Barón2 · Bertha Hernández2

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Abstract
Effective adaptation assumes a feedback between the experience or anticipation of harm, and the actions of those individuals whose decisions and actions are necessary to reduce that harm. In urban areas, citizens often expect support from the public sector to facilitate their adaptation efforts and to protect them from exposure. This expectation—grounded in notions of the social contract between citizens and the state—presumes efficient feedback between public sector actors and residents concerning vulnerable states and adaptation needs. Through a case study of Mexico City, we analyze the role of social mobilization, specifically, neighborhood protests associated with water scarcity, as an informal means for a vulnerable population to communicate its needs to those actors with the mandate and capacity to alter risk exposure. On the basis of the findings from the case study, we propose a simple framework to begin a more systematic process of analyzing the expression of grievances as a feedback among actors involved in urban adaptation. We argue that by making visible these expressions as an informal mechanism of feedback between risk exposure, impact, decision-making, and the biophysical environment, we can reveal a potentially important lever on system change: one that highlights existing asymmetries in power, equity, and rights in urban adaptation.

Keywords Water insecurity · Conflict · Governance · Adaptation · Social contracts · Mexico City

Introduction
For adaptation to be effective, there needs to be a feedback between the experience or anticipation of harm, and the actions of those individuals whose decisions and actions are necessary to reduce that harm (Eisenack and Stecker 2012; Smit et al. 1999; Smit and Wandel 2006). Nevertheless, there are circumstances in which the stimulus for adaptation is not effectively communicated to the multiple actors who need to act. Mobilizing that support not only demands communication across organizational levels and population groups but also the availability of informal and/or formal institutions to meet
those needs. In other words, in most contexts, adaptation is also “predicated on effective governance and management structures” (Nelson et al. 2007, p. 397). These structures, undergirded by the existence of social contracts, enable vulnerable populations’ requests for support, and mandate action in response.

In this paper, we explore the challenge of adaptation when the expectation of an uninhibited flow of information and effective governance is problematic. Through a case study of Mexico City, we analyze the role of social mobilization—defined as collective action in the form of neighborhood protests and complaints associated with water scarcity—as a feedback between residents and government, where formal institutions are failing to communicate chronic vulnerability. We seek to understand the role of these expressions of collective grievance as an informal means for a vulnerable population to communicate its needs to public agencies with the mandates and capacities to alter risk exposure. While there is increasing attention to environmental change as a cause of violent conflict (Mach et al. 2019), less attention has been given to more mundane and decentralized expressions of local grievances, and how these influence the adaptive decisions of responsible actors. Such protests cannot be called elements of “social movements” given that they are not typically ideologically motivated, formally organized, or aligned with broader objectives of change in social structure (Jenkins 1983). Here, we use the case of neighborhood protests around water scarcity to explore these more mundane expressions of grievance, adopting a systems approach (Nelson et al. 2007). We use the case study findings to propose a simple framework that can serve to guide future analyses of collective grievance as a feedback among actors involved in urban adaptation. We argue that by highlighting this informal feedback mechanism between risk exposure and impact, decision-making, and the biophysical environment, we can reveal a potentially important lever on system change, but one that highlights existing asymmetries in power, equity, and rights in urban adaptation. Asymmetries in the response of the public sector to the differential needs and status of the urban population likely affect the spatial and social patterns of urban development, ultimately influencing the dynamics of the city over time (Eakin et al. 2017).

**Informality, social contracts, and adaptation feedback**

Formal policy and programs, public services, planning instruments, and assessments are institutional structures that can channel information about the state of the system to decision-makers. When the formal capacity for urban service provisioning is stretched, as it is in many areas in the global south, populations may acquire services through complex informal institutional arrangements involving public agencies, private service “brokers”, and residents (Tellman 2019). In cases characterized by high informality, there is a need for better understanding of how actors mobilize resources to influence the governance system to meet their needs, and the effect these efforts have on infrastructure, ecological processes, and social outcomes such as vulnerability over time.

One way to explore such rules-in-use is through the analytical lens of social contracts—or the implicit or explicit rules and agreements conveying mutually agreed on expectations about responsibilities and rights in citizen and state relationships (Blackburn and Pelling 2018). Social contracts define citizens’ expectations of state action to provide public goods and services, and state expectations of citizens concerning the basis of their political legitimacy and boundaries of their authority to govern (Brinkerhoff 2011). Social contracts imply a state’s willingness to assume responsibilities and its capacity to respond to citizen demands (Brinkerhoff 2011).

Scholars of climate change adaptation have used the construct of social contracts for insight into how climate change is challenging state-society relations (Adger et al. 2012), as well as for understanding how governance contributes to inequity and injustice in climate change impacts and action (Blackburn and Pelling 2018; O’Brien et al. 2009). Rather than one single contract, Blackburn and Pelling (2018) claim that there typically exist a multiplicity of contracts among all actors involved in risk governance: the private sector, civil society organizations, and other citizens. They identify three types of contracts: (1) those that are based on formal institutions and legal structures (Legal Social Contracts, or LSC); (2) those that are manifest in the practice of social relations (Practice Social Contracts, or PSC); and (3) those that are based in what specific individuals and groups imagine the social relationships to be (Imagined Social Contracts, or ISC). They argue that these three forms of social contracts can be used analytically to identify “gaps”: for example, where legal realities diverge from practiced or imagined relations, undermining the legitimacy of such legal structures, or where practiced contracts compensate for failures in legal obligations (Blackburn and Pelling 2018).

Brinkerhoff (2011), drawing from a framework produced by the Organization for Economic Cooperation and Development (OECD), shows that a resilient and responsive state depends on a balance between citizens’ expectations, and the state’s capacity and willingness to meet expectations. For example, city managers may have a strong incentive to address the needs of the legally recognized “formal” urban population, in order to reinforce its authority and legitimacy, and ensure political gain in electoral processes. A government agency’s lack of capacity to meet the expectations of service provisioning will undermine implicit social contracts, fostering distrust and lack of confidence in the public sector as a legitimate authority in urban governance (Adger et al. 2012). In such cases, administrators may seek to avoid obligations of
service provisioning. They may label the populations making such claims as informal, illegal, or illegitimate (Cavill and Sohail 2004; Roy 2005). Marginalized citizens may thus seek, in practice, alternative social contracts to meet their needs, for example, through clientelist alliances with individual politicians or powerful non-state actors (Wood 2003). In doing so, residents may internalize ideas about the (il)legitimacy of their claims to state protection and response, and thus legitimize the state’s neglect of these obligations.

Citizens’ public expression of grievances associated with climate risk can thus be understood in terms of frustration with the realization of imagined and/or legally constituted social contracts (Blackburn and Pelling 2018; O’Brien et al. 2009). When efforts of citizens to cope with risk are ineffective or too costly to bear alone, underserved populations may mobilize collectively to express their grievance and attract the attention of the public sector (Castells 1983; Cavill and Sohail 2004). Such conflict may also be an expression of pre-existing conditions of degraded trust between public agencies and citizens, and asymmetries in rights, which then are exacerbated in conditions of environmental stress, leading to conflict (Siddiqi and Canuday 2018; Zografos et al. 2014).

Nevertheless, not all instances of differential expectations and longstanding frustration result in conflict. If residents normalize the degree of risk they are exposed to, they may invest in imagined social contacts in which they repress their expectations of society and the state, bearing the full burden of risk (Eakin et al. 2014). In these cases, a household’s threshold of tolerance is high, and their appraisal of risk is shaped by their low expectations of public protection (Grothmann and Patt 2005). In such cases, one would expect a limited flow of information on the vulnerability of such citizens to public actors (Eakin et al. 2016).

Propensity to engage in protests also must account for the personal and political costs and benefits. Protesters are ultimately strategic: they will engage in the cost of protest when and where they expect to have the most significant impact (Hendrix et al. 2009), and expected benefits exceed costs (Eckstein 2001; Klandermans 1984; Stockemer 2012). Organized social groups can help assuage costs of mobilization and enhance benefits for individuals (Jenkins 1983). Contextual dynamics—the political business cycle, moments of political weakness or opportunities for resource access, or the emergence of new local leadership—all can influence the thresholds at which a population will mobilize through social protest (Stewart 2000).

In summary, effective adaptation depends on feedbacks between populations experiencing impacts and coping with harm, and the institutions and actors of broader scale risk governance. The effectiveness and reliability of such feedbacks is at least partially a function of existing social contracts, and social conflict can be a manifestation of tensions and imbalances in such social contracts. Where risk governance is only partially effective and functional, expectations from the state-citizen relationship is likely divergent from both the practice and legal reality, creating conditions conducive for social mobilization. In this latter circumstance, social protests are not only a signal of problematic risk governance but also of an attempt by vulnerable citizens to restore the essential feedbacks necessary for effective and equitable adaptation. It is with this premise that we explore the role of protests in Mexico City.

**Water insecurity in Mexico City**

With a population of over 20 million, the Valley of Mexico represents the fifth largest metropolitan area of the world and the largest megalcity of North America (United Nations (UN) 2018). The sprawling urban footprint of the metropolitan area is shaped by a complex topography with significant influence on urban hydrology and water access. The city initially was founded on an island situated in the midst of five shallow lakes; the basin floor was drained over time to permit urban expansion and to control chronic flooding (Tellman et al. 2018). As the city has grown, water supply has become a persistent challenge. Today, water is pumped through a system of aqueducts originating in the Lerma and Cutzamala watersheds to the west of the city, in the state of Mexico, to supply approximately 40% of the city’s potable water demand through the Lerma–Cutzamala system. The majority of remaining demand is met largely through groundwater, pumped from an aggressively overexploited aquifer underlying the city (SACMEX (Sistema de Aguas de la Ciudad de México) 2018).

Approximately 30% of the population in the city lack reliable delivery of water to their households and must rely on other means of provision (de Alba and Hernández Gamboa 2014; Jiménez Cisneros et al. 2011; SACMEX (Sistema de Aguas de la Ciudad de México) 2018). Some households receive water by “tandeo”—a system in which they have “a turn” (tandeo) at water delivery through the city’s network, at specified hours during the day and/or only one or two times a week. Others not on the city’s water network receive water by public or private water tankers (called pipas). By law, informal settlements cannot be connected to the formal water distribution network; these areas are provided water by water tankers in order to comply with the constitutionally mandated right to water. In addition, despite significant investment in gray infrastructure and drainage, the city has continued to experience impacts of chronic urban ponding and large-scale flooding, as well as drought. The impact of these hazards is aggravated by urbanization, subsidence, land cover changes, and now, climate change (Romero Lankao 2010). Drought may become more frequent in the future, affecting the supply through the Lerma–Cutzamala system (SACMEX (Sistema de Aguas de la Ciudad de México) 2018).
The urban residents most exposed to scarcity and flooding tend to be concentrated in specific urban boroughs (Alcaldías, see Fig. 1) where geological and infrastructural conditions exacerbate exposure, or where institutional constraints (informality) limit water access (SACMEX (Sistema de Aguas de la Ciudad de México) 2018). A greater proportion of households in the southern and eastern parts of the city face unreliable water supply, and are more likely to be poor and often located in or near areas of informal urban growth (Jiménez Cisneros et al. 2011). In these areas of high exposure and limited economic capacity, residents will use their available resources for water storage (through purchasing, for example, water barrels or constructing cisterns), and will purchase water from private providers when the city’s distribution fails them (Eakin et al. 2016). To mitigate flood exposure, households will raise the threshold or sometimes even the foundations of their homes, construct concrete barriers, and raise furniture and valuables off the floor (Eakin et al. 2016).

These strategies, however, are often only partially successful, resulting in chronic vulnerability and unmet demands. Not infrequently, unmet demands, whether produced by physical scarcity or dissatisfaction with service provisioning, result in protest (Bennet and Balvanera 2007; Castells 1983; Castro 2004). Castro (2004) documented over 2000 separate incidences of protests associated with water access, quality of supply, and water management between 1985 and 1992. Castro’s research suggests that both water insecurity and associated protests are products of multiple stressors, and significantly influenced by political circumstances, expectations of citizens of government, social relations of trust, and institutional agility (Castro 2004). Protests, for example, may be provoked by electoral politics, and the ability of a local leader to mobilize a population to score political points or pursue an ideological agenda. As we report below, construction projects that disrupt service can be a source of water insecurity and produce resistance in neighborhoods. Water insecurity is exacerbated by other dimensions of poverty, such as households’ lack of ability to invest in water storage (Eakin et al. 2016). In the sections that follow, we describe and evaluate diverse data sources for insights on the role of protests in the dynamics of vulnerability to water risk in Mexico City. From these insights, we construct a conceptual model to guide future analysis of this feedback mechanism in urban vulnerability.

Methods

Following a multimethod approach, two separate data collection and analysis processes were conducted and then integrated in terms of inference and interpretation through triangulation (Morse, 2003). Qualitative data was gathered from interviews and focus groups as part of a larger NSF-funded project on socio-hydrological risk in Mexico City (“MEGADAPT”) between 2014 and 2015. Social protest emerged as an important topic in these interviews. A supplementary newspaper media analysis was then conducted in order to better understand the conditions under and places in which water-related protest occurs in the city, and data was acquired from the city water authority on formal complaints issued by citizens regarding water concerns at the borough level. This latter data was analyzed together with data on the prevalence of poverty and water insecurity at the borough level, as a means of triangulating the qualitative interview data.

Interviews and focus groups

We purposively selected 36 officials in federal level agencies with explicit water management mandates, city-level public officials that were responsible for water and watershed management, and local level political representatives responsible for service provisioning for interviews. In addition, we interviewed 10 academics and 15 civil society leaders in three city boroughs known for high vulnerability to water-related issues: Iztapalapa, Xochimilco, and La Magdalena Contreras.
We also conducted twelve focus groups with city residents \((n = 100)\) of neighborhoods (both formal and informal settlements) affected by flooding and scarcity in these three boroughs (see Eakin et al. (2016) for more details on participants).

In the interviews and focus groups, respondents were asked to explain the issues of water in the city, particularly related to water scarcity (quality and quantity of water) and flooding and the ways in which these issues are, or could be, managed. These sessions were audio recorded, transcribed, and inductively coded for the main problems concerning water, causes of the problem, reactions to the problem, and potential and actual problem solutions. Social pressure emerged as a sub-code for how people react to water scarcity and flooding, and protests emerged as a means that households address water scarcity and flooding.

**Media analysis**

The media database we used for this analysis was an online archive of articles from the national Mexican newspaper, *La Jornada*, for the 5 year span of 2011–2015. We searched for articles about protest events with the following search terms (in Spanish): “*agua* Mexico D.F.” (water Mexico D.F.) exact word or phrase, AND “*protesta OR manifestación OR movilización OR marcha*” (protest OR manifestation OR mobilization OR march). We collected over 100 articles, 43 of which covered protests that specifically mentioned water as a direct or indirect motivation. Of those reports, 41 represented unique events. Articles were coded for the causes or triggers of protest, the type of protest (i.e., complaints, petitions, boycotts, manifestations/ marches/mobilizations, street interruption/blockades, and lengthy public sit-ins), the kind of participant groups carrying out the protest (i.e., social movement, neighborhood, community), and the target of the action (i.e., particular agencies or actors). We also coded for whether or not protests coincided with any elections or allegations of corruption. Each protest was also coded for its location: *Alcaldía* (city borough) and *colonia* (neighborhood).

**Results**

**Proximate causes of protests**

In both the media and interview data, it was clear that protests were as much driven by a lack of trust in public authorities as by a direct experience of water scarcity. Reports of protests associated with water occurred in 12 of the 16 boroughs with more frequent manifestations in three: Coyoacán, Iztapalapa, and Álvaro Obregón (Fig. 1). Water scarcity was the primary source of conflict in 58% (24 of 41 cases) of the media cases recorded over the 5 years, often concurrently with causes such as construction projects disrupting water delivery (36%), or problems in the efficiency of water delivery (19%). Just over 28% of the recorded protests were associated with allegations of corruption or improper public sector action. Interviewees attributed causes of protests to the experience of scarcity or lack of adequate access as well as to the experience of flooding (which was not a major feature of the media reports), the disruption to supply caused by construction and urban development policies, poor water quality, demands for “regularization” of service provisioning, and demands for water rights.

**The threshold for action**

According to interviewees, protests appear more likely when established entitlements are perceived to be threatened or suddenly uncertain, as with the case of construction projects threatening water supplies. One interviewee explained:

“The mentality of people does not permit [water infrastructure] projects, people feel that they will lose services, as now more than 60 people will be living in an area and using the water. Although the water supply is the same, the uncertainty grows.”

In recent years, protests—sometimes violent—have also occurred when the city has approved new urban developments near what are known as “*pueblos originarios*” or “original villages”—villages predating the Spanish conquest. One respondent summarized this sentiment as “How is it possible that we don’t have water, and yet they give Santa Fe [the new wealthy community] water, if we’ve been here 300-500 years….”

Protests also emerge when formal channels of expressing dissatisfaction have been ineffective. The city receives citizens’ complaints or demands in the form of letters, hotline calls, and petitions to the appropriate authority in local government, and occasionally through citizens’ legal action. These complaints are recorded and become part of government records. Official data indicate a positive association between the prevalence of poverty in a city borough and prevalence of households not connected to the water network in that location (Fig. 2). Nevertheless, it appears that boroughs in the wealthier quartiles tend to file more formal complaints than their more impoverished neighbors, suggesting both an increased accessibility to such formal channels as well as a lower tolerance threshold among such populations (Fig. 2). For example, if it is assumed that the...
prevalence of tandeo in a borough is an indication of irregular water supply, then areas of higher tandeo prevalence should be positively correlated with the frequency of complaints. As Fig. 3 shows, the opposite is true: boroughs with higher rates of complaints are more likely to have less prevalence of service by tandeo, and on average, are wealthier (with the exception of Iztapalapa) (Fig. 3).

Interviewees shared that their decision to protest was often made after these formal channels were ineffective. Residents in Iztapalapa affected by flooding explained:

“First, like any citizen, we write a petition...we need them to send us something, to repair lamps, or clean drains, or whatever it may be, in official letters ... but if they don’t pay attention to us, we organize a march …”.

Similarly, an official in Xochimilco said,

“...first they [residents] send written documents, which are based on the eighth article of the constitution, and the authority is asked to intervene...in the case where there is no action taken, the neighbors unite and go directly to the borough [government] and protest …”.

Residents also protest when their voices are more likely to be heard, for example, at critical points in...
the political cycle. One academic interviewee explained that it was in electoral periods that the politicians finally pay attention to the city’s large number of informal residents, offering to pave streets, bring water, provide household water storage tanks, and pay for cisterns in exchange for votes. In a group interview with residents in Iztapalapa, one respondent commented,

“… it’s only when the politicians come seeking our vote when they say they are going to try to fix the water situation, but only then, because we know that while the water will arrive, whatever the politician’s promise is never fully resolved, we can just get so far [with this issue] … the authorities never are going to come and say to us ‘Hey, your water is contaminated’ … they wash their hands of us and say ‘see you later!,’ as long as they get what they want.”

Prior adaptations establish what is “normal” in terms of water access and thus what degree of scarcity is intolerable. For example, in one La Magdalena Contreras focus group, participants said that they were accustomed to having water most every day. On the second day without water, they begin to organize. In contrast, some residents in Iztapalapa said that, while they only receive water every 8 days, they have invested in the capacity to store water; thus they begin considering protest only when they have gone 15 days or so without a water delivery: “… we are already used to what we have and we try to solve it on our own.”

Protests and other forms of collective action are also costly to residents. First, many households perceive the benefits of any form of collective action highly uncertain. As one respondent explained,

“I believe that this situation most of the time is out of our control; we do what we can … but this doesn’t resolve the real problem … if the authority doesn’t want to address it, we are not able to do anything. We could do something extreme like a sit-in or a march, but I think it would still be this way …”.

Second, protests require organization, and organization takes time with often a high opportunity cost. As one individual in Iztapalapa summarized,

“not all the neighbors cooperate, … and the majority work, so the truth is that Saturday and Sunday we have to clean the house, go to the market, to get ready for the week; and the truth is that to submit documents to demand an improvement of water service would be very good, but we don’t have the time…”

Conversely, effective community leadership helped ensure protests were more likely to be effective. As one respondent explained, “…you have to organize in groups, but not small ones, you have to organize in mass groups, in order to make the government, the borough, give us what we deserve ….”. Another in Iztapalapa explained,

“here we say that if the pueblo doesn’t organize, if we are not united and organized, the government won’t account for you, if I as a simple citizen go to them and say I want housing because in the constitution it says that all Mexicans have a right to housing, do you believe that they are going to give it to me? They are not going to give it to me … and that’s why we are together, united and organized we achieve things …”.

### Public sector response

In the media data, the borough officials were the most frequent target of most protests (17 of 41 events), followed by the city-level and even federal level water authorities with offices located in Mexico City (each was targeted in 10 of 41 events). A few protests targeted the city legislative assembly (3 out of 41 events), and specific businesses (3 out of 41 events). Interviews indicated that protesters strategically target particular actors according to the specificity of their demands, although they are not always correct concerning the mandates of particular agencies. In such cases, the agency may defer the claim to others, or reorient it to something the agency can provide. Some residents attempt to target multiple authorities simultaneously, or switch targets if they are not met with a response.

In some cases, the public officials we interviewed clearly described the complaints and protests as a signal of vulnerability to which they felt required an immediate response. In Iztapalapa, a borough notorious for chronic water problems, a local official described how he perceived phone calls as a signal of emerging crisis:

“… they are indicators, because not all people will call, but … [thus] just one or two calls, well, we begin to be alarmed … it isn’t who calls us, but the area from which they are calling … it tells us that something is happening there … So the calls are a signal that something is failing.”
That official recognized the significant effort required for households to express their grievances, and thus felt that when the signals were received, they had to be taken seriously: “First the people have to have the number to call, then the air time, and if then they are successful then, well, they’re signaling that something happened …”

Institutional mandates, limitations on capacity or resources, and more informal norms based on bias or political interest can all affect the probability of response. Residents reported that they most frequently were told that the borough lacked the budget to address their complaints. Capacity is also constrained by material resources. One official in Iztapalapa commented that “… sometimes we just make things worse, because if we arrive with a small tanker and there are 100 people without water, well we’ve really exacerbated the problem.”

Social and political concerns also appeared to influence the government’s response. Interviewees explained that relatively larger protests were needed to draw attention to the issues that affect those of lower socioeconomic class. As one scholar of social mobilization commented, “… in order to achieve something in Iztapalapa, it would have to be a massive protest, massive, with a number of people that here [in Coyoacán, a wealthier borough] would not be required ….“ Achieving service provision and regularization of informal settlements has happened, but it often takes many years and considerable social organization to achieve this success.

Public officials acknowledged differences in their responses to requests for help, as is also reflected in the official data on the number of formal complaints registered and the time to response. The time recorded to resolve water complaints ranged from a few days to over a hundred days in some boroughs (SACMEX (Sistema de Aguas de la Ciudad de México) 2017). These figures are likely affected by the complexity of the solution required, the number of complaints received, and the sheer capacity of the sector to respond. But interviewees suggested that other factors also come into play. One public sector respondent, for example, commented, “Often in areas that are off the water supply network [the complaints] are constant: every 8 days, every 15 days. But there are also complaints when some urban neighborhood, because of maintenance of a public tank or because of a leak, lacks water and we have to supply it, but then our response is immediate, 3-4 hours and they have the water tank; … we don’t take more time than that.”

The political visibility— or threat of visibility—of the protest also motivates responses. Another scholar explained, “So let’s say I am an official in SACMEX and there is a march in front of my office … what is the risk of doing nothing? Well, it could result in a bigger conflict, no?…That they never leave, and it lasts for months … I’ll have a stain on my political career …” An official in Iztapalapa was particularly concerned with the unwelcome publicity that protests could cause: “Now it isn’t only cell phone calls, they are [also] coming to the office, [seeking responses] through social media, the t.v., or through the paper …“

**Conceptual framework**

Based on the empirical evidence we assessed in Mexico City, we present a conceptual framework to articulate how citizens’ expressions of grievance—in incorporating everything from expressions of dissatisfaction with current conditions, to vocal or violent protests—functions as a feedback in multi-actor urban adaptation to water stress (Fig. 4). The model outlines the distinct pathways through which such feedback occurs. We conceptualize two primary social actors: A public sector authority with a mandate to ensure water security for its citizens, and a vulnerable household exposed to water-related risk. Any household anticipating or experiencing the impacts of water insecurity has four possible strategies to pursue. Which strategy they pursue is a function of relative costs and benefits, and thresholds of risk tolerance: what is perceived of as “normal” for the resident in relation to past experience, as well as legal, imagined, and practiced social contracts.

The resident can choose to “do nothing”, bear the burden of risk and hope that such impacts will not re-occur. Their capacity to take action may be constrained by a lack of economic or material resources, a lack of knowledge, time or skill, or by perception, attitudes, and beliefs. They may be aware that there is no legal obligation of the city to act, or have past experiences that have shape their appraisal of the utility of protests. The net result, however, is that their vulnerability is not communicated to other actors, such as the government, who might take action on their behalf.
Alternatively, the household can choose to cope and adapt to the hazards it is exposed to as many households described doing in Mexico City (e.g., buying additional water storage, constructing barriers to protect themselves from flooding). In pursuing this strategy, the households implicitly expresses that it is less costly, more efficient, or more effective for it to “go it alone” than to engage in collective action or to demand support from the government for its efforts.

When a household perceives that it is reaching the limits of its capacity, that the burden of coping and adapting is unfair, and/or that ultimately, it would be more effective, efficient or less costly to engage in collective action than to manage risk alone, it can attempt to enlist support from government actors. Here the household has two options: a formal channel, involving following the protocols for citizen complaints and demands established by the government, and an informal channel, in which the household organizes with other households to express discontent through protest. Which pathway is chosen is likely influenced by the households’ past experience with formal petitions, the socio-demographic characteristics of the neighborhood (including capacity for social organization), the households’ level of risk tolerance, and the household’s opportunity costs. Wealthier neighborhoods or those recognized as legitimate urban citizens may have more success with formal institutional channels; economically marginal households and those in informal settlements may feel they have little recourse to bring attention to their needs if not through vocal street protest.

In these latter two pathways, a signal of vulnerability is conveyed to the government with a demand for action. The case of Mexico City suggests that there are many mediating factors affecting the reception of this signal: whether the agency feels it has the legal, social-political, or institutional obligation to act, whether resources are available, or whether the city is in the midst of electoral politics. The government agency can choose not to respond, or to deflect the problem to other agencies. Alternatively, the public agency can decide to address and dispel the expression of discontent, in which case, a temporary “fix” to the problem might be implemented, or to focus on the underlying source of the problem, in which case a more permanent infrastructural investment is more likely. The former case might be called a “squeaky wheel” response: resources are allocated for palliative measures for those who complain the most vocally (Baeza et al. 2019). In the latter case, more structural and potentially systemic investments are made, potentially (if successful) altering the sensitivity of the neighborhood to future stress through a physical modification of the built environment.

The government agency’s response, in turn, provides a signal back to the residents concerning whether their choice of strategy was effective, and whether it would be worth pursuing in the future if needed. Uncertainty permeates the decision process for all actors involved: the residents do not know whether their own autonomous actions will be effective, whether a formal petition or informal protest will result in a government response, nor whether any action taken by the government will adequately address their risks. The public sector actor has greater control over the outcome through its choices; nevertheless, ignoring calls for attention may aggravate vulnerabilities over time. How the agency responds will also affect expectations from citizens both in terms of the agency’s ability to follow through with promises as well as what sort of response will be expected in the future. The interplay of chronic but also variable exposure, heterogeneous sensitivity and capacity across the population, and a context of high uncertainty in governance lead to the perpetuation of such public expressions of grievance as a feedback, albeit imperfect as a signal of vulnerability.

Discussion

The case of Mexico City suggests that large segments of the population may experience harm and struggle to cope and adapt, and find it difficult and costly to draw attention to their circumstances. Public expressions of grievance, from households making individual phone calls and filing petitions, to creating street protests and blocking traffic, plays a role in shaping how vulnerability is experienced in different parts of the city, what investments are made, and whose needs are addressed.

Nevertheless, as a form of feedback, this mode of communication is imperfect. Households legally denied access to urban services because of their “informal” status have to mobilize considerable social, financial, and political resources to get the attention of authorities, and to present their complaints as legitimate. Here, differences in the imagined and practiced social contract between authorities and informal residents translate into significant uncertainty and distrust, and provide opportunities for political manipulation of residents’ vulnerability. Households who have internalized their chronic exposure to water insecurity (for example, those disconnected completely from the formal water supply network at the urban periphery) will have a higher threshold of risk tolerance than those who are accustomed to more reliable supplies. Those who have legal claim to water services by being in the formal urban area, but who are provided with unreliable or irregular service (e.g., the tandeo system), are in an ambiguous position. They have a legal social contract for water provisioning, and conceivably an imagined social contract in which their needs should be equivalent to any other citizen in the city. Nevertheless, in practice, their status is uncertain, their tolerance of risk varies, and their strategies for expressing needs will likely oscillate between formal and informal channels.
Thus, while protests may be an indication of the existence of harm (experienced or anticipated), a lack of social mobilization is not necessarily a sign that all is well.

The ambiguity in the significance of grievance in relation to vulnerability is illustrated by a recent water shortage in Mexico City, instigated by the government as part of a program to repair part of the aqueduct that services Mexico City in October 2018. In this case, the government appeared to focus on managing residents’ expectations by informing the public of the cut almost a month in advance (Anonymous 2018) and identifying what neighborhoods in which boroughs would be affected, for how long, what the government would be doing to address needs, and what residents could do to conserve water (Aldaz and Gonzalez 2018). The city was intentionally managing both its legal social contract with citizens, and, in doing so, was also influencing the imagined social contract, in an attempt to build trust. Because the city government anticipated a potential crisis, it allocated significant resources to temporary water delivery, ironically resulting in an increase in the availability of water in many areas of the city that are chronically water insecure, while encouraging more water secure neighborhoods to conserve (Alvarado 2018; Hernandez 2018). As a result of the government’s proactive shaping of citizens’ expectations, widespread social mobilization was avoided although water insecurity was either aggravated or remained the same.

This event, and the emerging evidence in Mexico City underscores the fact that protests are not a clean signal of environmental stress, but rather are messy indicators that capture both experienced harm as well as past and anticipated injustice, associated with differences in imagined social contracts (e.g., Blackburn and Pelling 2018), efforts to claim and protect rights (e.g., Castro 2004), and the manipulation of inequities in the city for political ends (e.g., Wood 2003). Water insecurity itself is the result of multiple stressors, and the manifestation of grievance is similarly complex. The case of Mexico City thus echo the conclusions of Siddiqi and Canuday (2018), Castro (2004) and others, who argue that conflict apparently associated with environmental stress reflect broader concerns about citizenship, rights, and social inequality. Households turn to protests, despite the costs associated with such action, because they have limited access to formal institutional channels, perceive that they will not be recognized nor will their needs be attended to if they do not take to the streets, and because they feel their rights to the city and their specific entitlements have been violated. As others have recently concluded, climatic stress often serves as a “risk multiplier,” exacerbating existing injustices, economic development deficiencies, and vulnerabilities (Mach et al. 2019).

The simple framework we provide is a first step in helping elucidate the relationship between citizens’ expressions of grievance and public responses to environmental stress in urban areas, and can be used to situate household-level autonomous strategies with knowledge on thresholds of tolerance, institutional channels for communicating household-level vulnerability to authorities, and the factors that mediate the likelihood of public sector response. Every specific case will have specific rules-in-use that create the parameters of the interaction of elements in the framework: when and why specific actions are taken, what determines the likelihood of one response over another.

Critically, more knowledge is needed on the implications of public sector response to these formal and informal signals of vulnerability. Does the differential ways in which public sector authorities interpret and respond to grievances lead to asymmetries or distortions in infrastructure investments and publicly funded adaptation measures? How do such responses affect the evolution of the built environment and patterns of vulnerability over time? Or, to the contrary, in the absence of reliable alternative information, can such mobilizations provide an efficient, if imperfect, indicator of where support is needed? Initial explorations of the issues in an agent based model for Mexico City (Baeza et al. 2019; Bojórquez-Tapia et al. 2019) suggest that there can be significant differences in the patterns of vulnerability that emerge when authorities respond to protests—“squeaky wheel”—vs. more technical signals of vulnerability. What these differences mean over time requires further analysis, but it is highly possible that the absence of efficient, just, and accessible institutional channels for the expression of dissatisfaction can lead to actions that reinforce existing social inequities in hazard exposure (Bojórquez-Tapia et al. 2019).

More broadly, in an era of climate change and growing uncertainty over the nature and frequency of environmental stress, there is a need to revisit the role of social contracts in shaping adaptive responses and future vulnerabilities in urban environments. The social contracts in play now involve multiple actors, operating at multiple organizational levels and spatial scales. Aligning imagined social contracts with what is in practice and what is legally constituted may become increasingly critical (Blackburn and Pelling 2018). In particular, there is a need for vulnerability and adaptation science to grapple more directly with the role of informality in economic activity, in urban settlements, in social and political relations and institutions in order to more accurately understand the dynamics of urban vulnerability in much of the world (Eakin et al. 2017).

**Conclusions**

Interest in the relationship of social conflict and protests in relation to climate change, environmental stress and disasters is increasing. The case we present here adds to a chorus of voices that suggest that the relationship is far from simple.
Nevertheless, from the perspective of vulnerable households demanding support for adaptation and from public sector authorities needed to prioritize action, citizens’ public expressions of grievance may play an important role in determining patterns of vulnerability and their persistence over time. The condition of social contracts in urban areas has a significant influence over why and when protests are elected as a course of action. Critically, while protests may not in themselves be a clean indicator of vulnerability, they may amplify and potentially reinforce—in a socially uneven way—the expression and experience of vulnerability in complex and highly dynamic urban spaces. The effect of such protests on infrastructure, risk management and other decision-processes in cities may, on the margins, be significant. Understanding the role of such protests as a feedback between risk-exposed residents and public authorities can thus be essential to understanding the evolution of the built environment and vulnerability over time.

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Compliance with ethical standards

The protocols for this study were approved by Arizona State University’s Institutional Review Board.

Disclaimer Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the NSF or the IAI.

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