



Household water sharing: Implications for disaster recovery and water policy

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ABSTRACT

Access to safe water is vital for community health, especially during disaster and recovery periods when standard solutions may be slow or politically stalled. Water sharing, an informal and self-guided coping mechanism, becomes critical during disasters when standard water infrastructure is damaged or destroyed. Drawing on diverse literature, we highlight the prevalence and importance of household water sharing in disaster contexts, emphasizing its potential benefits and trade-offs. We explain why these systems –while often invisible –are important and relevant to disaster recovery. Our review identifies five key observations and implications for disaster intervention, emphasizing the need for tailored support for economically marginalized groups and the integration of water sharing practices as a short-term coping mechanism into disaster response and recovery agendas. We advocate for further research to evaluate the long-term impacts of water sharing and inform policy and intervention strategies while recognizing that such community-level coping mechanisms alongside formal water services may effectively address water insecurity and bolster resilience in disaster-affected communities.

1. Introduction

Water insecurity – the lack of access to adequate and acceptable water for well-being[26] – is expected to worsen in the years ahead as a result of climate change, population growth, and increased frequency and severity of disasters, such as floods and droughts [38]. A quarter of the world currently does not use a safely-managed drinking water source [52]. By 2030, half of the world's population is expected to live in chronic water-stressed conditions, given expected climate change scenarios[49,59]. Household-to-household water sharing is a potential self-guided household practice for coping with water insecurity[57]. Often informal and invisible to non-participants, it nonetheless follows local

rules and norms[56] and adheres to local “moral economies”[6]. Household water sharing can be defined as a transfer of water between households[10,44,45,57], including the transfer of water in bottles, buckets, or hoses. It may be present in most, if not all, water-insecure communities, although typically, only a portion of households participate in this practice[10,44,45,57].

In the context of disasters, emergent water sharing practices provide one possible survival strategy. For instance, following Hurricane Maria in 2017, a third of households were left without water services in Puerto Rico and had to find means to deal with water insecurity. As federal and local government agencies delayed the distribution of water supplies, households relied on *autogestión* (self-management) to meet their water

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2468-3124/© 2024 Elsevier B.V. All rights are reserved, including those for text and data mining, AI training, and similar technologies.

needs and reported spending up to two hours daily to acquire it [39]. Such water sharing arrangements proved vital to many community recovery efforts [48,39,40]. Strategies included collective actions for capturing water from different locations (e.g., rivers, wells, and municipal water tanks), including support for the elderly, and generally with no expectation of reciprocation [39]. This case study in Puerto Rico demonstrates how water sharing practices may emerge following disasters, but there is a key gap in the literature examining the scope and implications of water sharing during and after disasters.

In this paper, therefore, we review what is currently known or suspected more widely about water sharing practices in the context of community-based disaster response and recovery. First, we clarify how water security and disaster response are linked; second, we review the current literature that describes how households experience and cope with water insecurity; third, we discuss the current understanding of household water sharing as a community-based practice beyond the framework of a disaster. We then examine the implications of our findings and consider potential avenues for future research. By weaving these disparate lines of evidence together, we join calls (e.g., [40]) to develop a framework for assessing the potential of water sharing for disaster recovery, including possible limitations and liabilities.

2. Household water insecurity (HWI) and Disaster: Some basics

Environmental hazards such as floods, landslides, tsunamis, hurricanes, droughts, wildfires, and earthquakes are becoming more intense, frequent, and impactful, partly due to climate change [12]. These natural events may become disasters when human infrastructure and institutions are unable to respond adequately [54]. The consequences of these disasters include more severe water insecurity, impairment of social capital and human resources, and disruption of governance and sociopolitical systems [18]. For example, proximate causes of disaster-related water insecurity can include physical damage to water sources or infrastructure (i.e., municipally piped water services or access points such as domestic wells) or contamination of the water supply with pathogens or toxins [37,43].

Compromised access to sufficient, reliable, and safe water can create acute or chronic stress and it can further limit adaptation to and recovery from disasters in affected communities. The World Health Organization maintains that access to 20–25 L of water per person per day is an absolute minimum. Yet this amount poses challenges because it is insufficient to meet the requirements for consumption and hygiene beyond brief periods of time [24,28]. Water insecurity also heightens psychosocial stress, exposure to infectious diseases, and injury [1,7].

It is also important to recognize that water insecurity is a key challenge households face outside of clearly recognized and labeled crisis events. Half a billion people already experience severe water insecurity as a slow and often chronic challenge, and four billion people endure extreme water scarcity for at least one month throughout the year [32]. Recognizing the growing scale of the challenge, here we discuss the idea of water insecurity at the household level.

We define household water insecurity (HWI) as the inability to access and benefit from adequate, reliable, and safe water for a healthy and productive life [26,56]. Household water insecurity (HWI) occurs when any of its four constituent dimensions are affected: *availability* – is there any water present and is the supply adequate?; *accessibility* – if there is water, can it be accessed without barriers?; *use* – if there is water present, which can be accessed, is it safe and appropriate to consume?; and *stability* – the dependability or reliability of the water source, i.e., no disruptions or intermittency [60]. For example, during severe droughts, the physical availability of water is limited, whereby surface water evaporates, groundwater becomes depleted, and wells dry up [25,34]. During historic droughts, such as those recently affecting the Horn of Africa [31] and the U.S. West [21], communities employ a variety of coping strategies, including technological interventions, digging deeper boreholes to pipe up water [1], and distributing bottled water. If all else

fails, communities tend to relocate to a place with access to water [51].

All disasters, by definition, affect the *stability* dimension of HWI, but different disaster types can also disrupt the *availability*, *access*, and *use* dimensions in various ways. Earthquakes, severe storms (cyclones/hurricanes), tsunamis, volcanic eruptions, wildfires, or conflict/military strikes destroy available water infrastructure, including pumps and water treatment plants. In such scenarios, although water may be physically available, the disaster's aftermath can render it inaccessible or unsafe for consumption [37,39]. Consequently, households are often forced to use substitute water sources, which may include temporarily relying on bottled water, secondary sources, or traveling farther distances to fetch water. However, these alternatives may not offer the same level of safety, accessibility, or reliability as primary sources [34].

Flooding is another interesting example of a disaster affecting HWI, particularly the *use* dimension. Flooding can occur after natural disasters, such as cyclones, hurricanes, tsunamis, or severe storms, and can be acute (flash flooding) or sustained [42]. Flooding increases the amount of water physically present, technically rendering it accessible. However, the water is more likely to be contaminated and unsafe to consume, as documented in Bolivia [41], Pakistan [46], and many other locations. In such scenarios, where the *use* dimension is compromised, coping strategies again must be utilized to meet water needs or relocate.

3. Water Sharing: How it works

Household water sharing has recently been recognized by social scientists as a cross-cultural practice that is likely universal in water-insecure settings around the world [10,9,16,44,45,57,58]. An in-depth review of 100 + years of ethnographic field data found that water sharing reliably occurs across a wide array of water-insecure communities in different livelihood contexts: urban, agricultural, pastoral, and hunter-gatherer societies [57]. This was confirmed in the first in-depth cross-cultural research on water sharing in sub-Saharan Africa, which found that between 30–80 % of households had received water in the previous month via sharing [10]. Prior research has also shown that water sharing regularly occurs between water-insecure households [10,50] to meet their needs [57], thereby addressing gaps in water availability or quality. Those engaged in these transfers often view them as gifts, loans, borrowing, or simply helping out [22].

One primary example of how water sharing intersects with disasters in the context of marginalized communities comes from the colonias in southern Texas. The colonias (*peri*-urban and rural informal housing settlements along the U.S.-Mexico border) of the Rio Grande Valley are particularly prone to extreme weather events that can unfold into disasters. These communities are situated in high-risk flood zones and, in the aftermath of disasters, often lack support from the state of Texas and have been denied post-flood aid for home repair from the U.S. Federal Emergency Management Agency (FEMA) [20]. To cope with a lack of support and inadequate water infrastructure and access, households often rely on water sharing and gifting, primarily with family and neighbors [5,4]. Particularly in times of flood-induced water supply contamination, these water sharing practices become an important way to address post-disaster water needs.

As illustrated by this example and recent research evidence, when water sharing works well, it frequently happens between geographically-proximal and socially-close households, such as family, neighbors, co-religionists, or friends [10,57]. Repayment for water may occur but is often embedded in long-term caring relationships, such as shared childcare or elder care. Water sharing in these contexts is typically seen as a supportive, caring, and security-enhancing practice. Conversely, in the absence of such socially supportive water-sharing relationships, people are more likely to seek water from geographically- and socially distant acquaintances or even strangers, putting their health and lives at risk. Following Hurricane Maria in Puerto Rico, residents were compelled to utilize water from a Superfund site known to be contaminated by harmful chemicals because they saw no other

choice[29,47]. During disasters and emergencies, individuals may also find themselves compelled to exchange highly valuable goods and labor to get a survival allotment of water, resorting to direct payment with cash, services, or other forms of exchange (including sex or illicit exchanges). In these circumstances, water sharing is often experienced as uncertain, stressful, and even humiliating [9,16,58].

Yet the tendency for water sharing to be concentrated in economically-marginalized social groups and to function unreliably among the most socially-isolated households means that its performance in disaster settings is not easily extrapolated from empirical findings in non-disaster contexts. Understanding the dynamics and implications of water sharing amid disaster scenarios while accounting for social, economic, and environmental factors across diverse cultural settings is critical for crafting tailored interventions and policy responses that uphold dignity, safety, and wellbeing for all households and communities involved.

thousands of water bladders, flocculation and disinfection sachets, water buckets, and water purification tablets to provide immediate access to clean water for flood-affected households (USAID, 2022).

Geological disasters like earthquakes can also cause extensive damage to water infrastructure, requiring emergency management institutions and policymakers to prioritize swift repairs and temporary water solutions, such as mobile water treatment units and the distribution of physically more portable water supplies. For example, after the 2010 earthquake in Haiti, the country's water infrastructure was severely compromised, leaving many affected households without access to clean water[55]. Years after the devastating disaster, the country remains deficient in the infrastructure and governmental capacity required to facilitate improved water sources and guarantee access to clean drinking water[55]. In communities where government investment in water infrastructure is still limited, water sharing practices are commonly used to combat water insecurity. Gressier is an expansive peri-urban commune located about 7.5 miles north-north-east of the

Box 1

Key observations of current knowledge on water sharing practices within disaster contexts.

Water sharing practices may serve as effective self-organized responses to disasters, leveraging social structures within communities.

Water sharing practices are vital for providing swift access to water, bolstering community resilience while nurturing social bonds and solidarity.

Water sharing tends to be concentrated in economically-marginalized social groups, often those most severely impacted by disasters.

Water sharing practices are invaluable during disasters as they can provide immediate access to clean water. However, water sharing comes with certain trade-offs, including social, economic, and health-related risks.

Integrating water sharing strategies into disaster response efforts is paramount, alongside bolstering formal water infrastructure, to uphold community wellbeing and enhance resilience.

4. Discussion

4.1. Water sharing: Unrealized potential for disaster intervention

In this paper, we have underscored the theoretical and practical importance of water sharing practices in disaster contexts and identified five key observations (Box 1). First, recent research[10]; Rosinger et al., 2021; [40,58] indicates that household water sharing, which leverages social structures within affected communities, is a common and potentially effective self-organized response to disasters. The availability and accessibility of clean water are directly tied to the resilience and speed of recovery of affected communities[3,30]. People engage in mutual aid to ensure community members have a basic survival allotment when disasters disrupt conventional water access[39]. Typically, households self-organize water sharing predictably, leveraging pre-existing exchange relationships that draw on kinship, neighborhood, religion, or other tight-knit forms of social organization[57]. This kind of coordination happens even in the absence of governmental or philanthropic support, as evidenced during Hurricane Maria in Puerto Rico when federal and local government agencies delayed the distribution of water supplies, compelling households to employ water sharing strategies[40].

Second, floods are known to cause immediate and severe disruptions to both water and wastewater infrastructure, frequently disrupting access to clean water[43]. In such circumstances, prioritizing the rapid distribution of safe drinking water emerges as a critical strategy to ensure immediate access for affected communities. Water donations that are physically more portable—i.e., sachet and bottled water, designed to facilitate redistribution through household water sharing networks—might have a greater impact than water donations that are less portable or sharable. For instance, in 2022, Pakistan experienced severe flooding and landslides caused by heavy monsoon rains and glacial lake outbursts. In response, international and local NGOs distributed tens of

epicenter of the devastating 2010 earthquake[13]. In this community, households, especially women, frequently turn to water sharing practices to alleviate water insecurity (e.g., borrowing water from neighbors) when community sources are inaccessible or access to piped water is restricted[13].

Third, it is well-documented that disasters disproportionately impact socio-economically disadvantaged communities and households [2,14,19]. These vulnerable groups often face heightened challenges in preparing for, responding to, and recovering from disasters due to limited access to resources, infrastructure, and support systems. For example, Hurricane Katrina starkly exposed deep inequalities (i.e., race, gender, social class) in the U.S. Thousands of low-income African Americans in New Orleans were left without government aid in a city with over 30 % of households living in poverty; many were forced to shelter in an inadequately equipped sports arena [8]. Economic and social disparities exacerbate their vulnerability, often forcing them into the most fragile and risk-prone areas and increasing their susceptibility to the adverse effects of natural or man-made disasters[27], such as reduced access to clean water.

Economically and socially-marginalized groups, as we noted, tend to engage in water sharing practices outside of disaster contexts[57]. Recent research[39,40] demonstrates that these water sharing networks become even more crucial during disasters, providing a vital coping mechanism for affected communities and helping to mitigate the impact of water insecurity. While outside intervention is often not needed to spur water sharing, material support, and social coordination may improve the efficacy and reach of water sharing networks. After the water contamination emergency in Flint, Michigan, for example, community help centers have provided and kept on supplying bottled water to households with unsafe water[23]. State and federal assistance, as well as private donations, enabled these water sharing networks to reach more households[17,33].

Considering the various dimensions of household water insecurity – *availability, affordability, use, and stability* – past research has demonstrated that the effectiveness and type of water sharing practices can vary significantly [10,57]. In communities where water services are scarce or inadequate, for example, informal neighbor-to-neighbor sharing networks often emerge as the primary means of accessing clean water[57]. As such, water sharing practices not only signify a critical response to water insecurity but also serve as a vital and potentially growing communal strategy for nonmarket water supply [50]. As disasters unfold, the significance of water sharing amplifies, as community members often rely on it to enhance the availability of safe water. Therefore, disaster agencies and scholars should recognize that household water sharing is likely a bedrock response – albeit understudied and poorly understood – during disasters that disrupt water security. Yet, water sharing practices involve certain trade-offs, including social, economic, and health-related risks.

4.2. Water sharing: Potential trade-offs

Our fourth key observation pertains to the trade-offs and considerations associated with water sharing despite its potential advantages (Table 1). These practices can come with significant social, economic, and health-related risks and trade-offs[50]. While water sharing can address immediate water needs, it can become a burden and produce risks to those who engage in it without proper capacity training or planning. Households primarily relying on shared water may be more at risk for exposure to untreated and chemically or microbiologically contaminated water. The transfer of water between storage containers, for example, increases the likelihood of cross-contamination, potentially spreading waterborne diseases such as cholera, dysentery, and typhoid fever[50]. Moreover, participation in water sharing practices – including both giving and receiving households – may undermine mental health. It can heighten the risk of experiencing emotional distress [58,61], anger [11], signals of depression and anxiety [9], and exacerbate socioeconomic health inequalities[35]. Water sharing typically yields only small, survival allotments of water quantity—putting people at greater risk of dehydration and related problems such as fatigue, irritability, trouble concentrating, kidney stones, or breastmilk supply issues[36]or in dangerous water acquisition scenarios (e.g., lifting injuries, debt).

De-emphasizing efforts to provide formal water service in favor of “do it yourself” solutions like water sharing can also easily violate principles of basic human rights to adequate water provision[53]and place the burden of water security squarely on the shoulders of

individuals and households. At the same time, there is an opportunity to prepare households given the frequency and intensity of hazards as well as the pre-existing and continuous degradation and vulnerability of formal water systems. When planned, water sharing can fill service gaps while communities await official assistance. This proactive approach may, in turn, foster enhanced resilience and greater community cohesion throughout disaster and recovery periods.

4.3. Water sharing: Implications and future directions

Our final key observation emphasizes how water sharing practices underscore the potential for community resilience in the face of disasters. Communities that self-organize and manage their water resources during disasters exhibit a significant degree of self-sufficiency, often mitigating the immediate impacts of water insecurity without external aid[48,39,40]. These practices, rooted in trust, mutual aid, and reciprocity, reinforce social bonds and networks crucial during disasters [10,57]. Incorporating such strategies into disaster risk-reduction measures could significantly mitigate community vulnerabilities and enhance disaster resilience. Future research should investigate water sharing systems and practices under conditions requiring rapid response during and after disasters, particularly when formal water infrastructure fails or governmental aid is delayed. These processes could be better understood through collecting longitudinal data to assess water sharing’s long-term effectiveness and risks.

Developing frameworks that formally recognize and integrate water sharing practices into disaster response and recovery plans may enhance their effectiveness. This may involve several key components, such as providing material support, capacity training, and/or improved coordination to optimize water sharing networks during disasters. Thus to further advance the resilience of affected communities, studies focusing on understanding the dynamics and impacts of household water sharing networks and their integration into broader disaster management frameworks are critical. For instance, the FEMA National Disaster Recovery Framework[15]could be adapted to incorporate water sharing practices within the affected communities as a short-term coping strategy when formal support is interrupted or delayed. Monitoring and evaluating water sharing is another critical aspect. Establishing systems to track these practices during and post-disaster can yield valuable data for assessing their effectiveness and identifying areas for improvement, informing future policy and intervention strategies.

As we noted, the burden of water sharing disproportionately affects socially and economically marginalized households, raising concerns about social equity and the need for tailored support[57]. Targeted interventions are essential to support economically marginalized communities that rely heavily on water sharing, particularly during and post-disasters. Ensuring equitable access to water and resources can reduce the vulnerability of these groups and enhance their resilience.

While water sharing is a valuable short-term coping strategy, long-term solutions must focus on improving formal water infrastructure and services, including resilient water systems capable of withstanding disasters and ensuring consistent access to safe water. At the same time, emergency management institutions and policymakers remain responsible for implementing large-scale disaster risk-reduction measures, mitigating community vulnerabilities, and ensuring water safety[40].

5. Conclusion

Water sharing emerges as a critical practice for communities facing water insecurity, particularly during disasters. This informal and self-organized response is a vital mechanism that helps fill gaps left by damaged infrastructure and delayed official aid, ensuring immediate access to water. Understanding water sharing potential and limitations is essential for developing effective interventions and policies that support community resilience and recovery during and after disasters. Future research should focus on mapping water-sharing networks,

Table 1
Water sharing benefits and trade-offs.

Water sharing benefits	Water sharing trade-offs
Emergency response	Cross-contamination risks
● Immediate access to clean water when formal supplies are unavailable or disrupted	● Water contamination
	● Mosquito-borne illnesses
Flexibility and Cost-Effectiveness	Economic risks
● A flexible response to emergent water needs	● Financial Burden
● A cost-effective way to manage water insecurity when formal water infrastructure is inadequate	● Debt
Community Resilience	Physical health risks
● Solidarity	● Underhydration
● Mutual aid	● Injuries
Psychosocial Support	Mental health risks
● Promoting trust	● Emotional distress
● Reinforcing social connections	● Anger
● Building social capital	● Depression
● Enhancing psychosocial wellbeing	● Anxiety
● Reducing psychosocial stress	● Social inequality

assessing long-term impacts, examining cultural contexts, and integrating these practices into formal disaster response and recovery plans. Moreover, much more direct research is needed to identify under what conditions it is safe to encourage and support community-based water sharing systems. Therefore, recognizing and leveraging community-level coping mechanisms such as water sharing, while promoting sustainable, formal water services is crucial for addressing water insecurity and enhancing resilience in disaster-affected communities.

CRedit authorship contribution statement

Jelena Jankovic-Rankovic: Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing. **Anaís Roque:** Writing – review & editing, Writing – original draft. **Asher Rosinger:** Writing – review & editing. **Ellis Adams:** Writing – review & editing. **Amber L. Pearson:** Writing – review & editing. **Hilda Lloréns:** Writing – review & editing. **Carlos García-Quijano:** Writing – review & editing. **Justin Stoler:** Writing – review & editing. **Leila M. Harris:** Writing – review & editing. **Amber Wutich:** Conceptualization, Writing – original draft, Writing – review & editing. **Alexandra Brewis:** Conceptualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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