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State of Water in the Southwestern Region of Puerto Rico: Perceptions and Experiences

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Abstract

Reliable access to drinking water is essential for public health, economic stability, and quality of life, yet communities across Puerto Rico face recurring service interruptions linked to both climatic events and structural limitations of the water system. This study documents how residents of the southwestern region of Puerto Rico experience and perceive these interruptions. Using a descriptive, cross-sectional survey design, data were collected from 149 adults, most of them residents of eight southwestern municipalities (Mayagüez, Lajas, Cabo Rojo, Guánica, Sabana Grande, Yauco, Hormigueros, and San Germán), between April and May 2026, through an online questionnaire distributed by non-probability convenience sampling. Results indicate that water insecurity is structural rather than episodic: while 41.9% of participants reported interruptions one to three times per year, 36.5% reported monthly interruptions and 16.9% weekly or daily ones. Concern about future access increased consistently with the frequency of interruptions, from 61.3% to 100%. Participants attributed the crisis mainly to lack of maintenance, infrastructure breakdowns, and development pressure, while drought was among the least mentioned causes. Nine out of ten participants reported private expenses to cope with interruptions, primarily bottled water and storage tanks, and 73.5% of those who estimated their spending reported more than $100 per year. Although 88.5% considered their community unprepared for extreme events, 83.1% expressed openness to participating in community preparedness initiatives, and the most supported solutions combined system maintenance with water source protection and nature-based solutions. These findings suggest that water security in the region should be addressed as a governance, equity, and territorial planning challenge, through integrated strategies that combine infrastructure investment, land use planning, and community participation.

Keywords: Water Security, Water Insecurity, Household Experiences, Governance, Community Participation, Nature-Based Solutions, Puerto Rico

1. Introduction

Reliable access to drinking water is a basic condition for public health, economic stability, and quality of life in any community. In recent years, various regions of Puerto Rico have faced recurring interruptions in water service, attributed both to climatic phenomena and to structural limitations of the distribution systems. The structural dimension of the problem is significant: according to data from the Puerto Rico Aqueduct and Sewer Authority (PRASA) reported by the Centro de Periodismo Investigativo, approximately 66% of the water produced is not billed, and the agency's president has acknowledged that the aging of its 20,000 miles of pipelines is one of the main causes of water loss. Despite this, of the $845.8 million PRASA allocated to capital improvements in 2025, only $60.8 million, or 7%, was set aside to repair existing infrastructure [1]. Given these conditions, understanding how communities experience and perceive service interruptions, beyond technical infrastructure data, is essential to guide public policy, infrastructure investment, and community resilience strategies.

The academic literature on water security has evolved from definitions focused exclusively on the physical availability of the resource toward more comprehensive frameworks that incorporate governance, equitable access, and institutional trust as central

components of the problem. Cook and Bakker argue that an integrative concept of water security is desirable because it brings governance issues to the forefront, whereas narrow, discipline-specific approaches often fail to address them [2]. This perspective is particularly relevant to the present study, as it suggests that understanding water insecurity requires examining not only the availability of water and the built infrastructure, but also how institutions manage, maintain, and distribute that resource.

In parallel, a growing body of social science research has documented that water insecurity is, above all, an experience lived by households, and that this experience can be captured systematically through perceptual and survey-based metrics. Jepson et al. describe these metrics as psychometric scales that assess how often households or individuals experience water problems, such as not having enough water to wash hands or enduring supply interruptions [3]. The same authors argue that targeted infrastructure investments informed by these metrics can improve water security, reduce reliance on emergency social services, and promote public health and economic vitality. The present survey adopts this experiential approach, which assesses water insecurity as it is lived and perceived at the household level: rather than relying solely on technical indicators of the distribution system, it documents the perceptions, coping strategies, and priorities of the community itself.

This paper presents the results of a survey conducted in the southwestern region of Puerto Rico, which included eight municipalities: Mayagüez, Lajas, Cabo Rojo, Guánica, Sabana Grande, Yauco, Hormigueros, and San Germán (Figure 1). Its purpose is to document the frequency of water service interruptions, the causes the population perceives as responsible, the private costs households assume to compensate for the system's lack of reliability, the perception of community preparedness for extreme events, and the solutions the community prioritizes. The study is based on the premise, supported by the cited literature, that water security is not solely a technical supply phenomenon, but also a social, economic, and governance phenomenon.

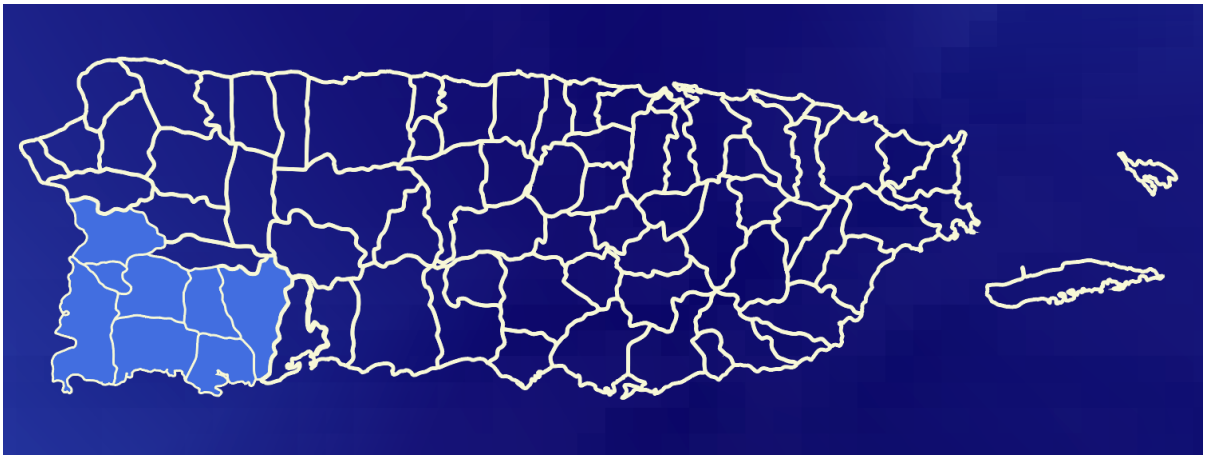


Figure 1: Study Area: The Southwestern Municipalities of Puerto Rico (Mayagüez, Lajas, Cabo Rojo, Guánica, Sabana Grande, Yauco, Hormigueros, and San Germán). Source: N. Montcourt, 2026.

The specific objectives of this analysis are: (1) to characterize the frequency and regularity of water service interruptions; (2) to examine the relationship between the lived experience of interruptions and concern about future access to water; (3) to identify the causes the population attributes to the water crisis; (4) to identify the private expenses households incur in response to failures of the public system and estimate their annual magnitude; (5) to assess the perception of community preparedness and willingness to participate in resilience initiatives; (6) to identify the priority solutions and actions supported by the community; and (7) to explore the perceived economic impact of water service interruptions.

2. Methodology

This study used a descriptive, cross-sectional survey design to document self-reported perceptions and experiences related to the access, reliability, and governance of water service in the southwestern region of Puerto Rico. Each participant completed the questionnaire once. Data were collected between April 1 and May 6, 2026.

The sample consisted of 149 adults. Participants were recruited through a non-probability convenience sampling strategy, with the questionnaire disseminated via social media, email, and telephone messages, and participation was voluntary. Of the participants, 123 (82.6%) resided in the eight municipalities of the study area: Cabo Rojo (83), Mayagüez (19), Lajas (10), San Germán (5), Guánica (3), Hormigueros (1), Sabana Grande (1), and Yauco (1). The remaining 26 participants (17.4%) indicated that they did not reside in any of these municipalities; they were included in the analysis because their responses reflect experiences with water service in the region, although this limits the territorial representativeness of the sample.

Data were collected through an online questionnaire consisting of 15 items on water service experiences and perceptions, in addition to 4 sociodemographic questions. The core items addressed the frequency and duration of water service interruptions, notification of interruptions, their effects on daily life, the level of concern about future access to water, perceived causes of interruptions, private expenses incurred and their estimated annual amount, perception of community preparedness for droughts and other extreme events, willingness to participate in community planning processes, level of support for priority actions and solutions, and the perceived economic impact of interruptions.

Responses were analyzed using descriptive statistics, including frequencies and percentages, calculated on the valid responses to each question. To examine the association between lived experience and risk perception, responses on the frequency of interruptions were cross-tabulated with the level of concern about future access to water. For multiple-response items, such as perceived causes, private expenses, and priority actions, results are reported as the number and percentage of participants selecting each option; because participants could select more than one option, percentages do not add up to 100%.

3. Results

Finding 1. Water Insecurity Appears to be Structural, Not Episodic

The most common category was experiencing interruptions 1 to 3 times per year (41.9%); however, a substantial proportion of participants (36.5%) reported interruptions 1 to 3 times per month, while 16.9% reported weekly or daily interruptions (Table 1). Only 4.7% reported never experiencing interruptions. This distribution suggests that the problem is not concentrated solely in extreme and infrequent events, but is part of everyday life for a significant proportion of the region's residents. Interruptions are also prolonged and poorly communicated: 47.3% of participants reported that interruptions usually last between 6 and 12 hours and 21.2% that they last more than 12 hours, while 53.1% reported never receiving notification from the municipality or agency, and only 4.8% reported receiving it consistently.

Frequency of interruptions	n	% of participants
1–3 times per year	62	41.9%
1–3 times per month	54	36.5%
Weekly	19	12.8%
Daily	6	4.1%
Never	7	4.7%
Total	148	100%

Table 1: Distribution of The Frequency of Water Service Interruptions Reported by Participants (N = 148 Valid Responses)

Finding 2. Association Between Frequency of Interruptions and Future Concern

Overall, 74.3% of participants expressed great concern about access to water in the coming months. There is a clear and consistent association between the frequency of interruptions experienced and the level of concern: the more frequent the reported interruptions, the higher the proportion of participants who express great concern (Table 2). Even among those who report the lowest frequency of interruptions (1–3 times per year), 61.3% already express great concern, which suggests that the lived experience of interruptions is closely linked to the perception of future risk. Notably, 6 of the 7 participants who reported never experiencing interruptions also expressed great concern, which indicates that concern is also shaped by the broader regional context. Because the daily, weekly, and never categories include few participants, their percentages should be interpreted with caution.

Frequency of interruptions	n	% reporting "great concern"
Daily	6	100%
Weekly	19	94.7%
1–3 times per month	54	77.8%
1–3 times per year	62	61.3%
Never	7	85.7%

Table 2: Percentage of Participants Reporting Great Concern About Future Access to Water, by Frequency of Interruptions Experienced

Finding 3. Perception of Governance and Infrastructure Failures Over Climatic Causes

When asked about the perceived causes of interruptions, mentions were concentrated mostly on infrastructure and governance factors rather than on climatic causes such as drought (Table 3).

Perceived cause	Participants	%
Lack of infrastructure maintenance	113	76.4%
Infrastructure breakdowns	109	73.6%
Increased demand / tourism / new developments	95	64.2%
Low pressure / system capacity	86	58.1%
Poor planning	75	50.7%
Drought / less rainfall	28	18.9%
Contamination of drinking water sources	26	17.6%
Don't know	8	5.4%

Table 3: Perceived Causes of Water Service Interruptions (N = 148; Multiple Responses Allowed)

This community perception is consistent with findings documented in the literature on water infrastructure management: Wallis-Lage warns that deferred maintenance and aging infrastructure directly threaten the sustainability and reliability of water systems, while Bennich, Engwall, and Nilsson document how water utilities frequently fail to manage the deterioration of their infrastructure, not due to a lack of technical knowledge, but because of organizational and governance limitations [4,5]. Participants therefore appear to understand the water crisis more as a problem of infrastructure, institutional capacity, and territorial pressure (demand, tourism, and development) than as an exclusively climatic phenomenon. Drought was selected by only 18.9% of participants, placing it among the least mentioned causes. This result should be read in light of the timing of data collection, which concluded in May 2026, before the severe drought and water rationing that affected Puerto Rico during the summer of 2026; perceptions of drought as a cause may have increased since then [6].

Finding 4. Private Costs to Solve Public Failures

Service interruptions generate direct private expenses for households, which individually assume resilience costs due to the public system's lack of reliability. A total of 135 participants (90.6%) reported incurring at least one type of expense, mainly the purchase of bottled water and of tanks or cisterns (Table 4). Among the 136 participants who estimated their annual spending, 26.5% reported less than $100, 51.5% between $100 and $1,000, and 22.1% more than $1,000; in other words, nearly three out of four (73.5%) spend more than $100 per year to compensate for the unreliability of the public system.

Type of expense	Participants	%
Purchase of bottled water	112	75.2%
Purchase of tanks / cisterns	77	51.7%
Installation of rainwater harvesting	30	20.1%
Private water hauling services	9	6.0%
Medical and health expenses	7	4.7%
No expenses incurred	14	9.4%

Table 4: Private Expenses Incurred by Households to Mitigate Water Service Interruptions (N = 149; Multiple Responses Allowed)

This pattern is consistent with Jepson et al., who note that declining water quality and public trust lead to patterns of tap water avoidance that are costly in terms of both affordability and human health [3]. The system's lack of reliability thus appears to be shifting resilience costs from institutions to individual households, which end up privately financing a function that belongs to the public system.

Finding 5. Low Perception of Community Preparedness, But High Willingness to Act

Of the participants, 88.5% (131 people) consider that their community is not prepared to face prolonged droughts, increased service interruptions, or extreme weather events, while 8.8% consider it partially prepared and only 2.7% consider it prepared. However, this low perception of preparedness does not translate into apathy: 45.9% of participants indicated that they would participate in community processes to plan water management solutions, and an additional 37.2% indicated "maybe," for a total of 83.1% showing at least openness to participation (Table 5).

Indicator	Result
Perceive that the community is NOT prepared	88.5% (131)
Would participate in community processes	45.9% (68)
Would "maybe" participate	37.2% (55)
Total openness to participation (yes + maybe)	83.1% (123)

Table 5: Perception of Community Preparedness and Willingness to Participate in Community Planning Processes (N = 148)

This willingness is an important asset. A recent systematic review of community water management practices found that grassroots water governance strengthens both water accessibility and ecological resilience, particularly when practices align with local environmental and social circumstances [7]. The results suggest a gap between the community's perceived capacity and individuals' willingness to act, which represents an opportunity for the design of community participation initiatives.

Finding 6. Preferred Solutions: Infrastructure Combined with Territorial Management

The priority actions with the greatest support combine conventional infrastructure interventions with territorial and ecological management strategies, suggesting that the community does not conceive of the solution solely as an engineering problem (Table 6).

Priority action	Participants	%
Protection of drinking water sources (aquifers and water bodies)	122	82.4%
Better maintenance of the potable water system	122	82.4%
Green infrastructure / nature-based solutions (NbS)	117	79.1%
Restrictions on construction and new developments	110	74.3%
Better land use planning	107	72.3%
Community education	79	53.4%

Table 6: Priority Actions to Improve Water Security Supported by Participants (N= 148; Multiple Responses Allowed)

Finding 7. Interruptions as an Economic and Daily-Life Barrier

A total of 126 participants (85.1%) consider that water service interruptions limit community economic development, while 6.1% do not and 8.8% are unsure. Interruptions also affect daily life in multiple ways: participants most frequently reported effects on hygiene and health (90.6%) and food preparation (84.6%), followed by stress or anxiety (51.0%), caregiving for older adults or children (30.2%), and work or study (28.9%); 6.7% reported loss of income from having to miss work. These perceptions directly connect access to water with employment, economic activity, health, and the daily stability of the region's residents.

4. Limitations

Because the study relied on a non-probability sample, the findings reflect trends among participants and should not be generalized to the entire population of the southwestern region without caution. The sample is concentrated in Cabo Rojo (55.7% of participants), several municipalities are represented by very few participants, and 17.4% of participants reside outside the study area, which limits territorial representativeness. Recruitment through online channels may have favored individuals with internet access and greater interest in the topic, introducing potential self-selection bias; in fact, most participants reported a bachelor's degree or higher. In addition, the data are self-reported and perception-based, and are therefore subject to recall bias, subjective risk perception, and social desirability bias. The analysis was descriptive and did not include statistical tests, so the associations reported should not be interpreted as causal relationships, and categories with few participants, such as daily interruptions, should be interpreted with caution. Finally, the present analysis does not disaggregate results by sociodemographic variables or municipality, which limits the examination of differences among subgroups.

5. Conclusions

The results of this survey indicate that water insecurity in the southwestern region is being experienced not only as a technical supply problem, but as a combination of infrastructure failures, deficient territorial planning, development pressure, climate vulnerability, and limited institutional capacity. Interruptions are not perceived as isolated events or as exclusively linked to drought, but as a structural and recurring condition that is part of the daily life of a significant proportion of the population, often prolonged and without prior notification.

The consistent association between the frequency of interruptions and concern about future access suggests that direct experience is closely linked to risk perception, possibly more than institutional messaging or informational campaigns. At the same time, the community attributes the crisis mainly to failures in maintenance, governance, and planning rather than to climate, which is consistent with Cook and Bakker's argument that good governance is essential for managing the multiple stressors that affect water

environments [2]. This has direct implications for public policy design: the interventions perceived by the community as most legitimate and necessary are those related to infrastructure, water source protection, and land use planning.

The shift of resilience costs onto households, through the purchase of bottled water, tanks, and rainwater harvesting systems, shows that communities are absorbing, privately and unequally, the costs of a failure of public origin. With nearly three out of four households spending more than $100 per year, and more than one in five spending over $1,000, this has clear equity implications, as not all households have the same economic capacity to bear these expenses.

Finally, although the perception of community preparedness is low, the willingness to participate is remarkably high (83.1% openness), which represents a concrete opportunity for the design of resilience strategies based on community participation, in line with evidence that grassroots water governance strengthens resilience when adapted to the local context [7]. Taken together, these findings point to the need for integrated interventions that combine infrastructure investment, protection and management of water sources, land use planning, and community participation mechanisms, rather than addressing water security as an exclusively technical or climatic matter.

Recommendations

Based on these findings, several lines of action are proposed to strengthen water security in the southwestern region. First, investment should prioritize the maintenance and repair of existing infrastructure, given that lack of maintenance and infrastructure breakdowns were the causes most frequently mentioned by participants and are among the most documented in the literature on deferred maintenance [4]. Allocating a greater share of capital improvement funds to repairing pipelines and reducing water losses would not only improve service reliability, but also respond directly to the priorities expressed by the community. In addition, PRASA and the municipalities should establish consistent notification protocols, since most participants reported not being informed of interruptions.

Second, water planning should adopt a territorial perspective. The protection of water sources, recharge areas, and green infrastructure should be incorporated as central, rather than complementary, strategies in regional water planning, since they reduce pressure on the system by safeguarding the quantity and quality of water at its origin. Mechanisms should also be evaluated to restrict or condition new developments, including tourism and residential projects, based on the actual capacity of the water system, so that territorial growth does not compromise the supply of existing communities. These measures align with the strong support participants expressed for water source protection, nature-based solutions, and better land use planning.

Third, the high willingness to participate identified in the survey (83.1%) represents an opportunity that institutions should not overlook. Community preparedness programs should be designed to channel this willingness, even in communities that perceive themselves as poorly prepared, following grassroots water governance models that strengthen resilience when adapted to local conditions [7]. Such programs could include emergency water storage plans, training in rainwater harvesting, and community monitoring of service interruptions. In parallel, support or subsidy mechanisms should be explored for households that currently bear resilience costs privately, such as the purchase of bottled water, cisterns, and rainwater harvesting systems, particularly in lower-income sectors, where these expenses deepen existing inequalities.

Finally, future studies should use probability sampling with balanced representation across municipalities, report results by municipality and sociodemographic group, and apply statistical tests to assess the associations identified in this study. Complementing perception data with technical information on the frequency and duration of interruptions reported by PRASA would also make it possible to compare residents' experiences with the operational performance of the system and to identify the areas where interventions are most urgent.

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