Wells of Privilege: Collective Resource, Private Solutions: Unequal Adaptation to Drinking Water Scarcity in Samaipata, Bolivia

Pozos de privilegio – recurso colectivo, soluciones privadas: Adaptación desigual a la escasez de agua potable en Samaipata, Bolivia

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Abstract

This paper examines how residents of Samaipata, Bolivia, adapt to clean water scarcity amid climate change within a cooperative-based water system. Drawing on hydrosocial and political ecology perspectives, this study employs the concepts of access and commoning. Through a mixed-methods approach, this research shows how unequal access to adaptation strategies shape unequal access to clean water. While water is constitutionally a right, and framed as a collective responsibility, the local cooperative struggles to provide clean water, prompting wealthier residents to seek private solutions like wells, bottled water, and large-scale rainwater harvesting. These individualized strategies deepen existing inequalities, as poorer residents remain dependent on the unreliable cooperative. The study highlights the paradox of water as a collective resource increasingly accessed through private means and calls for greater awareness of how uneven capacities to adapt can shape who gets access to clean drinking water in the face of growing climate pressures.

Keywords: *water governance, access to resources, commons, climate change adaptation, social inequality, water scarcity.*

Resumen

Este artículo examina cómo los residentes de Samaipata, Bolivia, se adaptan a la escasez de agua potable en el contexto del cambio climático dentro de un sistema de agua gestionado por una cooperativa. Enmarcado en la literatura de ecología política e hidrosocial, el estudio se basa en los conceptos de acceso y gestión colectiva de los comunes. A través de un enfoque de métodos mixtos, muestra cómo las diferencias en las estrategias de adaptación generan un acceso desigual al agua potable. Aunque el agua está reconocida constitucionalmente como un derecho y se presenta como una responsabilidad colectiva, la Cooperativa local enfrenta dificultades para proveer agua limpia, lo que lleva a los residentes con mayores recursos a buscar soluciones privadas como pozos, agua en botellas y recolección de agua de lluvia. Estas estrategias individualizadas profundizan las desigualdades existentes, ya que los residentes más pobres siguen dependiendo de una cooperativa poco confiable. El estudio resalta la paradoja del agua como recurso colectivo al que se accede cada vez más por vías privadas, y hace un llamado a tomar conciencia sobre cómo las capacidades desiguales de adaptación influyen en quién accede al agua potable.

Palabras clave: *gobernanza del agua, acceso a los recursos, bienes comunes, adaptación al cambio climático, desigualdad social, escasez de agua.*

Introduction

"It is not a problem of scarcity; it is a problem of redistribution," says Roberta, a Samaipata resident and former participant in local water governance debates, capturing the central paradox of the town's water crisis.

Water is both a basic human need and a growing global concern. As climate change intensifies droughts, floods, and water insecurity, ensuring equitable access to clean water has become more critical (United Nations, 2017)—and in Bolivia, this urgency is especially pronounced. The country has the lowest levels of water access and service quality in South America (Braun, 2019), yet it is internationally recognized for its progressive stance on water rights. Following the Cochabamba Water Wars (2000-2005), Bolivia enshrined water access as a constitutional right (Plurinational State of Bolivia, 2009) and shifted toward decentralized, community-based governance (Assies, 2003).

Samaipata, a small town inhabited by around 10,000 people in central Bolivia at the foot of the Andes, experiences a paradoxical water scarcity. Although surrounded by rivers, the town has long struggled with water quality. Tap water often runs yellow, and despite a cooperative model designed to ensure equal access, many residents lack trust in the system and turn to alternative solutions. The experience of increasingly intense rainy seasons and droughts, along with rapid urbanization and deforestation affecting precipitation patterns, suggests that water provision problems will become even more important to address. As climate change intensifies existing vulnerabilities, these adaptations become more urgent. This raises the question of whether all residents have equal capacity to adapt. What happens when adaptation itself becomes a marker of inequality, when, in the face of a changing climate, access to clean water depends less on rights and more on resources?

In each town within the Florida province, where Samaipata is located, water provision involves the government, the municipality, and its local water cooperative. The government oversees the flow of international and national funding towards the area, which the municipality manages. While the municipality is responsible for broader urban planning decisions that affect the city's water resources, COOPFLOR R.L.[1] controls the actual flow, cleaning, distribution, and water provision in the town. The cooperative operates at the intersection of the private and public spheres: while it is a private entity dependent on income from paying water users, its management is elected every fourth year by its members, and its authority is granted by the government and municipality. More specifically, the cooperative consists of two bodies: an administrative part—the board of directors led by the president—which manages its operations (COOPFLOR R.L., 2024, Art. 62), and an oversight council, responsible for monitoring its work and ensuring proper use of resources (COOPFLOR R.L., 2024, Art. 75). Evidently, Samaipata's context offers a unique opportunity to explore the interplay between formal water governance and local adaptation.

The research explores these dynamics and examines how water users in Samaipata adapt to the scarcity of clean drinking water and how these adaptation strategies reflect and reproduce patterns of unequal access.

This study addresses the following questions:

1. How is water provision in Samaipata organized, and what water user groups emerge within this system?

2. How does access to capital, knowledge, and technology influence the ability of different water user groups to adapt to clean water scarcity in Samaipata?

3. In what sense do water users in Samaipata perceive water as a common resource, and how do their adaptation strategies reflect or challenge this perception?

To examine water access in Samaipata, this research draws on political ecology and hydrosocial cycle scholarship. In line with political ecology, water scarcity is understood not just as an environmental issue but as one rooted in the organization of the water system and local power dynamics (Neumann, 2009). The hydrosocial perspective highlights how water both reflects and reshapes social relations and power (Linton & Budds, 2014). This report extends this perspective by considering water's materiality and the technologies mediating access, moving beyond tech-

1 Samaipata's Cooperative for Public Drinking Water and Sanitary Sewerage Services "Florida" R.L., shortened as COOPFLOR R.L.

nical explanations. It explores how adaptation strategies to secure clean water are influenced by power and how they, in turn, reinforce existing inequalities amid climate change.

Earlier political ecology research emphasizes how power shapes access to resources (Lafaye de Micheaux & Jenia, 2020). For example, Bryant (1998) argues that environmental conflicts are inherently political and shaped by historical and economic inequalities. While Bryant (1998) supports hybridity, he overlooks alternatives like cooperatives. This study addresses that gap by focusing on a local water cooperative in Samaipata.

Hydrosocial scholars like Swyngedouw (2009) and Wild (2023) show how water governance is embedded in political, economic, and social systems. Swyngedouw (2009) critiques how privatization and commodification reinforce structural inequalities but overlooks how non-capitalist models like cooperatives engage with power and exclusion. Wild (2023) adds that community-based governance, while intended to be inclusive, often reproduces existing exclusions and is shaped by political restructuring and climate pressures. Yet, neither explores how adaptation strategies—such as private wells, informal networks, or bottled water—may also reinforce broader power asymmetries, which is the focus of this research. Despite valuable contributions from political ecology and hydrosocial scholarship, little empirical research examines how adaptation to water scarcity under cooperative or hybrid governance produces new exclusions. This research addresses this critical empirical blind spot.

To address the gaps mentioned, this research mobilizes two interrelated concepts: (1) access and (2) commoning. These offer a framework for analyzing how social structures and material infrastructures interact to shape adaptation strategies—and how these, in turn, reinforce unequal access to drinking water. Samaipata's cooperative governance model, combined with climate-related pressures and uneven adaptive capacities, provides a valuable context for exploring these dynamics.

The report draws on the concept of access as defined by Ribot and Peluso (2003) as "the ability to derive benefits from things" (p. 153). This conceptualization includes a broader range of social relations that enable or constrain resource use. For instance, one may have formal rights to land but lack access to capital or technology to benefit. In this report, access to capital is understood as wealth in the form of finances and equipment. Furthermore, knowledge is understood as the direct benefit of skills and specialized knowledge that can be used to maintain access to natural resources. Additionally, specific water-related technologies—such as wells—function as forms of expertise that enable physical access to resources, disproportionately benefitting those with the means to acquire and operate them (Ribot & Peluso, 2003). The present research applies this framework to analyze who gains access to clean drinking water and through what mechanisms. Specifically, the study examines how different actors adapt by drawing on varying degrees of access through capital, technology, and knowledge as key forms of power.

To complement the access framework, this research draws on the concept of commoning to analyze both the cooperative water system in Samaipata and the exclusions that emerge outside of it. Nightingale (2019) defines commoning as collective practices that resist privatization and neoliberal individualism, instead fostering shared governance and collective resource use. Yet, commoning is shaped by power, which introduces contradictions: while it enables collective action, power can also produce control and exclusion. Importantly, Nightingale notes that commoning inherently creates an "outside" where some are excluded from shared resources and governance structures (Nightingale, 2019). This framework is particularly relevant in Samaipata, where cooperative water provision coexists with informal and individualized strategies. However,

while Nightingale (2019) focuses on structural exclusion, this study considers that some actors may actively opt out of the communal system, seeking alternatives perceived as more beneficial or reliable.

Adaptation strategies are not treated as a separate analytical category but understood as embedded in and shaped by dynamics of access, commoning, and exclusion. They emerge in response to cooperative limitations, climate-induced water scarcity, and broader social inequalities. Drawing on the access framework, particular attention is paid to how capital, technology, and knowledge enable some actors to adapt. Taken together, the concepts of access and commoning guide the analysis of how efforts to build shared water governance may paradoxically create an "outside," where some actors turn to private solutions that reflect and reinforce their position of power.

Method

This research draws on both qualitative and quantitative data. The methods were used complementarily: the quantitative data provided a broader, descriptive perspective on water access patterns across the population, while the qualitative data allowed us to gain more in-depth exploration of individual experiences and local dynamics (Small, 2009). Together, they enabled triangulation across methods—using each to contextualize, verify, and deepen the findings of the other (Small, 2009).

The qualitative component used an ethnographic approach to explore the social and infrastructural dynamics related to drinking water in Samaipata. The study relied on non-probability sampling methods, primarily purposive and snowball sampling, to identify participants for interviews, observations, and other ethnographic encounters. The purposive sampling strategy enabled the inclusion of individuals and households who met predetermined criteria: (1) residence in Samaipata or in the surrounding area, (2) direct involvement or dependence on water-related activities, (3) lived experience of water-access challenges in Samaipata, or (4) recognized expertise or influence in the political, institutional, or technical dynamics shaping local water governance. Non-probability sampling was considered most appropriate given the absence of a complete sampling frame and the need to include participants whose experiences and knowledge were highly context-specific (Tansey, 2007). Snowball sampling further expanded the research, as initial informants acted as gatekeepers, introducing us to new interlocutors and contributing to the initial understanding of the cooperative and the mapping of local water groups (Bernard, 2011). The water user groups were not predefined analytical categories but emerged iteratively from the fieldwork: early conversations and observations revealed distinct patterns in how residents accessed and experienced water, which were subsequently refined through continued data collection and interpreted through the conceptual framework of access and commoning. Participants were therefore selected based on their direct involvement in, or reliance on, different water provision systems, ensuring variation in both institutional roles and everyday experiences. In addition to survey data and interviews, relevant local reports were reviewed to contextualize and support the analysis.

In total, 21 semi-structured interviews were conducted, with a diverse group of participants, as shown in Table 1. This distribution of respondents ensured variation across institutional roles, levels of water access, and everyday experiences of water scarcity.

Table 1
Summary frequency table of number of interviewees per category

Category of Interviewee	Number of Interviewees
Government and municipal officials	4
Cooperative members (both administrative board and oversight council members)	6
Residents relying solely on the cooperative system	5
Individuals using alternative or hybrid water sources	4
Community figures with specialised local knowledge of water governance and infrastructure	2
Total	*21*

The interviews lasted between 40 and 150 minutes and were mostly conducted in Spanish. To explore how water was perceived as a common resource and how this shaped behavior, we followed a semi-structured format, asking open-ended questions about informants' views on collective water management, individual responsibility, and lived experiences (Vandermause & Fleming, 2011).

Particular attention was paid to how informants described their access to resources, helping the identification of mechanisms of inequality and variation in adaptive capacity. Interview transcripts and fieldnotes were analysed through an iterative coding process, beginning with open coding to identify recurring themes and followed by focused comparison across interviews to trace patterns of inequality, responsibility, and adaptive strategies.

Aiming to gain a broader understanding of the field, revealing both people's narratives and observable practices, and highlighting discrepancies between lived experiences and material realities, interviews were complemented with elements of participant observation (Bernard, 2011). The researchers' position as external actors inevitably shaped the research perspective (Pike, 1967). Coming from contexts where reliable water infrastructure is often taken for granted may have shaped our interpretations of local practices and notions of scarcity. During the fieldwork in Samaipata, engagement with public spaces, the use of different water sources, and informal conversations with residents provided insight into everyday practices. It included visits to households, local establishments, the self-sustained community EcoVivienda, and some of the main water sources—the rivers El Fuerte and El Chorrillo (Ranque, 2022). However, language barriers and time constraints limited full immersion. These limitations should be considered when interpreting the findings. In addition, aiming to get a comparative perspective on our field, visits to the neighboring town Mairana were conducted; there, a well-functioning water system, both in terms of quality and reliability, was found.

The quantitative analysis built on a positivist approach to provide descriptive results. It mapped water user groups and explored perceptions of water systems, focusing on common water sources and their links to education, capital, and knowledge—key indicators of inequality and power. Using standardized instruments to capture internal diversity (Bryman, 2012), the approach provided a way to uncover patterns that might not have come to surface through qualitative methods alone. The quantitative part consisted of a survey of 147 Samaipata residents, with the sole criteria for participation being residence in Samaipata and a minimum age of 18, but the sampling strategy also aimed to reflect the town's internal diversity. Because online responses skewed toward a more highly educated segment, 40 surveys were distributed in person to ensure broader representation and to accommodate possible illiteracy and limited technological know-how. To explore how water insecurity shapes adaptation strategies and reinforces exclusions, the research also included a lab-in-the-field experiment with 23 participants. These constituted an in-

dependent group from the survey sample, recruited through purposive sampling in public spaces in Samaipata to ensure variation in age, neighborhood, and water source dependency. In a hypothetical scenario, participants were asked to allocate funds among four options: two individual ones (building a well and buying bottled water) and two collective ones (sharing rainwater tanks and investing in the local cooperative). After introducing a drought scenario, participants were asked to reallocate the funds. While the sample was small, limiting the causality and significance of our results, the experiment facilitated informal conversations with local people, providing an understanding of how they view the cooperative and private systems.

The research followed principles of respect, transparency, and accountability, based on the AAA (American Anthropological Association, 2012) and ASE (Association for Social Economics, 2019) ethics statements. The research process ensured informed, voluntary participation through oral consent, confidentiality, and the right to withdraw. The purpose was clearly communicated, and preliminary findings were shared in a public workshop. As external researchers, our positionality and methods—particularly conducting interviews in person—may have shaped participants' responses (McCorkel & Myers, 2003). Being in situations marked by conflict of interest, this issue became especially evident, as some actors sought to use the research to legitimize their own narratives, carefully planning the visits or posting about the meetings on social media. The mixed-methods approach made it possible to map water user groups, identify adaptation strategies, and explore how access to technology, knowledge, and resources shapes access to adaptation. Together, these methods provided a comprehensive understanding of how water users in Samaipata adapt to scarcity, and how these strategies reflect and reproduce patterns of unequal access.

Results

Organization of the Water Provision System in Samaipata

After days of navigating Samaipata's intricate social and political climate, the researchers finally secured a meeting with the cooperative president (CP). Entering the meeting room, a palpable tension quickly filled the air, affirming our impression that water management, despite its technical nature, is a highly sensitive and political matter in Samaipata. Despite the short notice for the meeting, it was obvious that the meeting and its content were carefully planned., and the coordinated, rehearsed answers nonetheless, provided a glimpse into the core of the city's water management issues: diverging perceptions of the main challenges and who is ultimately responsible for addressing them.

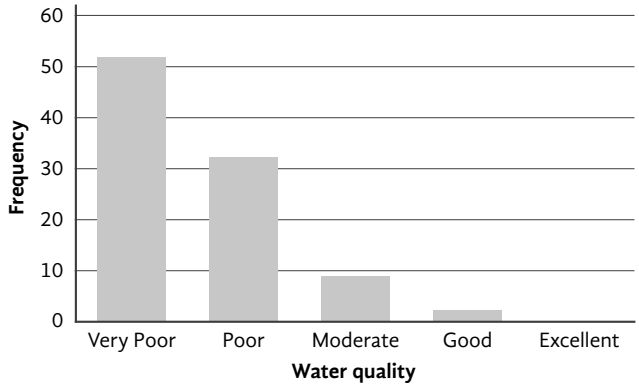
As mentioned, the cooperative's official administration of Samaipata's water provision is directly entangled with the municipality's urban planning decisions and regulatory policies. Nonetheless, the interview with the CP suggested an apparent absence of cooperation between these overlapping responsibilities, leading to inefficiencies, competing interests, and a lack of accountability. In the interview, the CP repeatedly stated: "According to the political constitution of the state, the ones who should guarantee basic services, such as water and sewage, are the municipal governments." Similarly, municipal officials expressed aspirations to secure access to drinkable water for all citizens. However, contrary to the CP's statement, the municipal informants stressed that since water administration fell under the cooperative's jurisdiction, they were ultimately responsible for its management. As evident through interviews with both the municipality and the CP, both parties seemed to agree that clean drinking water should be commonly accessible. However, conflicting views on management and responsibility appear to have created a bureaucratic standstill, hindering prospects for an efficient water distribution system. Speaking with

Louisa, an informant formerly leading the oversight council, confirmed this pattern: "There is no cooperation between entities, it's mostly a power struggle where one blames the other or they both blame lack of funding... ultimately, the citizens of Samaipata lose." These findings suggest that, although the cooperative is primarily responsible for water provision, differing views persist regarding who is accountable for the challenges both facing and within the formal water system. Engagement in cooperative meetings was also declining: only 30 of 2,000 members attended the latest assembly (COOPFLOR, 2024).

Furthermore, public perceptions reflected management shortcomings, particularly through accusations of misuse of public funds. Even the current CP acknowledged a history of mismanagement within the cooperative, with instances of former employees prioritizing personal interests over the collective good, stating that: "We conducted an audit last year. And for the past five years, the same names keep showing up. When we notify them, they get angry. They even want to come and hit us." (CP, February 2025). However, similar accusations regarding corruption had been directed against the sitting president, resulting in ongoing legal actions from the oversight council.

In addition, the quantitative results revealed widespread perceptions that the cooperative failed to meet water quality and accessibility standards—extending beyond concerns about management alone. The histogram in Figure 1 shows that a majority of respondents rated the water as either "very poor" (n=75) or "poor," (n=46) collectively making up 82% of responses.

Figure 1
Perceived water quality among tap water users



Note. Histogram showing the distribution (in frequency) of answers to the perceived water quality among people connected to the cooperative across five categories, ranging from "very poor" to "excellent".

Furthermore, our findings indicated that water shortages are a common occurrence: 43% of respondents (n=63) reported experiencing water interruptions at least once a week, while an additional 29% stated they faced shortages several times a month. Furthermore, our results suggested that climate change is increasing the risk of these shortages, affecting weather events and thus the variability and intensity of rain and the town's natural water resources. Our survey, illustrated in the histogram in Figure 2, shows that 51.7% of respondents were "very concerned" about climate change, with overall 86% expressing some level of concern, indicating strong awareness of its impact in Samaipata.

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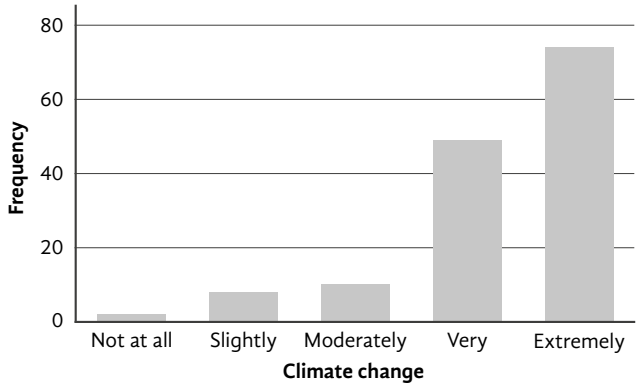
Figure 2
Concern about climate change in Samaipata



Note. Histogram displaying five categories of concern about climate change in Samaipata (from "not concerned" to "extremely concerned"), with corresponding frequencies.

Additionally, personal stories from the interviews clearly demonstrated that the effects of climate change on Samaipata's water provision were already evident. Javier, a hotel maintenance manager we visited, expressed: "The droughts are getting longer; last year was the worst in 20 years." Longer droughts put additional strain on the city's fragile water system and its limited backup tank capacity, sometimes leaving cooperative members without drinking water for hours or even days. Additionally, the area was experiencing urban expansion and deforestation, and frequent excessive rainfall, triggering landslides which damaged the city's pipes and contaminated the water supply. This concern was reinforced in an interview with the engineer Cristóbal, who had been tracking deforestation in Samaipata: "The city has expanded beyond its capacity, we need to secure the surrounding forest and make better long-term planning than before, or else the water supply will decrease even more." Consequently, beyond issues of mismanagement and current poor water quality and reliability, there was a growing concern about the worsening of current insecurities.

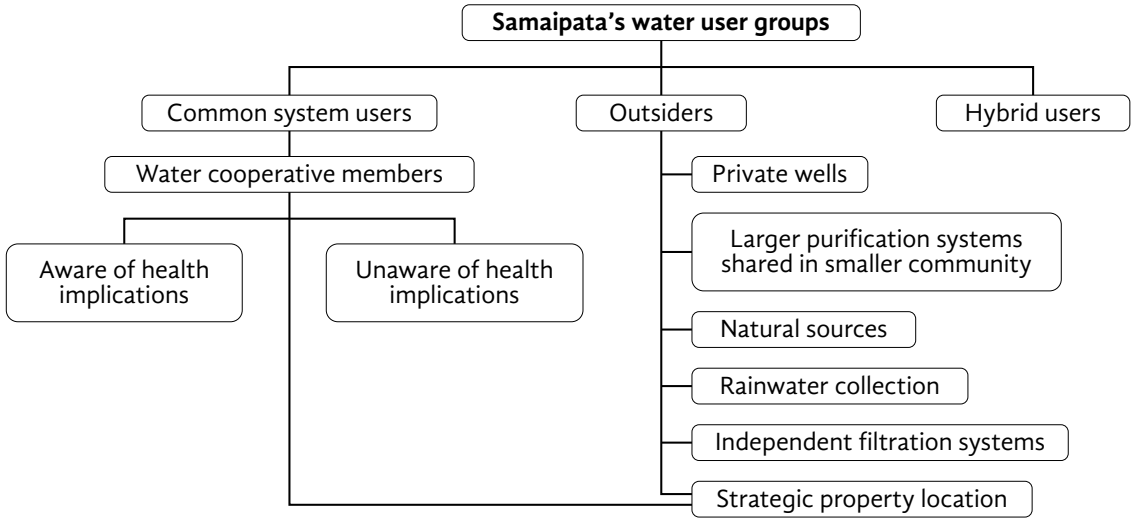
Water User Groups

Drawing on survey results and the concepts of access and commoning, Samaipata's residents can analytically be grouped into three broad water user categories: those relying on the common, the outside, or hybrid water networks. This typology emerged inductively from patterns in water source use and adaptation strategies became visible across interviews, observations, and surveys, subsequently interpreted through the conceptual framework. Currently, the quantitative findings, combined with reports on the topic (Ranque, 2022), indicate that the largest water group was the one reliant on the cooperative's common water-system. Conversations with informants revealed that many cooperative members were aware of the water's health risks, but lacked means of adaptation, while others were unaware and, perhaps to a certain extent, accustomed to the bacteria in the water.

In contrast, the water user group belonging to the outside presented a more complex and diverse landscape, emerging from a range of adaptation strategies. Five main adaptation strategies were identified within this category: those relying on private wells, independent filtration systems, rainwater collection, natural surface sources (rivers, streams, and springs), and communities or networks using larger independent purification systems.

Figure 3

Conceptual map showing Samaipata's water user groups



Access to Adaptation Strategies

While the previous section outlined the fragmentation of Samaipata's water landscape, this one turns to unequal access to adaptation opportunities. Ribot and Peluso (2003) argue that access is shaped by multiple mechanisms: social, political, and economic. Among these, capital—defined as "wealth in the form of finances and equipment used for extraction, production, and labor mobilization" (p. 165)—plays a particularly visible role in Samaipata. It played a decisive role in determining who could access adaptive strategies such as purchasing bottled water, installing filtration systems, collecting rainwater, digging wells, or buying property in strategic locations. For instance, several informants emphasized that the poorest residents could not afford bottled water and were often left with no choice but to drink contaminated tap water, even if it made them sick. As illustrated in Figure 4, most neighborhoods primarily relied on tap water, whereas more affluent areas often accessed multiple water sources, underscoring how exclusion from adaptation was structured by economic inequality.

These dynamics were also visible among hybrid water users who combined cooperative supply with alternative water sources. In the small neighborhood café Tío Álvaro, the owner, Julia, recalled the three days the previous year when water was completely unavailable: "We gathered water in buckets," she said. "We were lucky to be able to buy bottled water." Her approach—storing water, boiling tap water, and turning to bottles in emergencies—reflected a flexible but resource-dependent strategy. She expressed, "Not everyone can afford that option," adding, "They drink whatever water they get, even when it's yellow, even when there are bugs in it." Her account illustrated how even mixed strategies depended on the ability to pay—and without that, residents faced unsafe alternatives. Survey data confirmed this disparity: in Salitral, a less privileged neighborhood, 78% of residents relied solely on tap water despite frequent disruptions and poor quality. For those lacking economic flexibility, adaptation was not a possibility: as a taxi driver put it, "When the water doesn't come, I just wait."

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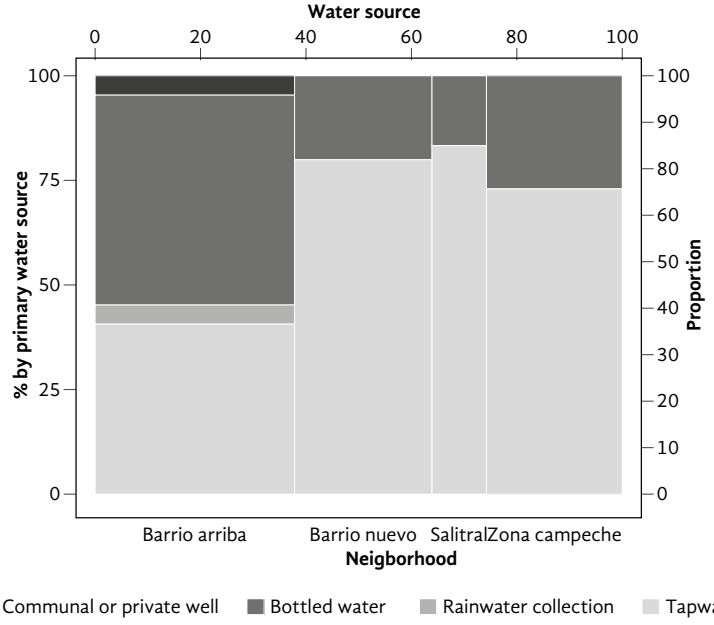
Figure 4

Geographical patterns in water access

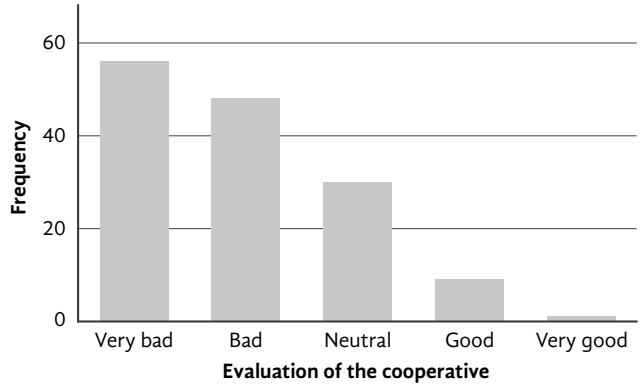


Note. Spine plot showing primary drinking water sources by neighborhood. The colors represent water sources, while the section width reflects the number of respondents

In the survey, 72.2% of respondents rated the cooperative's communication related to their water provisions as "bad" (34.7%) or "very bad" (37.5%) (Figure 5). One former member expressed frustration that people criticized the administration without proposing improvements, reflecting how a lack of knowledge makes collective adaptation inaccessible. Technical knowledge matters for identifying effective adaptation strategies. As mentioned by Carlo, a local with an academic background, many wrongly believed that boiling water always ensured safety. The survey work revealed instances of illiteracy, pointing to barriers in accessing and applying adaptation strategies. These disparities in knowledge, therefore, affected the ability to identify water problems as well as the solutions required to solve them both individually and within the cooperative.

Figure 5

Perception of the cooperative's communication about its operations

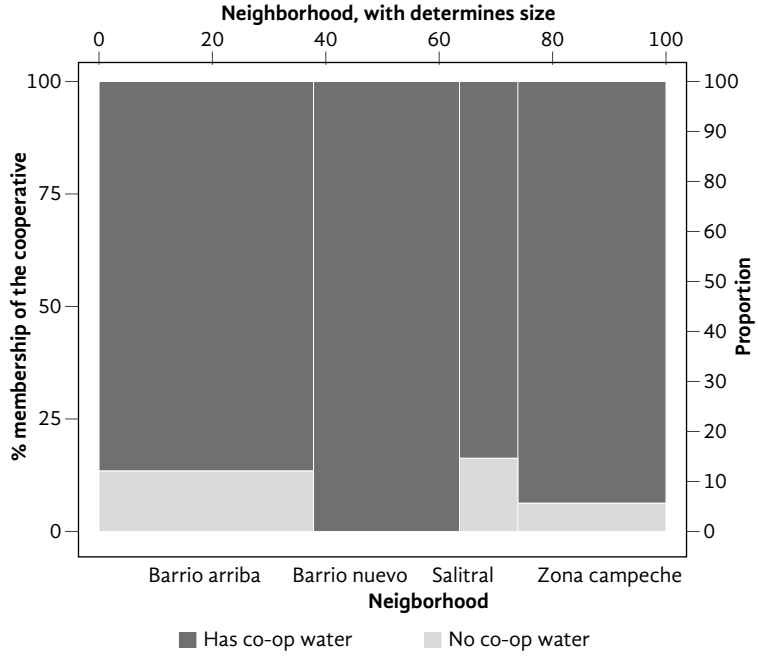


Note. Histogram examining respondents' evaluation of the way the cooperative communicates, with frequency in individuals counted on the y-axis. The x-axis presents data on a Likert scale where lower values indicate poorer evaluation of cooperative communication and higher values indicate better evaluation of cooperative communication.

At Hotel Árbol, access to capital fostered expertise: the owner hired a specialist to drill a 130-meter-deep well—an USD 55,000 investment now providing nearly unlimited clean drinking water. On the outskirts of the town, a couple had designed a self-sufficient water system using rainwater collection. Their home could capture and filter 35,000 liters of rainwater from the rooftop, stored in massive tanks, ensuring a constant supply. "We trust the cycles," the wife explained, emphasizing their reliance on natural rainfall.

Figure 6

Geographical patterns in co-op provision



Note. Spine plot showing the proportion of households receiving (blue) and not receiving (pink) Cooperative water across Samaipata's neighborhoods. Section widths reflect the number of respondents per neighborhood.

Water as a Common Resource: Perceptions and Contradictions

As mentioned, poor management of water in Samaipata created mistrust in the cooperative and discouraged participation in its assemblies. As cooperative informants expressed, people only took part when they wanted to complain rather than to discuss possible improvements. This resulted in less collective management, leaving decisions mostly in the hands of the few people within the administration. The allocation experiment employed as part of the data collection suggests low trust in the collective solutions (common rainwater collection and the cooperative), when comparing standard water investments with emergency-driven decisions during scarcity. The preference for individual options (bottles and wells) increased by 9% in the emergency situation, with building the private well being the choice with the overall highest investments (from 23% to 34%). Although the number of participants was too small to produce statistically significant results or establish causal relationships, the experiment provides an illustrative indication of how preferences may shift toward individual solutions during periods of water scarcity.

Figure 7
Photos from field experiment

Note. Left: Scenario A, all funds invested in collective rainwater collection. Right: Scenario B (drought), part of the funds reallocated to the individual solution of constructing a private well.

Taken together, these findings not only map the fragmented and unequal landscape of water access in Samaipata, but also set the stage for a deeper examination of the institutional, social, and power dynamics that underpin them. The following discussion develops through the lenses of commoning, access, and governance.

Discussion

The findings revealed a pervasive mistrust of local institutions, most notably expressed through recurring allegations of corruption. While the validity of these accusations fall beyond the scope of this research, allegations from citizens and cooperative management could explain the erosion of public trust revealed by the quantitative results. These indicated that only 7.7% of respondents trusted the cooperative to ensure a fair distribution of water. As also reflected in the interviews, this distrust hindered participation in elections and collective solutions, suggesting that the erosion of trust weakened the cooperative's ability to act as a responsive and legitimate institution.

Looking into patterns of access and inclusion, and the various water groups identified, the research drew conceptual inspiration from Ribot and Peluso (2003), who argue that access to resources is shaped by socially embedded capabilities and power relations, meaning that certain actors are better positioned to benefit than others. As a result, patterns of access often reinforce existing inequalities.

Employing this framework, the results show that, aside from basic rainwater collection and manual collection of water from natural surface sources, access to clean drinking water was shaped not only by the physical availability, but also by access to technology, knowledge, capital, and property. As most adaptation strategies involved costly, technologically advanced, and complex systems, a large part of Samaipata's population was excluded from converting available water sources into reliable access to clean drinking water. Within this context, property location became an important mechanism of access, as some households were able to maintain access to both the common system and private water sources on their land.

Looking into adaptation strategies, the research unfolded the importance of knowledge, understood as the practical benefit of skills and information used to maintain access to natural resources, which shapes both individual and collective adaptation (Ribot & Peluso, 2003). Ribot

and Peluso's (2003) framework is useful for understanding how capital and knowledge overlap with technology, understood as forms of expertise that enable physical access to resources.

A system blending knowledge, technology, and capital remained inaccessible to most in Samaipata. Rainwater collection, however, was widely seen as a cost-effective adaptation strategy that, if taught, could benefit different demographic groups. Yet, we observed that many residents were unaware that rainwater could be used as a clean drinking source. Informants often referred to it as "waste", showing reluctance toward its use. The taxi driver who drove us to the couple that lived in a house in the mountains expressed admiration for their rainwater collection system, while sharing that his daughter frequently suffered from diarrhea from contaminated tap water. This contrast highlights that while large-scale systems remain out of reachfor most due to a lack of capital, limited knowledge also prevents many from adopting even low-cost solutions, such as collecting rainwater with buckets. This reveals how capital, technology, and knowledge are important enablers of access and enhance adaptation (Ribot & Peluso, 2003).

Through Ribot and Peluso's (2003) framework, the analysis reveals clear differences in access to adaptation strategies among the mapped water user groups in Samaipata. Those lacking capital, technology, and knowledge were largely dependent on the cooperative and had limited options beyond unreliable coping strategies like boiling or storing contaminated tap water. Hybrid users combined cooperative water with other alternatives, but their ability to do so depended on financial flexibility. As shown, adaptations such as private wells, rainwater collection, and filtration systems were secured through capital, knowledge, and technology, allowing some residents to achieve full independence while others remained exposed to water insecurity. Consequently, the ability to act through adaptation strategies is not equally distributed but tied to broader social and economic hierarchies. Therefore, the ability to adapt not only reflects inequalities but also produces unequal access to clean drinking water.

Mobilizing Nightingale's (2019) conceptualisation of commoning is useful for understanding how water users in Samaipata perceive water as a common resource, and furthermore, how adaptation strategies challenge this perception. The administration of the cooperative was elected by the town's citizens, thus reinforcing the idea that water was (or was intended to be) treated as a collective responsibility. Over the data collection process, the idea that "water is for everyone" was brought up repeatedly by our informants.

The findings show that due to years of unstable, inadequate access to clean drinking water—and limited prospects for change—many citizens had already adopted or were considering having alternative solutions to the cooperative's water distribution. Mobilizing Nightingale's (2019) theory that commoning inherently leads to forms of exclusion, the Samaipatan institution's aim of establishing water as a common resource through the cooperative had paradoxically created an outside. However, contrary to Nightingale's (2019) argument, the position of being "outside" Samaipata's common water system, was often a voluntary decision determined by means of adaptation. Conversely, those who remained within the "common" system were typically those without the resources to adopt viable alternatives, making their inclusion less a matter of choice and more of necessity.

Community-based management following the Water Wars have shifted Samaipata from one problematic situation to an equally unsatisfying one. Mateo, who participated in the Wars, noted that power merely shifted from one company to multiple actors. In Samaipata, many informants saw cooperative functionaries as pursuing personal interests, like political recognition, attributing management struggles to historical issues: the lust for power, individualism, and wi-

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despread corruption. These perceptions explain further the motivation to opt out of the cooperative, enforcing the idea that, in the case of Samaipata, the "outside" commoning creates is often not passively excluded but chosen over the collective as the preferable position.

Nightingale's perspective on power—something that enables and produces collective action, but also control, and exclusion (Nightingale, 2019)—explains how power relations influence who participates in and benefits from the system. This sheds light on the dynamics behind the perceived uneven distribution of the service. Power can produce exclusion by creating informal networks of obligation between individuals and authorities. Lauermann and Mallak (2023) describe this as "elite capture", a "process by which economically or politically powerful actors subvert institutions, thereby redirecting resources toward themselves" (p. 657). Some informants stated preferential access for certain people to the collective water infrastructure. only 7.75% trusted the cooperative to distribute water fairly, while 53.52% were unsure. One informant replied that he did not trust it, stating: "No, because there are members who do not pay their consumption for years due to their influence, there are people who connect to the tubes without authorization and with thick pipes".

Certain houses reportedly had bigger tubes and received better water pressure because of special affiliations with the service management. Commoning in Samaipata is thus significantly shaped by power, especially in its technological declination (Ribot & Peluso, 2003). The resource may be commonly accessible, but in a pattern reflecting existing power structures, as agents leverage interpersonal relationships, technology, and finances. Commoning is therefore continuously produced: depending on the power structure in place at a given moment. The research thus reveals a nuance to Nightingale's (2019) framework: while she argues that power dynamics in commoning can reinforce exclusion of those lacking social, technological, or financial resources, the present findings suggest that being on the "outside" is often desirable and some individuals actively choose to be excluded from the common solution.

Within this context, the informant Mateo expressed that one of the core problems in Samaipata's water system was a loss of conscience and thinking on a community level, using water with care and being parsimonious. He said there is a "*falta de vivir pensando en el bien común*"—a lack of living thinking in the common good. Consequently, his account illustrates how some residents interpret the challenges facing the common water system as connected to weakening collective responsibility and more individualistic approaches to water management. This adds nuance to Nightingale's (2019) framework by showing how commoning is continuously negotiated through both power relations and changing ideas about the common good.

As illustrated, the case of Samaipata highlights the complexities and contradictions inherent to the management of water as a common resource. While the cooperative system was established to promote shared responsibility, issues of power, corruption, and mismanagement led to a loss of trust in the system, fostering an emergence of individual solutions. The findings suggest that despite the ideal of collective water management, some residents actively chose to opt out of the system, finding self-sufficiency more appealing. Additionally, a hypothesis suggested by some interlocutors proposes a possible link between the decline in indigenous cultural connections and a more disjointed approach to water as a communal resource, with many lacking a sense of collective responsibility. However, this connection remains an exploratory hypothesis rather than an empirically substantiated finding, and would require further research to establish more firmly. Ultimately, these findings reveal a tension between collective ideals and individual practices in water management in Samaipata.

Conclusions

This study examines how water users in Samaipata adapt to lack of clean drinking water, and how adaptation strategies reproduce patterns of unequal access. By mobilizing Ribot and Peluso's (2003) theory of access and Nightingale's (2019) concept of commoning, the analysis shows that adaptation is not equally available to all. Rather, it is dependent on access through capital, knowledge, and technology, resulting in a fragmented system of unequal water access. In doing so, the study contributes to existing scholarship by demonstrating that adaptation strategies do not merely mirror pre-existing inequalities, but actively generate new exclusions, as private solutions pursued by resourceful actors leave those without capital, knowledge, or technology increasingly exposed to water insecurity.

The cooperative model, rooted in ideals of collective governance and equal access, has in practice been undermined by unclear responsibilities, institutional distrust, and perceptions of corruption. In response to poor water quality and unreliable service provision, residents turn to a range of adaptation strategies,from boiling tap water to constructing private wells or rainwater harvesting systems. For some, exclusion from the cooperative system is a position of privilege, as they turn to more reliable alternatives. In contrast, those who remain within the "common" system often lack the resources to pursue alternatives, making their dependence on the cooperative a matter of necessity rather than choice.

This divergence points to a deeper stratification underlying the cooperative ideal: one in which the capacity to "opt out" is itself unevenly distributed, and where the residual reliance on collective provision falls disproportionately on those least equipped to shape or contest it. The cooperative system, intended as an equalizing structure, may thus paradoxically reinforce the very inequalities it was designed to mitigate

While many residents continue to articulate water as a shared right and value collective principles, there is a growing turn toward individual solutions—illustrating a tension between the ideals of commoning and everyday realities. The paper also highlights that adaptation strategies in Samaipata are not neutral but conditioned by existing power dynamics: those with capital, technology, and knowledge can navigate water scarcity more effectively, while others remain dependent on the unreliable cooperative. Finally, as climate change intensifies droughts and extreme rainfall on Samaipata's already fragile water infrastructure, existing inequalities in who secures clean drinking water are exacerbated.

Several methodological limitations should be noted. Beyond the short duration of the field research, language barriers, and difficulties achieving full representativeness, the lab-in-the-field experiment's small sample of 23 participants constrains the generalizability of its findings. Furthermore, the cross-sectional design of the study does not allow for causal inference; the observed associations between capital, knowledge, technology, and adaptive capacity reflect patterns rather than established causal relationships.

Moving forward, future research could explore how water access in Samaipata has changed over a longer span of time, particularly since the establishment of the Cooperative, and investigate why access differs so significantly in nearby towns like Mairana. A more long-term, comparative approach could help shed light on how different governance models, histories, community dynamics, and future effects of climate change shape people's ability to adapt to water scarcity and what the most effective systems are. Finally, it could be interesting to examine how expanding urbanization and deforestation affect microclimates and reinforce inequalities in drinking water access throughout Bolivia.

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