

TREATED WASTEWATER REUSE UNDER A CHANGING CLIMATE

An ethnographic health risk assessment in the
Chinchaya community in La Paz, Bolivia

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**Treated Wastewater Reuse under a Changing Climate:
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community in La Paz, Bolivia**

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Treated Wastewater Reuse under a Changing Climate: An ethnographic health risk assessment in the Chinchaya community in La Paz, Bolivia

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Treated wastewater, water, water security, water insecurity, WASH, water governance, agriculture, health, risk assessment, ethnography, climate change, Bolivia, South America.

Abstract

Treated wastewater reuse is increasingly promoted as a climate adaptation strategy for water-scarce agricultural settings, yet its health risks are often assessed through approaches that foreground pathogens, contaminants, and modelled exposure pathways while overlooking everyday social practices related to water. This thesis explores how local practices, understandings, and systemic drivers of water use shape potential health risks from a pilot treated wastewater reuse project in Chinchaya, a peri-urban agricultural community in La Paz, Bolivia. Drawing on social practice theory, the hydrosocial cycle, structural violence, and One Health, the study conceptualises health risk as a social and ecological phenomenon produced through situated practice rather than as a fixed property of treated water. Fieldwork was conducted between January and March 2026 and included a participatory risk-mapping workshop, field observations, and walking and semi-structured interviews with community members and project experts. Thematic analysis identified five main findings: cumulative and interchangeable use of multiple water sources; place-based water quality hierarchies; predominantly human-made drivers of water insecurity; contested community water governance; and overlapping water risks involving runoff, contamination, animal contact, and landslides. The findings show that treated wastewater will enter an already plural, fragile, and contested water landscape. Its health implications will therefore depend not only on its laboratory profile, but on how it is incorporated into existing practices, infrastructures, and governance arrangements. The thesis argues that safe reuse of treated wastewater requires health risk assessment and project implementation to engage with local practice landscapes, hydrosocial knowledge, structural inequalities, and human-animal-environment interactions.

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Reutilización de aguas residuales tratadas en un clima que cambia: una evaluación etnográfica de los riesgos para la salud en la comunidad de Chinchaya, en La Paz, Bolivia

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Resumen

La reutilización de aguas residuales tratadas se promueve cada vez más como una estrategia de adaptación climática en contextos agrícolas con escasez de agua; sin embargo, sus riesgos para la salud suelen evaluarse mediante enfoques centrados en los patógenos, los contaminantes y las vías de exposición modeladas, pasando por alto las prácticas sociales cotidianas relacionadas con el agua. Esta tesis explora cómo las prácticas locales, los entendimientos y los factores sistémicos que impulsan el uso del agua determinan los posibles riesgos para la salud derivados de un proyecto piloto de reutilización de aguas residuales tratadas en Chinchaya, una comunidad agrícola periurbana de La Paz, Bolivia. Basándose en la teoría de la práctica social, el ciclo hidrosocial, la violencia estructural y el enfoque «One Health», el estudio conceptualiza el riesgo para la salud como un fenómeno social y ecológico producido por la práctica situada, más que como una propiedad fija del agua tratada. El trabajo de campo se llevó a cabo entre enero y marzo de 2026 e incluyó un taller participativo de mapeo de riesgos, observaciones de campo, recorridos a pie y entrevistas semiestructuradas con miembros de la comunidad y expertos del proyecto. El análisis temático identificó cinco hallazgos principales: uso acumulativo e intercambiable de múltiples fuentes de agua; jerarquías de calidad del agua basadas en el lugar; factores de inseguridad hídrica predominantemente provocados por el ser humano; gobernanza comunitaria del agua en disputa; y riesgos hídricos superpuestos que involucran escorrentía, contaminación, contacto con animales y deslizamientos de tierra. Los hallazgos muestran que las aguas residuales tratadas se incorporarán a un panorama hídrico ya de por sí plural, frágil y disputado. Por lo tanto, sus implicaciones para la salud dependerán no solo de su perfil de laboratorio, sino también de cómo se integren en las prácticas, las infraestructuras y los mecanismos de gobernanza existentes. La tesis sostiene que la reutilización segura de las aguas residuales tratadas requiere que la evaluación de riesgos para la salud y la implementación de los proyectos tengan en cuenta los contextos de prácticas locales, el conocimiento hidrosocial, las desigualdades estructurales y las interacciones entre los seres humanos, los animales y el medio ambiente.

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Summary

The world entered an era of “global water bankruptcy” (United Nations University Institute for Water, Environment and Health, 2026), and the reuse of treated wastewater from sewage treatment plants (STPs) has been proposed as an adaptation strategy for agricultural irrigation in water-scarce settings. However, pathogens, antibiotic-resistant genes, microplastics, and other contaminants have been found in STPs’ effluents, posing a risk to human health. While microbiological assessments of STP waters and risk modelling are relatively established risk assessment practices, the social dimensions of risk – how community practices, local understandings of water, and structural conditions shape exposure – remain understudied. This thesis addresses that gap through an ethnographic health risk assessment of a pilot wastewater reuse project in the peri-urban community of Chinchaya, La Paz, Bolivia, where the San Antonio STP was established in 2024 with funding from the Swedish International Development Agency (Sida), as part of the Bolivia WATCH (WASH Thinking Connected to Hydrology) programme led by the Stockholm Environment Institute (SEI).

The study is anchored in social practice theory (Bourdieu, 1972) as its overarching analytical framework, reading health risk not as a static property of pathogens but as a social phenomenon produced in everyday practice. Two complementary frameworks – the hydrosocial cycle (Linton & Budds, 2014) and structural violence (Farmer, 2009) – address the knowledge and power dimensions of practice, respectively. The One Health framework (Winkler et al., 2025; Zinsstag et al., 2023) serves as a bridging concept, connecting this social science analysis to the applied health risk assessment literature and echoing the inquiry's multi-domain scope.

Fieldwork was conducted between January and March 2026, during the Altiplano rainy season. Data were collected through a participatory risk-mapping workshop (20 participants from the community), six walking interviews and six semi-structured interviews with community members, and ten interviews with project experts. Data were analysed thematically using Braun and Clarke's (2019) six-step framework in NVivo. Five themes emerged from the data. First, water use in Chinchaya is cumulative and interchangeable: households draw simultaneously on multiple sources for overlapping domestic and agricultural purposes, sustained by a hybrid, multi-scalar, informal and formal infrastructure. Second, community members apply coherent, place-based water quality hierarchies grounded in proximity, altitude, and sensory experience rather than microbiological thinking – hierarchies that might shape how the STP-treated wastewater is classified and used, independent of its laboratory profile. Third, human-made rather than natural factors emerged as the primary drivers of water insecurity, including contested and delayed routine maintenance of the community irrigation system Mi Riego, the

destruction of traditional irrigation ditches during potable water infrastructure construction by the municipality water agency EPSAS, and uneven access to the keys needed to open Mi Riego irrigation hydrants. Fourth, community governance around water is marked by more or less open conflicts: unequal participation in maintenance work, delayed elections in the local irrigation association, and discontent over hydrant placement, which reportedly reflected political rather than equity criteria. These dynamics warrant caution in handing over management of STP water to the local irrigation association, as not everyone in the community feels represented. Fifth, water-related risks in Chinchaya overlap significantly: at least 25 surface water streams, environmental contamination, occasionally shared animal-human water sources, landslides, and surface runoff across cultivated plots together constitute a complex risk landscape that cannot be adequately captured by single-hazard quantitative risk assessments.

The discussion situates these findings within four interconnected theoretical debates. Drawing on social practice theory, it argues that cumulative and interchangeable water use is not a failure of compliance but a skilled, materially embedded adaptation to a fragile plural water environment. Through the hydrosocial cycle, water quality hierarchies are reframed not as misperceptions to be corrected through health communication, but as coherent socio-natural knowledge systems with their own epistemological logic. Structural violence provides the analytical frame for the governance and maintenance findings, situating water insecurity not within individual or community behaviour, but within the political and economic conditions that constrain the practice landscape available to community members. Finally, the overlapping risk landscape is read through the One Health framework as evidence that risk circulates across the human-animal-environment interface in ways that single-hazard quantitative assessment frameworks cannot capture, and that an integrated, multi-domain approach to risk monitoring is warranted for the project to best deliver on its health objectives.

The study concludes that health risk from treated wastewater reuse in Chinchaya is a social phenomenon shaped by cumulative water practices, hydrosocial knowledge systems, fragile governance, and structural conditions of water insecurity rooted in inequality and infrastructure deprivation. Climate adaptation interventions do not automatically produce resilience: when introduced into socially heterogeneous and governance-challenged communities without attending to existing practice landscapes, they risk increasing complexity, inequality, and exposure.

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Acronyms

EPSAS: Empresa Pública de Agua y Saneamiento

LAC: Latin America and the Caribbean

SEI: Stockholm Environment Institute

STP: Sewage Treatment Plant

WASH: Water, Sanitation and Hygiene

QMRA: Quantitative Microbial Risk Assessment

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1. Introduction

In January 2026, and without much ado, the world entered an “era of global water bankruptcy”, as per a new flagship report of the United Nations University Institute for Water, Environment and Health, UNU-INWEH (2026). According to the scientists, the language of “crisis” that has described the global water situation for decades is no longer applicable, as a return to “normal” after a temporary emergency is no longer within reach (UNU-INWEH, 2026). Water bankruptcy, instead, describes a world where water systems in many regions find themselves in a “persistent post-crisis state of failure”, such that “previous levels of water supply and ecosystem functions cannot realistically be restored” (UNU-INWEH, 2026).

Indeed, almost three-quarters of the world’s population lives in countries affected by water insecurity, or critical water insecurity (UNU-INWEH, 2026). Approximately 1.42 billion people, including half a billion children, live in areas of high or extremely high water insecurity (UNICEF, 2021). It is estimated that by 2050, three out of four people worldwide could face the impacts of droughts, which already cost 307 billion USD annually (UNU-INWEH, 2024). The Latin America and Caribbean (LAC) Region is no exception to this global trend. As of 2019, about 150 million people in LAC lived in extremely water-scarce areas, and 166 million people still lacked access to safely managed water supplies (The World Bank, 2022). Approximately 69 per cent of the LAC population lacks access to safely managed sanitation services, and 40–60 per cent of drinking water in Latin America comes from aquifers polluted by mining and agriculture (The World Bank, 2022), which are also linked to conflicts, dispossession, and contamination of water in the region, further decreasing its availability especially for rural communities (Fragkou et al., 2023). Agriculture is also responsible for 70 per cent of water withdrawal in the LAC (The World Bank, 2022).

Globally, too, 72 per cent of all water withdrawals are used in agriculture (UN Water, 2021), and 3.2 billion people live in agricultural areas with high to very high water shortages or scarcity, with 1.2 billion of these (almost 15 per cent of the world’s population) living in severely water-constrained areas (FAO, 2020). Reuse of treated wastewater from sewage treatment plants (STPs) has been proposed as an adaptation strategy for settings experiencing water insecurity under a changing climate, including for agriculture, groundwater and aquifer recharge, landscape irrigation, toilet flushing, and industrial processes (Silva, 2023; European Commission, 2025). However, pathogens, antibiotic-resistant genes, microplastics, and other contaminants have been found in STPs’ effluents (Girón-Guzmán et al., 2024; Khan et al., 2024). The reuse of treated wastewater can thus pose a risk to human health (Penserini et al.,

2024). Pathogens in STPs' water can get in contact with human hosts through at least three possible pathways (Bengtsson-Palme et al., 2018): contact with water bodies where STPs' effluents are discharged; STPs' effluents' use for irrigation; contact with domestic animals that drank from water where STPs discharged their effluents. Disruption of STP infrastructure during extreme weather events and other disasters could also lead to the spillage of pathogen-laden wastewater into the surrounding environment (Basaria et al., 2023; Hyde-Smith et al., 2022).

The presence of pathogens in the environment, however, does not necessarily imply an increased risk of disease in humans. In fact, human interactions (with the environment, with other humans, and with animals), more than pathogen presence alone, are a key factor in determining protection or vulnerability to the spread of disease (Lambin et al., 2010). Health risk from STP water reuse is, thus, a social phenomenon. Nevertheless, the social aspects of the health risks associated with the reuse of treated wastewater are importantly understudied. In fact, the majority of studies addressing health risks from reclaimed wastewater focus on quantitative assessments of environmental contaminants, quantitative microbial risk assessments (QMRAs), life cycle environmental assessments, and risk modelling (Penserini et al., 2024). When social aspects of risk are investigated, they mainly examine risk perception, implementation barriers, willingness to use reclaimed wastewater, or willingness to pay for it (Penserini et al., 2024).

This research project addresses the knowledge gap regarding how social *practices* around water use influence the health risks associated with the reuse of treated wastewater for agriculture. It does so through ethnographic observation of human–animal–water interactions in the community of Chinchaya, in peri–urban La Paz (Bolivia), where an STP has recently been established, and a pilot project is ongoing to reuse reclaimed wastewater for crop irrigation, with the dual aim of addressing seasonal water scarcity and meeting growing water demand driven by urban expansion. La Paz sits at an altitude of approximately 3,600 metres and depends significantly on glacial meltwater from the surrounding cordillera – a supply that is declining under accelerating climate change (Kinouchi et al., 2019; Vuille et al., 2018). Chinchaya, on the peri–urban margins of the city, represents a type of setting (peri–urban, low–income, recent infrastructure) that is disproportionately exposed to climate–driven water stress in the Global South (Narain, 2021), and in which the social dimensions of planned, treated wastewater reuse remain poorly understood relative to the extensive literature on informal, untreated irrigation in similar contexts (Dickin et al., 2016).

1.1 Purpose

The purpose of this research is to explore three main aspects of social practices around water. First, human–animal–water interactions in Chinchaya were mapped from an ecological perspective to identify critical practices and risk hotspots. Second, local understandings of water bodies have been explored, as situated ontologies shape social practices around water (Quiroga & Castelblanco, 2024). Third, systemic drivers of water use in Chinchaya have been investigated, acknowledging that structural factors also play an important role in shaping local knowledge systems and social practices, and thus risk, including health risks (Farmer, 2009; Harnesk et al., 2024; Sharifian et al., 2022).

1.2 Research Questions

Main research question: How do local practices, understandings, and systemic drivers of water use affect local health risks from reusing treated wastewater for agriculture?

Sub–research questions:

1. What interactions with water unfold at the human–animal–environment interface in Chinchaya?
2. How do local residents understand water and water bodies?
3. What are the systemic drivers of water use in Chinchaya?

2. Theoretical Framework

The overarching analytical framework informing this study is Social Practice Theory (Bourdieu, 1972), which helps to understand health risk (including that from treated wastewater reuse) as a phenomenon produced in everyday practice rather than a static characteristic of pathogens, water or individual behaviour. Two complementary frameworks – the Hydrosocial Cycle (Linton & Budds, 2014) and Structural Violence (Farmer, 2009) – address the knowledge and power dimensions of practice respectively, attending to how water is understood and classified, and to the structural conditions that underlie local practices around water. The One Health Framework (Winkler et al., 2025; Zinsstag et al., 2023) operates as a bridging concept connecting, through its ecological lens, this social science perspective to the applied health risk literature, within which health risk assessments of treated wastewater are often situated.

Social practice theory holds that the appropriate unit of social analysis is neither the individual actor nor social structure, but the practice itself: a routinised configuration of

bodily activity, material artefacts, knowledge, and meaning (Reckwitz, 2002). Shove, Pantzar and Watson (2012) further illustrate this framework, showing how practices are reproduced through the interplay of materials (physical objects and infrastructure), competencies (embodied skills and knowledge), and meanings (purposes, values, and symbolic associations). Applied to water use, this framing repositions apparently irrational or risk-producing behaviours (drinking from an irrigation hydrant, mixing water sources, using stream water alongside potable water) not as individual failures of knowledge or risk perception, but as skilled, contextually rational adaptations to specific material and social conditions. Health risks, in this perspective, do not arise from ignorance or non-compliance; they are embedded in the socio-material fabric of daily life (Cahill et al., 2024). Social practice theory is the primary lens for the first sub-research question (what interactions with water unfold at the human-animal-environment interface in Chinchaya) and informs the methodological choice of walking interviews to access practice in situ, rather than solely through retrospective self-report.

The hydrosocial cycle, as theorised by Linton and Budds (2014), extends the social practice framework into the domain of knowledge, providing an analytical lens for the second sub-research question: how local residents understand water and water bodies. The concept maintains that water is not a singular biophysical substance with fixed properties, but the result of a socio-natural process in which water and society co-produce each other across time and space. Water, in this framework, is always simultaneously material and social: a bundle of material substance and of the history, power relations, and cultural meanings of the settings through which it flows. This analytical perspective resonates with a longer tradition in political ecology and environmental anthropology that has challenged the separation between nature and society as a foundational analytical category (de la Cadena, 2015; Descola, 2005; Ingold, 2000; Latour, 1993). It is particularly salient in the Andean context, where Aymara and Quechua cosmological frameworks position water as a living, relational entity embedded in reciprocal obligations between humans and the natural world: ontologies that shape practices in ways that technical or hygienic approaches to water management are incapable of capturing (Quiroga & Castelblanco, 2024). Reading the community's understanding of water through the hydrosocial cycle allows this study to interpret it not as a perception to be corrected, but as a coherent socio-natural knowledge system that carries its own epistemological logic.

Structural violence, as developed by Farmer (2009), provides the analytical corrective to social practice theory's potential risk of under-theorising power and has been used in this

manuscript to analyse the findings of the third sub–research question: what are the systemic drivers of water use in Chinchaya? Farmer argues that the distribution of disease risk in marginalised communities reflects the political and economic arrangements that systematically expose some populations to harm while protecting others. According to the scholar, this is not an incidental effect but a structural feature of unequal societies (Farmer, 2009). This concept is directly applicable to water insecurity: the conditions under which communities manage, maintain, and share water infrastructure are shaped by historical dispossession, governance failures, and unequal resource distribution that precede and constrain individual choice (Harnesk et al., 2024; Jepson et al., 2017). Structural violence situates the practices documented in Chinchaya within the structural conditions that make them possible or necessary, rather than treating them as freely assembled configurations of materials, competencies, and meanings.

The One Health framework holds that human, animal, and environmental health are inseparable and can only be understood through their interconnections (Winkler et al., 2025; Zinsstag et al., 2023). Such a framework shares with political ecology and environmental anthropology a rejection of single–domain explanations of health risk and can be read as a medicalised articulation of what these fields have long argued: that health cannot be separated from the ecological and social relations within which it is produced. In this study, the One Health framework thus legitimises, within the health risk assessment literature, the scope of inquiry advanced by social practice theory. It also serves as a bridge between the social science traditions above and the applied biomedical risk assessment literature underpinning health risk assessments of treated wastewater. In doing so, it provides an applied scaffold through which the social science findings of this study are translated into implications for project implementation and health risk governance.

Together, these frameworks articulate a coherent analytical architecture: social practice theory establishes that risk is produced in practice; the hydrosocial cycle unveils that water is known through socio–natural relations; structural violence illustrates that practice is constrained by power; and One Health shows how risk circulates across the human–animal–environment interface, bridging the previous analytical frameworks to medical and public health scholarship. Their combination allows this study to address health risk from treated wastewater reuse as a social phenomenon, and to translate its analysis into health recommendations grounded in the conditions the community inhabits. The selection of theoretical perspectives underpinning the study, and their alignment with each research question, was informed inductively by the field data.

3. Methodology

3.1 Context and Access

The community of Chinchaya, in peri-urban La Paz, Bolivia, faces combined pressures from urban expansion and traditional agriculture. Local livelihoods depend on the cultivation of vegetables and flowers for both subsistence and market sale. Like the rest of the Bolivian highlands (the Altiplano), the area experiences a two-season climatic pattern, consisting of a rainy summer (from November to April) and a dry winter (from May to October). Chinchaya lacked access to state-provided sanitation and potable water services until July 2025, when the municipal water agency, EPSAS (Empresa Pública de Agua y Saneamiento, “Public Social Water and Sanitation Agency”), inaugurated its infrastructure in the area. As of August 2025, around 87 per cent of households were connected to the EPSAS potable water system, and 61 per cent were connected to the EPSAS sanitation system, as residents must privately bear the connection costs (EPSAS water officer, personal communication, May 4, 2026).

Since 2022, a state-funded irrigation initiative, Mi Riego (“My Irrigation System”), has been operating in the community. As part of this system, a water-catchment infrastructure has been constructed to capture water from a local river, store it in a series of tanks, and distribute it to agricultural plots via a network of hydrants. A locally based irrigation association, formally registered under the Mi Riego project, brings together community members whose farms are connected to the hydrant network. It is responsible for the maintenance and cleaning of pipes and storing tanks, and for regulating and sanctioning non-irrigation uses of the water.

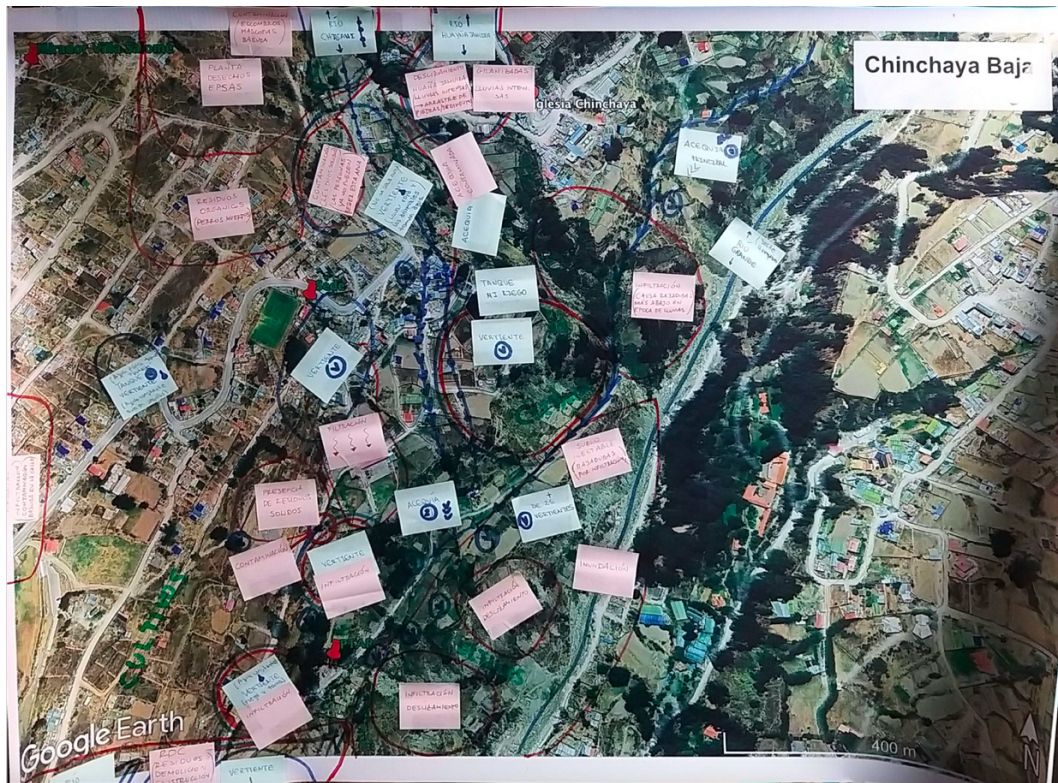
In 2024, the San Antonio STP was built in Chinchaya with funding from the Swedish International Development Agency (Sida). Under the Sida-funded Bolivia WATCH (WASH Thinking Connected to Hydrology) programme, the Stockholm Environment Institute (SEI) and local partners are piloting the reuse of reclaimed wastewater from the San Antonio STP for agricultural purposes in Chinchaya. The pilot project aims to help meet the growing water demand driven by population growth and to address the seasonal water scarcity the community experiences during winter. It also includes a health component to develop guidelines for the safe reuse of treated wastewater, under which this research project has been carried out, in partnership with SEI’s Sanitation and Health Team. My access to the field has been facilitated by SEI and local partners in Bolivia, including the SEI local team, the non-governmental organisation Agua Sustentable (supporting the implementation of the pilot project in the field), and La Paz’s Universidad Del Valle (conducting epidemiological analyses under the health component). A local translator provided support in the Andean

language Aymara when needed, as Spanish is a second language for many residents in Chinchaya.

3.2 Data collection

To address the project's research questions, I used a combination of data collection methods. I organised a participatory risk-mapping workshop designed to elicit local knowledge and to map relationships among people, animals, and the environment, thus identifying risk hotspots without using geospatial software. A total of 20 participants from the community attended. Participants were divided into three groups, each supported by an expert facilitator. Each group received a large, printed map of the community generated using Google Earth, along with coloured cards and stickers, pens, and markers. Groups were then asked to identify and mark water-related risks within their community on the map using red sticky notes. Blue sticky notes were used to mark water sources. No definition of "risk" was provided, in order to allow local understandings of risk to emerge from the group discussions. However, a list of example water-related risks was handed over to participants to prompt discussion and reflection. The list included landslides, water contamination, extreme weather events, water scarcity, flooding. It was based on historical data of water-related events in the area and on information provided by residents during earlier project activities in the community. Participants were encouraged to bring up any additional water-related risks that came to their mind. At the conclusion of the workshop, a representative from each group presented a summary of their discussion and mapping outcomes to the other participants. The three maps were subsequently consolidated into a single aggregated map (Figure 1).

In addition, I conducted six walking interviews and six semi-structured interviews with a total of 12 community members, purposively identified during two introductory visits to the community, the participatory risk-mapping workshop, and careful consultation with project officers. Snowballing was also used during interviews with community members to identify additional interviewees. During walking interviews, I visited interviewees' farms and houses, asking questions to understand people's routines and movements across different social and physical spaces in the community. I also conducted field observations of the activity of domestic and wild animals in the area at different times of the day. Walking interviews are a consolidated research method for understanding the implications of place for social practices, including health and well-being (Carpiano, 2009; Evans & Jones, 2011; Kusenbach, 2003). Semi-structured interviews were used to directly engage with local conceptualisations of water and its relationship with the local community.



To complement community interviews and the participatory risk mapping, and gain a broader understanding of the systemic drivers of water use in Chinchaya, I also conducted ten interviews with nine experts working on the pilot project: two walking interviews with the project agronomist, and eight semi-structured interviews with project officers leading the health, social, technical, and community work components of the project. All experts involved in field activities were thus interviewed. All interviews were anonymised, and all were conducted in Chinchaya, so that there are no identifiers in any of the quoted excerpts in this manuscript. Data was recorded through a portable voice-recorder and fieldnotes. Interviews were conducted in Spanish, with translation support to and from Aymara provided by a professional translator when needed. Table 1 summarises data collection information.

	Community members	Experts
Walking interviews	6	2 (two interviews with the same person, in different community locations)
Semi-structured interviews	6	8
Participatory risk-mapping	20	3 (workshop and group facilitators)

Table 1. Data collection methods, participating community members, and project experts.

3.3 Data analysis

Collected data were analysed thematically according to the six steps proposed by Braun and Clarke (2019). Fieldnotes, interview transcripts, and the transcription of participatory mapping results were imported into a single dataset in NVivo. I first familiarised myself with the dataset by reading and re-reading the raw data, noting down potential patterns. I thus generated initial codes inductively, and then grouped them into themes that reflect broad patterns in the dataset. Candidate themes (i.e. initial themes emerging from the data at this stage of the analysis) were then reviewed and validated against codes and against the entire dataset for coherence. Themes and their interrelationships were then summarised within an overarching narrative in the findings. The analysis was carried out in Spanish, and relevant excerpts then translated by the author to English for the purposes of this manuscript.

4. Findings

4.1 Theme 1: Cumulative and interchangeable uses of water

Most interviewees upheld a strict separation between potable water for domestic use (provided by EPSAS) and irrigation water (from Mi Riego hydrants, streams, wells, rain, and irrigation ditches), stating that they did not use EPSAS water for irrigation and did not drink irrigation water. As an interviewee explained: “We are connected to the potable water system, but we do not use that water for Mi Riego, not at all. That is just for cooking, showering, etcetera”. Others echoed the same rigid use separation: “We don’t use the water from EPSAS to irrigate, not at all. That is just for domestic use, in the home, to have a bath and all these things”, and “I don’t use irrigation water in the house, we have EPSAS. And before EPSAS, I would bring potable water in tanks from another house we have, I did not drink the other water.”

However, walking interviews indicated that as new sources of water became available, their use became cumulative and interchangeable, not exclusive, for both drinking and irrigation. During a visit to their home, two interviewees showed us two faucets in their garden and explained that one had EPSAS water, while the other had stream water. “Now we have EPSAS water”, explained one, “but we keep using stream water for chores and for cooking. I also drink it. We use both waters.” The other added: “Once they cut EPSAS water because I forgot to pay. I drank well water for two or three months, what else could I have done?” While visiting his home and garden, another resident illustrated: “I keep using well water for drinking. As the EPSAS water is recent, I need to think about how to use it. Of course, I am thinking of the kitchen, the toilet...” A farmer mentioned he sometimes drinks water from the Mi Riego hydrant system while he is in his plot working: “Sometimes heat forces you to drink [water from the hydrants]. Yes, sometimes you are forced by chance to drink it while working in the field because of the heat. Nothing happens; this water is normal.” Another woman also swore she never got ill from drinking stream water: “In my long decades, I never visited the hospital once, can you imagine?”

Some residents described the situation as an alternative water system operating in parallel with EPSAS in the community. This system collects stream water through a network of pipes and stores it in tanks for use in drinking, animal watering, and laundry. An interviewee explained: “The stream water is stored in tanks, and from there it gets to the houses. People connect to these tanks and put a faucet in their homes. It’s like an alternative system to that of EPSAS”. Another resident further detailed: “I have both EPSAS water and stream water, one here and one here, both. It’s two different faucets. The stream water comes through a network, too. The community built it, and the majority is keeping this water for laundry and for the animals.” A project officer added: “There are superficial and deep stream waters in the community, and people have sought to build pipes and tanks to channel this water to their homes”. Such a system was also described, and tanks were identified, during the participatory risk mapping workshop.

Others mentioned that, despite the community adhering to the governmental program Mi Riego, they use various water sources for irrigation. Many have access to Mi Riego hydrants, but when water is not present in them because of (frequent) maintenance disruptions or because of the dry season, wells are used instead: “I have two wells with subterranean water. They never dry up. I can empty them to irrigate in the morning, and they will be full again in the evening. When there is no water in the hydrants, I use them”, an interviewee explained. Another illustrated that, when hydrants are dry, community members turn to streams and

rivers, irrigation ditches, and rain: “When there is no water in the hydrants, we turn to rivers and collect water in buckets to irrigate. We also wait for the rain or use rainwater that we have been harvesting from our roof in a tank. Others continue using the irrigation ditches we all used before Mi Riego was installed”. Sometimes, such alternative sources of water are mixed, as a farmer explained: “At times, I fill the well with hydrant water. I sort of mix well and hydrant water. And I irrigate with that”. Other residents clarified: “We use both Mi Riego and the old irrigation ditches. That’s very effective”.

In addition, not everyone in the community has connected to EPSAS, and those who haven’t are still using surface water, Mi Riego hydrant water, or rainwater for domestic use, albeit boiling it first. As a resident illustrated: “We don’t have EPSAS water in our street. We use hydrant water and stream water. During the rainy season, this water turns brown. Then we use the rainwater we harvest in two big tanks. We always boil it before using it, though.”

4.2 Theme 2: Water quality hierarchies

People in the community appear to apply different quality standards to water based on its proximate source. Water springing from Mi Riego hydrants is generally considered of good enough quality for irrigation. A resident summarised the prevalent view in the community: “The water [from the hydrants] is fine. It doesn’t have any unusual smell or colour. It has never made me sick. We don’t treat it because the quality is good, we use it as it is”.

However, the nearby river supplying water to the Mi Riego system was labelled by virtually all interviewees as highly contaminated, with dead dogs, black and grey water discharge, sand and mining residues from upstream work, garbage, and rubble from construction work:

“Water from up there [from the river supplying the Mi Riego system] is being contaminated. They discharge debris, garbage... People living up there raise many dogs and throw their waste in the river too. There are also dead dogs,” commented a resident. Another added: “Further above, there are mines, they do sandblast work as well... and that contaminates the river. People living there do not have toilets connected to the sanitation system either, they use septic tanks... the river smells really bad there”.

Thus, although it was the same water at different locations in the community, there seemed to be a disconnect between the quality assigned to this water at its proximate point of origin (the hydrants) and at its source. When I raised the issue during an interview, one of the participants dismissed the concern, saying that “the river is far away, uphill”. One of the interviewed project experts supported this interpretation, suggesting that community members

likely perceived the Mi Riego water as pure because they knew it originated from the nearby cordillera (the mountain range surrounding La Paz). However, he pointed out, “Since these areas are being incorporated into the city only recently, waste management is handled directly in a scattered manner using dry sanitation systems, where each household builds a septic tank in their home and then uses that septic tank. And that generates a pollutant load that, because of the underground water dynamic, is surely contaminating the water from the sources they are using”.

Such a location-based evaluation of water quality is also applied to other water sources in the community. An interviewee illustrated how hydrant water and stream water quality are considered less than well water quality, due to well water gushing deeper in the ground: “There are shallow waters and deep waters. You have to be very careful with the shallow ones. The deep ones are clear: I’ll show you my well, you will see how crystalline it is”. Another described how rainwater is considered of higher quality than potable water, due to falling from the sky: “Rainwater is cleaner. I have a roof; my kids hooked it up to a rainwater system. It’s a little tank, and that rainwater lasts for years. It stays crystal clear. It’s not like the water from EPSAS. That turns green. Water from EPSAS barely lasts four months; even if you keep it clean, it still turns green. Now this rainwater doesn’t turn green at all. It stays clear; it never turns green. You can store it for 10 years, 20 years – you can keep it that long.”

Superficial water from the higher part of the community is also considered to be of a different quality than superficial water from the lower part, as a resident mentioned: “The water from the springs is clean because it comes from above. Yes, I think the water down below does smell; that’s true, because everyone here – since they don’t have bathrooms – uses septic tanks, so it has a strange smell.”

These hierarchies might affect how the project’s treated water is used and handled: if the plant is considered a reliable water source, treated water might be used irrespective of its laboratory profile. Such classifications are thus worth monitoring after the treated water distribution is fully working.

4.3 Theme 3: Prevalence of human-made reasons for water insecurity

Some of the interviewed people identified climate change as a source of future water scarcity in the community: “So, in a little while, water here will be like gold – it’ll be in high demand, and there won’t be enough of it anywhere in the world. I think we’re starting to see that now – global warming and all that.” However, the significant seasonal deviation from rainfall

averages the area experiences in certain years was not straightforwardly connected to climate change. “Well, last year we had more rain, this year less, but that's okay, that's okay”, one resident commented, while another did not elaborate further than “Sometimes it rains, sometimes it doesn't. It doesn't always rain.”

Seasonality emerged as a far more established and well-known reason for water insecurity in the area. This was a predictable finding, as the Altiplano climate alternates between a rainy summer (November–April) and a dry winter (May–October). Virtually all interviewees reported a significant reduction in the availability of both superficial water (from springs and irrigation ditches) and Mi Riego hydrants' water (which is supplied by a local river) during the winter, as exemplified by the comment of this farmer: “It's getting cold now, and [the water] is already starting to drop. It'll be over soon. The water's already starting to drop, up above. In the dry season, there is not always water in the hydrants. In October and November, the spring water dries up. It all dries up.” Some report they just give up on irrigating during the dry season: “When there's no water in the hydrants... that's just it, because there isn't any in the irrigation ditch either – the water isn't coming anymore. When there's a water shortage, we don't water our plot at all, really.” The reuse project aims to address this yearly issue precisely, and many interviewees hope that the availability of treated water coming out of the plant will help compensate for water scarcity during the austral winter, as one plot owner explained: “I think that could work in our favour when there's no water. That could be useful when there's no water. So, the crops don't dry out.”

Nevertheless, human activities seem to contribute far more to water scarcity than natural factors. Virtually all interviewees mentioned poor and untimely maintenance as a main driver of water scarcity during the rainy and dry seasons: “Hydrants need maintenance, otherwise they will not have water. They need constant cleaning”, many voiced. Heavy rain during the summer means a progressive build-up of mud coming from the river in Mi Riego catchment points, storing tanks, and pipes, leading to obstruction if cleaning does not happen regularly: “The tanks fill up with mud. So, you have to go in and scoop it out – sometimes using shovels and picks, sometimes buckets – to remove the sediment. During the rainy season, the water comes out chocolate– or coffee–coloured. The hydrant pipes get clogged with fine soil and gravel, and we need to clean that up.” Some interviewees even reported finding dead animals stuck in the pipes after cleaning was delayed for too long a time: “It's not that there's a lack of water; it's that the pipes keep getting clogged. In fact, on one occasion, it broke, and in the photos they sent, they pulled out a rat.”

The tanks storing river water before it reaches the pipes also need to be manually filled every day. The designated operator described how he does that by opening a specific valve: “The tank is filled every day. You just have to adjust the valve so it doesn’t let in too much water; otherwise, the tank will overflow. The valve has to be set just right so there’s a small overflow – it overflows through a four-inch pipe – so that when the tank is full, it starts overflowing into the pipes.” Delays in this operation might mean the hydrants downstream do not receive enough water to accommodate community needs. A resident commented: “There’s not always water in the hydrants: sometimes they just cut the water, close the hydrants... There’s very little water in those cases.” In addition, maintenance work is performed by community members, convened by the president of the irrigation association, when a member flags that water is missing from the hydrant system or that disruptions need to be fixed. However, some interviewees reported delays between the time an incident is reported and the time association members are called to intervene: “Where I have my plot, down there, there are just a few of us using Mi Riego water, so they probably don’t maintain it anymore. The responsible person was supposed to call to organise maintenance activities; he told me he’d call me. He hasn’t called, he hasn’t called for two or three months, and I haven’t run into him either. That’s it, I have a complaint, that’s it, things are bad there. I don’t know what he was doing.” In addition, many interviewees highlighted that even when called, some community members do not respond, making maintenance operations inefficient and unreliable in general: “The community members who are part of the Mi Riego irrigation association are not a united group. Those who want to work on cleaning and maintaining the system go; those who don’t want to, don’t go. Some go to do the work, others don’t: not everyone comes.”

Finally, members of the Mi Riego hydrant system should own a key to the hydrants serving their farm; however, not everyone seems to own such keys. One project officer commented, “I think you can get a key for the hydrants, or someone has the key. So, you need to find that person. And I think you need to pay. It’s like every six months, and it’s mainly for maintenance. They are not really paying for how much water they are using. There isn’t a meter. But I think if you don’t pay, you don’t get a key, or they won’t lend you one. So also, some people didn’t have access because of that.” Such considerations are important to consider when planning to hand over the management of treated wastewater to the local irrigation association: doing so before maintenance issues are resolved may increase maintenance challenges and fuel discontent.

Maybe counterintuitively, structural works to establish potable water and sanitation services in the community also reduced irrigation water availability for some interviewees and worsened maintenance challenges. Such construction work, in fact, resulted in some irrigation canals being paved over or cut off, depriving local farmers of an easily accessible source of irrigation water when hydrants run dry. A farmer commented, “The water from the irrigation ditch used to flow here. That’s why we cry, we’re always crying because they’ve cut off the water from upstream. They have sealed off all our irrigation ditches when building the sanitation and potable water systems... Now the ditches just get to the community before ours. So there’s no water left for us. Hydrant water is a lot of work.” In addition, open irrigation ditches were reportedly much easier to keep clean and maintain than the piped network of Mi Riego hydrants and tanks. Another farmer explained: “It was better that way [with irrigation ditches] – it really was. Now it’s so hard... We didn’t know that the water was going to come into a pipe, a pipe this little... now it’s much harder to clean it inside, that cement channel, that was great. It’s harder now to get inside; now we’re scooping out a bucket of black dirt that’s like gum – it sticks to the bucket and won’t come out. We’re taking the bucket to the river to wash it, and little by little it comes out... that’s hard.”

Some interviewees also reported that, finally gaining access to potable water from the municipality, some residents and even the irrigation association committee lost interest in maintaining the local irrigation system, as they perceived water availability to be no longer a problem. A resident commented: “When people just had a little well, they took care of it because it was their source of water, but now that they have potable water, they don’t give this little well as much importance anymore. They used to clean it, keep dogs and other animals away, even fence it off, put a lid on it – they did all the maintenance. But now with potable water available, people don’t care anymore.” Another interviewee added: “After they’d laid the asphalt, installed the sewer system, and provided drinking water... until then, the current leaders were good, they would show up. After that, they were like, “What are they [community members] going to complain about now? What are they going to fine me for?” The interviewee expressed concern that treated wastewater from the project might cause similar setbacks if people discounted the need to maintain the local irrigation system.

4.4 Theme 4: Contested community water governance

Virtually every interviewee highlighted that communal work to maintain and clean the Mi Riego irrigation system was not distributed equally in the community. Despite the irrigation association committee calling on each member of the association to go and help clean and

maintain the pipe and tanks network when incidents happened, in fact, many simply did not show up: “They don’t listen to the president of the irrigation association. He invites them to the association meetings, and they don’t come. They’re not interested. That’s how it is. When it comes to doing maintenance work, they still don’t come; they don’t care. They don’t care about the water or their plants drying up. They just care about complaining.” This caused resentment in those who actively participated, who felt they were doing work for everyone. A community member complained: “Others are taking the easy way out, brother. We work like donkeys, while others take the easy way out. We’re working our butts off for them.”

Interviewees also attributed the scarce participation to a lack of active follow-up and sanctioning from the directive of the irrigation association: “The person responsible for water needs to fix this. Everyone needs to participate in the maintenance work, everyone”, a resident complained. The internal life of the association, as well as the political life in the community, was also described in conflictive terms, with elections delayed due to a lack of agreement or delays in resolving pending matters. “We still haven’t elected the new committee of the irrigation association,” a farmer explained, “because there is so much disagreement”. Another added: “The current president is staying in place longer than the usual term because there were some pending issues that took time to solve, and he couldn’t go before they were fixed.”

A project officer also reported that community members reckoned that the hydrant system had been designed to place hydrants closer to certain farms than others, reflecting political and party affiliation: “Some people in the community think that how the hydrants were located was not really fair. They reckon the government placed hydrants closer to party supporters, who could then just connect a short hose and irrigate their crops. Other families would have to use a 150-meter hose, which of course they don’t have.” This also fueled discontent and mistrust. Connecting to the local municipal water supply system was also a source of conflict in the community, with some streets still lacking access because some residents refused to give up a fraction of their property to make space for the pipes. This resulted in the entire street not being connected to the potable water network: “We don’t have EPSAS water,” a resident explained, “they haven’t approved it up here because our neighbours started fighting, they did not want to lose even 50 centimetres of their property to make space for the pipes. So, we don’t have it.”

4.5 Theme 5: Overlapping water risks

During the participatory risk mapping workshop and individual interviews, participants highlighted how water-related risks in the community overlapped.

4.5.1 Superficial water runoff, extreme weather events and landslides

During the participatory mapping workshop, surface water runoff was described as prevalent year-round in the community, spanning the entire lower part of the area where farms and fields are located (Figure 1). Participants counted 25 surface-water streams running through the area, which explains the high prevalence of runoff (Figure 1). In the community, they believed this might contribute to soil instability and frequent landslides further down the hillsides: “This water runoff filtrates across the soil and causes crevices in the lower part of the hillside”, many pointed out during the mapping workshop.

An interviewee explained that installing the Mi Riego hydrant system also contributed to increasing water filtration: “When they installed the pipes for the irrigation system’s hydrants, they destroyed several sections of the traditional irrigation ditches. And there are places where the water disappears. So, there are sections where the water disappears from the irrigation ditch, and we don’t know where it goes. It seeps away. And they themselves don’t know where it goes. Last year, a neighbour took photos of the lower part of the community where, according to him, the irrigation ditch that had disappeared was gushing out of the ground. People are afraid that this contributes to landslides.” When presenting their maps during the mapping workshop, participants also commented that some of this running water infiltrates houses, causing cracks in the buildings: “We’ve identified that the entire upper section has slopes that cause water to run down the sides of the houses, causing cracks in the walls. Moisture builds up in the lower section.”

Extreme weather events were also mentioned as a concerning water-related risk in the community. Participants in the workshop described frequent hailstorms that hit a specific area on the outskirts of the community. Such events were described as charging soil with additional water, contributing to landslides in the lower part of the hillside.

4.5.2 Contamination

Participants in the mapping workshops highlighted multiple areas of contamination in the community, affecting various water sources, including the river supplying water to the Mi Riego irrigating system, streams and local irrigation ditches, that were used as drinking water sources by people not connected to municipal water (Figure 1). According to participants, contamination made drinking such water impossible, making drinking water less available for those not connected to the municipality’s potable water network: “We used to draw water from the irrigation ditch and streams and drink it, and we used to cook with it, but not anymore. Now that the area is full of houses, it’s no longer clean. Before, the water in that

ditch was really clean; we used to drink it all the time.” However, the same streams were still used to provide drinking water for the animals and to wash clothes (Figure 1).

Mentioned sources of contamination were solid waste, black water discharge, animal waste, dead dogs, garbage, and rubble from construction work (Figure 1). Participants suggested that the high water filtration, combined with the high contamination, could cause contaminated water to spread throughout the community: “For example, at the top of this reservoir is the pet cemetery. There’s runoff water, and there are also pollutants like trash, bottles, and debris – everything is washing in. That’s why this reservoir, which used to supply water to all the irrigation ditches for the plots, is now contaminated.”

4.5.3 Animals using the same water sources as humans

During multiple interviews, participants commented that animals (livestock and pets) drank from the irrigation ditches, wells and streams that also served as alternative irrigation water sources, and sometimes, drinking water sources: “Livestock and pets drink from the remaining irrigation ditches and from stream water. People also use well water to water animals”, a farmer illustrated. The participatory mapping workshop yielded similar results (Figure 1). During one of our walking interviews, the project’s agronomist pointed towards two cows grazing in a plot, where superficial water run-off was evident: “The waste from these animals is going directly to the ground and in that water”, he pointed out, “that is another form of contamination in this area.”

Such findings are particularly relevant to the implementation of the treated wastewater reuse project. In fact, project experts intend to recommend using treated wastewater to irrigate either food crops and flowers, or flowers alone, depending on its laboratory profile. However, substantial surface runoff across cultivated land within the community suggests that treated wastewater may inadvertently be conveyed to food crops as well, since these are often grown in the same plots. Moreover, the high levels of environmental contamination in the area indicate that the laboratory profile of treated wastewater should not be assessed in isolation, but rather considering the likelihood that it may become mixed with other contaminants.

5. Discussion

This study set out to explore how local practices, understandings, and systemic drivers of water use may affect health risks from reusing treated wastewater for agriculture in the peri-urban community of Chinchaya, La Paz, Bolivia. The five themes emerging from the data –

cumulative and interchangeable water use, water quality hierarchies, the prevalence of human-made reasons for water insecurity, contested community water governance, and overlapping water risks – together reveal that health risk from the San Antonio STP reuse project is not only a function of the laboratory profile of treated water. It is, instead, a social phenomenon shaped by the material, relational, and structural conditions under which water circulates in the community (Lambin et al., 2010).

5.1 Water use as social practice: cumulative, interchangeable, and materially embedded

Despite the availability and institutional separation of two distinct water systems in Chinchaya (potable water from the municipal provider EPSAS and irrigation water from the government program Mi Riego), fieldwork revealed a more complex and plural water landscape in the community. Water sources are used cumulatively and interchangeably, with the same household drawing on EPSAS water, stream water, well water, rainwater, and Mi Riego hydrant water for overlapping domestic and agricultural purposes, sometimes simultaneously.

Social practice theory provides an analytical lens for understanding this finding. Reckwitz (2002) defines practices as routinised configurations of bodily activity, material artefacts, knowledge, and meaning – not as individual choices made by rational actors. Shove, Pantzar, and Watson (2012) further argue that practices are reproduced not because people consciously decide to reproduce them, but because the material and social conditions of everyday life sustain them through materials, competencies, and meanings. In Chinchaya, the practice of drawing on multiple water sources simultaneously is assembled around infrastructure scarcity, seasonal variation, and informal community engineering. It is sustained by material conditions – two faucets in a single garden, rainwater harvesting tanks, pipes built by the community to channel stream water to homes – and by competencies acquired through the experience of water insecurity: knowing when the hydrants will be dry, knowing how fast wells replenish, knowing to boil stream water. These are not irrational behaviours but skilled adaptations to a fragile and plural water environment (Cahill et al., 2024).

Reading social practices around water in Chinchaya through the lenses of social practice theory is useful for advancing both sustainable development and health risk assessment perspectives on the STP reuse project. From a sustainable development perspective, this analytical framing highlights how the social water system in Chinchaya is embedded in a multi-scalar infrastructure configuration that encompasses water pipes, rainwater collection tanks, the Mi Riego hydrant network, faucets connected to both EPSAS and stream water

sources, and wells. This hybrid, disaggregated arrangement is consistent with what Furlong (2014) identifies as the predominant water supply model across the Global South: plural systems with varying degrees of formal and informal coexistence, as distinct from the universalised network infrastructure that emerged in the Global North following post–Second World War development. The author argues that improving access to water and sanitation requires supporting the coexistence of multiple systems, rather than consolidating provision under a single provider (Furlong, 2014). As she notes, moving beyond a network–centred perspective requires greater attention to the ecological interconnections among the multiple water flows circulating within and around urban environments (Furlong & Kooy, 2017). The findings of this study support this perspective, as they add to the evidence from Central and South America showing that households continue to rely on diverse water sources even after gaining access to centrally distributed potable water (Furlong & Kooy, 2017; Meehan, 2014).

A social practice theory framing is also useful for advancing health risk assessment perspectives on the STP project. International frameworks on climate–resilient WASH (water, sanitation and hygiene), such as the World Health Organisation’s Indicators, Measures and Methods for Monitoring Climate Resilient WASH (2025), aseptically address social practices related to water as “adaptation actions”, “user experiences of hygiene behaviours” or “user experiences of water and sanitation services” (ibidem, p. 6). In addition, the most commonly used methods for assessing the health risks of water reuse in agriculture – such as quantitative assessments of environmental contaminants, quantitative microbial risk assessments (QMRA), life cycle environmental assessments, and risk modelling (Penserini et al., 2024) – barely address social components of health risks. However, as the anthropology of major epidemics has consistently shown (Abramowitz, 2017; Giles-Vernick & Villa, 2025), risk emerges in lived practice rather than in isolation from it. Overlooking the situated socio–material practices through which health risks emerge creates significant blind spots in understanding the specific practices and broader ecological and social relations that shape the health implications of treated wastewater reuse.

5.2 Between lay expertise and risk: water quality hierarchies as situated knowledge

Residents and farmers in Chinchaya seem to hold a place–based understanding of water quality in the community, which was acknowledged but challenged by some of the interviewed project experts. In the dominant “deficit model” of risk communication, divergences between lay and expert assessments of water quality are treated as knowledge

gaps to be closed through education and information provision (Abunyewah et al., 2020; Wynne, 1993; Wynne, 2006). The findings from Chinchaya do not support this framing.

Community members in Chinchaya apply a coherent and locally consistent quality hierarchy: deep well water is perceived as cleaner than shallow water; water from the cordillera is considered purer than water from the lower valley; rainwater is ranked above EPSAS potable water when stored in tanks; and water at the hydrant is assessed as separate from and better than water in some parts of its river source. These classifications are grounded in sensory experience (clarity, smell, colour), spatial reasoning (elevation, distance, proximity to contamination sources), and historical knowledge accumulated over years of living with these water systems. As Slovic (1987) demonstrated, lay risk evaluation is not simply a degraded version of technical risk assessment – it systematically incorporates dimensions of risk that technical frameworks exclude, including familiarity, personal experience of outcomes, and perceived control. In this case, community members correctly identify the river as contaminated; their apparent lack of connection between that contamination and the hydrant water is not ignorance but a specific form of spatial reasoning about how water changes between its source and its point of use, mediated by understandings about filtration, distance, and altitude.

Linton and Budds (2014) offer a useful theoretical framework to interpret this finding through the concept of the hydrosocial cycle: a socio–natural process in which water and society co–produce each other over time and space. In the hydrosocial cycle, water and society do not relate to each other as preformed entities but emerge as a function of their reciprocal relations. In the hydrosocial cycle, thus, water is a configuration of H₂O *and* the social circumstances in which it is produced (Linton & Budds, 2014). In Chinchaya, water is experienced as cordillera water, river water, deep water, sky water, hydrant water – each with its own history and social relations that make it pure, polluted, accessible, inaccessible, reliable, or unreliable. Each of these waters, thus, has its own place in the community's understanding of the local natural and social world.

Scholarship in medical anthropology helps move the analysis further, from understanding to ontology. In her foundational book *The Body Multiple* (Mol, 2002), Annemarie Mol shows that atherosclerosis is not a single disease viewed from different perspectives, but a multiple object enacted differently across practices – for instance, as a thickened vessel wall in pathology, as obstructed blood flow in clinical examination, and as a target for intervention in surgery. In doing so, she argues that situated socio–material practices bring different versions

of an object – even diseases – into being (Mol, 2002). This perspective resonates with both social practice theory and the hydrosocial cycle, suggesting that in Chinchaya, water is not a single substance variably perceived, but a set of distinct socio–natural entities – cordillera water, hydrant water, river water, rainwater, deep water – emerging through different configurations of infrastructure, use, and social relations. De La Cadena (2015) and Quiroga and Castelblanco (2024) make a closely related argument in the Andean context, showing that situated ontologies of water – including Aymara and Quechua cosmological frameworks in which water is a living, relational entity embedded in reciprocal obligations between humans and the natural world – shape practices in ways that purely hygienic or technical approaches to water management fail to capture.

5.3 Structural drivers of water insecurity: beyond scarcity

Themes 3 and 4 – the prevalence of human–made causes of water insecurity, and the contested water governance in the community – resist analysis at the level of individual behaviour and are more fruitfully addressed through a relational and structural framing. The San Antonio STP project aims to address seasonal oscillations in water availability in Chinchaya and projections of future water scarcity due to climate change. While some community members were aware of climate change challenges and all acknowledged seasonal variability in the area, human–made causes, rather than natural ones, emerged as a primary reason for water insecurity in Chinchaya. Water insecurity is commonly defined across four dimensions of water: affordability, reliability, sufficiency, and safety (Workman et al., 2021). The social sciences have extended previous definitions of water insecurity, moving beyond quantifying scarcity to encompass the relationships and politics surrounding water provision (Workman et al., 2021). Such a relational approach maintains that water security is as much about securing access to water as a material good as it is about the social relations of access (Jepson et al., 2017). This perspective is particularly relevant for the context of Chinchaya, where irrigation water is virtually available to all members of the Mi Riego program, but access and availability vary depending on the – often conflictual – social dynamics around hydrant maintenance and cleaning. Such a conflictual situation warrants caution in handing over the distribution of treated wastewater and humus from the plant to the local irrigation association or other community groups, as not everyone in the community might feel that these groups operate in everyone’s best interests.

The establishment of potable water and sanitation networks in Chinchaya also reduced the availability of irrigation water for some residents by disrupting existing irrigation ditches

during construction. It also inadvertently generated new inequalities: between those with access to EPSAS water and those excluded due to financial constraints or neighbour disputes, and between residents who participated in maintenance work of the Mi Riego system and those who, reportedly, were less invested after gaining EPSAS access. Through her ethnography of flood control embankments in the Bengal Delta, Dewan (2021) shows how water infrastructure interventions can reshape hydrological flows in unintended ways, often worsening access, environmental conditions, and existing water relations and practices. Similarly, Jepson et al. (2017) draw attention to how technology and governance change social relations of water, positing that policy emphasis should turn from delivery of drinking water to promoting social relations conducive to securing safe and affordable water.

The findings of this study support extending such an ambition from policy to sustainability interventions, such as the STP treatment plant, as changes to water supplies inevitably transform hydro-social relations by incorporating different technologies and institutions into a reconfigured waterscape of treatment, provision, and access (Jepson et al., 2017). In this perspective, securing water does not mean only securing H₂O delivery, but securing a set of relationships in the political and public spheres (Jepson et al., 2017). Development and water interventions introduced into socially heterogeneous or conflictive communities also can reproduce or exacerbate existing inequalities and tensions, particularly when underlying power relations, participation dynamics, and institutional arrangements are not adequately accounted for (Shunglu et al., 2022). This risk warrants serious consideration by project planners in Chinchaya, given the multiple ongoing conflicts in the community.

Framing water insecurity as a relational issue in Chinchaya also warrants structural analysis. Farmer's (2009) concept of structural violence is helpful here and is directly connected to health. Farmer argues that the distribution of disease risk in poor communities is neither random nor a function of individual choices, but follows the contours of political and economic arrangements that systematically expose some populations to harm while protecting others. The water insecurity documented in Chinchaya is not only a product of seasonality or of maintenance challenges. It also originates from the fact that a peri-urban community on the margins of La Paz was without formal sanitation and potable water infrastructure until July 2025; that the costs of connecting to the EPSAS system must be borne by individual households, placing connection beyond reach for some; that irrigation infrastructure is maintained through collective labour with no formal compensation; that hydrant placement reportedly followed political rather than equity criteria; and that the construction of formal water and sanitation infrastructure obliterated existing irrigation canals without replacement.

This underlying political economy is important to consider if the San Antonio reuse project is to avoid exacerbating existing issues.

5.4 Overlapping risks and the limits of single-hazard assessment

The fifth theme – the overlapping and mutually reinforcing nature of water-related risks in Chinchaya – challenges the single-hazard framing that governs most quantitative risk assessments of wastewater reuse. The dominant approach in the literature, including quantitative microbial risk assessment (QMRA), models the risk associated with a specific pathogen (or pathogens) in a specific water source under specific exposure conditions (Penserini et al., 2024). This approach is technically rigorous but contextually blind: it does not model the conditions under which treated water might be mixed with contaminated runoff, used for crops beyond its intended application, or consumed by animals that then interact with humans.

The participatory risk mapping conducted in this study reveals a landscape of interconnected risks that challenge the controlled assumptions of QMRA frameworks: 25 superficial water streams running through cultivated land, roads, and residential properties; animals partially sharing water sources with humans and crops alike; high levels of environmental contamination; hailstorms that saturate the soil with additional water; and landslide risk fuelled by the steep landscape and by the local water and weather dynamics. In this context, the laboratory profile of treated water matters, but it is only one variable in a much more dynamic risk landscape. This points to the limits of applying risk assessment frameworks based on controlled, single-hazard assumptions to settings characterised by environmental complexity and informal infrastructure, where exposure occurs through dynamic mixtures of contaminants and overlapping pathways that cannot be adequately captured by isolated laboratory measurements (Checker, 2007; Dickin et al., 2016; Drakvik et al., 2020).

The One Health framework (Winkler et al., 2025; Zinsstag et al., 2023) is particularly well suited to capturing this complexity precisely because it rejects the separation between human, animal, and environmental health that single-hazard frameworks assume. The evidence from Chinchaya – animals drinking from the same streams used for irrigation and, in some cases, household water; runoff potentially mixing environmental contaminants with STP water on crops – confirms the value of this framing and suggests that risk assessment for the project should be correspondingly integrated, rather than siloed by crop species or water use category. Anthropological methods, such as ethnography, can further help situate health risk

assessments within local social worlds by detailing how social practices and relations contribute to risk in nonlinear ways (Panter-Brick, 2014).

5.5 Technology introduction and the sociotechnical assemblage

Taken together, the five themes constitute a portrait of an existing sociotechnical assemblage into which the San Antonio STP and its treated water output is being introduced: a specific configuration of materials (pipes, tanks, irrigation ditches, wells, faucets, hydrants), social relations (between neighbours, within the irrigation association, with the municipal water agency), knowledge systems (quality hierarchies, seasonal rhythms, maintenance practices), and governance arrangements (collective labour, association rules, state programmes). The outcomes of that introduction will be determined not by the technical properties of the STP water alone, but by how the treated water is incorporated into, and modifies, this existing assemblage. This is the central insight of the social construction of technology tradition (Bijker et al., 1987) and of more recent sociotechnical systems scholarship (Bijker et al., 2012; Furlong, 2014; Jepson et al., 2017): technologies do not have fixed social effects. Their consequences emerge from the interaction between the technical artefact and the social, material, and institutional context into which it is inserted.

The findings of this study also illustrate how risk is not a static feature of water or pathogens: it is produced in practice landscapes (Panter-Brick, 2014). Projects designed with technically sound parameters can fail to produce the intended outcomes because they enter social contexts characterised by existing practices, social relations, governance arrangements, and risk classifications that were not accounted for in project design (Shaheed et al., 2014). The evidence from Chinchaya suggests the San Antonio project faces similar conditions: cumulative water use practices that may absorb new sources into existing ones, instead of replacing them; quality hierarchies that could determine how treated water is stored and used independent of its laboratory profile; presently fragile and contested governance structures; and an environmental risk landscape that may interact with treated water in unpredictable ways.

Finally, this study points out that climate adaptation interventions do not necessarily translate into increased resilience: interventions can increase complexity, inequality, and exposure unless aligned with everyday practice (Barnett & O'Neill, 2010; Dewan, 2021; Thomas et al., 2019). This does not amount to an argument against the project. The community's water insecurity is real, and the STP addresses a genuine need, particularly the winter shortage that leaves some farmers without irrigation water for months at a time. Rather, it is an argument

for project adaptation: for designing implementation, communication, and monitoring strategies that take the social conditions documented in this study as parameters, not as obstacles to be overcome.

6. Limitations

This study was conducted between January and March 2026, during the Altiplano rainy season. This time window presented two limitations: first, participants' perceptions of water availability in the area may have leaned towards sufficient water and towards risks related to excess water, such as landslides. Had I carried out fieldwork during the dry season, accounts may have leaned towards scarcity and drought. This is a well-known phenomenon in psychology: recent experiences are more readily available cognitively and experientially salient, which may affect risk perceptions, including those related to climate change (Tversky & Kahneman, 1973; Weber, 2006). The second timing-related limitation concerns observations: the Altiplano goes through rainy and dry seasons, and a full risk-mapping exercise would have required a year-long research stay that captured both seasons, or at least extended through the transition between them. Time constraints did not allow this, but future studies are needed to complement this research's findings with data from the dry season.

For the purposes of this study, I conducted in-depth interviews with 12 community members and nine project experts. While these numbers cover all project officers actively working in Chinchaya, the interviewed community members represent only a fraction of the population that owns farming land in the community, which, according to the Bolivia WATCH project managers (Bolivia WATCH international manager, personal communication, January 20, 2026), amounts to around 80 families. The participatory mapping workshop included 20 further people from the community, of whom around 14 were not interviewees. This expands the sampled participants slightly. However, the findings must be interpreted with these numbers in mind. It is also worth mentioning that secondary data from the Bolivia WATCH project include surveys of 14 further farmers from the community, of which 13 were not interviewed in this study. Thus, when considered within the broader framework of the Bolivia WATCH project, 39 community members were engaged for the purposes of data collection. They represent a larger proportion of the 80 families owning land in Chinchaya.

In Chinchaya, not all families have connected to EPSAS potable water and sanitation systems. I mainly interviewed people who already had access to both, except for two interviewees. Their profile of water security was understandably lower than that of people with access to

EPSAS water. This might affect the findings of this study, although it is worth noting that 87 per cent and 61 per cent of families in the community had connected to EPSAS potable water and sanitation water, respectively, in August 2025. If the number of connected families continues to grow, as seems to be the case (EPSAS water officer, personal communication, May 4, 2026), the findings of this study will keep be representative of the water situation in the community. However, future studies should strive to engage families excluded from EPSAS's service provision to ensure that more vulnerable community members are not overlooked in the implementation of the reuse project.

A final limitation of this study is the short fieldwork period, from January 17th, 2026, to April 13th, 2026, due to logistical constraints and the Bolivia WATCH project's conclusion in June 2026. While rapid ethnographic assessments are becoming increasingly common in ethnographic practice (Vindrola-Padros & Johnson, 2020), ethnographic work typically requires longer time frames. However, the Bolivia WATCH project started in Chinchaya in 2024. Complementing this study's findings with existing secondary data from Bolivia WATCH may help overcome the limitations of limited fieldwork time.

7. Conclusions

This study set out to explore how social practices around water, local understandings of water, and structural determinants of water use might affect health risks from reusing treated wastewater for agriculture in the peri-urban community of Chinchaya, La Paz, Bolivia. The qualitative research design allowed for the unveiling of a plural water landscape in the community, characterised by cumulative and interchangeable use of water sources (with the coexistence of formal and informal infrastructure), an understanding of water quality tied to place, a system of water governance based on collective labour and embroiled in disputes, and a complex landscape of overlapping risks related to contamination and unruly water flows. Reading these findings through the lenses of social practice theory and related frameworks, as well as structural violence, revealed how risk emerges in lived practice rather than as a static property of pathogens or water. Using these analytical lenses allowed this study to address the specific practices and broader ecological and social relations that shape the potential health implications of treated wastewater reuse in Chinchaya.

Recent scholarship has highlighted the need for more qualitative work in the WASH sector to guarantee a comprehensive understanding of what WASH entails and how WASH interventions are integrated in communities and households (Workman et al., 2021). Drawing

from the results of recently conducted clinical trials, which indicated that the impact of WASH and nutrition interventions is uneven (Humphrey et al., 2019; Pickering et al., 2019), Workman (2021) suggests that our current understanding of WASH may be missing important exposure pathways that contribute to the overall disease burden related to WASH. This study confirms these concerns and adds to the growing body of evidence and experience that technology fixes alone do not address WASH challenges in WASH- and water-insecure communities (Kennedy-Walker et al., 2013). The synergism and analytical potential of coupling biological and social system analyses has been recognised for more than a decade (Johnston, 2012), although such an integration has been described as one of the great challenges facing engineering approaches to global WASH (Mihelcic et al., 2017). This study contributes a small but grounded tile to the international effort for developing sophisticated, integrated approaches to improving health and well-being through a better understanding of sociotechnical and socioenvironmental relationships (Workman et al., 2021).

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Annex 1. Semi-structured Interview Guide – Community Members (ENG)

Preamble:

“As we discussed, during this interview I would like to understand how people here live in relation to water, and what they think about water. I am not testing your knowledge. There are no right or wrong answers. What I want is to learn from your experience: what you consider important is important to me.”

Interviewee general data

- What is your name?
- What is your age?
- How long have you been living here?
- Do you have any agricultural fields?
- Can you point them out on the map?
- Do you have pets or livestock?
 - If yes – Which ones?
- Do you have any other job apart from taking care of the fields?
 - If yes – Which one/s?

Uses of water

- Can you describe how you use water on a typical day, starting from when you wake up? I am referring both to drinking water and water for other purposes.
 - Home
 - Fields
 - Anything else that comes to mind
- Where do you get your water? Here, too, I am referring to both drinking water and water for other purposes (in case it is not the same water).
 - One source or multiple sources
- How is the quality of the water that you use?
 - Does it have any unusual smell, taste, or colour?
 - Why do you think this is the case?
 - What is making it smell or taste bad, you think?
 - Has it ever made you sick?
- Do you use the water as is, or do you treat it before using it?

- If they treat it – How and what methods do you use? How effective are they in your opinion?
- Do you store water? If so, how? Where? How long does it usually stay stored before you use it?
- (If having animals) Where do your pets and livestock drink from?
- Are there places in the community where the water is bad or dangerous?
 - Where?
 - Why?

Understanding of water

- What is water for you?
- Is water just something to be used, like a resource, or does it have other meanings for you and the community?
- How is water connected to the land here?
 - Physical aspects
 - Spiritual aspects
 - Ecological aspects
- How should water be taken care of, and what happens when it is not taken care of that way?
- Has water changed over time here?
 - In which ways?
 - When water is scarce, for which uses do you prioritise it?
 - Which are discontinued first?
- What worries you about water today?
- In light of what you have been telling me, what do you think about the water that will come from the treatment plant?

Ending

- Thank you so much for your time and for sharing your experience and knowledge. Is there anything else you would like to add?
- Lastly, what do you think is important to ask about the water in the community and on the treatment plant that I have not asked?

Annex 2. Semi-structured Interview Guide – Community Members (SP)

Preámbulo:

“Como discutimos, durante esta entrevista me gustaría comprender cómo vive la gente aquí en relación con el agua, y qué piensa sobre el agua. No estoy poniendo a prueba sus conocimientos. No hay respuestas correctas o incorrectas. Lo que quiero es aprender de su experiencia: lo que usted considera importante, para mí es importante.”

Datos generales de la persona entrevistada

- ¿Cómo se llama?
- ¿Qué edad tiene?
- ¿Cuánto tiempo lleva viviendo aquí?
- ¿Tiene algún campo agrícola/parcela?
- ¿Puede señalarlos en el mapa?
- ¿Tiene mascotas y/o animales de cría?
 - Sí - ¿Cuáles?
- ¿Tiene algún otro trabajo además de cuidar los campos?
 - Sí – ¿Cuál/cuáles?

Usos del agua

- ¿Podría describir cómo utiliza el agua en un día normal, desde que se levanta? Me refiero al agua para beber y agua para otros usos, si no son la misma.
 - Hogar
 - Parcela
 - Cualquier cosa que le venga a la mente
- ¿De dónde obtiene el agua? Aquí también me refiero al agua para beber y agua para otros usos, si son aguas diferentes.
 - Una fuente frente a múltiples fuentes
- ¿Cómo es la calidad del agua que utiliza?
 - ¿Tiene algún olor, sabor o color inusual?
 - ¿Por qué crees que es así?
 - ¿Qué crees que hace que huelga o sepa mal?
 - ¿Alguna vez le ha causado malestar o enfermedad?
- ¿Utiliza el agua tal cual la obtiene o la trata/limpia de alguna manera antes de usarla?
 - Si la trata – ¿Cómo y qué métodos utiliza?

- ¿Qué tan eficaces son en su opinión?
- ¿Almacena agua?
 - Si es así, ¿cómo?
 - Dónde?
 - ¿Cuánto tiempo suele permanecer almacenada antes de usarla?
- (Si tiene animales) ¿De dónde beben sus mascotas y animales de cría?
- ¿Hay lugares en la comunidad donde el agua sea mala o peligrosa?
 - Dónde?
 - Por qué?

Conceptos del agua

- ¿Qué es el agua para usted?
- ¿El agua es algo que solo usamos, como un recurso, o tiene otros significados para usted y para la comunidad?
- ¿Cómo se relaciona el agua con la tierra aquí?
 - Aspectos físicos
 - Aspectos espirituales
 - Aspectos ecológicos
- ¿Cómo se debe cuidar el agua y qué sucede cuando no se cuida de esa manera?
- ¿El agua aquí ha cambiado con el tiempo?
 - ¿En qué sentido?
 - Cuando hay escasez de agua, ¿para qué la prioriza?
 - ¿Qué usos se dejan de hacer primero?
- ¿Qué la preocupa hoy en día con respecto al agua?
- A la luz de lo que me ha venido contando, ¿qué opina sobre el agua que vendrá de la planta de tratamiento?

Final

- Muchas gracias por su tiempo y por compartir su experiencia y conocimientos. ¿Hay algo más que le gustaría agregar?
- Por último, ¿qué cree que es importante preguntar sobre el agua en la comunidad y en la planta de tratamiento que no le haya preguntado?

Annex 3. Walking Interview Guide – Community Members (ENG)

Preamble:

“As we discussed, during this interview I would like to understand how people here live in relation to water, and what they think about water. I am not testing your knowledge. There are no right or wrong answers. What I want is to learn from your experience: what you consider important is important to me.”

Interviewee general data

- What is your name?
- What is your age?
- How long have you been living here?
- Can you point out your agricultural field on the map?
- Do you have pets or livestock?
 - If yes – Which ones?
 - If yes – Where do you keep them?
 - Can you show me?
- Do you have any other job apart from taking care of the fields?
 - If yes – Which one/s?

Uses of water

- What crops do you grow in your field?
 - Food crops
 - Flower
 - Other
- Do you use fertilizers to facilitate the growth and health of your crops? Do you use any other methods?
 - If yes – Which ones?
- Are there pests or plant diseases you fight against in your fields?
 - If yes – Which ones?
 - What could be the cause, in your opinion?
- How do you irrigate? Do you use particular techniques?
- Who is responsible for irrigating your fields? Do you do it yourself, or is there anyone else who helps you out?
 - If there are others – Who are they?

- Where do you get irrigating water?
 - Can you show me?
- How is the quality of the water that you use to irrigate?
 - Does it have any unusual smell, taste, or color?
 - Why do you think this is the case?
 - What is making it smell or taste bad, you think? Has it ever made you sick?
- Do you use the water as is, or do you treat it before using it?
 - If they treat it – How and what methods do you use?
 - How effective are they in your opinion?
- Has the water changed over time here?
 - In which ways?
 - Are there any problems with water availability for agriculture in the community?
 - In periods of water scarcity, how do you manage your fields' irrigation?
- Do you store water?
 - If so, how?
 - Where?
 - How long does it usually stay stored before you use it?
 - Can you show me?
- Are there any problems with contamination in this area that may affect your crops?
 - If yes – Which ones?
 - Where?
 - Can you show me?
- (If having animals) Where do your livestock/pets drink from?
 - Can you show me?
- Are there places in the community where the water is bad or dangerous?
 - Where?
 - Why?
 - Can you show me?
- How is water connected to the land here?
 - Physical aspects
 - Spiritual aspects
 - Ecological aspects

Understandings of water

- What is water for you?

- Is water just something to be used, like a resource, or does it have other meanings for you and the community?
- How should water be taken care of, and what happens when it is not taken care of that way?
- What worries you about water today?
- In light of what you have been telling me, what do you think about the water that will come from the treatment plant?

Ending

- Thank you so much for your time and for sharing your experience and knowledge. Is there anything else you would like to add?
- Lastly, what do you think is important to ask about the water in the community and on the treatment plant that I have not asked?

Annex 4. Walking Interview Guide – Community Members (SP)

Preámbulo:

“Como discutimos, durante esta entrevista me gustaría comprender cómo vive la gente aquí en relación con el agua, y qué piensa sobre el agua. No estoy poniendo a prueba sus conocimientos. No hay respuestas correctas o incorrectas. Lo que quiero es aprender de su experiencia: lo que usted considera importante, para mí es importante.”

Datos generales de la persona entrevistada

- ¿Cómo se llama?
- ¿Qué edad tiene?
- ¿Cuánto tiempo lleva viviendo aquí?
- ¿Puede señalar su parcela/campo agrícola en el mapa?
- ¿Tiene mascotas y/o animales de cría?
 - Sí - ¿Cuáles?
 - Sí – ¿Dónde los tiene?
 - ¿Me puede mostrar?
- ¿Tiene algún otro trabajo además de cuidar los campos?
 - Sí – ¿Cuál/cuáles?

Usos del agua

- ¿Qué cultiva en su parcela?
 - Cultivos alimentarios
 - Flores
 - Otros cultivos
- ¿Utiliza fertilizantes u otras prácticas para facilitar el crecimiento y la salud de los cultivos?
 - Sí – ¿Cuáles?
- ¿Hay plagas de plantas contra las cuales pelea en cultivar su parcela?
 - Sí – ¿Cuáles?
 - ¿Cuál podría ser la causa, en su opinión?
- ¿Cómo riega? ¿Utiliza técnicas particulares?
- ¿Quién se encarga de regar en su parcela? ¿Usted solo/a, o hay otras personas que la ayudan?
 - Si otras – ¿Quién?

- ¿De dónde obtiene el agua para regar a su parcela?
 - ¿Me puede mostrar?
- ¿Cómo es la calidad del agua que utiliza para regar?
 - ¿Tiene algún olor, sabor o color inusual?
 - ¿Por qué crees que es así?
 - ¿Qué crees que hace que huelga o sepa mal?
 - ¿Alguna vez le ha causado malestar o enfermedad?
- ¿Utiliza el agua tal cual la obtiene o la trata/limpia de alguna manera antes de usarla?
 - Si la trata – ¿Cómo y qué métodos utiliza?
 - ¿Qué tan eficaces son en su opinión?
- ¿El agua aquí ha cambiado con el tiempo?
 - ¿En qué sentido?
 - ¿Hay problemas en la disponibilidad del agua para uso agrícola en la comunidad?
 - Cuando hay escasez de agua, ¿cómo maneja el riego de su parcela?
- ¿Almacena agua?
 - Si es así – ¿Cómo?
 - Dónde?
 - ¿Cuánto tiempo suele permanecer almacenada antes de usarla?
 - ¿Me puede mostrar?
- ¿Hay problemas de contaminación en el área que podrían afectar a sus cultivos?
 - Sí – ¿Cuáles?
 - Donde?
 - ¿Me puede mostrar?
- (Si tiene animales) ¿De dónde beben sus animales de cría?
 - ¿Me puede mostrar?
- ¿Hay lugares en la comunidad donde el agua sea mala o peligrosa?
 - Dónde?
 - Por qué?
 - ¿Me puede mostrar?
- ¿Cómo se relaciona el agua con la tierra aquí?
 - Aspectos físicos
 - Aspectos espirituales
 - Aspectos ecológicos

Conceptos del agua

- ¿Qué es el agua para usted?
- ¿El agua es algo que solo usamos, como un recurso, o tiene otros significados para usted y para la comunidad?
- ¿Cómo se debe cuidar el agua y qué sucede cuando no se cuida de esa manera?
- ¿Qué la preocupa hoy en día con respecto al agua?
- A la luz de lo que me ha venido contando, ¿qué opina sobre el agua que vendrá de la planta de tratamiento?

Final

- Muchas gracias por su tiempo y por compartir su experiencia y conocimientos. ¿Hay algo más que le gustaría agregar?
- Por último, ¿qué cree que es importante preguntar sobre el agua en la comunidad y en la planta de tratamiento que no le haya preguntado?

Annex 5. Semi-structured Interview Guide – Project Officers (ENG)

General information about the interviewee

- What is your name?
- How old are you?
- What is your role in the project?
- How long have you been working on the project?

General questions

- Can you explain how the project started?
- There are three project components: a social one, a health one, and a financial one. Can you introduce each and explain what they aim to achieve and how?
- [For health experts] Regarding the health component specifically: various partners are collaborating, and Univalle performed a literature review, surveys in the community and epidemiological analyses of diseases and climate. How did you decide about these deliverables?

Water uses and understanding of water

- Could you describe the water system in Chinchaya? I'm referring to the hydrological characteristics of the watershed and also the water sources the community uses for irrigation and household purposes.
- What is the quality of the water used for irrigation in the community?
- What is the quantity of water available for irrigation in the community? Is there a shortage, an abundance...
- And what is the quality and quantity of water for individual use in the community?
- Do you know if people store water? If so, how? Where?
- In your view, what are the main water-related problems in the community?
- In your view, which of these problems are most likely to affect people's health?
- What problems is the reuse project trying to solve?
- What are the main difficulties you encountered while developing the project component you are working on?
- Thank you very much for your time and for sharing your experience and knowledge. Is there anything else you would like to add?
- Finally, what do you think is important to ask about water in the community and at the treatment plant that I haven't asked you?

Annex 6. Semi-structured Interview Guide – Project Officers (SP)

Datos generales de la persona entrevistada

- ¿Cómo te llamas?
- ¿Qué edad tienes?
- ¿Cuál es tu rol en el proyecto?
- ¿Cuánto tiempo llevas trabajando para el proyecto?

Preguntas generales

- ¿Podría explicar cómo comenzó el proyecto?
- El proyecto consta de tres componentes: uno social, uno sanitario y uno financiero. ¿Podría presentar cada uno de ellos y explicar qué se pretende lograr con cada uno y de qué manera?
- [Para los/las profesionales de la salud] En lo que respecta específicamente al componente sanitario: hay varios socios colaborando, y Univalle llevó a cabo una revisión bibliográfica, encuestas en la comunidad y análisis epidemiológicos de enfermedades y del clima. ¿Cómo se decidieron estos métodos?

Usos y conceptos del agua

- ¿Podría describir el sistema hídrico de Chinchaya? Me refiero a las características hidrológicas de la cuenca hidrográfica y también a las fuentes de agua que utiliza la comunidad para el riego y el consumo doméstico.
- ¿Cuál es la calidad del agua que se utiliza para el riego en la comunidad?
- ¿Cuál es la cantidad de agua disponible para el riego en la comunidad? ¿Hay escasez, abundancia...
- ¿Y cuál es la calidad y la cantidad de agua para uso individual en la comunidad?
- ¿Sabe si la gente almacena agua? Si es así, ¿cómo? ¿Dónde?
- En su opinión, ¿cuáles son los principales problemas relacionados con el agua en la comunidad?
- En su opinión, ¿cuáles de estos problemas son los que más probablemente afecten la salud de las personas?
- ¿Qué problemas intenta resolver el proyecto de reutilización?
- ¿Cuáles son las principales dificultades con las que se ha encontrado al desarrollar el componente del proyecto en el que está trabajando?
- Muchas gracias por su tiempo y por compartir su experiencia y conocimientos. ¿Hay algo más que le gustaría añadir?

- Por último, ¿qué cree que es importante preguntar sobre el agua en la comunidad y en la planta de tratamiento que no le haya preguntado?

Annex 7. Walking Interview Guide – Project Agronomist (ENG)

General information about the interviewee

- What is your name?
- How old are you?
- What is your role in the project?
- How long have you been working on the project?

Questions

- Could you describe the water system in Chinchaya? I'm referring to the hydrological characteristics of the watershed and also the water sources the community uses. What do you see around us?
- Based on what we are seeing, what is your assessment of the quantity of water used for irrigation and for domestic purposes in the community?
- Based on what we are seeing, what is your assessment of the quality of water used for irrigation and for domestic purposes in the community?
- Based on what we are seeing, what are the main water-related problems in the community?
- In your view, which of these problems are most likely to affect people's health?
- If you were to assess water issues in the community based on what we are seeing, what would you name as water priorities here?
- Thank you very much for your time and for sharing your experience and knowledge. Is there anything else you would like to add?
- Finally, what do you think is important to ask about water in the community and about the water of the treatment plant that I haven't asked you?

Annex 8. Walking Interview Guide – Project Agronomist (SP)

Datos generales de la persona entrevistada

- ¿Cómo se llama?
- ¿Cuántos años tiene?
- ¿Cuál es su función en el proyecto?
- ¿Cuánto tiempo lleva trabajando en el proyecto?

Preguntas

- ¿Podría describir el sistema hídrico de Chinchaya? Me refiero a las características hidrológicas de la cuenca y también a las fuentes de agua que utiliza la comunidad. ¿Qué ve a nuestro alrededor?
- Basándose en lo que estamos viendo, ¿cuál es su valoración de la cantidad de agua que se utiliza para el riego y para uso doméstico en la comunidad?
- Basándose en lo que estamos viendo, ¿cuál es su valoración de la calidad del agua que se utiliza para el riego y para uso doméstico en la comunidad?
- Basándose en lo que estamos viendo, ¿cuáles son los principales problemas relacionados con el agua en la comunidad?
- En su opinión, ¿cuáles de estos problemas son los que más probablemente afecten a la salud de las personas?
- Si tuviera que evaluar los problemas relacionados con el agua en la comunidad basándose en lo que estamos viendo, ¿cuáles serían, en su opinión, las prioridades en materia de agua aquí?
- Muchas gracias por su tiempo y por compartir su experiencia y conocimientos. ¿Hay algo más que le gustaría añadir?
- Por último, ¿qué cree que es importante preguntar sobre el agua en la comunidad y sobre el agua de la planta de tratamiento que no le haya preguntado?