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Water Management in the midst of Climate Change and
Growing Tourism

A Field Study from the Peruvian Andes

Master Thesis in Global Studies
Spring Semester 2016
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Abstract

According to climate researchers, melting glaciers is one of the most severe effects of the global climate change. Peru that contains more than seventy percent of the world's tropical glaciers is particularly vulnerable to this effect. This can be noticed in the country's southern highlands where the glaciers work as water buffer for millions of people and where the glaciers' vital function for sustaining life makes their shrinkage an issue of great concern. Simultaneously with decreasing water supplies the region is also experiencing a tourism boom, which is leading to increasing water demands. The biggest attraction in region is the Colca Valley, where the town of Chivay serves as the center point for tourism. Based on data collected during a field study this thesis explores the allocation of Chivay's potable water and the users' perception of the quality, the distribution service, and the equity of the potable water scheme. The interviews that this thesis draws on show that the allocation of potable water in Chivay is based on a *demand-side approach* that uses water meters and price reforms to make the users appreciate water as a scarce resource. They also show that the users who were most concerned about effects of climate change are also among the most positive to the new water management approach. Finally, the interviews show a clear dissonance between the water providers' and the water users' perception of Chivay's water quality, distribution service, and water equity.

Key words: *Water Management, Peruvian Andes, Water Users, Climate Change, and Tourism*

Acknowledgements

I would like to thank all of the participants in my field study in Chivay for their time. Without your narratives this study would not have been possible. Secondly, I would like to extend my thanks to Karsten Paerregaard for his inspiration as a supervisor. I also would like to thank the scholar Malene Brandshaug for taking her time to show me around in Chivay and for her useful local insights. Furthermore, would like to thank my friend Karina Chicaña for taking her time to visit SEDAPAR's Arequipa office on my behalf, as well as my friend Laura Hurtado for her translation of my recorded interviews. At last I would like to thank my dad Roger Nylander for notifications on spelling and grammar in my text.

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1 Introduction

According to United Nations Department of Economic and Social Affairs (UNDESA), fresh water scarcity today exists on every continent. In total about 1.2 billion people live in areas that are considered as water scarce, while 500 million live in areas on the brink of physical water scarcity (defined as an annual fresh water supplies of less than 1,000 cubic meters per person). Another 1.6 billion people, almost a quarter of the world's population, are experiencing what is called economic water shortage (i.e. lack economical means to extract existing fresh water from rivers and subterranean deposits). Furthermore, it has been predicted that by 2025, fueled by current climate changes, another 1.8 billion people will live in areas with absolute water scarcity (UNDESA 2016). Looking even further into the future The Intergovernmental Panel on Climate Change (IPCC) states that: *“The fractions of the global population that will experience water scarcity and be affected by major river floods are projected to increase with the level of warming in the 21st century”* (IPCC 2014a: 67).

In South America, and particularly in Bolivia, Colombia, Ecuador, Peru and Venezuela, glaciers have provided a much need water buffer during the year's dry months and during occasional years of drought. Since the middle of the 20th century these tropical glaciers has been retreating in an accelerating pace and since the melting was first observed the total area loss has been estimate to somewhere between 20 to 50 percent. Although the river and subterranean deposits below Peru's glaciers – at the moment - are experiencing an increased in melt water runoff this will not last long since most of the glaciers of the tropical Andes are predicted to disappeared completely during the coming 20 to 50 years. With the disappearance of the glaciers' buffer function the water sources in the affected areas will see a sharp decline during the dry months, which is something that, according to researchers, risk to: *“exacerbate current water resource- related vulnerability”* (IPCC 2014b: 1521)

Peru is particularly exposed to such water resource-related vulnerability. While the country's Andean region is considered economical water scarce, its arid coastal plains are approaching absolute water scarcity (WWAP 2012). In the Colca Valley that is situated in the southern part of the Peruvian Andes two disputes in recent history show how water access had become a contested issue even before the glaciers' disappearance. The first dispute occurred over a water source situated between the villages of Coporaque and Yanque, a matter that in 1971 was settled in favor of the latter after one of its community members was killed in a violent confrontation between the two villages. The second dispute occurred between the villagers of Cabanaconde and the Peruvian state

over irrigation water from the Majes channel when the channel opened in 1983 (Gelles 2000).

Since the 1980's the Colca Valley's glacial meltwater supplies have diminished in a dramatic speed. At the same time, tourism has generated an increasing demand on fresh water in the region, which now receives more than 100,000 tourists annually (AUTOCOLCA 2016). In the light of these growing strains on the water resources this thesis explores the potable water provision of the valley's tourist hub Chivay, both from the users' and the water authorities' perspective.

2 Background

2.1 Shrinking Peruvian glaciers

Tropical glaciers have two unique features which distinguish them from the glaciers found in the polar and temperate regions. Firstly, they are exposed to significantly higher levels of sun energy due to their geographical locations in low latitudes close to the equator and at high altitude closer to the sun. Secondly, they receive most precipitation during the summer period that causes an accumulation of volume in the higher parts of the glaciers, while the lower parts are melting rapidly due to the higher temperatures at these altitudes. This in turn reduces the albedo and its cooling effect on the glaciers, which accelerates the melting even more. These features make tropical glaciers particularly vulnerable to the increased global temperature induced by climate change and according to measurements made during the last 50 years they are retreating at an alarming rate. For 18 of the main glacier mountain ranges in the Peruvian Andes the estimate is that between the years of 1960 and 2000 some 20 percent of the glacial volume was lost (Chevallier et al. 2011).

Peru's glaciers work as natural "water tower" assuring a stable water flow in the country's rivers and streams between rainy seasons and in periods of drought. The present glacial shrinkage gives rise to a temporary increase in water flow in many of the country's river basins but as Anne Coudrain and her colleagues put it: "*The recent increase in runoff is not likely to last very long. This is not good news for future generations—it raises sustainability concerns*" (Coudrain et al. 2005: 930). The acute situation is confirmed by Pierre Chevallier and his colleagues (2010) who suggest that the glacial water runoff in the Peruvian Andes will be considerably reduced and might cease completely by the end of the twenty-first century.

As much as eighty percent of the water resources found on the Pacific side of Peru, where the majority of its population lives, comes from Andean glaciers and their accelerating shrinkage therefore creates a tremendous future water management challenge (ibid). To adapt and prepare for

a future with less available water Mathias Vuillet and his colleagues propose (2008) that Peru should introduce water conservation measures, shift to a less water intensive agricultural production and construct new water catchment reservoirs.

2.2 Chivay

Chivay is the capital of the province of Callyoma, which is one of the eight provinces that make up the Arequipa region. The town is situated at 3,650 meters above sea level and is surrounded by steep mountain sides. In March 2016 the town's population was 6,895 people who were almost even distributed gender wise (3428 males and 3467 females) (RENIEC 2016).

As mentioned in the introduction more than 100,000 tourists visit the Colca Valley every year (AUTOCOLCA 2016). The main tourist attractions in the valley are the chance to see soaring condors and hike in the Colca Canyon (at the foot of Cabanaconde). Being the biggest town between these attractions and Peru's second biggest city Arequipa, as well as being located just three km from the valley's biggest thermal springs, have made Chivay the epicenter of the tourist industry in the area. According to the last national population census (INEI 2007), the majority of Chivay's inhabitants gets their incomes from activities related to the town's booming tourism industry while a small fraction supports themselves as farmers.

In 2007 the average age in Chivay was 26.5 years and among the population above 14 years 31.1 percent had only finished primary school, 34.5 percent had secondary school as highest education, and 34.4 percent had pursued higher studies while 8.2 percent were illiterate (INEI 2007).

According to the nutritionist at Chivay's hospital, in 2015 the malnutrition rate among the town's children was 17 percent among children under five years of age, and five percent among children five years or older. Furthermore, according to the nutritionist, many of the children have in health controls been found to host parasites which are spread mainly through insufficiently cleaned water and food.

2.3 Potable Water and Sewerage Service of Arequipa

The organization that today is known as Servicio de Agua Potable y Alcantarillado de Arequipa (SEDAPAR) was founded in Arequipa 1961 under the name Corporación de Saneamiento de Arequipa. In 1969 it was renamed Empresa de Saneamiento de Arequipa (ESAR) and shortly thereafter renamed again to its present name. SEDAPAR is a state own company that is responsible for providing potable water and sanitation to Peru's second biggest city, and regional capital, Arequipa, as well as 18 towns situated in the eight provinces of the Arequipa region. In total

SEDAPAR provides potable water and sewerage service to almost a million people. The organization's commitment to their costumers is to: *"Provide the customers with a quality service, interpreting and meeting their needs as well as exceeding their expectations."*; and its commitment to the environment is to: *"Reduce the environmental impact of our activities through efficient use of resources, and by promoting sustainable use of natural capital."* (SEDAPAR 2016).

In Chivay SEDAPAR took over the responsibility for the potable water and sewerage provision from the municipality during the nineties (Stensrud 2016). However, since the mayor of Chivay is the representative of the region of Caylloma in the constitutional board of SEDAPAR, the municipality still has a say in the town's water and sanitation provision. The municipality can also start projects within the area of potable water and sewerage service under the condition that they are approved and supervised by SEDAPAR (information shared during an interview with an employee at Chivay's municipality).

The latest numbers at hand (from the end of 2015) on properties in Chivay connected to potable water shows that there were 1,992 properties with meters and 110 properties without meters (see appendix 2). The owners of these properties are charged by SEDAPAR according to one out of four tariffs: domestic, commercial, industrial or governmental. In addition to the volume-based charge of each tariff category SEDAPAR also charges a fixed monthly fee of 2.780 soles. The domestic tariff has three different levels, water consumption up to 10 cubic meters are charged 0.345 soles per cubic meter, the water consumption between 10 and 30 cubic meters are charged 0.715 soles per cubic meter and all water consumption above thirty cubic meters are charged 1.301 soles per cubic meter. The other three tariffs are not progressive. The fixed price for the commercial and industrial tariffs are 2.340 soles per cubic meter and 1.301 soles per cubic meter for the governmental tariff (SEDAPAR 2016).

Chivay's local SEDAPAR office has four employees. Two weeks before the monthly water bills are collected two or three of the employees walk around town lifting the water meter protection lids in the ground to check the users' water consumption. The readings are then manually recorded before being computerized and mailed in bills to the water users who can chose to pay these either directly at the SEDAPAR office or through any of the handful of bank representatives in Chivay. If a bill is not paid in time the user risks getting his or her service disconnected and having to pay 40 soles to have it reconnected (information shared during an interview with an employee at SEDAPAR's Chivay office).

3 Research aim and questions

The aim of this thesis is to explore how the potable water in the town of Chivay is allocated and how the users perceive the water quality, distribution service and water tariffs in terms of equity, as well as how Chivay's water authorities work to promote water sustainability. This exploration is guided by the following questions:

1. How is Chivay's drinking water scheme organized, how are the water tariffs determined, and how are they charged?
2. Who are the users of Chivay's potable water scheme, what are their water needs, and what do they think about the water quality and the distribution service?
3. How do the local water authorities promote water saving behaviors, how do they respond to the water users' complaints, and how do they address potential conflicts relating to drinking water?

4 Delimitations and Relevance to Global Studies

We are living on a planet where fresh water's unreplaceable role in biological processes makes it a key resource for all forms of life. Without fresh water life is at risk anywhere in the world.

According to United Nations Deputy Secretary General Jan Eliasson: "*Worldwide, water demand is projected to grow by over 40 percentage by 2050*" (UN 2015). This in combination with recent decades' decrease in readily available fresh water reserves around the globe due to climate changes makes a sustainable management of the still existing fresh water resources one of the most pressing and grand global challenges of our times.

In recent decades international institutions have acknowledged the prime importance of well-managed potable water for human health and wellbeing in countless policy documents. For example United Nations recently proclaimed the right to safe potable water as a human right essential for the satisfaction of all other human rights (UN 2014). By presenting how potable water is being managed in the Andean community of Chivay in southern Peru this thesis will give insights into the challenges of Peru's potable water management.

As mentioned in the introduction Chivay has in recent years experienced a steady increase of both permanent inhabitants and visiting tourists. At the same time, the region's fresh water supply has

diminished because of the climate change induced glacial melting (Coudrain et al. 2005; Vuille et al. 2008). These two trends are parts of a chain of events that is not unique to the Peruvian or even the Andean region but are global by nature (Scholte 2005: 72, 68). The global scope of both the climate change and tourism that affect Chivay's potable water management scheme makes an inquiry of the sort presented in this study most relevant for a thesis written within the field of global studies.

Given the limited time for field inquiry the thesis has been delimited to focus on Chivay's potable water management scheme. This focus was chosen for two reasons. Firstly, potable water is an essential resource for everyday physical health throughout the globe and, secondly, in the region where Chivay is situated it hasn't been as much investigated as irrigation water management. Within the field of potable management the thesis examines how the water users experience the water management and how the distributing agency views its own role as water provider. However, the thesis's main focus is to examine the users' side of the water provision, which is of particular importance since they are most vulnerable to the consequences of the water management - experiencing them in their own homes and in every aspect of their daily lives.

5 Previous research and theoretical framework

The following section explores previous research on water management in the context of Colca Valley, as well as the theoretical framework chosen for this study. Throughout the section similarities between the different theories presented will be pointed out and discussed.

The section's first part explores previous related research in the form of a literature review that is followed by a suggestion of what new insight this thesis may contribute to its field of inquiry. The section's second part explores the theoretical framework used when analyzing the data collected for this thesis. In this part the theoretical themes discussed in order of appearance: water management discourse, perceptions of waters quality and quantity, the importance of trust in water management and tourists' water use in the global south. The section is concluded with a discussion on the research approach of this thesis.

5.1 Traditional water cosmologies in motion

In his book "Water and Power in Highland Peru" (2000) Paul H. Gelles gives a thoroughly historical account of how the irrigation system of Cabanaconde, a neighboring community of Chivay, has developed since the pre-Colombian times. Gelles examines the clashes, negotiations

and the intertwining of older ways of organizing water distribution introduced by the Inca-empire with the more western model of irrigation introduced by the Peruvian nation state during the 20th century. The author explains that the old ways of organizing the irrigation management roles was a dual organization with two *regidores* (from Spanish *regar* = to water) responsible for a moiety each at any one time. This way of organizing also entrusted the *regidores* with the responsibility to perform cultural ceremonies to please the mountain deities believed to play a key role in the yearly water flows. According to Gelles, this type of organization has come more and more in the line of fire with the increased Peruvian national development interventions in the area from the 1960's and onwards. He asserts that: "*Implicit in most ideologies of national development throughout the Americas is the assumption that indigenous peoples must renounce their cultural orientations and ethnic identities to progress.*" However, at the time of his study Gelles didn't see any signs that the dual organization nor the ceremonies to the mountain deities were ceasing.

Thirteen years later Karsten Paerregaard published his research on Cabanaconde's irrigation management - with the poignant title *Broken Cosmologies* (2013) – claiming that the villagers had replaced the traditional management in which they elected *regidores* on a yearly basis with a modern system in which they pay professional *regidores* to cater for the irrigation of their field. According to Paerregaard, Cabanaconde had shifted from dual moieties system to a state-introduced system where a locally elected water committee sells tickets to the villagers, which gives them the right to gain water from the *regidores*. Paerregaard also noted that the traditional ceremonies to please the mountain deities no longer was carried out on a regular basis, and when performed was conducted in a stripped down version. Paerregaard goes on to note that the trust in the mountain deities to provide the water the villagers need now seems to have been transformed into a trust in the Peruvian state to perform this service. This change in worldviews he sees as a result of several coinciding developments. In 1983, shielded by the night a dozen of villagers' in Cabanaconde made a hole in the state owned Majes channel, which prompted the state to grant the community a certain yearly amount of water from the canal and which made it possible to almost triple its potential irrigation area. A second development is the state's increasing presence in the last decades that coincides with Peru's economic progress and the Peruvian state's investments in the infrastructure of marginal areas such as the Colca Valley. A third factor is the increased openness to benefits of global ideas and flows following the introduction of modern communication technology, e.g. satellite television and internet service, as well as later years development where the community has been seen as a convenient stopover by an ever growing flow of tourist visiting the nearby iconic canyon. Last but not least Paerregaard observes a growing awareness among the villagers of the community's future water challenges, which he attributes to their experiences of the growing impact

of climate change in the form of unpredictable seasonal rain patterns but which he also asserts is a consequence of the community's shift to a state managed irrigation system and its dependence on the state managed Majes channels that constitutes a more reliable water supply than the local mountains. To Paerregaard the sum of all these factors lead to "*a breakup of the villagers' cosmology*" (ibid: 208) and a reorientation toward new socio-political contexts that allow them to claim identity as Peruvian citizens.

5.2 Welcomed as national and water citizens

A couple of years after the publishing of his book Gelles published an article (2005) together with colleague Rutgerd Boelens in which they elaborate further on development strategies of the costal *criollo* ethnic groups in the Andean regions. Since the Andean countries gained independence, Boelens and Gelles argue, *criollos* have been able to assert political and cultural hegemony and control the nation-building processes using the modernization and development projects of the postcolonial era to create a *postcolonial equality discourse*, that makes visible not only powerful authorities and landlords but also common people, peasants and indigenous groups who are now included as *citizens* in the nation project (ibid: 315). According to the authors the proponents of the *postcolonial equality discourse* views peasants and indigenous people as subjects of development, who in the authors' own words:

"are brought to the fore, by means of a Foucauldian 'disciplining', 'participatory' power of 'equalising normalisation', which is present in everyday interactions; 'it actually manifests and reproduces or transforms itself in the workplaces, families and other organisational settings of everyday life' [...] Yet, the powerful groups that benefit from this 'inclusive' power, as well as the new mechanisms and rules of subordination, in fact remain invisible" (ibid: 315)

The authors exemplify what they mean with "*inclusive*" power by pointing at how development professionals and irrigation engineers introduce western developed norms, knowledge and irrigation techniques that are then accepted and internalized by the Andean communities without having to be imposed in a top-down manner. In fact the authors note:

"in many instances, it is the indigenous peasants themselves [...] who ask for this same technology, in order to 'progress' and leave behind their traditional 'backward' technology, in order to become like the western-oriented, modern farmers, in order to gain economic parity" (ibid: 316)

As part and parcel of the development mechanisms that the Andean communities engage in to

access modern technology Boelens and Gelles see an introduction of *neoliberal market ideologies* imposing a gradual individualization of water rights, a commoditization of relationships in local water control and gradual increase in monetary water rights transfers (ibid: 316). According to the authors, the introduction of these neoliberal economic arrangements as well as the modernization and development projects is done with the explicit aim to “include” the citizens of the Andean communities in projects with the false pretense of universal benefit, while the final result instead becomes an: “*exten[sion] of state control and the cultural orientations of national and international power holders*” (ibid: 316). It is here interesting to note the similarity between what the authors are describing as *neoliberal market ideologies* and the introduction of water rights tickets in Cabanaconde discussed by Paerregaard in his article mentioned above.

Building upon Boelens and Gelles discussions on the process through which the members of the Peruvian Andean communities are being welcomed as national *citizens* Paerregaard and his colleagues in their article *Water Citizenship: Negotiating Water Rights and Contesting Water Culture in the Peruvian Andes* (2016) examines how Colca communities receive and respond to different state institutions’ attempts to enact Peru’s new water resources law. The authors introduce the concept of *water citizenship discourse* to shed light on “*the ways community members and state institutions practice rights and obligations concerning water management*” (ibid: 200) and describe how the water law tries to achieve an increased consciousness of good water practices (e.g. measuring and avoiding unnecessary wasting of water through water efficient infrastructure and conscious management), and a sound water valuation (e.g. seeing water as precious economical resource worth paying tariffs for) by making sustainable water use the means by which the water users in the country's highlands achieve recognition as Peruvian citizens. It's noteworthy how similar these aims are to the kind of mechanisms Boelens and Gelles discuss as parts of a *postcolonial equality discourse*. However, Paerregaard and his colleagues also provide examples of indigenous peasant communities that refute the *water citizenship discourse* and its attempt to make them internalize a citizenship based on sustainable water management. To begin with, the authors point to the challenge that the Peruvian government faces when trying to create a singular form of *water citizenship* in a country with a history of such deep social inequalities and traumas as Peru. The authors give one example where a water engineer tried to persuade a rural community to install water meters to be able to measure consumed water, as a way of reducing the risk of unintended overconsumption. Trying to convince the community leaders the engineer urged them to think about future generations but they responded that while the future water availability is a cause of great concern in the community they are even more worried that they will be unable to pay the water tariffs which the installment of meters might entail. The authors conclude that the examined Colca communities were opposing the water resources law because their and the state’s way of valuing

water differ and because they were disapproving of the Peruvian state's authority to grant mining companies or other industries the right to the same water sources as the communities use.

All of the studies introduced in this section focus on the management of irrigation water destined for agricultural uses, which ring true among anthropological studies in other parts of the Andes as well (Orlove and Caton 2010: 403). In contrast, by examining the potable water management of the community of Chivay this study sheds light on a topic that has been sparsely explored by previous research in the Andes.

5.3 Divergent discourses on water management

A moment will now be given to clarify connections between some of the earlier research from the Colca Valley described above and the concepts introduced under the following two headlines.

Embedded in both Boelens' and Gelles' *neoliberal market ideologies* concept and Paerregaard's and his colleagues' *water citizenship discourse* concept is the view that water is a scarce economical resource worth paying a tariff for, a view on water that is also echoing in the *demand-side approach* concept and *commodity view* concept presented under the two headlines that now follow.

5.3.1 Supply- or demand-side approach

In their discussions about water resource allocation Bill Derman and Anne Ferguson describe *supply-side approach* and *demand-side approach* as opposite poles (Derman and Ferguson 2003). According to the scholars, the *demand-side approach* views water first and foremost as a scarce resource and therefore argue for the need of measuring available stocks and using pricing as well as other mechanisms to ensure a sustainable management. According to the two scholars, the *demand-side approach* is: "often promulgated by water engineers with seemingly little concern for its social consequences" (ibid: 280). The *supply-side approach*, on the other hand, puts emphasizes on individuals' and groups' right to water and frames this as a public good (ibid).

The interest in the *demand-side approach* is steadily growing. It is now promoted by international institutions such as the UN and the World Bank and it is mentioned in research from local contexts as far apart as South Africa and Norway (UN 2016; The World Bank 2009; Derman and Ferguson 2003; Herbertson and Tate 2001; Venkatesh and Brattebø 2014).

5.3.2 Water resources as commons or commodities

With the concepts of the *supply- and demand-side approaches* described above in mind we now examine the relation between these concepts and the concepts of *commons and commodity view* put forward by Karen Bakker.

In her article *The “Commons” Versus the “Commodity”* Bakker uses the concept of *market environmentalism* to name: “a mode of resource regulation which aims to deploy markets as the solution to environmental problems” (Bakker 2007: 431). With the field and thematic delimitation chosen for this thesis the most severe environmental problem is the predicted future shortage of clean drinking water. The fact that the same prediction has been made in not only the area of this field study but also other parts of the Andes hints at the magnitude of the challenges ahead. Bakker suggests that the solutions the proponents of the discourse are prescribing springs from a wish to combine environmental preservation with economic growth and efficiency. A reasoning Bakker describes as:

“through establishing private property rights, employing markets as allocation mechanisms, and incorporating environmental externalities through pricing, proponents of market environmentalism assert that environmental goods will be more efficiently allocated if treated as economic goods”(ibid: 432)

At the same time there is according to Bakker critical research that depict *market environmentalism* as a neoliberalization of nature (ibid: 432).

According to the aut, the proponents of an introduction of *market environmentalism paradigm* into the water sector argue that water as a resource in this day and age gets evermore scarce and that it therefore is necessary to price at its full economic and environmental cost. Bakker sees the promoting of this kind of pricing mechanisms as a mean to reach what she regards as the proponents’ goal - allocate available water to its highest-value uses. She describes the result of this commodification processes as a shift from viewing water as a public good to viewing it as an economical resource, and from viewing its users as a collective to viewing them as individual customers. Through such a shift, the author claims, *commodity view* proponents imagine that conservation can: “be incentivized through pricing”, which implies that: “users will cease wasteful behavior as water prices rise with increasing scarcity” (ibid: 441).

Bakker also describes a contrasting group that favors a *commons’ view of water* and points to water’s unique properties in relation to human life and healthy ecosystems, that is, the lack of substitutes for water in biological processes and the close bounds between ecosystems and human communities with the cycle of hydrology. According to the author, another important argument that the *commons* group makes in support of a community rooted water management scheme is the diverse array of spiritual and culture dimensions ascribed to water in different communities around the world, an argument that is closely related to the findings from Gelles’ study of the culture surrounding water management in the community of Cabanaconde described above. A third

argument Bakker notices that the *commons* group makes is that the nature of water as a resource is one of a *local flow* whose quality and flow, or lack of these, is most profoundly felt at the local community level. Moreover, due to water's critical impact on the local users' general health and preservation of local ecosystems the *commons* group finds that the surest way that these interests can be met is through a mobilization of the local water users to claim an active role in the local water governing. When it comes to the global imperative to use water as efficient as possible and thus minimize the risk of depleting its often shrinking sources the author points out that the *commons* group: "*asserts that conservation is more effectively incentivized through an environmental, collectivist ethic of solidarity, which will encourage users to refrain from wasteful behavior*" (ibid: 441).

From the above descriptions of the *supply and demand-side approaches* and the *commons and commodity view* it becomes clear that the *supply-side approach* and the *commons view* both perceive water as a public good that is best preserved through conservation initiatives by the water users themselves, while the *demand-side approach* and the *commodity view* both perceive water a scarce economic resource that is best managed through the introduction of measuring and pricing mechanisms.

5.4 Water quantity and quality - materiality and social constructs

Ben Orlove and Steven C. Canton suggest the total connections that water has in a community include the themes of governance, knowledge, value, equity and politics, which resonates with the conclusions from the literature discussed above. The lesson learned from these insights is that water must be acknowledged not solely as a resource with economic value but also as a socially and culturally important substance (Orlove and Caton 2010).

Orlove and Canton (2010) also suggest that the properties of water relating to its *quantity* and *quality* give it a very specific materiality when it comes into contact with the human body or human-made structures (ibid: 403). Examples of these properties are: fixedness at a given volume due to its incompressibility, tendency of losses through leakage, evaporation and soil absorption; ability to contain a plentiful of chemical and biological contaminants of which not all are easily detectable for the human smell and taste senses. Furthermore, the authors claim that *quantity* and *quality* of water have a socially constructed side that is deeply intertwined with, although not always equivalent to, its materiality.

Other noteworthy observations that Orlove and Canton (2010) make is that substantial labor and economic means are needed to create and sustain water infrastructure. Moreover, they observe that whether or not a water source can be considered as resilient may have as much to do with governance

aspects as with the actual physical existence of water. Last but not least, – and closely related to the findings discussed under the next headline - the two researchers claim that water has the characteristic feature of *connectivity*, which is derived from its existence in delicate webs where its use in one domain will affect its possible use in others.

5.5 Trust and tourists water consumption in the Global South

Susanne Becken states that reforms focusing on the demand-side and a commodification of water in order to manage a shrinking water quantity are likely to: “*reinforce disparities between those who can afford to pay for water compared with those who find water prices prohibitive*” (Becken 2014: 19). For such reforms to be sustained, Becken argues, the establishment of trust between its actors is a key ingredient, which she claims can be found in the fairness of tariffs as well as in the accountability and efficiency of the new water management institution. She also suggests that trust in that other water users do their equal part to save water are likely to influence individuals’ response to such reforms (ibid).

Moreover, Becken claims that due to economic disparities between the tourism industry and domestic households in low-income countries trust is of vital importance. Based on data about water use and availability from 21 countries spread over several continents Becken has contrasted the water withdrawal per capita of local residence with that of visiting tourist in these countries. From her data analysis Becken is able to derive that tourists visiting low-income countries generally use manifold more water than the local inhabitants in these countries. Further, Becken points out that she sees no obvious systematic relation between the availability of water sources in a country and the water use efficiency among its tourist facilities in her data. Also relating to the topic of equity, Becken notes that within the tourism industry itself the smaller local hotels often cannot compete with the large hotel chains that use most of the locally available water and often have economical leverage to invest in extensions of their water infrastructures. Relating to this Becken identifies the presence, or non-presence, of swimming pool in a hotel as a key differentiating factor when it comes to using water efficiently. Becken concludes that there is a potential for significant water savings if targeted management initiatives should be implemented (e.g. using of specific tourism water tariffs and voluntary initiatives from conscious industry operators) (ibid).

5.6 Research approach: conceptualizing the Andean water management discourse

According to Boelens and Gelles (2005), the Peruvian state, together with national and international power holders, have in an effort to extend their influence in the region invented a *postcolonial*

equality discourse framing the inhabitants of the rural Andes as *subjects of development* that through a mixture of infrastructure and education efforts will be converted in devoted *citizens* of the nation project. In the Colca Valley one area where an increased Peruvian state presence has been felt is in the valley's water management, something that was initially opposed by the Colca communities (Gelles 2000; Boelens and Gelles 2005). Due to a number of changes, many have later embraced the new water management, although a few still resist. The most significant change has been the growing awareness of the need for water efficiency investments to adjust to climate changes and the Peruvian state's more active role as an economic investor in the Andean region over the last decades (Paerregaard 2013; Paerregaard et al. 2016).

The concept of *water citizenship* was introduced by Paerregaard (2016) and his colleagues to examine water management in the Colca Valley in the wake of the new water law introduced in year 2009. In their research Paerregaard and his colleagues (2016) found that many Colca farmers were ready to consider themselves as water citizens given that the benefits from state water infrastructure investments outweigh the cost that the introduction of a general tariff implied, while others resisted the sustainable water management discourse embedded in the new water law due to their inability to afford raised tariffs. In the last part of the *Result and Analysis* section the narratives collected during the thesis' field trip will be examined through the lens of Paerregaard's and his colleagues' (2016) *water citizenship* concept and Boelens' and Gelles' (2005) concept of *postcolonial equality discourse*.

Derman's and Ferguson's (2003) concept *supply- and demand-side approach* as well as Bakker's (2007) concept *commons' and commodity views* explain how different groups believe that water is best managed. In the last decades the *demand-side approach* and *commodity view* (both viewing water as most sustainable managed by carefully measuring it and giving it a price reflecting it as a precious economic resource) has gained significant ground on the expense of the *supply-side approach* and *commons' view* (both viewing water as a public good instilled with social and cultural rights) (Derman and Ferguson 2003; Bakker 2007). Since previous research have shown that a similar rise of the *demand-side approach* and *commodity view* concepts has taken place in other Colca communities there are reasons to believe that using the concepts also would be highly relevant when studying potable water management in Chivay.

Orlove and Canton (2010) claim that the perceived *quantity* and *quality* of water are not only determine by its material characteristics but also by socially constructed ones, and that this is something that is important to keep in mind when studying different societies' ways of managing water. The studies by Gelles (2000) and Paerregaard (2013) in the Colca Valley supports Orlove and Cantons (2010) claim by showing that socially constructed water characteristics played an

important role in deciding how the water was managed in the studied communities. Besides from the insights on water *quantity* and *quality* Orlove's and Canton's observations that the substantial means are needed to create and sustain water infrastructure, that resilience of a water source may have as much to do with physical water availability as with governance aspects, and that water's existence in delicate webs gives it the characteristic of *connectivity*, are all relevant when studying a potable water scheme.

Susanne Becken (2014) warns that demand-side and commodification reforms are likely to accentuate the gap between those who can afford to pay for water and those who find the introduction of tariffs as prohibiting. Becken (2014) also suggests that for these kinds of reforms to be sustained a basic trust between all involved actors is essential. Moreover, Becken (2014) findings show that for tourist hotspots in low income countries the importance of trust between the water actors becomes even more urgent. This since the economic disparities between the tourism industry and the domestic households at these locations in worst case scenario could result in that the former group ends up using all available water. To show the plausibility of such an outcome Becken (2014) present data showing that tourists in low-income countries generally uses manifold more water than the local population. Since Chivay is a tourist hotspot Becken's (2014) insights becomes highly useful when analyzing the relationships between the town's tourist industry, domestic water users and water authorities.

6 Methodology

In the light of the significant population growth and tourism boom that Chivay has been witnessing in recent years and the growing potable water demand that it has caused this thesis focuses on water user's perception of equity in the town's potable water scheme. It uses an inductive approach to gather data, i.e. an approach where gathering of empirical data is the starting point that eventually leads to the abstraction of themes and their interpretations, as opposed to a deductive approach where the reverse causality is used. (Mikkelsen 2005). Further, this study has an interpretative epistemological approach, meaning that it's not occupied with discovering an absolute truth, but rather to explore different narratives and social situations as a way to shed light on the implicit local meanings and understandings that can be ascribed to the topic of inquiry. Given the pivotal importance of these local meanings and understandings to the thesis it would be unfitting to arrive at the location of the field study with a bag already packed to the brim with preplanned themes and concepts. Instead, throughout most of this study the process of reviewing literature on theory and concepts has been interlaced with the analysis of collected field data (Bryman 2012: 111).

The thesis employs both quantitative and qualitative methods. The former encompassed a contextualizing survey carried out with 46 of Chivay's inhabitants while the latter consisted of the 13 semi-structured interviews that were conducted with respondents of the initial survey as well as participant observations and analysis of written documents.

The choice to include qualitative methods was inspired by previous anthropological fieldwork in the Colca Valley studying water management. As mentioned, potable water management in the community of Chivay has so far been sparsely examined something, which makes the topic well suited for the exploratory nature of qualitative methods (Creswell 2009: 18). In addition, to broaden its analytical scope thesis makes use of the before mention contextualizing quantitative survey.

6.1 Pre-study and preliminary research design

According to Kathleen M. Dewalt and Billie R. Dewalt (2011: 81), most researchers enter the field with a plan of what kind of individuals they would like to interview, what kind a venues they'll visit and what kind of events they'll try to attend. I therefore made a plan relating to the issues put forward by Dewalt and Dewalt to conduct the field study drawing on email correspondence with Malene Brandshaug and relevant academic literature. In this pre-research of the field I realized that tourists consume a significant share of Chivay's potable water. Recalling Becken's findings on tourist water consumption in the global south (see headline 6.5) this lead me to include owners of and staff at Chivay's tourist accommodations in my survey.

My pre-study research design included a preliminary survey template, methods and research questions that I decided to conduct by approaching water users when they paid their water bills at Chivay's SEDAPAR office. At this stage, I also planned to select respondents to the survey and the semi-structured interviews by using the *Nonprobability Sampling Method of Purposive Sampling* (Bernard 2011: 144; DiCicco-Bloom and Crabtree 2006: 317), which is a sampling method that opposite to *Quota Sampling* don't prescribe fixed sample size to different respondent groups rather than move on to a new interview group when data saturation in the first has been reached. This decision was based on that such an adaptive and time efficient streamlined focus would be well suited for the kind of intensive field study that I planned to conduct (Bernard 2011: 146).

6.2 Field Survey

To answer the second research question and gather information on how Chivay's potable water is managed, distributed and consumed the study employed a field survey among the town's water users. The survey included questions about the water users sex, age, profession, number of

household members, fields of use for potable water, monthly potable water consumption, monthly potable water payments, total monthly budget, strategies to save water and estimated water consumption compared to their neighbors (for the complete range of questions in the survey see appendix 3, N.B. in spanish). The field survey was organized by knocking doors and asking the household members who opened to participate. To enhance the respondents' diversity this approach was applied in all three geographical sectors of Chivay. Similarly, representatives from the town's different business sectors were asked to participate. In case the owners were not present their employees were asked to reply on their behalf. The survey sample includes 27 female and 19 male respondents comprising 15 big households (four or more members), eight small households (three or less members), 10 hostels, seven hotels, four restaurants, and two gas stations.

Apart from providing a general picture of Chivay's water users the field survey served as a tool to select the respondents for the semi-structured interviews that encompassed in-depth questions about the water users' view on the management and the quality of the town's potable water. To ensure a representative picture of Chivay's demographical profile the following characteristics were used to select the interviewees: gender, employment, as well as size of and age composition in their households. Representatives from Chivay's business community and municipal and water management authorities were also interviewed. In total the semi-structured interview sample included seven women and six men within the age range of 18 to 56. Of these five had university educations, one was employed by the municipality, one employed by SEDAPAR, three were members of big households, two were members of small households, three were representatives of tourist companies with less than five employees, and three were representatives of tourist companies with more than five employees. More characteristics of the interviewees will be presented in the *Result and Analysis* section.

6.3 Qualitative methods

6.3.1 Semi-structured interviews

I have used semi-structured interviews because they, as oppose to structured interviews, leave freedom to pose questions that are not included in the original set of questions if it should be considered fruitful to probe deeper into new topics arising during the interview process. At the same time it allowed me to maintain comparability between interviews which would not have been possible if I had used e.g. unstructured interviews (Bryman 2012: 470-2).

Research suggests that as few as ten knowledgeable people suffice to discover and understand the pivotal themes in a distinct organizational domain (Bernard 2011: 154). With this in mind, to have

some margin, I decided to conduct 13 semi-structured interviews.

During the work with the preliminary research design some general strategies to get individuals to agree to part take in the semi-structured interviews was identified. To create a *shared positional space* with the approached persons a strategy of wearing formal clothes when approaching hotel chain representatives as well as public officials, while wearing more casual clothes when approaching persons that could be suspected not to wear formal clothes on a daily basis was used (Mullings 1999: 340). A cover letter that introduced myself, my academic background and the study also helped me gain access to the first group. The importance to tone down my academic background to easier reach a *shared positional space* when communicating with the latter group became evident after reading that: “*Today racism in Peru has been reconfigured in terms of culture and education and enabled by the consensual idea that education, meaning schooling, creates legitimate hierarchies*” (Paerregaard et al. 2016: 203).

The characteristics that I took into consideration when I selected the interview sample for the semi-structured interviews were: sex, age, employment and household size. Besides selecting a diverse mix of respondents with these characteristics in mind the respondent sample - due to their obvious impact on Chivay’s prospect of a sustainable potable water management - also included representatives from the tourist businesses, as well as from Chivay's municipality and SEDAPAR.

I used the same interview guide in all the interviews except the ones I conducted with the employees of the Chivay's municipality and SEDAPAR. The interviews took place in settings chosen by the interviewees – interviewees’ homes, offices, empty restaurants, hotel receptions and lobbies. I did all the semi-structured interviews in Spanish using in an audio-recorder, except the one with the chief at the SEDAPAR office in Chivay since he insisted on answering the interview questions in writing.

6.3.2 Participant observations and document reviewing

I performed participant observation on a daily basis during the six weeks in Chivay as well as during the four days that I spent in Arequipa visiting SEDAPAR main office and INEI (Instituto Nacional Estadísticas y Informática or the Peruvian Ministry of Statistics and Informatics). While carrying out participant observation I engage in several informal conversations relating to the topic of inquiry in this thesis. The people I spoke with included a hostel owner, a travel agency owner, municipality employees, an alpaca shepherd, a mountain guide, a restaurant owner and SEDAPAR employees (both in Chivay and Arequipa). Meanwhile, I made field notes of my observations. I also had a guided tour of the filtering and chlorination facilities in Chivay lead by one of SEDAPAR's employees.

Finally, I collected relevant documents from INEI (Instituto Nacional de Estadística y Informática), Chivay's municipality office, SEDAPAR's main office and a local newspaper.

6.3.3 Generalizability of qualitative methods

A shortcoming of qualitative methods is that they generally are not generalizable to other context than where the study using the methods has been performed (Mikkelsen 2005). However, some researchers claim that in situations where a thorough protocol documentation of the case study and its data-base exist, qualitative methods can be made generalizable (Creswell 2009). Protocol rigor has therefore been essential to this study.

6.4 Analysis

The data collected during the survey was compiled into a document to facilitate a good overview when starting the analysis process. To facilitate the analysis of the recorded material from the semi-structured interviews as well as to save time a Peruvian professional interpreter was hired to simultaneously interpret the audio-recordings from Spanish to English. The risk that information got lost or corrupted in this process was reduced by frequent stops where the interpreter explained things in depth and by the author's possibility to go back and review the original interview recordings.

Through a review of earlier research and theory base and careful listening to the interpreted audio-recordings material, I identified a number of themes relating to the research questions. Coded through this themes I have analyzed the empirical material and sorted this into the headlines found in the *Result and Analysis* section.

To analyze the collected data I have used an *Ethnographic Content Analysis* (ECA) that David L. Altheide defines as: "*the reflexive analysis of documents*" (1996: 14). In the case of this thesis the documents consist of survey answers, semi-structured interview transcriptions, field notes and printed documents. Altheide sees that ECA has many characteristics in common with the more commonly used *Grounded Theory*. Where Altheide sees the two methods differ is when it comes to the results they strive to achieve - the *Grounded Theory* he sees as focusing on developing rigid theories, while he sees that ECA: "*is more oriented to concept development, data collection and emergent data analysis*" (ibid: 17). This insight lead to the conclusion that an ECA method would better serve the limited time span of the thesis than the more inflexible *Grounded Theory* method (Bryman 2012: 567-78).

6.5 Ethical considerations

Water scarcity is a contested issue in Peru and the research was therefore done with the outmost care for the security of the persons participating in the study (Gelles 2000: 64. In accordance with Vetenskapsrådet's research ethical principles (2002: 7) I always introduced myself to potential informants as a university student in the process of writing a thesis about potable water management in the Chivay community. Before participating I gave all the informants who took part in the semi-structured interviews a short written presentation of the aim of the field study and asked them to sign a written consent stating that their answer could be used in the finish thesis (ibid: 9). At the start of every interview, I reminded the interviewees that they were free to cancel the interview at any time and if they so wished could withdraw their consent to that the information shared could be used in the study (DiCicco-Bloom and Crabtree 2006: 319). I did not ask the survey respondents for their written consent given the survey's general nature (see appendix 3) and the fact that their answers was to be presented anonymously in the final thesis. In addition, my decision to design an survey of this kind was influenced by Bryman's observation that the willingness to answer surveys decreases when respondents are asked to sign a consent form (Bryman 2012: 148).

According to Barbra DiCicco-Bloom and Benjamin F. Crabtree as well as Vetenskapsrådet, when an interviewee shares information with the potential to harm her or him (if should the act of sharing become known to people with conflicting interest), the shared information must be handled in such a way that the interviewee can remain anonymous (DiCicco-Bloom & Crabtree 2006: 319; Vetenskapsrådet 2002: 12). With this in mind I notified all potential informants, except the officials from SEDAPAR and Chivay's Municipality, that if they agreed to have their narratives included in the finished thesis these would be presented without mentioning information that could reveal their identities. This also included the locations where the conversations or interviews with them had taken place. The public officials were excluded from the opportunity to remain anonymous since such promises might have tempted them to share information that if included into the thesis could have gotten them into trouble. An exclusion further justified by the fact that with the relative small amount of people working at SEDAPAR's office in Chivay and Chivay's Municipality the risk of an anonymous informant working there being identified could be considered quite large. Throughout the field study I stored all information pertaining to specific persons in locked spaces, when I did not use them, to minimize the risk of others to getting hold of it (Vetenskapsrådet 2002:12-13). Furthermore, to minimize the risk that sensitive information would end up in the wrong hands I used code names for informants, places and events. The information with the codes was at all times stored separately from a list made to be able to decipher the codes into their real names (DeWalt and DeWalt 2011: 222).

7 Results and Analysis

This section presents and examines the empirical material collected during the Peruvian field trip. The first part offers an insight into the water needs and water saving measures of Chivay's potable water users. Following the more descriptive first part, the water users' in depth views on potable water quality, service and future availability, as well as water distributors' complaints and conflict strategies, will be analyzed in the relation to the previous potable water research and theory base. This will be followed by a third and final part discussing how the thesis' data relates to the concepts developed during previous studies in the Colca Valley.

7.1 Potable water need and saving measures

When answering the questions about their monthly potable water consumption and payments the survey respondents consulted their most recent water bills. Since the survey was carried out during the first half of May the numbers given by the respondents are referring to the respondent's consumption during and payments for the month of April.

During April the small household respondents used in average 4.2 percent and big household respondents in average 3.6 percent of their monthly budgets to pay for potable water. Among the hotel and hostel respondents the same numbers were 13 percent and 21 percent. The close to double percentage among the hostels in comparison to the hotels shows that the hostels in the survey have less room in their budget for future increases in water expenditures. The results from the survey show that Chivay is not exempted from Becken's claim (2014) that smaller local tourist accommodations have less economical leverage and have a harder time competing over water sources than bigger high-end ones. A gap in water equity that in a future scenario where higher water tariffs are introduced as a way to battle increased water scarcity - as proposed by *demand-side* and *market environmentalism* proponents – are at risk of increasing even more.

The survey shows that during the month of April the average tourist accommodation respondent used more than six times as much water as the average household. Since April is considered part of the tourism low season in Chivay and the households' water usage remains more or less the same all year around this difference is presumable bigger during the rest of the year. This shows that the difference between tourists' and inhabitants' potable water use in Chivay is part of the trends Becken (2014) has found in her water use research. It also suggests that Chivay could get a more equitable water distribution by using the kind of targeted water management initiatives that Becken (ibid: 20) argues for in her research (described under headline 6.5).

It became clear from the respondents' answers to the survey that the majority used one or more

measures to save water (31 out of the 46 respondents). Examples of these water saving measures were: to examine pipes and toilets for small leakages; not leaving running taps; re-using of shower and laundry water to water gardens, mop floors and flush toilets. To re-use shower water and laundry water for garden irrigation seems to be an effective way for Chivay's household users to lower their water bills. When comparing the survey answers of the four households watering their gardens with re-used water with the eight that watered theirs with potable water the result showed that the first group in the month of May had in average 40 percent lower water bills (3.25 compared to 5.45 soles per household member). The answer from one interviewee who was a teacher and lived in a big household at the time of the survey showed the big water saving potential that just paying a little attention at home could have. The teacher explained that:

“In the past I was not aware of how to care for water. Back then I was paying around 50 soles a month for the potable water. Now after becoming aware and fixing leakages, carefully closing taps and fixing flowing toilets I pay at most 15 soles a month.”

The view that every user through water saving measures could reduce their water bill and contribute to a more sustainable water use in the community was shared by two tourist hotels. According to the survey both hotels have installed water savers in the toilets of their guest rooms. Through their survey responses as well as field visits it also became clear that the two hotels are at the top end of the tourist accommodations in Chivay, which supports Becken's claim (2014) that high-end tourist accommodations gains comparative advantages by being able to invest in extensions of their water infrastructure.

The kind of relatively easy water saving changes that the teacher above has used are also promoted by SEDAPAR in Chivay through posters hanging on the walls in their local office. However, since it is possible to pay potable water bills through any of the town's handful of banking service offices it is quite plausible that not everybody in the community have consulted these instructions. For water users who pay the potable water bill in this way only those who want to make some sort of complaint have reasons to visit their local SEDAPAR office. During the field study I made three observations that suggested that SEDAPAR had not fully succeeded in making the public in Chivay aware of the economical and sustainability benefits from the kind of water saving measures used by the teacher described above. Firstly, many business keepers around noon used water hoses to keep the dirt roads from dusting outside their businesses, which is a method that in water scarce areas, if used at all, tends to be carried out at hours during the day when less water directly evaporates. Secondly, the puzzled look that a hostel owner interviewee gave me before answering that he didn't understand why he had been asked if his hostel had any water saving measures when everybody

could see that there is a lot of water available in the community. Thirdly, an interviewee originating from the Cusco region who claimed that “*people in Chivay don't consider water as a vital element*”. The man elaborated on the claim saying:

“The other day I myself left the valve open and unattended wasting water for quite some time when I was watering the garden. At the time I did not think much about it but I have seen others doing the same. I suspect that because water is so cheap incentives not to miss use it fail.”

The first comments disclose a lack of trust in other water users’ effort to do their equal part to save water, which according to Becken is a key ingredient (2014) for a *demand-side* or *commodity* water management to be sustainable. The second comment supports the *demand-side* and *commodity view* proponents’ claim that if water is not given a sufficient price incentives to use it efficiently is lost. More opinions on Chivay's water tariffs will be discussed under the headline *Fair tariffs* below.

Among the semi-structured interview samples only one respondent did not write any personal water saving measures in their survey. Instead this owner of a mid-size tourist restaurant answered the survey question *do you use any water saving measures, if so which?* with only one word: *SEDAPAR*. Later in the semi-structured interview when the respondent was asked about her thoughts on future water availability in Chivay she said: “*lately SEDAPAR has started to replace the pipes. According to them we will have better service, but we haven't seen how this will play into the availability issue yet*”. This answers could be seen as an indication that the respondent, although with a healthy dose of skepticism, believes that water availability matters are best taken care of by a major distributor with economical resource to install large water saving technology, which is a view that are more in line with the introduction of large scale water measurement and pricing infrastructure that has been proposed by *demand-side* and *commodity view* proponents.

7.2 Safe potable water - divergent views between the users and the distributor

At the time of the field trip SEDAPAR’s water distribution chain in Chivay consisted of three main steps.

First, the water that is to become potable water in Chivay are collected from the river San Andres, a river that has its origin in the mountains above the valley flat where Chivay is situated. After being separated from San Andres river bed the water is directed into a number of subterranean pipes that are filled with small pebbles intended to give the water a mechanical filtering. After passing through these filtering pipes the water is directed to Chivay's two potable water reservoirs, which completes

the first step.

In the second step the filtered water is chlorinated. This is done four times a day seven days a week by a SEDAPAR employee who uses a well-worn motorcycle to make the ten minute ride from the organizations office in Chivay along a bumpy gravel road up to a secluded chlorination facility situated about a third way up one of the hills surrounding the town. These daily rounds are called *cloración artesanal* by the employees. It is not hard to guess where the nickname comes from after having seen how a small bucket of chlorine granulates are poured into a big bucket of water and then stirred with a wooden stick for a minute or two before being added to a tank distributing liquid chlorine evenly between the rounds into Chivay's two potable water reservoirs.

In the third and final step of the water distribution chain the water is transported from the reservoirs to the users. This final step is done without any help of pumps. Instead the difference in altitude between the reservoirs and Chivay is used to create sufficient gravity pressure inside the town's pipe network. With this pressure through main network pipes followed by smaller distribution pipes the water finally reaches its goal - the water users.

Six out of the 11 water users who took part in the semi-structured interviews mentioned that they were concerned about the quality of Chivay's potable water. The general concern among these respondents is well summarized by a small tourist restaurant owner who said: "*SEDAPAR calls the service 'drinking water' but I believe in Chivay 'drinking water' is not drinking water*". The reason why the water is not living up to what these respondents consider a satisfying water quality can be ascribed to three main factors.

The first factor has its origin in a non-effective water treatment service. According to the users, the water has at times a bad taste and appears untreated. Two of the concerned respondents also mentioned that when examined samples from the potable water have revealed the existence of micro-organisms in the water. Another respondent, a hostel manager, pointed out that she sometimes had noticed that the potable water has something in it that she thought looked like small insects. When concluding her experience on the topic the same respondent said: "*Once some visiting friends of mine got sick after they had been drinking the water*".

The second factor can be ascribed to over usage of Chlorine in the water treatment process, which several of the respondents believe is a major reason for the bad water quality.

The third cause mentioned is the occasional heavy flooding during the seasonal rain period. The small tourist restaurant owner cited above said: "*Sometimes when Chivay is flooded by heavy rainfall the potable water is no longer fully transparent*". Another small hostel owner confirmed this views stating that: "*Sometimes the potable water seems to contain litter, especially after heavy*

rainfalls". A third hostel manager pointed out that: "*Here drain water during rain floods pollutes the rivers. Once during heavy rainfall I saw that the water in the river was full of sewage*". All three respondents' observations signal that several pipe system in Chivay is overloaded during heavy rain floodings.

When asked about the water quality the SEDAPAR interview respondent answered that they put the water through a proper treatment process to make it potable by first passing the water through the filtering pipes and then giving it a sufficient chlorination. He also assured that the chlorination processes was done every day at the correct hours according to a beforehand decided schedule.

That SEDAPAR's water treatment efforts in Chivay have not always been sufficient to produce proper potable water are confirmed by the answer given by the water responsible at one of the high-end hotels in Chivay who said: "*To make sure we can always provide safe potable water to our guests we have installed filter machines in the kitchen and in the bar*". This statement confirms that the water distributed by SEDAPAR in Chivay is not always living up to minimum potable water requirements. The respondent continued:

"We measure the water distributed to us on a daily basis to see if the chlorine levels are within the range of human consumption, and the water usually arrives with chlorine levels that are within the range recommended by the health department of Peru"

"Usually" rather than "always" indicates that the respondent believes that Chivay's water users from time to time have reasons to be concern about chlorine levels in the town's potable water.

Under this headline we have seen examples of what Orlove and Canton (2010) call the material and social constructed aspects of water quality; the first in the form of discussions related to the concern that Chivay's potable water's contains biological and chemical contaminants, in our case the existence of micro-organisms and possible harmful doses of chlorine, and the second in the form of discussions related to the risk of drinking Chivay's potable water and the recommendations of Peru's health department. The respondents' association of water's material and social aspects resonates with Orlove's and Canton's observation (2010) that this two aspects are deeply intertwined.

7.3 Perceptions of the service in the potable water scheme

When asked the question *what do you think of SEDAPAR service?* only one of the 11 semi-structured interview respondents answered *good* while five answered *bad* and five answered *so and so*. The respondent who considered SEDAPAR service as *good* was from the hotel respondent group. The other ten answers were spread fairly even among the respondent groups in a way that no

major pattern could be identified. Nor could any major pattern be identified in the answers relating to the respondents' age, gender or years in Chivay. How the respondents perceive SEDAPAR's service and the reasons for their perception will be discussed in detail below.

7.3.1 Water flow and broken water pipes

Among the semi-structured interview respondents five had noticed that the flow pressure of the potable water has decreased during the last decades. The fact that not all respondents had noticed this change in the flow pressure could be attributed to the unequal distribution of SEDAPAR's water service that is driven by gravity pressure. This explanation is supported by the observation of the water responsible at the high end hotel referred to above who said that:

“Fifteen years ago there was enough water flow for all inhabitants in Chivay. Now the areas situated in higher altitudes on the opposite side from the water reservoirs has very low water flows. Between September and November just before the rains season starts the pipe pressure is just hardly enough to reach these places”

Similarly, the above mentioned hostel manager affirmed that at her previous work, uphill on the other side of the valley from SEDAPAR's reservoirs, she frequently experienced low potable water pressure and at times no water at all for a whole day.

However, at times low potable water pressure seems to affect users in not just the peripheral high altitude parts of Chivay but also more central parts of the town. One example of such cases was given by a respondent who owns a small hostel not more than a few hundred meter from Chivay's main square who when asked if he had experienced any changes in the potable water availability answered:

“Yes I have noticed changes in the potable water pressure. The pressure used to be better in the past when the population in Chivay was smaller. Usually the pressure is the lowest on Saturdays and Sundays when most people are free from work. At these occasions the water doesn't reach the forth and fifth floor here. Due to this we now have a backup water tank on the roof of the building”

Another respondent living and working close to the Chivay's main square pointed out that since she moved back to Chivay five years ago she has observed that the potable water flow is weaker than when she lived in the town twenty years ago.

Many of the respondents who had noticed a decrease in water pressure related this to Chivay's recent population growth. Some respondents also noticed a connection between Chivay's population growth and the tourism boom that have taken place in the last decades. According to these

respondents, the latter has led to an increase in businesses opportunities that in turn have served as pull factor for Chivay's population growth. Interestingly, when asked what they thought could turn the issue of low potable water pressure around none of the respondents suggested modifications of the local population's or the tourists' water consumption habits. Instead they all pointed to large scale infrastructural solutions. While some as the above mentioned mid-size tourist restaurant owners put their hopes in the improvements of the main pipe network that SEDAPAR was carrying out at the time of the field study others thought that SEDAPAR should build a big rainwater collection reservoir to harvest the water from the heavy floods that are recurrent during the rainy season, which supports Orlove and Cantons' (2010) claim that the resilience of a water source may has as much to do with aspects relating to governance as the physical characteristics of water. The lacking awareness of the importance of the respondents' own behavior as water users in these suggestions reveals a perception of potable water as a public good that SEDAPAR should provide them as tax paying citizens, which adheres to the *supply-side approach* and the *commodity view* (Derman and Ferguson 2003; Bakker 2007). By contrast, SEDAPAR's installing of water meters, reforms of the potable water tariffs (see the next headline), and promotion of water saving initiatives through a poster campaign at their office in Chivay that presents water as a scarce resource shows that they have adopted a *demand-side* and *commodity* water management (ibid).

Orlove and Canton (2010) claim that it takes extensive economical means to create and sustain water infrastructure, which seems to be in line with the observation of the water responsible of the high-end hotel cited above who commented:

"The responsibility for the potable water distribution was passed to SEDAPAR after the municipality failed to manage the big economical cost of extending the pipe infrastructural to all new inhabitants in Chivay"

The same respondent asserted that this change of potable water distributor *"Increased the potable water pipe pressure for a period of time, before a decrease started"*, which implies that even though SEDAPAR's infrastructural investment initially was sufficient to meet Chivay's needs it has been outgrown by the water demand of its increasing population during the last 15 years. Nevertheless, when asked about their distribution the SEDAPAR employee respondent didn't show any sign of concern about changes in water pressure. Instead he claimed that everybody have water 24 hours a day.

While having daily strolls along the streets of Chivay I observed nine places with big water puddles even though it had not been raining for weeks. After asking the workers who had dug a hole exposing the water pipes next to one of the puddles why these had emerged I realized that they had

been created by broken water pipes. One of the water pipes was still broken at the end of my field study period. When I showed a photo of the leakage to the head of Chivay's SEDAPAR office he looked surprised and said that he was not aware of the broken pipe. He then thanked me for sharing the information. However, one of his colleagues affirmed that he had noticed the broken pipe and given an exact account of its location to his superior, which points to the inefficiency of SEDAPAR's internal communication. An interviewee working as a receptionist at a high-end hotel supported this view. She said: *"I think the management of SEDAPAR's services could be better coordinated"*.

When asked about broken pipes nine of the 11 user respondents said that they had either personally experienced water leakages in Chivay or been told by friends of such damages, which they argued was caused by the increasing number of heavy delivery trucks that use the town's fragile dust roads. Throughout my field study I observed the deteriorating conditions of Chivay's roads on a daily basis, which lead me to conclude that the current traffic by far exceeds their capacity.

The interviewed SEDAPAR employee informed me that the organization uses two or three hours to repair broken main network pipes. By contrast, the user respondents who reported the broken pipes claimed that the repairing times varied between four to eight hours during weekdays. Moreover, four of the respondents gave examples of breakages that occurred during the weekend when the employees of SEDAPAR rest. These four examples are all similar to the observations made by the mentioned hostel manager I referred to above who said:

"On a Sunday a pipe broke at the main square. We tried to contact SEPAPAR but couldn't get ahold of them, so the water was left to flow the whole day. I believe the head of the office are not in Chivay during weekends and although his associates live in Chivay they do not care to do anything. Even if a pipe breaks during the weekend they should be able to fix it the same day"

SEDAPAR's lack of attention during weekends prompted a small size restaurant owner to say: *"SEDAPAR don't consider our complaints as something they need to cater to immediately to provide a good service"*.

7.3.2 Fair tariffs?

When asked how they perceived the potable water tariff introduced by SEDAPAR the reply by the 11 user respondents varied from very critical to relatively positive. Seven respondents think that the tariffs are unfair while four find them fair. Furthermore, four of the respondents claimed that tariffs were much lower before SEDAPAR took over the water distribution. One of the members of a big

household explained that before SEDAPAR introduced the current tariffs:

“We used the water without treatment straight from the mountain and we didn't measure the amount of water we used since we all paid a fixed tariff of around one sol each”

Another respondent explained that some water users opposed the new tariffs introduced by SEDAPAR when the organization took over the management of Chivay's potable water distribution. He also told that they tried to make the municipality re-assume the responsibility of the town's potable water distribution but that their initiative failed.

Two of the respondents who didn't object Chivay's potable water tariffs claimed that these were much lower than in other Peruvian cities. Two other respondents who approved Chivay's water tariffs both expressed their concerns about the impact of climate changes on the future water supply, and, accordingly, said that they see the tariffs as an attempt to value water as a scarce resource, which resonates with the *demand-side* and *commodity* paradigms. The respondents also argued that tariffs should be used to incite individuals to use water saving measures reflected in the changes of water user behavior which the teacher described under the headline *Potable water need and saving measures* above pointed to.

Apart from pointing to the rising tariffs after SEDAPAR took over Chivay's water distribution the small restaurant owner respondent referred to above argued that:

“For a good service we could pay a good price. Given that we are not delivered proper potable water quality the tariffs are exaggerated. I pay more for water than gas or electricity”

Another discontent respondent said that the tariffs are unfair since everybody within the same tariff category pays the same tariff even though the service varies because of the uneven water pressure. The above mentioned hostel manager pointed out that:

“Every year the tariffs rise. SEDAPAR says it because we are using more water but I think they want to raise the tariffs. Meanwhile, they are not enhancing the quantity nor improving the quality of the water they provide us”

The before mentioned respondent who comes from the Cusco region contented that:

“I'm sure people working for example in the construction sector may negotiate and get a reduced tariff”

The statements of the two respondents underscore their lack of trust in the fairness of SEDAPAR's

tariffs, which Becken (2014) argues is a key to sustain a *demand-side* and *commodity* water management.

During my interviews with the SEDAPAR employee and the municipality employee I was told that the water users who found the potable water tariff to be too high had no idea of what they were talking about and that the tariffs in other Peruvian cities were much higher.

7.3.3 Complaints, conflict strategies and future projects

Among the 11 user respondents seven answered yes to the question if they had contacted SEDAPAR to leave complaints. Below follow some summarizing examples of these complaints and how SEDAPAR catered to them.

One respondent said that he had contacted SEDAPAR after the water service had been cut without prior notice and that he was told that the cut was due to pipe breakage accident caused by a passing vehicle. The respondent pointed out that he would have appreciated if SEDAPAR had notified him and other affected water users about the cut when it was discovered. A small restaurant owner mentioned that he once got an unreasonable high water bill and when he complained to SEDAPAR they told him that it was due to a water leakage in his restaurant. After the owner had checked all the toilets and the pipes of his restaurant he contacted SEDAPAR again and told them that there were no leakages or damages. The owner described his second visit to SEDAPAR's office in the following way:

“Their representative began to talk to me about changing my meter, which I didn't see as a real solution to my complaint. I ended up paying the bill to avoid having my water service cut”

Another respondent said that he complained to SEDAPAR that his water bill had skyrocketed after he and his family opened parts of their home as a hostel. SEDAPAR then installed two separate meters in the hostel, one domestic meter for the family's potable water usage and one for their hostel guests' potable water usage, which the respondent found *“more or less”* satisfactory.

The water responsible at a high-end hotel, on the other hand, sounded more pleased when he explained that:

“We have been in contact with SEDAPAR for example to get some education on how to use chlorine and clean our tanks at the hotel, they gave us good attention”

The respondent also said:

“As I see it SEDAPAR needs to work on improving their communication with the people

of Chivay. They should provide education to not only us as a hotel but also the general public about how to use potable water more efficient and its benefits”

When asked if SEDAPAR had invited them to any meetings about their potable water usage all of the user respondents answered no, which confirms the claim in the comment above and in the *Potable water need and saving measures* section that SEDAPAR could do much more to educate Chivay’s water users about how to save water.

One hostel manager who found SEDAPAR’s reply to the hostel's complaints unsatisfactory pointed out:

“When we complain nothing ever gets solved. At the Chivay office they tell us to make written complaints to the main office in Arequipa but over there our complaints don't seem to be taken seriously.”

Similarly, the owner of a mid-size tourist restaurant pointed out that: *“the decisions are not made by them. They are made in Arequipa”*. However, even though SEDAPAR had not replied to her water bill complaint properly she found that the attention from the local SEDAPAR employees had been good.

The critical comments on SEDAPAR’s public relations can be seen as a lack of trust in the accountability and efficiency of the potable water management, which Becken (2014) sees as key to sustain a *demand-side* and *commodity* water management.

When the SEDAPAR employee respondent was asked if he had any strategies to avoid conflicts between different water user groups he responded:

“The strategies we are using are to listen to the water users complaints. In general conflicts exist in places where there is shortage in water. In Chivay we have no shortage”

When asked the same question the municipality employee respondent first looked puzzled and then said: *“There is no need for such strategies here in Chivay since all the inhabitants here have water twenty-four hours a day”*.

Nonetheless, SEDAPAR’s main office in Arequipa proves to be more far-sighted. In 2010 the organization made a calculation of Chivay's expected population growth and water demand development for the upcoming 31 years (see appendix 4). Between 2016 and 2020 this calculation foresees a population growth of 17 percent and between 2016 and 2030 a growth of 71 percent. The foreseen changes in water demand follow a similar pattern, between 2016 and 2020 the calculation

anticipates a 14 percent increase in water demand and between 2016 and 2030 one of 62 percent. The calculation also predicted that SEDAPAR's potable water distribution in Chivay from 2012 and beyond was going to have 100 percent user coverage. However, the narratives in the thesis show that 100 percent coverage had not yet been reached in Chivay by 2016. Regardless of its correctness the mere existence of the calculation shows that SEDAPAR has paid attention to Chivay's recent demographic growth and suggests that the organization acknowledges this as a major challenge to its effort to provide potable water to the town's future population, which also becomes clear by its recently initiated project to upgrade Chivay's potable water infrastructure including the modernization of the pipe network and the potable water treatment facility (SNIP 2012).

7.4 Through the lens of previous research in the Colca Valley

As mentioned in the *Previous research and theoretical framework* section Boelens and Gelles (2005) argue that the adaptation of the *postcolonial equality discourse* lead to a view of the people in the Peruvian Andes as *citizens* and *subject of development* welcomed into the nation project. The narratives presented in this thesis suggest that Boelens' and Gelles' discourse (2005) was at best present among Chivay's potable water authorities in a watered down version at the time of the field study, this since the *citizens* in Chivay were not treated as if they had equal potable water rights (e.g. in terms of water quality and pressure) as *citizens* in more urban parts of the region (where automatic water treatment facilities and pump systems already had been installed). A more certain sign of the discourse's presence was found in Chivay's water users' demands on the water authorities to provide them with new infrastructure and western technology (e.g. a modern treatment facilities, a pump system and catchment reservoirs), something that could be seen both as a sign of the "*inclusive*" power that according to Boellens and Gelles (2005) is an integral part of the discourse, and that the water users view themselves as *citizens* entitled to the same level of potable water service as the *citizens* in urban metropolises of the country. The gap between what the water users in Chivay were expecting from the potable water authorities and what they were actually receiving generated a discontent that arguably served to lessen the extension of the state's control that the *postcolonial equality discourse* is said to promote (Boelens and Gelles 2005).

According to Boellens and Gelles (2005), the framing of peasants and indigenous groups as *subjects of development* helps keeping the rules and mechanisms of subordination hidden. In the case of irrigation water management that Boellens and Gelles (2005) were examining this might have been the case, however, in the potable water management context in Chivay, examined in this thesis, the reality looks different.

Examining the new rules introduced when SEDAPAR was made responsible for the potable water

provision in Chivay we find that these mainly consist in that if you don't pay your monthly water bill in time you will have your water service disconnected, something that for the poorest water users has created a severe economic risk since the price of getting their service back (40 soles in 2016) has been manifold higher than their average water bill. Hence, it can be assumed that the new rules introduced in Chivay's potable water scheme stay visible in the water users' minds.

Examining the new mechanisms introduced in the potable water scheme in Chivay we find that these consisted in the installment of water meters, a poster campaign at SEDAPAR's office and water tariffs better reflecting the actual water availability in the area. The public nature of the new mechanisms introduced by SEDAPAR certainly assures that these also become visible in the water users everyday lives: the water meters when they are installed and at SEDAPAR's monthly readings; the posters for the users visiting SEDAPAR's office; the tariffs when the users receive their monthly water bills.

One might argue that the combination of above discussions on the visibility of the new rules and mechanisms introduced by SEDAPAR and the organization's inability, deliberate or not, to provide Chivay's water user with a service up to par with the one they offered users in more urbanized parts of the region played a significant role in instigating the water user initiative aimed at making the municipality re-assume the water management responsibility. Moreover, given the water users' narratives presented in this thesis, one might argue that even though the Chivay's water users at the moment are abiding to the introduced *neoliberal market ideologies* rules (Boelens and Gelles 2005) there are signs of a dormant discontent which in the absence of improvements in water quality and pressure - after the present infrastructure projects are finished - might give rise to a new mobilization campaign among the users.

In the light of the earlier accounted for field observations of business keepers watering the roads around noon, as well as the comment from the interviewee originating from the Cusco region that he had seen other inhabitants in Chivay misuse water, one might argue from Paerregaard's and his colleagues' (2016) *water citizen* perspective that not all water users in Chivay had fully internalized the new water law's sustainable water management discourse (serving as a vehicle to achieve recognition as Peruvian citizens). Moreover, signs of not having fully internalized the discourse are not only visible among some of the water users, the comments about Chivay's abundance of water made by the representatives of Chivay's potable water authorities imply that they also failed to recognize water as a precious economical resource. In addition, one might argue that the existence of a water puddle from a leaking water pipe – during the whole thesis field study - indicated that the potable water authorities in Chivay were not applying the kind of conscious management that Paerregaard and his colleagues view as one of the pillars of the sustainable water management

discourse.

8 Conclusion

The aim of this thesis has been to explore how the potable water in the town of Chivay is allocated and how the users perceive the water quality, service and tariff equity. To gather data for this research the thesis has used a survey and also conducted interviews and participant observations in Chivay.

The gathered data show that since SEDAPAR took over the management of Chivay's potable water scheme in the nineties it has shifted from having what Derman and Ferguson (2003) describe as a *supply-side approach* to what they describe as a *demand-side approach* to collect water tariffs, or if you will, a shift from having what Bakker describes as a *commons' view* to what she describes as a *commodity view* on the collecting of tariffs. While the tariffs previously were held low at fixed level, SEDAPAR has introduced water meters to make tariffs reflect water as a scarce resource. The interviewed water users' attitudes to this change vary. While some find that climate change and Chivay's growing population justify these changes, others see water as a public good which they as water users have the right to enjoy in abundance.

The majority of the interviewed water users were critical of the way SEDAPAR manages Chivay's water supply. This comes to the fore in their narratives about unsafe water quality, low water pressure, long repair times for broken pipes, unannounced cuts, unreasonably high water bills, bad coordination among service employees, SEDAPAR's response to their complaints and insufficient public education on how to save water. The respondents' narratives reveals a disbelief in that other users know how to save water as well as in the tariff fairness, accountability and efficiency of Chivay's potable water scheme, all essential parts of the trust that Becken (2014) sees as key to sustain a *demand-side* water management. Moreover, the respondent narratives about the low water pressure, in a time characterized by a temporally water abundance in the Colca Valley, seems to confirm Orlove's and Canton's (2010) claim that whether or not a water source is considered resilient has as much to do with management aspects as with the actual physical existence of water. The interview answers given by the employee of SEDAPAR's Chivay office and the employee at Chivay's municipality suggest that the town's authorities do not take water users' critique seriously and that they worry little about the town's future water provision. Moreover, SEDAPAR bases its water management on a water demand prognosis for Chivay - compiled by its main office in Arequipa - that differs from the water users' concern about a possible future water scarcity. This

dissonance is reinforced by SEDAPAR's recently initiated project to modernize Chivay's water pipe network and potable water treatment facility, which the organization believes has the potential to correct many of the potable water issues that the interviewed water users are concerned about. Whether SEDAPAR's project will solve Chivay's future water problems is an open question. However, what can be concluded at this point is that it does little to calm the water users' worries and to meet their demands.

Other important issues are the water users' sense of fairness in the way SEDAPAR collects water tariffs as well as the gaps in the ability to pay for water among the different water users that they cover. In contrast to the data shared by SEDAPAR this field study shows that the average tourist accommodation in Chivay uses six times more potable water than the average household, which in combination with the observed pull effect on migration in Chivay and a continued growth in visiting tourists could jeopardize the gains made by SEDAPAR's new potable water infrastructure investments and further enhance the water users' uneven water consumption. Here the usage of a specific tourist tariff as proposed by Becken (2014) could play an important role. Furthermore, the collected data show the same advantage of having economic leverage to invest in water infrastructure are found among the hotels in Chivay belonging to large hotel chains as in Becken's research, suggesting that a tourist tariff might be most fair if divided into two subcategories: one for small locally owned tourist accommodation and one for bigger complexes with owners often residing elsewhere.

Looking into the future, the reason behind the divergent views between SEDAPAR's Chivay office and its main office in Arequipa on the risk of the town's future scarcity could be an interesting topic for further research, just as studying how Chivay's water users perceive its potable water scheme after the recently initiated infrastructural projects has been completed could yield relevant insights into the water management of regions that are vulnerable to climate change and water scarcity.

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Appendix

Appendix 1

Map of Peru showing Arequipa region¹



Map of Arequipa region showing Caylloma and Chivay²



¹ Wikipedia. *Arequipa Region*. Accessed 2 November 2016.
https://en.wikipedia.org/w/index.php?title=Arequipa_Region&oldid=744798606.
² Poder Judicial del Perú. *MapaArequipa.jpg*. Accessed 2 November 2016
<http://historico.pj.gob.pe/CorteSuprema/ncpp/images/MapaArequipa.jpg>.

Appendix 2

SEDAPAR S.A.

Ger. Planeamiento y Desarrollo Empresarial

**CONEXIONES DE AGUA POTABLE Y ALCANTARILLADO
POR LOCALIDAD - SERVIDAS POR SEDAPAR
AL MES DE DICIEMBRE 2015**

LOCALIDAD	CONEXIONES DE AGUA POTABLE					CONEXIONES DE ALCANTARILLADO N°
	TOTAL N°	Con Medidor	Sin Medidor	PILETAS PUBLICAS		
				c/medidor	s/medidor	
AREQUIPA METROPOLITANA	255,787	217,641	38,109	34	3	227,137
PROVINCIAS	40,628	36,173	4,394	3	58	29,976
Arequipa						
La Joya	2,083	1,955	125	3	0	1,559
Caylloma						
Chivay	2,104	1,992	110	0	2	1,607
El Pedregal	3,322	2,979	343	0	0	3,284
Castilla						
Apíaco	2,663	2,178	484	0	1	1,731
La Unión						
Cotahuasi	898	808	88	0	2	621
Condesuyos						
Chuquibamba	1,223	1,136	86	0	1	1,026
Islay						
Mollendo	9,644	8,306	1,308	0	30	8,630
Matarani	1,387	1,256	119	0	12	945
Mejía	1,159	1,003	156	0	0	0
Cocachacra	2,120	2,043	76	0	1	1,259
La Curva	481	469	12	0	0	468
El Arenal	696	614	82	0	0	444
Punta de Bombón	2,175	2,101	70	0	4	1,805
Camaná						
Camaná	6,384	6,073	306	0	5	4,751
Caravelí						
Caravelí	1,281	1,128	153	0	0	1,090
Chala	1,176	730	446	0	0	756
Atico	1,231	911	320	0	0	0
Yauca	601	491	110	0	0	0
TOTAL DEPARTAMENTO	296,415	253,814	42,503	37	61	257,113

Fuente: Reporte 2020 Módulo de Catastro mes de Diciembre 2015 - Resumen: Tipo de Servicio/Condición - AQP y Prov. - SISCOM
LCSS-2015

Appendix 3

Cuestionario sobre su uso del agua



¿Sexo? *Hombre* *Mujer*

¿Edad?

¿Estado civil?.....

¿Cuántos hijos tiene?.....

¿Profesión?.....

¿Tiene usted un negocio, hostel/hotel, taller, o realiza otra actividad en la casa?

.....

¿Años de residencia en Chivay?.....

¿Cuántas personas viven en su casa?.....

¿Quiénes son? (puede marcar más de una opción)

familia (¿Cuál es la relación de parentesco?) *inquilinos* *empleados* *otros*

.....

¿Para qué usan el agua potable en su casa?

beber/cocinar *baño* *lavar* *regar* *otros usos*

Si marcó "otros usos" ¿puede especificar cuáles?.....

¿Qué cantidad de agua potable consume su familia mensualmente?.....

¿Cuánto paga usted mensualmente a SEDAPAR?.....

¿Cuánto es su presupuesto mensual para alimentación y servicios básicos?

.....

¿Qué mecanismos usan para ahorrar agua potable en su casa?.....

¿Comparado con otras familias en Chivay, ¿usted cree que su familia / negocio consume

más *igual* *menos*

agua potable?

Appendix 4

CUADRO N° 3.6.1: DEMANDA DE AGUA POTABLE - CHIVAY

(LOCALIDAD CHIVAY)

Año	Población Urbana	Cobert. Domest (%)	Poblac. Servida	Conexiones																Consumo Total Conectado m ³ /Año
				Doméstico				Comercial				Estatal				Industrial				
				C/Med	S/Med	Total	% Micromed.	C/Med.	S/Med.	Total	% Micromed.	C/Med	S/Med	Total	% Micromed.	C/Med	S/Med	Total	% Micromed.	
2 010	6 852	93.2%	6 389	1 325	70	1 395	95,0%	106	9	115	92,2%	21	5	26	80,8%	1	1	2	50%	308 324
2 011	7 120	93.2%	6 641	1 380	70	1 450	95,2%	108	9	117	92%	21	5	26	81%	1	1	2	50%	324 797
2 012	7 399	100%	7 399	1 616	0	1 616	100%	119	0	119	100%	26	0	26	100%	2	0	2	100%	356 163
2 013	7 688	100%	7 688	1 678	0	1 678	100%	121	0	121	100%	26	0	26	100%	2	0	2	100%	367 911
2 014	7 989	100%	7 989	1 746	0	1 746	100%	123	0	123	100%	26	0	26	100%	2	0	2	100%	380 736
2 015	8 302	100%	8 302	1 814	0	1 814	100%	125	0	125	100%	26	0	26	100%	2	0	2	100%	393 561
2 016	8 627	100%	8 627	1 884	0	1 884	100%	127	0	127	100%	26	0	26	100%	2	0	2	100%	406 746
2 017	8 965	100%	8 965	1 959	0	1 959	100%	129	0	129	100%	26	0	26	100%	2	0	2	100%	420 829
2 018	9 316	100%	9 316	2 034	0	2 034	100%	131	0	131	100%	26	0	26	100%	2	0	2	100%	434 912
2 019	9 680	100%	9 680	2 113	0	2 113	100%	133	0	133	100%	26	0	26	100%	2	0	2	100%	449 713
2 020	10 059	100%	10 059	2 195	0	2 195	100%	135	0	135	100%	26	0	26	100%	2	0	2	100%	465 053
2 021	10 453	100%	10 453	2 282	0	2 282	100%	137	0	137	100%	26	0	26	100%	2	0	2	100%	481 292
2 022	10 862	100%	10 862	2 371	0	2 371	100%	140	0	140	100%	26	0	26	100%	2	0	2	100%	498 195
2 023	11 287	100%	11 287	2 464	0	2 464	100%	143	0	143	100%	26	0	26	100%	2	0	2	100%	515 816
2 024	11 729	100%	11 729	2 560	0	2 560	100%	146	0	146	100%	26	0	26	100%	2	0	2	100%	533 976
2 025	12 188	100%	12 188	2 662	0	2 662	100%	149	0	149	100%	26	0	26	100%	2	0	2	100%	553 214
2 026	12 665	100%	12 665	2 765	0	2 765	100%	152	0	152	100%	26	0	26	100%	2	0	2	100%	572 632
2 027	13 160	100%	13 160	2 873	0	2 873	100%	155	0	155	100%	26	0	26	100%	2	0	2	100%	592 948
2 028	13 675	100%	13 675	2 987	0	2 987	100%	158	0	158	100%	26	0	26	100%	2	0	2	100%	614 341
2 029	14 210	100%	14 210	3 102	0	3 102	100%	161	0	161	100%	26	0	26	100%	2	0	2	100%	635 915
2 030	14 766	100%	14 766	3 224	0	3 224	100%	164	0	164	100%	26	0	26	100%	2	0	2	100%	658 746
2 031	15 344	100%	15 344	3 351	0	3 351	100%	167	0	167	100%	26	0	26	100%	2	0	2	100%	682 475

(*) Para la elaboración del cuadro de demanda, se ha utilizado una densidad poblacional de 4.58 hab/viv (obtenido de encuestas)

(**) El porcentaje de pérdidas han sido tomadas de la información proporcionada por la EPS SEDAPAR.

FUENTE: Elaboración propia