

# **The Beginnings of the Tragedy of the Commons in Chile: analysis of water-conflicts from colonial times**

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## **Abstract**

Water Users Associations (WUAs) play a key role in accomplishing a collective water management in Chile since they are in charge of the distribution of the resource as well as the conflict resolution. Even though they have proven to be efficient in fulfilling their objectives, they have low participation and formation rates. Previous research has shown that these problems may come from a weak institutional structure and its limited capacity. However, we lack the information of the institutional situation before 1819. This study then pursues to understand the water management system and how the conflict resolution worked in Chilean colonial times (pre-1819) and how it may have influenced the present system. To this purpose, the transcription of nearly 40 judicial water-related trials from 1729 to 1802 was analyzed in the scope of collective water governance. Results show that even though the main principles of collective action were in fact present during colonial trials, not all actors were equally represented. The lack of representation of all actors in the given institutional framework may have influenced posterior rulings. Thus, current policies must be adapted in order to promote inclusion of all actors in the institutional framework as to promote WUAs successful formation.

**Keywords:** Common goods, collective action, water management, colonial Chile, water conflict resolution, National Archive trails.

## **Introduction**

As a result of population growth and economic development, several authors point out that water scarcity has become a constraint on economic growth and development, food production and poverty reduction at a global scale (Barbier, 2004; World Bank, 2011; Gerbens-Leenes and Hoekstra, 2012; Jiménez and Galizia, 2012). Water management problems that have resulted in water scarcity, are largely due to the fact that water is a free access resource or common property resource and it tends to be overused leading to its exhaustion (Ostrom, 2015; Hileman, Hicks and Jones, 2016). This, since individuals sharing a common resource will act in their own benefit, obtaining worse results than if they acted collaboratively, theory known as the Tragedy of the Commons (Hardin, 1968). However, Ostrom (2015) and Van Vugt (2002) show that users with a common goal, have the ability to cooperate in the conservation and management of resources used in common, achieving sustainable management. To accomplish this with common goods or free access resources such as fisheries, prairies and water resources, requires the formation of participatory organizations, capable of learning and continuously modernizing to adapt to the challenges of self-regulation (Lopez-Gunn and Cortina, 2006; Rica *et al.*, 2014).

Collective water management has been a characteristic in Chile in the modern times and it can be tracked to the first national set of regulations issued in 1819 (Donoso, 2006). Here, the size of irrigation districts was defined, which led to the formation of Water User Associations (WUAs). Nowadays, WUAs play a key role in water management in Chile since they are in charge of the distribution of the resource as well as the conflict resolution<sup>1</sup>. WUAs have had positive results performing their administrative functions (Puig, 1999; World Bank, 2013; Bauer, 2015; Donoso, 2018). This scenario, however, is not the norm along the Country. Multiple basins and rivers have not yet succeeded organizing around a WUA, and, of those that are organized, most do not have the active participation of their users (World Bank, 2013). In surface water in central Chile, nearly 37% of the WUAs have not formally organized (CNR, 2016). Considering groundwater, the situation is critical, since only 14 out of the 159 aquifers facing scarcity<sup>2</sup> have been organized (DGA, 2016). Also, there is a lack of representation of all sector involved, usually leaving hydroelectric, mining and environmental uses aside. This lack of management has led to over-extraction, depletion of multiple aquifers and conflicts, thus leading once again to the Tragedy of the Commons (World Bank, 2013).

The question that arises is where does it all come from. It is possible that the water management and conflict resolution from Chilean colonial times (pre-1819) influenced the present system? Is it possible that nowadays we are confronting problems that had already been solved back then? We know nothing. Despite its strategic importance, studies on historical collective water management in Chile are scarce. Much of it has focused on the analysis of the legal regime of water and the evolution of its legislation (Dougnaç and Barrientos, 1991; Dougnaç, 1994; Palerm-Viqueira, 2010; Arévalo, 2013; Vergara, 2017) or works carried out to supply potable water to Santiago (Castillo, 2014; Piwonka, 2017). Water, as a vital element in dispute has been studied in the present time by Bauer (2015) and Rivera *et al.* (2016). However, the evolution of water conflicts and its management during colonial times, as well as its current influences, hasn't been studied.

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<sup>1</sup> Among other attributions, according to what is established in the Chilean Water Code of 1981.

<sup>2</sup> Where official decrees of restriction or prohibition to new water extractions have been raised, DGA (2016).

The present article shows the results of reviewing the transcripts of nearly 40 judicial files with water-related conflicts from the *Real Audiencia de Santiago* (Royal Hearing of Santiago), a court of law that ruled in the colonial period. The goal was to understand how the use of a common property good, such as water, was managed during the colonial and early republican period. A secondary objective was to compare past and present water management. For this, current water legislation was also reviewed identifying collective management problems, and how has the situation evolved since colonial times. Results show that even though the main principles of collective action were in fact present during colonial trials, not all actors were equally represented. Nowadays, the problem remains, adding more issues to effectively managing water in a common way.

### Conceptual Framework

In 1968, Hardin published his well-known Tragedy of the Common Goods theory, stating that individuals sharing a common resource will act in their own benefit, obtaining worse results than if they acted collaboratively. This tragedy can happen in any social situation characterized by the following two elements: i) each individual has a non-cooperative dominant strategy, receiving a higher outcome for it no matter what others do; and ii) the entire community is better off under the cooperation strategy (Dawes, 1980).

However, significant literature was written in group theory, where the assumption was that individuals with common interests would voluntarily act together as to pursue them (Bentley, 1949; Truman, 1958, in Ostrom 2015). In his revolutionary work, *The Logic of Collective Action*, Olson (1965) challenges these presumptions, indicating that it would only happen if the number of individuals is small and if complementary methods were placed.

Ostrom (2015) observed that the Tragedy and the self-interested attitudes were preventable.<sup>3</sup> She studied that common pool resources problems sometimes are solved by voluntary organizations using collective action. For this to happen, eight principles were defined as key for successfully governing the commons:

- i. Defining clear boundaries;
- ii. Matching rules to the local needs and situations;
- iii. Guaranteeing that those affected by the rules can participate in modifying them;
- iv. Ensuring that the rights of the community members are respected by external authorities;
- v. Developing a system for monitoring the compliance of the rules;
- vi. Using graduated sanctions for rule violators;
- vii. Providing accessible and low-cost solutions to disputes; and,
- viii. Building nested collective institutions, from the lowest level up.

Setting aside the principles, studies show that higher levels of social capital in its different forms -trustworthiness, strong networks, and effective institutions- contribute to successful collective associations by developing higher trust (Coleman, 1988; Ostrom and Ahn, 2009).

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<sup>3</sup> The first edition of the publication was released in 1990 (Ostrom, 1990).

These results comply with the study carried out by Van Vugt (2002) regarding domestic water demands during droughts.

Thus, the formation and promotion of self-governing institutions depends on the existence of certain principles, and a well-established social capital. Altogether they enhance higher trust among users and cooperation outcomes can be boosted.

### **Chilean water management through colonial times**

The first national set of regulations governing water use in Chile dates from 1819 and was authored by Bernardo O'Higgins, who issued an Executive Decree defining the size of an irrigation system, the form of sale and the parties responsible for the outlets (Donoso, 2006). Before 1819, the picture of water resources management is not as clear. Contrary to what has been indicated in some texts, recent research shows that when the conquistador Pedro de Valdivia arrived to the Maipo Valley in Central Chile, there was already a fairly populated territory (Camus, Castillo and Muñoz, 2019). For instance, it had an irrigation system developed since 900 BCE (For context, see a map in Annex 1).

One of the first set of norms of the conquistadores was the application of Castilian law through the *Fuero Juzgo* (Jurisdiction Forum), the *Fuero de Castilla* (Castilla Forum), the *Fuero Real* (Royal Forum), and the *Código de las Siete Partidas* (Code of the Seven Parties)(Camus, Castillo and Muñoz, 2019). These legal provisions, paradoxically, strengthen monarchical control of water at the expense of the local power represented by municipalities, declaring that certain uses of fresh water were monarchical royalties (Stewart, 1970). However, at the beginning of the conquest and in a distant Chile, the Spanish Colony tried to generate their own forms of control in relation to the use of water for irrigation. Since the Castilian law contained different rules, some of them contradictory, and difficult to interpret, especially in the absence of competent jurists, the Spanish were able to do so. At the same time, the Castilian tradition gave importance to custom over the written law, so in the use and distribution of water it was common to proceed casuistically (Wobeser, 1989).

For example, according to the Castilian legal tradition, the Indian Law established that the pastures, mountains and waters common in the Indias, were common to all their neighbors (Zamora y Camino, 1844). However, the neighbors were, precisely, the members of Spanish colonies, who established the limits of their own properties, and granted themselves volumes of water (*mercedes*) such as rights of use. This, in spite of the legal support established by the crown to the natives, that supposedly assured them the full right to the enjoyment of water for irrigation (Silva, 1962).

The risks assumed by the heads of the Spanish conquest was rewarded with grants of lands and water, as well as the so called *encomiendas de Indias*<sup>4</sup>. The importance of the administration of water systems was then highly relevant since the development of Santiago and it was carried out primarily through the *Cabildo*.

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<sup>4</sup> *Encomiendas de Indias* was the delivery of a group of natives or indians to a Spaniard so that he could protect, educate and evangelize them.

The *Cabildos* were municipal corporations created by the Spanish Kingdom for the administration of the cities. The *Cabildo* was the legal representative of the city, similar to the figure of the City Council, that is, the municipal organ through which the neighbors watched over the judicial, administrative, economic and military problems. From the first years of the colony these institutions constituted an effective mechanism of representation for the local elites against the royal bureaucracy. Afterwards, they assumed more functions. For example, with time, they started demanding the neighbors to be concerned about the maintenance of ditches and other water passages, as well as started establishing conditions, terms and penalties for each particular misdemeanor. By the end of the colonial period, these institutions elaborated the ordinances for the delivery of water grants; the prohibitions from the misuse and adulteration of the acequias of the city, together with designating a person dedicated to distributing and monitoring the compliance with water regulations and the natural water canal: the *Alarife* (Camus, Castillo and Muñoz, 2019).

At the same time, with the evolution of the water management system, the *Cabildos* positioned themselves as the first instance to solve water disputes between neighbors, choosing annually a *Juez de Aguas* (Water Judge) who studied each case and issued a ruling. However, there has not been a written record of the development of these trials, since they used to be oral. For its part, the *Real Audiencia* (Royal Hearings) settled disputes that were not resolved by the Water Judge, as well as received the appeals from the first instance decisions (Camus, Castillo and Muñoz, 2019). Its files contain the lawsuits between private parties that disputed the use of a water source, as well as the motives, arguments and interests that substantiated the demands for water rights. The Royal Hearing, unlike the *Cabildo*, filed the judicial lawsuits, some of which are preserved until today in the Royal Hearing Fund of the National Archive of Chile and have been used along this research. This registration was a requirement of the colonial judicial system, since it was configured as a tool for the maintenance of the pre-established legal and social order (Agüero, 2006).

### **Water as a common good through Colonial Chile: what do the trials reveal**

The trials and documents collected from colonial times have been analyzed regarding water governance principles as well as Ostrom's Principles for Governing Common Goods. Translated summaries of the files, and their link to the Principles for Governing Common Goods, can be found on Annex 2.

#### *Effectiveness of water governance*

Water governance has been considered the series of political, social, economic and administrative systems that are placed to develop and manage water resources, and the delivery of water services, at different levels of society (OECD, 2012). Many have adopted the definition, including the Global Water Partnership (GWP) and the World Bank. GWP even proposes two broad sets of principles that underpin effective water governance:

- Approaches have to be transparent, inclusive, equitable, coherent and integrative; and,
- Performance/operations has to be accountable, efficient, responsive, and sustainable (Rogers and Hall, 2003).

Analyzing colonial water trials, we do see the presence of a transparent institutional system, where the function of each actor was clear, and there were physical registries or logs kept for the Royal disputes, and later on, from *Cabildos* meetings. However, the system was not inclusive, equitable, coherent nor integrative, thus, limiting its governance, at least regarding water matters.

First of all, analyzing the people involved in the trials, it's clear that not all actors were involved, since the presence of indigenous communities is limited, as well as the involvement of women. In detail, just 21% of the cases were requested by women; and none of them by indigenous people. Actually, they just appear mentioned in one case, regarding a third party that requested water to protect their *Encomienda de Indias* (Royal Hearing 1705, Vol. 1690). It must be noted that royal hearing trials were an expensive process for the time, being a dispute solution primarily for the wealthy. Thus, at least considering these aspects, it can be noted that the system was not inclusive nor integrative.

Second, when analyzing the conflicts brought to these trials, a series of injustice situations are manifested. Example of these are a number of cases brought by recent widows that had their land and water taken away right after their partner died. An interesting case is an appeal of a judicial trial where the claimer and the judge were cousins (Royal Hearing 1835, Vol. 1690). An even more disturbing one is presented by a current Royal Hearing Judge (Royal Hearing 1768, Vol. 1275). As expected in such an unequal situation, the trial favored the claimer. These cases reveal several unequal situations where the more powerful took advantage of the weak.

Finally, even though the system was accountable, or at least it adjusted towards it, aspects such as efficiency, response capacity and sustainability were not present. These elements were improved during colonial times, as it can be seen in later trials. For example, there are several meetings regarding the implementation of a water canal that would help the water sustainability for the city during droughts, as well as water judges and other institutional actors where appointed to help with providing a quicker response (*Cabildo* sessions 1742, Vol. 31 and 1782, Vol. 34).

Thus, we can see that the water governance dynamics occurring during colonial times in Chile had some of the elements to carry out its purpose and evolved significantly, at least during the 200 years we have records from. Nonetheless, it still lacked several concepts of effective water governance, especially regarding the inclusion of all actors, coherency, equity, and conflict resolution, all of them where not solved at the time.

#### *Development of collective water management in the colonial period*

Regarding common water management, the study has been based on the analysis of selected cases. The specific cases have been pinpointed by the digital scope of key concepts, and then these identified cases were reviewed to corroborate their selection. These were considered from each of the eight Principles for Governing Common Resources defined by Ostrom (2015). The concepts used and details on the results found are on Annex 3.

Principle 1: Define clear limits.

From the cases studied, in three of them, the definition and delimitation of the water source was part of the process. As an example, one of them is a conflict between Juan Baptista de las Cuevas and Manuel Ramírez and the construction of a pipeline on behalf of the latter during 1774-1777. The trial revolves around defining the hydrological source of the water intake to determine to whom it belongs. Although Ramírez appealed to tradition as an argument, since he had been using it for many years, the Royal Court decided against him, since it was discovered the water came from a different source (Royal Hearing 1774).

Even though is a decisive element for collective governance, the definition of the waterways appears as a conflictive matter in the trials. Thus, the limits nor the definition of the water source was always well-defined at the time.

Principle 2: Game rules adapted to local needs.

The adaptation of the ruling to fit local needs is viewed as an element in multiple trials. There are rulings in favor of the *Encomienda de Indias*, as the trial between Melchora de Mena and Luisa Parras in 1705. The resolution in favor of Luisa Parras has a purely social consideration, since she had a group of indigenous people under her care (Royal Hearing 1705, Vol. 1690).

Also, there are rulings favoring local necessities, such as productive matters. The example here is the trial between José de Ureta and Juan Antonio Araos, that concluded approving the first one to build a wheat mill near Juan Antonio Araos estate affecting his harvest, only justified on the fact that bread was a necessary asset for Santiago (Royal Hearing 1768, Vol. 1275).

Finally, there are several decrees in the *Cabildo de Santiago* (Santiago's City Council) sessions that have been placed for the City's needs. Examples of these are rulings regarding water scarcity measures from sessions (*Cabildo* session 1742, Vol. 31; and 1772, Vol. 24); as well as sanitation matters (*Cabildo* session 1729, Vol. 19; 1761, Vol. 33; and 1778, Vol. 34). In all of them, specific rulings are made favoring giving water for the cities, and towards a better sanitary management.

It can be concluded then, that in the Royal Hearing trials, as well as in the *Cabildo* sessions, the rulings were adapted to satisfy local needs. The needs, in this case, being the sustainable and clean provision of water and food for the cities.

Principle 3: Guaranteeing that those affected by the rules can participate in modifying them.

Few trials can be related with this principle. Even though the *Cabildo* was the institution that should have defended and act as a representative of the people, it appears that at least at the beginning of colonial times, it played a weak role. First, it did not consider original users, called natives o indians; and even more, many times, not only favored the Spaniards, but it stood out just for the elite of the colony. Also, as it has been mentioned earlier, participating on trials or hearings from the *Cabildo* was expensive, and few could afford it at the time.

Principle 4: Make sure that external authorities respect the rules.

In different instances, the Cabildo's work was respected and even supported by other political figures. For example, during a water scarcity happening in 1729, communal institutions such as the *Corregidor*, facilitated the work done by the *Cabildo*, by taking a vigilance role. He even hired guards to keep a safe eye over the city canals (*Cabildo* session 1729, Vol. 19). On a second occasion, the *Corregidor* helped the *Cabildo* by evaluating the supply and distribution of water in the city, as well as executing action plans based on their diagnoses. Also, in other sessions the figure of the *Corregidor* is seen endorsing previous settlements (*Cabildo* session 1742, Vol. 31).

In a second example, in 1763, there was a debate to bring waters to Santiago from a parallel river, Estero de Ramón, and the Governor himself proposed that prisoners under his watch could be used for building the canals (*Cabildo* session 1763, Vol. 33).

Thus, the function of the *Cabildo*, as well as the other communal authorities was respected by the rulings of the Royal Hearing, as well as the *Corregidor* and the Governor.

Principle 5: Development of a monitoring system carried out by members of the community

In different trials, the use of guards or pawns, from the same people involved, is used as a surveillance mechanism. Even though for a more proper monitoring system to be implemented, these elements should have to be permanent, it worked in situations of eventual causation. In 1729, for example, a drought hit Santiago city, and guards were hired to look out for neighbors manipulating the river flow (*Cabildo* session 1729, Vol. 19). In the same drought, there was a proposal for hiring guards for a year, however, the idea was left aside as soon as the drought was over.

Thus, there is a partial accomplishment of this principle, since there are monitoring systems in place carried out by users, however, these systems did not work permanently and just appeared sporadically along with droughts.

Principle 6: Using gradual sanctions

Regarding the establishment of gradual sanctions, the opposite happened. Many times, high or very strict sanctions were used at the first offense. There is just one identified case when a warning is mentioned, however, the warning came together with a fine. The case was to demand that the residents clean their own irrigation ditches, motivated by canals filled with sand during a serious drought affecting the city of Santiago (*Cabildo* session 1748, Vol. 32).

The commonly found in these books is the opposite, and misdemeanors such as being disrespectful were sanctioned with jail. Such is the case of Domingo Frías, who was found guilty after members of the *Cabildo* noted that he hadn't comply with a mandate, and when hitting the table with rage, he was sent immediately to prison (Royal Hearing 1775, Vol. 1044).

Principle 7: Provide accessible and low-cost means for the resolution of disputes

Many times, the use of field laborers is chosen for the surveillance or construction of works, as well as other solutions where costs are shared. Cheap solutions, as the provision of the fields pawns to monitor the rulings was placed. For example, the Governor proposed the usage of prisoners to build the canal providing Santiago with waters from the Ramon river (*Cabildo* session 1763, Vol. 33). The suggestion here was funded in the fact that there was a proportionally high population of delinquents of minor crimes, that weren't able to be sent to Spain to serve their sentence. These prisoners were "idleness" in prison and could help for free. This excuse was also used in 1772, to build a water passage to the main square of San Isidro, that was suffering such a drought, that neighbors didn't have water to drink (*Cabildo* session, 1772, Vol. 34).

Thus, creative and low-cost solutions were put in place for conflict resolution during colonial times.

Principle 8: Responsibility to govern the common resource "nested" from the lowest level

There are indications of a "gradual" institutionalization over the colonial period, since later trials consider and mention a more local association. This was an element that appears in later trials, with the *Alarife*. The figure was in charge of distributing water among users and monitoring the compliance with any ruling derived from the *Cabildo*. It can be then seen that there are local institutions "nested" in higher forms of common institutions.

Also, in the judicial branch, below the Royal Hearings and local Judges, the Water Judge would review first instances cases regarding water distribution and management (*Cabildo* session 1772, Vol. 34).

As a conclusion, most elements of collective action in water matters were already present in colonial times. However, reviewing the trials, three of the principles were almost nonexistent, referring to having clearly defined the aquifer or basin's limits; guaranteeing that those affected by the rules participated on their establishment; and regarding the use of gradual sanctions.

### **Have we learned anything? what does the current Chilean system reveal**

As has already been stated, the first set of regulations governing Chilean water use dates from 1819. Starting from that initial text and after a number of reforms, Water Users Associations (WUAs), were formally established in 1981 Water Code. Here, the creation of permanent and tradable water use rights was developed, so as to reach an efficient water usage. The initial allocation of these water use rights from now on is provided by the State through the General Water Directorate (DGA). However, WUAs are responsible of distributing the water among their users, keeping an accounting record with the information of the water uses, controlling and enforcing that this is carried out correctly and are the first instance of conflict resolution among users (Peña, 2018). They have the unique characteristic of being formed only by water users, without the participation of the State. The objective or assumption underlying this policy is that a common property resource, such as water, requires a group of

users to participate in its extraction, explicitly or implicitly agreeing on well-known rules for resource management (Ostrom, 2015). So far, researchers indicate that WUAs have been positively aware of performing these administrative functions and that they have the normative and administrative tools for good management of them, despite the fact that many still exist in precarious conditions (Puig, 1999; Donoso, 2006; World Bank, 2013).

In theory, these associations should involve all users of the watershed, including agricultural, mining, urban, hydroelectric, tourist, environmental and industrial users, as well as anyone else who uses those waters. Although it did not occur in practice, it has evolved, and many associations are now considering incorporating the mining and sanitary sector. However, there are still no instances of integration with electric companies that operate hydroelectric plants, for example. The latter, on occasion, has generated conflicts between farmers and generators (Larrain and Poo, 2010). A step in the direction of integrated watershed management occurred in the north of the country, where there have been instances in which generating companies and WUAs have developed agreements to share the resources.<sup>5</sup>

Few studies have evaluated the nationwide system since its formal establishment in the Water Code of 1981. An initial approach was done in 1999 for the *Dirección General de Aguas*, DGA (the General Water Directorate). The report indicated that the management of these organizations is generally carried out in an appropriate manner, since they have the legal and administrative tools needed (DGA, 1999). However, WUAs are financed by establishing a quota system that allows the operation of the organization but does not provide funds to carry out maintenance programs, to hire technicians, or to deal with emergencies, thus many of them carry out their work in a very precarious way (DGA, 1999).

In 2006 a follow up of the study was carried out, revealing that most of the Vigilance Committees were already in practice, except for a 23% of them, that either did not exist, did not work aligned with the Canal Users Associations or, were in the process of restructuring (DGA, 2009). Nevertheless, in those cases where a Vigilance Committee was missing, there was some type of organization or structure, recognized among the other WUAs, that manage the resource and carried out information collection process in the same way (DGA, 2009). The lack of technical support as a relevant factor hindering self-governance, was already detected by a brief study developed by Puig (1999) and aligns with Molle et al. (2018) findings.

These unresolved institutional issues have led to significant over-extraction of water resources in different basins. In a descriptive study of the over-drafted Copiapó basin, Rinaudo and Donoso (2019) identified the elements that may have caused the crisis by comparing it with Ostrom's eight principles. One of their recommendations is the establishment of a crisis management mechanism to be activated by users, raising the question of the level of involvement and role of the State in these decisions. On these lines, an analysis made by Bauer (2015) states that the relevant focal points related to water conflicts are due to watershed conflicts among users (industrial, social and environmental); groundwater overexploitation; and conflicts with a political and regulatory nature. Bauer's analysis directly blames the 1981 Water Code. However, this legal document brings

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<sup>5</sup> Huasco River Hydroelectric Power Plant: <https://www.riohuasco.cl/hidroelectrica-rio-huasco-s-a/>

formality to WUAs that were already in place, not designing a new structure. As has already been proven, the definition of the irrigation districts and thus, the definition of a collective management structure, was already in place in 1819 as a result of an evolution from colonial times.

#### *Collective water management in present times*

The question that we now ask is if the current system has been able to solve the issues regarding collective water management that were present since the beginning. The study then analyzes current Chilean Water Code and its implementation across the country. Once again, the review considers the existence of the eight Principles for Governing Common Resources defined by Ostrom (2015).

#### Principle 1: Define clear limits.

Currently, all Chilean basins are delimited, considering their surface and groundwater breadth (DGA 2016). Even though there hasn't been a nation-wide policy regarding this, every basin has a history of technical studies that altogether generate an idea of the water situation (World Bank 2013).

Regarding water users, however, the situation is not that clear. Even though all water use rights should be in the Public Water Registry<sup>6</sup>, there are several flaws. First of all, many historical users (*usos consuetudinarios*) have not yet regularized their situation in order to have a water use right title, and thus they are not included in the registry (World Bank 2011). Also, there are many imperfect water use right titles that don't specify their water flow, basin or aquifer, and other characteristics that made it difficult to account for the total intake (World Bank 2011). Thus, basins that have effectively organized regarding a WUA have done an additional study regarding the water use right titles that should be included as users.

Even though in the Chilean water management system, each basin has been clearly defined, the water user's accountability is weak, and thus the accomplishment of this principle is only partly satisfied.

#### Principle 2: Game rules adapted to local needs & Principle 3: Guaranteeing that those affected by the rules can participate in modifying them

One of the characteristics that defines the Chilean system is that it legislates only general aspects for the formation and functioning of WUAs, allowing for a wide range of conflicts or needs to be considered. For example, each WUA has to develop their own set of rules regarding the notification, system for penalties, and voting, their organizational structure, as well as their monthly fees<sup>7</sup>. Even though there are certain elements regulated, there are plenty of aspects where each community can adapt according to their specific needs.

Nevertheless, the common theme regarding the development of local norms has been the usage of a statutes model, with textual transcripts from articles of the Water Code. Thus,

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<sup>6</sup> *Catastro Público de Aguas*, Water Code 1981, Art. 122

<sup>7</sup> Water Code 1981, Art. 251

many users don't understand their own norms, know all they are entitled to do and know which elements can be changed.

Principle 4: Make sure that external authorities respect the rules.

In the Chilean Water Code it's stated that the communities will be understood organized once they are registered in the *Dirección General de Aguas* (DGA), the national agency surveilling water management. However, even though the formation of WUAs involves a judge resolution and a complex procedure where the public institution is consulted, the DGA acts as a second instance resolution, where WUAs have to again request register. This has led to a number of cases where communities are already organized and working, however are pending their registration and thus cannot access to public funding opportunities.

Thus, even though the law satisfies the fulfillment of this principle, in practice the external authority, in this case the DGA, limits and does not respect their rules.

Principle 5: Development of a monitoring system carried out by members of the community

At a national level, there is a requirement that all WUAs distribute and keep record of all water intakes, being the users themselves the ones to implement the system and pay for it.<sup>8</sup> This has been accomplished in most productive basins at a surface level (World Bank 2013).

For groundwater intakes, in 2016 the government placed a resolution for the private implementation of a monitoring system in all wells from central Chile to the north<sup>9</sup>. This norm is being slowly fulfilled only in regions where groundwater communities are organized, on a gradual way, partly with support of public funding. Nevertheless, groundwater communities do not have the capacity to analyze the data, nor develop regular reports about the development of the aquifer's situation.

Thus, there is a partial accomplishment of this principle, since there are monitoring systems in place carried out by users, but the implementation in groundwater is still pending.

Principle 6: Using gradual sanctions

As what occurred during colonial times, gradual sanctions are in place but have the opposite is implemented. There is a system of warnings, then the payment of a penalty, and, in the case of manipulating the water distribution or the monitoring system, recidivism may be fined with double or triple the fine.<sup>10</sup> Also, there is a second degree penalty allowed by the Water Code that considers that users may be deprived of the water during a delay in the payment of any imposed fee<sup>11</sup>.

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<sup>8</sup> Water Code 1981, Art. 212.

<sup>9</sup> *Resolución Excenta DGA 2016 de Normas y Procedimientos de Control de Extracciones.*

<sup>10</sup> Water Code 1981, Art. 217

<sup>11</sup> Water Code 1981, Art. 216

Even though some associations do send warnings, usually once the penalty is imposed, it involves an elevated one. Water deprivation and charging higher fees for relapses has never been implemented so far.

Even though gradual sanctions are considered by law, once again, its implementation is partially fulfilled.

Principle 7: Provide accessible and low-cost means for the resolution of disputes

The Chilean Water Code has developed a gradual system for conflict resolution, involving that WUAs act as the first instance<sup>12</sup>. Thus, the organization Board of Directories should arbitrate in case of any conflict that arises between users. This is much cheaper and faster than attending the regular legal process. However, their judgement is not always considered as impartial and the procedures are not always clear (Donoso and Rinaudo 2018).

A low-cost procedure to satisfy this principle is in place, however its actual usage is low.

Principle 8: Responsibility to govern the common resource "nested" from the lowest level

By the Chilean law, there is a system of "nested" communal institutions: if two or more people have water use rights from the same channel, reservoir or aquifer, they may form a Water Community or Canal Association<sup>13</sup>, and user organizations that take advantage of surface or underground waters of the same basin, may be organized as Vigilance Committees<sup>14</sup>. Thus, there is a structure that fulfills the principle.

However, there is a need for a higher communal organization. Due to river divisions, most vigilance committees don't surveil the totality of the river, and thus, have disputes with other Committees upstream and downstream. There are a few basins that have voluntarily organized beyond the law, in what has been called supra-organizations (Vergara *et al.* 2012). For the moment, this hasn't been supported legally nor financially by the administration.

The legal system has been implemented in most highly productive basins. Nevertheless, there have not yet considered the incorporation of Groundwater Communities, and there are some cases where the Vigilance Committee have not been organized yet. Thus, the complete implementation is just halfway completed.

Thus, even though there are indications of "gradual" communal institutions in place, its implementation is still partly fulfilled.

As a conclusion, all elements of collective action are in fact present and fulfilled in document that legislates water management in Chile, the Water Code of 1981. Nonetheless, the implementation of the policies there stated is not fully accomplished.

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<sup>12</sup> Water Code 1981, Art. 244

<sup>13</sup> *Comunidad de Aguas o Asociación de Canalistas*, Water Code 1981, Art. 186

<sup>14</sup> *Juntas de Vigilancia*, Water Code 1981, Art. 263

## Conclusions

A common theme for successful collective action in water involves the presence of trustworthy and well defined institutions. In the case of Chile, Water Users Associations developed during colonial times, and have evolved from the *Cabildo*, and later on, irrigation districts, into the figure we see today.

In the beginning, these institutions had issues that needed to be improved, such as a lack of participation of all actors. During colonial times this participation problem can be associated with a misrepresentation of all actors and the high sanctions users would receive for the first misdemeanor. Nowadays, the problem persists, however, it can be linked to a wider range of causes, since the implementation of the principles of collective action as a whole, is worse off.

It seems that the mistakes that were committed back then are persistent in our current system, and we haven't learned about previous mistakes. Thus, current policies should consider these elements, and previous errors, as to adapt correctly to promote the development of a successful collective water management, with the inclusion of all actors.

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## Annex 2.

#	Institution	Vol	Year	City	Parties	Summary of the trial	Ostrom's principles
1	Real Audiencia	N/A	1774	Colchagua	Juan Baptista de las Cuevas, Manuel Ramírez	Conflict over the construction of a pipeline that Ramírez wanted to carry out in order to irrigate his land. In this land there was already a water channel and a ditch. However, Ramírez wanted to build another pipeline, so that de las Cuevas demanded it. The goal of the trial was to determine the hydrological conditions of the area, to determine if they are one or two courses and to whom they belong. Although Ramírez appealed to historical uses of that water as an argument, the pipeline passed through the property of de las Cuevas, so the Royal Court decided against Ramírez.	1
2	Real Audiencia	N/A	1774	Colchagua	Juan Baptista de las Cuevas, Manuel Ramírez	De las Cuevas pointed out that Ramírez's ditch will pass through the most necessary part of his land, such as the sheepfolds where the smaller cattle were enclosed, which would cause serious damage.	None
3	Real Audiencia	N/A	1774	Colchagua	Juan Baptista de las Cuevas, Manuel Ramírez	Ramírez answered the lawsuit, indicating that the lands belong to his wife Gertrudiz Ramírez y Gaete. He added that he has always used the water from springs that were born at the beginning of his father's land. Ramírez denied that his father had sold to de las Cuevas a portion of land, adding that were the pipeline would be constructed, could be rendered as useless and fruitless lands, due to the lack of irrigation.	None
4	Real Audiencia	N/A	1774	Colchagua	Juan Baptista de las Cuevas, Manuel Ramírez	Response of the part of Juan de las Cuevas. It reveals that the litigated water is not that of the El Salvador estuary, as proposed by Ramírez, but that of the Carrizalillos; another basin. This water was born in the vicinity of the land of de las Cuevas, and served to supply its paddock, draining into the Claro river. On the other hand, the waters of El Salvador were then supplied to Tilcoco, including the possessions of Ramírez. All this is demonstrated by de las Cuevas through a plan presented to the Royal Hearing.	1
5	Real Audiencia	N/A	1774	Colchagua	Manuel Joseph Morales, defensor de de las Cuevas	Questionnaire made by defense of de las Cuevas. The attorney sent a letter to the royal Hearing in which he presented 18 questions to be answered by the witnesses who would appear in this trial.	1
6	Real Audiencia	N/A	1774	Colchagua	Juan Felipe Canol, defensor de Manuel Ramírez	Questionnaire made by Ramírez defense. This time, the attorney sent a letter to the royal Hearing in which he presented 15 questions to be answered by the witnesses who would appear in this trial.	None

7	Real Audiencia	N/A	1774	Colchagua	Juan Baptista de las Cuevas, Manuel Ramírez	Case resolution: The justice determined that de las Cuevas tried his claim in a good way, while Ramírez did not. Consequently, it was determined that there was no place for the opening of the new ditch that Ramírez intended, by deviating and carrying waters by a forbidden passage.	Non
8	Real Audiencia	755	1766	Vichuquen	Marcelo Jirón, Carlos Saravia, maestre de campo de Talca.	Conflict over the water use rights in an irrigation canal. The demander, Jirón, wanted to draw water from the ranch, but the field master Rafael Parrado, sentenced to cover the ditch, affecting neighbors. Jirón asked for the nullity of Parrado's sentence.	1, 8
9	Real Audiencia	755	1780	Chuchunco	Cayetano Fontecilla, Francisco Javier Errázuriz, Mateo de Toro y Zambrano	Errázuriz demands Fontecilla for usurping the water that passes through his property. Fontecilla wants a watercourse to water a vineyard. For that reason, he believes fair to divide the channel that passes through his property and that of Errázuriz. However, the later considers that the passage of a ditch through a property does not give the right to draw water from it; so, with the help of Mateo de Toro and Zambrano, they build a new ditch, breaking a public road and drying the Fontecilla property.	None
10	Real Audiencia	755	1694	Renca	Magdalena Negrete, Antonio de Carvajal, Vicente Carrion, Gonzalo de Córdova.	Negrete filed a complaint against the other three because she was violently stripped of the water on her property. De Córdova points out that the Negrete estate is old and that in his land they are cultivating new fruit trees and vines, so taking the water from the irrigation ditch in its legitimate right. Finally, the judges determine that the water should be distributed among the litigants.	None
11	Real Audiencia	767	1809	Santiago	Herederas de Francisco Henríquez, Ignacia Fierro, agrimensor Juan Jose Goycolea.	The inheritance of Fierro had a ditch. This ditch went through the part of Henríquez's heiresses. A surveyor (Goycolea) visits the site, measures it and suggests that canals be built so that Henriquez's legacy has water supply. However, Fierro declares herself in rebellion, does not want to give way to water and asks for the nullity of the trial. The dispute is finally won by the Henriquez's daughters.	None
12	Real Audiencia	1044	1775	San Juan de la Frontera	Petronila Cabrera vs. Domingo Frías, <i>Cabildo</i>	Conflict over a land purchase and its respective water right. Frías - Ordinary Major- disrespected Cabrera, so the <i>Cabildo</i> of San Juan de la Frontera filed a criminal case against him and was finally arrested. Frías was released before Real Cedula (a certificate signed by the King who granted a favor) and the payment of a bond. He asks for the Royal Hearing to settle the case of the lands and their water rights. In the trial, Petronila Cabrera asks for water rights to irrigate her land, since the water passes through the land of both owners.	6

13	Real Audiencia	1044	1775	San Juan de la Frontera	Manuel Morales, procurador de Domingo Frías	Morales, Frías's attorney, makes a presentation of the case. He said that Frías had bought lands in San Juan and when he took possession of her, Petronila Cabrera formed a criminal cause, assuming the town hall and <i>Corregidor</i> that Frías had disrespected them. Therefore, he was imprisoned for several days, even though he was "one of the luster subjects of the city" and that he was an Ordinary Mayor of it.	4, 6
14	Real Audiencia	1275	1768	Huechuraba	Jose de Ureta, Juan Antonio Araos y otros	Ureta, a lawyer from the Royal Hearing, wanted to build a wheat mill in a farm in Huechuraba, near the Araos estate that had a water ditch. That ditch was not owned by Ureta, but by Araos and other neighbors. Araos starts the lawsuit because the mill is harmful to his harvest. However, the Hearing concluded that bread was a necessary asset for Santiago, so there are positive witnesses and reports on the feasibility of the mill.	2
15	Real Audiencia	1401	1657	Polpaico	Antonio Méndez de Contreras, Antonio Martinez de Vergara	Trial for a water use right for the lands of Méndez. He had been in his ranch for many years supplied with the same water source. Martinez stripped it of it to be used, reason why Méndez begins the lawsuit.	None
16	Real Audiencia	1690	1835	Casablanca	P. A. León, Filiberto Montt	León had used his water for more than 30 years until Montt stopped him. This resulted in the drying of the fields of fruits, alfalfa and plants owned by León. The local judge gave the favor to Montt, but León appeals resolution in Santiago and alleges the personal links of the local judge with Montt. In retaliation, the governor of Casablanca and the local judge accused went to León's property with soldiers to remove the water. Finally, the trial was won by León.	8
17	Real Audiencia	1690	1767	Santiago	Manuela Cardenas, Dominga Garay, <i>Corregidor</i> Nicolas de Silva	The <i>Corregidor</i> Nicolás de Silva covered the water canal that irrigated the vines of Cardenas. In addition, according to the lawyer of Dominga Garay, the <i>Corregidor</i> de Silva made insults against her.	4
18	Real Audiencia	1690	N/A	N/A	Marco de los Rios, Agustina Barrios	De los Ríos suffered the dispossession of a ditch by Barrios, since the inheritance of the property wasn't clear. Barros points out that he has the possession of all the water rights and de los Ríos only had a servitude for his property. Barros requests that de los Ríos' water right be canceled.	None
19	Real Audiencia	1690	1795	Melipilla	Joaquín de Bustamante, sucesión de José Jofré	There was a deal between de Bustamante and the Jofré heir. However, de Bustamante complained because the deal was not respected, and he was stripped of the part of the ditch. It is likely that a ditch quota was delivered, thus, de Bustamante won his demand.	None

20	Real Audiencia	1690	1820	Renca	Josefa Maldonado, Juan Infante, agrimensor Vicente Caballero	Upon the death Maldonado's husband, Infante strips of the water and gives her a quota of water extraction every eight days. The trial revolves around the amount of water, the drought that plagues the area and the number of crops that each party has. Finally, a surveyor (Vicente Caballero) is hired to measure the land and do a work that allows the quota to be met.	2
21	Real Audiencia	1690	1705	Rancagua	Melchora de Mena, Luisa Parras	The conflict arises because de Mena deprives Parras of water because, according to de Mena, the water is her property. The sentence was that the property of Parras should receive water because she had <i>Encomienda de Indias</i> , and a <i>Royal Cedula</i> from the King Felipe V arrived in which he stressed the importance of water for these indigenous communities.	None
22	Real Audiencia	1691	1776	N/A	Diego de Soto, María Antonieta Macaya	Diego de Soto begs for free passage to his water through Macaya's land. Short file.	None
23	Real Audiencia	1713	1750	Santiago	Corregidor Pedro Jose Lecaros y Ovalle, María Antonia Andrade	The <i>Corregidor</i> tries to break down the wall of Andrade's house to access to the water because he had always wanted it. In the trial seeks to build a detour for half of the water that passes through the ditch access through its property. The Royal Hearing approves the request by the <i>Corregidor</i> ; However, Andrade appeals on several occasions to stop the construction.	4
24	Real Audiencia	1879	1804	Renca	Comuneros de acequia de Aedo, Domingo Santiago, Pedro José de Prado	There was a lawsuit between three commoners, against Aedo, since the later built a ditch to draw water from the river, which passed through their land. However, this was tolerated because it did not interrupt the community's water supply. A subsequent lawsuit was filed by the of the commoners against Domingo Santiago and de Prado; accused of altering the canal of the ditch and leaving them without water. The commoners asked that the water be distributed in equal parts, but the final resolution benefited Santiago and de Prado, leaving the community members without water.	None
25	Cabildo de Santiago	19	1729	Santiago	Cabildo, Corregidor de Santiago, guardias	At the meeting of October 31, 1729, due to an important drought, the <i>Corregidor</i> placed guards in the entrance of the ditches so that the neighbors with water rights would not manipulate the river flow. The guards were owed \$ 110 for that work.	2, 4, 5

26	Cabildo de Santiago	19	1729	Santiago, Estero de Ramon	Cabildo, Corregidor de Santiago	At the same meeting of October 31, 1729, due to a drought that hit the city throughout that year, the <i>Corregidor</i> explained the idea of bringing water from the Ramón River. For this, it was necessary to build a new ditch with a distance of three leagues, with a total cost of pawn tools of \$700, and a regular payment of \$80 for someone to take care of the waters for a year.	2, 4, 5
27	Cabildo de Santiago	19	1729	Renca	Francisco Ruíz y Berecedo, Gobernador Gabriel Cano y Aponte.	In the session, the lawyer Francisco Ruíz asks for a title of a <i>merced de aguas</i> (nowadays, a water use right) to the Governor for the irrigation of his farm in Renca. The authority considered most convenient that the <i>merced</i> would be taken from a near place of Hornillo, and that said <i>merced</i> be noted in the books of the Town Hall by the clerk.	None
28	Cabildo de Santiago	31	1742	Rio Maipo	Corregidor, Procurador General, Junta de Balanzas, Gobernador Gabriel Cano y Aponte.	In the session, the <i>Corregidor</i> spoke about the need for water from the Maipo river. He pointed out that the city was going through a moment of urgency due to scarcity and that the population of certain areas did not have enough water to drink. The <i>Corregidor</i> ruled that it was convenient to extract water from the Maipo because it was more abundant, of better quality and it was cheaper to undertake the works of extraction and water conduction than other sources. The <i>Corregidor</i> recalled that this issue had already been settled in previous sessions. However, it was stipulated that the water conducted from the Maipo would not be diverted, nor be taken partially or totally before arriving the Mapocho river. Thus, reserving the power to distribute all of the intake according to the City's more convenient and favorable uses.	2, 4
29	Cabildo de Santiago	32	1748	Santiago	Cabildo, vecinos de la ciudad	At the meeting it was agreed to demand that the residents of the block below the Cabildo clean their own irrigation ditch. This was motivated by the serious damage of the City due to the lack of water in the ditches because they were filled with sand. Previously, the general cleaning of the ditch had been made by the <i>Cabildo</i> . Neighbors that did not comply would be warned and receive a fine.	6
30	Cabildo de Santiago	33	1761	Santiago	Regidor y Alcalde de Aguas (Mayor of Santiago, and Water Mayor) Luis Manuel de Zañartu	The Governor ordered the Mayor of Santiago, and Water Mayor, Luis Manuel de Zañartu, to cover all the ducts used by the convents and private houses to extract water from the mother ditches that were then spilled on the streets. It was decided unanimously that the extraction of water from the legitimate channel or mother ditch was damaging, as the streets were flooded, making transit difficult, as well as owners of water rights farms downstream were exposed to losing their	None

						properties due to lack of irrigation. It is recalled that there are two ordinances that forbid to remove and spill water from the acequias with penalties. In short, the general prosecutor is asked to explain to the governor the decision of the <i>Cabildo</i> to prohibit the opening of the ducts.	
31	Cabildo de Santiago	33	1763	Santiago, Estero de Ramon	Gobernador, cabildo, presos de Santiago	The Governor proposed once again to bring water from the Ramon river, to supply a pile in the city's main square. Considering the high costs, the Governor thought that the prisoners of the jail without a capital offense, be assigned to work as a form of punishment. The authority justifies this decision by the high population, proportionally, of delinquents of little crime, the impossibility of sending them to the Kingdom and the idleness of the prisoners in the prison. To achieve that, the governor ordered the creation of four new places of assistants for the custody of prisoners in a continuous manner, without the need to use the real justices.	4
32	Cabildo de Santiago	34	1772	Curato de San Isidro	Cabildo, Juez de aguas, corregidor	In the session was agreed that given the scarcity of water in Curato de San Isidro, a water passage would be made from the canal of La Cañada to the main square of San Isidro. A pilon to provide the neighborhood would be placed in the square, and the remainder would continue running and the Water Judge would distribute it at his convenience. The <i>Corregidor</i> would provide with prisoners and tools for the work, while the rest of the costs will be requested by the Water Judge to the neighbors, depending on their benefit and the quality of the ditch.	2, 4, 7, 8
33	Cabildo de Santiago	34	1778	Santiago	Gobernador, Blas Gonzales (Military Officer) y Jose Antonio Frías	The <i>Cabildo</i> agreed and placed in consideration of the Governor the inconveniences of the pretension of Gonzales and Frías, that they be granted license to take two intakes from the river of the city with their ditches for the irrigation of their farms. The <i>Cabildo</i> introduces that the governor must tend to public utility and repair to the detriment of the common good. Likewise, the <i>Cabildo</i> argues that the request is made at times when the need for water is evident, even more so when there is a distribution of water that is already established. According to the <i>Cabildo</i> , if the request of extraction of the two interested parties was granted, it was removed from the common river, so it was scarce for the other interested parties and inconveniences would increase.	3
34	Cabildo de Santiago	34	1782	Santiago, rio Maipo	Cabildo, Matías Ugareta.	In 1782 the absence of rains led to a shortage that would threaten in the summer the river, that already was flowing low. The <i>Cabildo</i> considered that, before the critical circumstance manifest themselves,	2

						they had to bring water from the Maipo river. The <i>Cabildo</i> mentions that this work in the Maipo has been a concern of the Governors Royal Hearing, and the public in general. However, it was recalled that unsuccessful efforts to complete the work amounted to \$100,000. The minutes of the town hall culminate, indicating that they approved the definitive construction of the work to bring the water from the Maipo River to the Mapocho river.	
35	Cabildo de Santiago	36	1802	Santiago, Canal San Carlos	Pedro Manuel de la Cerda (Teniente de alguacil mayor), Manuel Quevedo (portero de Cabildo)	De la Cerda and Quevedo had been appointed by the Government for the collection of what was owed by users of the Mapocho river, since there was a new tax after opening of the San Carlos channel. However, they couldn't carry out this labor and maintain their daily assistance to their workplaces, despite the recognized difficulty of delegating this work in other hands. Therefore, the <i>Cabildo</i> appointed the <i>Alcalde Mayor de Aguas</i> (Mayor of Water), who had lieutenants that could manage the collection of that tax.	8

### Annex 3.

N°	Principle	Concepts	Obs	Mean	Std. D
1	Defining clear boundaries	"determinar si son uno o dos cursos"; "si este nace"; "esta agua nacia"; "dilucidar; cauce".	3	0,086	0,284
2	Matching rules to the local needs and situations	"sequia"; "escasez"; "bien necesario"; "afectando a vecinos".	8	0,229	0,426
3	Guaranteeing that those affected by the rules can participate in modifying them	"cabildo argumenta"; cabildo acuerdo".	1	0,029*	0,169
4	Ensuring that the rights of the community members are respected by external authorities	"corregidor dispuso".	7	0,200	0,406
5	Developing a system for monitoring the compliance of rules	"dispuso de guardias"; "cuidase las aguas".	2	0,057	0,236
6	Using graduated sanctions for rule violators	"en caso de no; se haria" "en caso de no; habria una multa"; "en caso de no; prision".	1	0,029*	0,169
7	Providing accessible and low-cost solutions to disputes	"dispuso de presos"; "reclusos"; "fuesen destinados los presos".	2	0,057	0,236
8	Building nested collective institutions, from the lowest level up	"juez de agua"; "juez local"; "Alcalde Mayor de Aguas".	3	0,086	0,284