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Privatizing Water in the Chilean Andes: The Case of Las Vegas de Chiu-Chiu

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The Chilean water model has been described as a textbook example of a free-market water system. This article contributes to the critiques of this model by showing the effect of its implementation in the Atacameño community of Chiu-Chiu, located in the Atacama Desert in the south-central Andes. In this community, the privatization of water rights ignored local water management practices that had produced a high-altitude wetland (known as a vega). This led to the

inhabitants' dispossession of crucial water rights and to wetland degradation. This process belies statements that the Chilean model relies on an unregulated market and instead highlights the state's role in marginalizing local irrigation practices by reducing the water consumption of the indigenous population while keeping the copper mining industry (the main source of Chilean income) and related growing urban populations supplied with water.

Keywords: Atacama; Atacameño people; Chile; neoliberalism; high-altitude wetlands; Andes.

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Introduction

Verzija and Quispe (2013) describe high-altitude wetlands in the Andes that are viewed by many as natural but are actually irrigated systems that “nobody sees.” They criticize the means by which the invisibility of these wetlands allows them to be perceived as wastelands and obstacles to progress. Following their invitation to conduct research on this phenomenon, this article analyzes the effects of the neoliberal Chilean water model on one such irrigated system in the Atacama Desert.

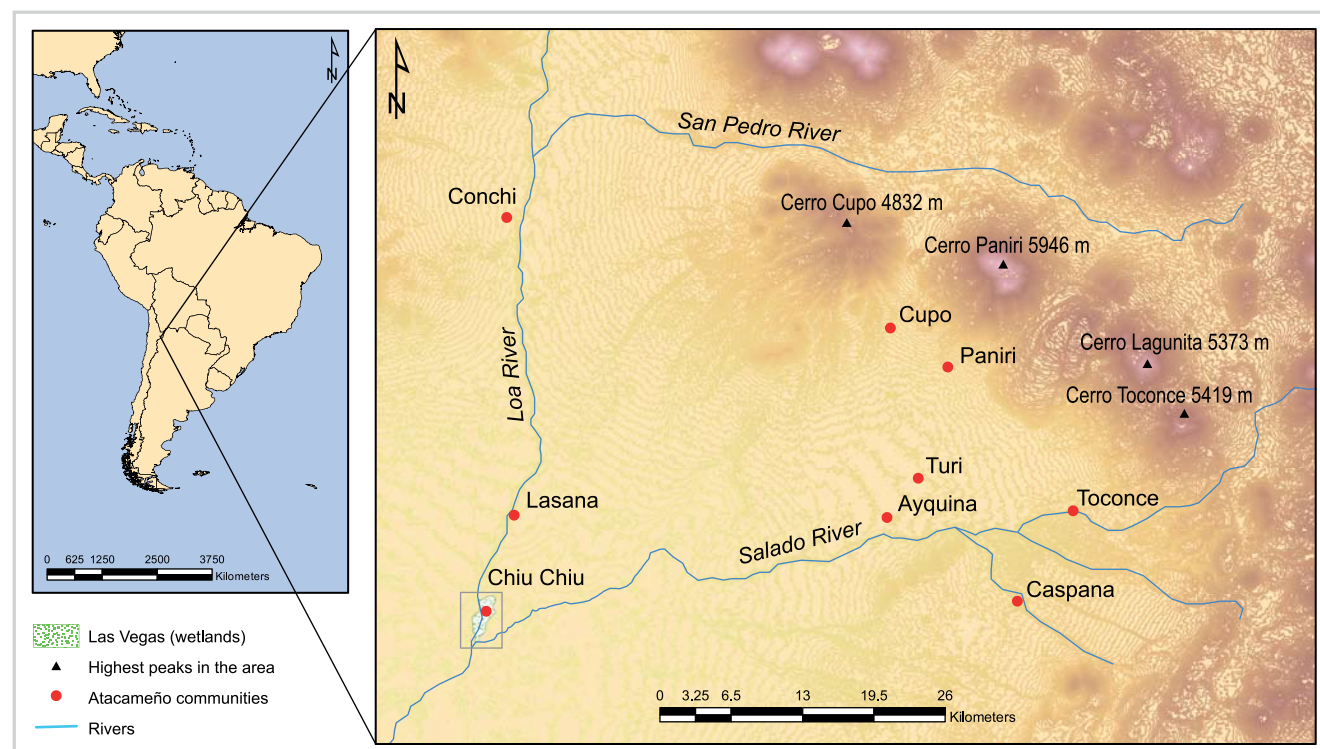
The Chilean military regime imposed a new water code in 1981, which is widely considered to be a radical example of the commodification of water (Bauer 1998; Budds 2004). Under this model, despite the fact that water remains public property, the state can grant private use rights. These rights are separate from land ownership and can be freely traded between different users. Water has also come to be governed by civil law, meaning that the state has limited regulatory powers and conflicts must be resolved through private negotiations (Bauer 1998). The rationale behind this model is that a laissez-faire regime would distribute water apolitically where it could produce the highest economic value, thus maximizing efficiency (Anderson 1991; Thobani 1995; Briscoe 1996).

The 1981 code established a uniform formula for managing water for the entire country without considering local geographic, economic, or cultural specificity. For the mountain waterscapes (water

landscapes) of the Atacama, this is a critical issue. These waterscapes have distinctive characteristics: the Atacama is the driest place on earth, water bodies have high mineral content, the mining industry and urban populations place heavy demands on the water supply, and indigenous communities manage water for agriculture and pastoralism. These elements are ignored by the universal neoliberal formula of private water rights and free markets. This article shows how this model was enforced in the indigenous community of Chiu-Chiu and the consequences of applying it in a high-altitude irrigated wetland used by the inhabitants of this community as a grassland for raising livestock.

Under Chilean law relating to indigenous people (Law No. 19,253), Chiu-Chiu is recognized as an Atacameño community (for a general overview of the Atacameño livelihoods and cultural practices, see Castro and Martínez 1996). It has a population of approximately 400 people. Inhabitants self-identify mainly as Atacameños. However, Aymara people have been migrating to Chiu-Chiu since the late 1970s. Chiu-Chiu is located in the South Central Andes at 2535 m above sea level (22°20'31"S, 68°39'0"W) (Figure 1). Its climate is cold desert, but water from the Loa River makes farming (mainly beets and carrots) possible. In imposing the 1981 water regime in Chiu-Chiu, the government intentionally hid the fact that a local *vega*—a peatland wetland of the high Andean arid zone, also referred to as *bofedal*, with cushion bogs, moor, and wet grasslands (Squeo et al 2006)—known as Las Vegas de Chiu-Chiu was irrigated rather than being in its natural state;

FIGURE 1 Location of the research site. (Map by I. Manríquez)



instead, the government presented it as a landscape belonging to no one.

This process was part of a broader state plan to create a water surplus to ensure the success of the copper industry (and the related urban growth required by this industry), the cornerstone of the Chilean political economy. Indeed, currently Chile is leading the world copper industry, producing 33.6% of the world's total copper production in 2011 (US Department of the Interior 2012). Copper production for the period 1990–2010 represented on average 42% of Chile's total exports (Cochilco 2012). The commune of Calama, where Chiu-Chiu is located, produces 22% of Chile's total copper production and is the commune with the highest copper production in the country (Cochilco 2013).

This article documents the earliest instance of water privatization on the Loa River, an event that later served as a model for other privatization efforts in the area, such as Las Vegas de Turi (Aldunate 1985), and the failed attempt by the government of Patricio Aylwin to impose privatization on all remaining Atacameño communities in the area in the early 1990s (see also Prieto 2014). This study complements previous reports on the implementation of the Water Code in this village (Molina 2012) and other Atacameño communities (Molina 2005; Budds 2010; Carrasco 2011; Yañez and Molina 2011). The findings challenge analyses that support the Chilean water

market as a successful model for managing water in the area of study (Donoso 2004). Finally, this article complements the literature that questions the effects of overlooking local management practices for mountain waterscapes (Lansing 1991), especially in high-altitude Andean wetlands (Verziji and Quispe 2013).

Methods

I gathered data during 2 field seasons in the southern winters of 2012 and 2013 and a short follow-up in the southern summer of 2015, conducting open-ended and semistructured interviews among current and former indigenous leaders, everyday water users, and those who experienced the privatization or who have been affected by it ($N = 25$). Full names given in this article are the real names of study participants. In some cases, fictional first names are used to ensure anonymity. All interview answers quoted here were translated for this article. To address the state's role in the privatization process, semistructured interviews were conducted among former government officials in charge of water privatization. Interviews were used to investigate the effects of water privatization on the Atacameños' water practices. At the documentation center of the national water agency (Dirección General de Aguas [DGA]), I reviewed the technical documents that served as the basis for privatization. Finally, I used basic remote sensing

techniques to illustrate changes in the vegetation cover driven by the privatization of water rights.

Wetlands as political artifacts

Cultural and political ecologists have challenged the dichotomy between culture and the environment (Rappaport 1968; Netting 1977; Posey 1985), studying nature as a hybrid phenomenon that is simultaneously social, political, and ecological (Castree and Braun 2001; Robbins 2011). This framework rejects the idea that waterscapes exist by themselves and instead stresses how they are socially produced by cultural practices (Geertz 1972), ritualized technologies (Lansing 1991), and power relations (Swyngedouw 2004). Thus, waterscapes are not just containers of water but the result of a combination of social and natural entities (Linton 2010; Budds and Hinojosa 2012). The biological and physical conditions of water are seen as interwoven with social dynamics and power asymmetries within what Swyngedouw (2004) calls “the hydrosocial cycle.” Following this approach, wetlands are inevitably political artifacts.

Edgeworth (2011) argues that rivers are cultural artifacts insofar as almost all of them have been shaped by human action. Similarly, while high-altitude wetlands are generally seen as pristine natural entities, it is almost impossible to find one that has not been altered by humans. Among many other anthropogenic factors, wetlands have been used for pastoralist activities and as such have become part of the cultural landscape of the Andes (Palacios 1977; Castro 2003, 2005; Verzijl and Quispe 2013). Through irrigation, these wetlands are the combined result of human labor and the hydrological cycle, truly cultural artifacts that ensure the reproduction of livestock and, consequently, the human communities and their cultural practices. The social production of wetlands, however, is not purely cultural. As part of Swyngedouw’s (2004) “hydrosocial” cycle, they are inevitably interwoven in politics, economic relations, and power struggles.

Considering that Chile is economically dependent on copper extraction, that the biggest copper mines in Chile are in the Atacama Desert, and that the large amount of water demanded by this industry is extracted from the highlands, the inevitable conclusion is that the Atacama’s high-altitude wetlands are shaped not only by traditional irrigation practices but also by the political economy of the copper industry.

Commodifying Andean waterscapes

In 1983, the DGA started a privatization program in 4 settlements on the Loa River: the city of Calama, the Aymara village of Quillagua, and the Atacameño villages of Chiu-Chiu and Lasana. This process aimed to transform existing informal and collective systems for

managing water into a formal model of private property rights that restricted water users’ access to measurable volumes of water per unit of time (cubic meters per year or liters per second).

To assign these water rights, the DGA mapped the territory and led several surveys (DGA 1982, 1983, 1984), using a report and maps commissioned by the state and created by hydrologist and archeologist Hans Niemeyer (1979), to reduce water consumption by the agricultural sector in favor of mining and urban consumption. These studies identified individual water users and the area of land they irrigated. Using these data, the DGA allocated water to *regantes* (users of water for agricultural purposes) based on a formula that took into account (a) the amount of water normally needed per hectare of agricultural crop and (b) only the extent of the irrigated cropland the *regantes* were using at the time of the privatization.

The DGA required each *regante* to participate in several hearings in the local civil court of Calama (oral communication, chief lawyer of the DGA at the time of privatization, Santiago, 28 June 2012). Participants in this study recalled how the *regantes* were transported to the hearings in trucks and buses. In the court, the chief lawyer of the DGA asked *regantes* if they agreed with the amount of land the surveys reported them as owning, fixing the amount of water based on these reports. A local judge then confirmed the allocation of water rights in a ruling, the director of the DGA approved it through a decree, and finally it was registered in a public registry.

The fact that privatization occurred during a military dictatorship made resistance impossible. Several informants told me that they were afraid of the consequences they would suffer if they did not follow official instructions. Simón described the situation as follows:

We were afraid. We were forced to privatize. The mayor came here and told us that if we did not privatize, [the military] would come and they would beat us with sticks. That is how they measured and privatized the way they wanted.

This was not the first time that Atacameños had suffered a loss of water rights; dispossession had resulted since the early 20th century from a number of state and private water projects, including the Conchi dam, Ojos De San Pedro wells, and Toconce intakes. Some Chiu-Chiguanos feared that, without privatization, their rights would be at even greater risk from the mining interests. Andrés told me, “Miners needed a lot of water, and they already had taken much of our water after the construction of the Conchi dam and the Lequena intake. That was when the rumors started, that they would take more of our water from the river.” Claudia added that the DGA “said that [mining companies] would take our

water ... and that they would leave us just a little amount. That was when people had more fear and started to accept the privatization.”

Drying the irrigated wetland that “nobody sees”

The technical reports used by the DGA to privatize water disregarded the existence of indigenous water practices in Chiu-Chiu. These long-standing traditions were either imperceptible in the state’s eyes or intentionally ignored. This decision was part of a plan to optimize water usage and create a water surplus to supply the copper boom of the early 1980s, as well as its associated urban growth in the cities of Calama and Antofagasta. Land surveys and maps were part of a broader plan to limit water availability for irrigation and to ensure the future development of sectors outside agriculture, especially the mining industry. The report that served as the basis for these surveys explicitly mentioned that the state had prioritized water distribution for extractive industry and urban consumption over irrigation: “It is clear that agriculture cannot be expanded in the future and any withholding of water from irrigation will benefit the first two priorities [urban consumption and the extractive industry]. ... It is imperative, therefore, that the first step is the reduction of agricultural use” (Niemeyer 1979: 1–2, translation by the author).

Thus, privatization, ignoring customary irrigation practices, led to the Chiu-Chiuguanos’ dispossession of their water in favor of mining companies and urban consumption. This article focuses on one customary irrigation practice—the social production of Las Vegas de Chiu-Chiu—among several others that I describe elsewhere (Prieto 2014) (eg fallow, local rules of land distribution, and vernacular water measurement units). Technical reports failed to acknowledge that this wetland was not produced by natural processes alone but was rather a cultural artifact created by irrigation practices over many years, as are other wetlands throughout Chile (Castro 2003, 2005) and the Andes (Palacios 1977; Verzijl and Quispe 2013).

Without exception, villagers from Chiu-Chiu who participated in this study said that Las Vegas de Chiu-Chiu had always been an irrigated wetland. The village’s irrigation canal network ends in the wetland; water not used for crop irrigation is used to irrigate the wetland. During the winter season when no crops are watered, all the water from the canals freely flows into the wetland. A canal network exists even within Las Vegas de Chiu-Chiu for the redistribution of water within the wetland. Chiu-Chiuguanos told me that until the early 1980s in the wetland, pasture grass was green, healthy, and full of grazing animals. Juana said:

The wetland had many cattle, there was much grass. ... My dad used to say that in the wetland, even corn was planted. I still

remember that the canals were immense and much water flowed within them. My mom was a shepherd and we also were; my mom even herded sheep for other people in the wetland and we also did. The wetland was full of water; my dad went duck hunting in the small lagoons.

Today the scene is radically different (Figure 2). The grass in the wetland is weak and brittle, and the lagoons have disappeared. Where animals once grazed, now dusty roads lead to houses owned by people who work in the nearby mining town of Calama (and either live here and commute to Calama or use these homes on weekends), and a few shepherds lead their animals through xerophytic grass (locally known as *grama*) coated with a layer of salt. This radical change was driven by the privatization process, which created a surplus of water for the mining industry (Molina 2005).

Techniques used to conduct and store water for the irrigation of high-altitude wetlands, as described by Verzijl and Quispe (2013) and Palacios (1977), are common among the Aymaras, Quechuas, and Atacameños (Castro 2003, 2005). When the DGA privatized water in Chiu-Chiu, it discursively framed the wetland as natural, publically denying that it was produced by irrigation. Thus, the DGA denied the wetland’s existence as a cultural artifact (Edgeworth 2011). This was described in the oral narratives of the Chiu-Chiuguanos that I collected.

Pedro Velásquez, who remembered what occurred during the privatization process, said that once he raised animals and cultivated land around Chiu-Chiu, but now he worked for a local laundry that served workers from the El Abra mining company—a clear example of the “accumulation by dispossession” (Harvey 2003) that forced the proletarianization of many Chiu-Chiuguanos. One study participant said:

Las Vegas lost their water rights because at that time the DGA came and told us that the wetland had its own water, and that it was natural. Thus [the local people] did not need any water rights. That is why the wetland dried up and livestock began to decline. Before, there were around 3000 animals between sheep and goats, but now there are just 100 or 50. ... Before the privatization, each channel brought water to the wetland. After we irrigated the crops, we [directed the remaining water to the wetland]. Afterward, we could not do that anymore. ... We were not able to oppose that decision, which was the DGA’s imposition. They came here to impose their plan; if not, they could have asked the opinion of the people, and the people would say: Give us water for irrigating the wetland!

In another interview, a woman angrily remembered her father’s attempt to protect the water that he used to irrigate his piece of land in Las Vegas de Chiu-Chiu:

FIGURE 2 The vegas in 2012. (Photo by M. Prieto)



My dad fought hard to maintain his right to irrigate the wetland with his water. We had sheep and [other] animals. But no, it was impossible for him to keep the water. [The DGA] said that the wetland had its own water; but that was not true, they lied, lied, lied! They told us that the wetland was a kind of natural thing, so [my father] had no right to water. My dad insisted, but they said no, no, and no; and the wetland dried up. After that, only 2 drops ran through the wetland, and our animals died. ... My dad could not do anything. ... They only gave him water for his cultivated land.

Her brother added:

They told him that those esas hueadas [literally “shitty places”] were abandoned, and have their natural waters. But the wetland was not natural or abandoned! We had our animals there. ... You should have seen it before, the wetland had ducks and pools, but now there is only chuska [dust]. [The DGA] either did not understand anything that was happening here or they just played dumb.

Despite privatization, Las Vegas de Chiu-Chiu are not completely dry. In the middle of the dry landscape, I found a remnant of what the Chiu-Chiuguanos told me the wetland looked like not so long ago. Here, it is still

possible to find green grass, corrals, alpacas, llamas, and sheep—living proof that the wetland is an irrigated, human-produced wetland rather than a natural one. This parcel of land, shown in Figure 3, is owned by an Aymara family from Cancosa, where irrigating wetlands is a common practice. The *abuela* (grandmother) of the family was proud of her “last *veguita*” (little wetland), as she called it. Her husband told me:

We have sheep and alpacas. We are the only ones in Chiu-Chiu that have alpacas. All the people have eliminated the animals. Before the privatization everything was green; now there is no water and no animals. [The DGA] told them that the wetland has its own water. False, false! Let me tell you something, there, where we have our animals, we irrigate the wetland. My canal goes there. That is my little wetland, I am the only one that uses the little water that we have for irrigating that last little wetland. ... I irrigate it for my animals. You can see how green it is.

All of the Chiu-Chiuguanos I interviewed in regard to the privatization of the water rights of Las Vegas de Chiu-Chiu told me that the DGA had argued that because the wetland was natural, there was no need to register

FIGURE 3 An Aymara family still irrigates a portion of the *vegas*, producing a *veguita* (little *vega* or wetland) for their animals. (Photo by M. Prieto)



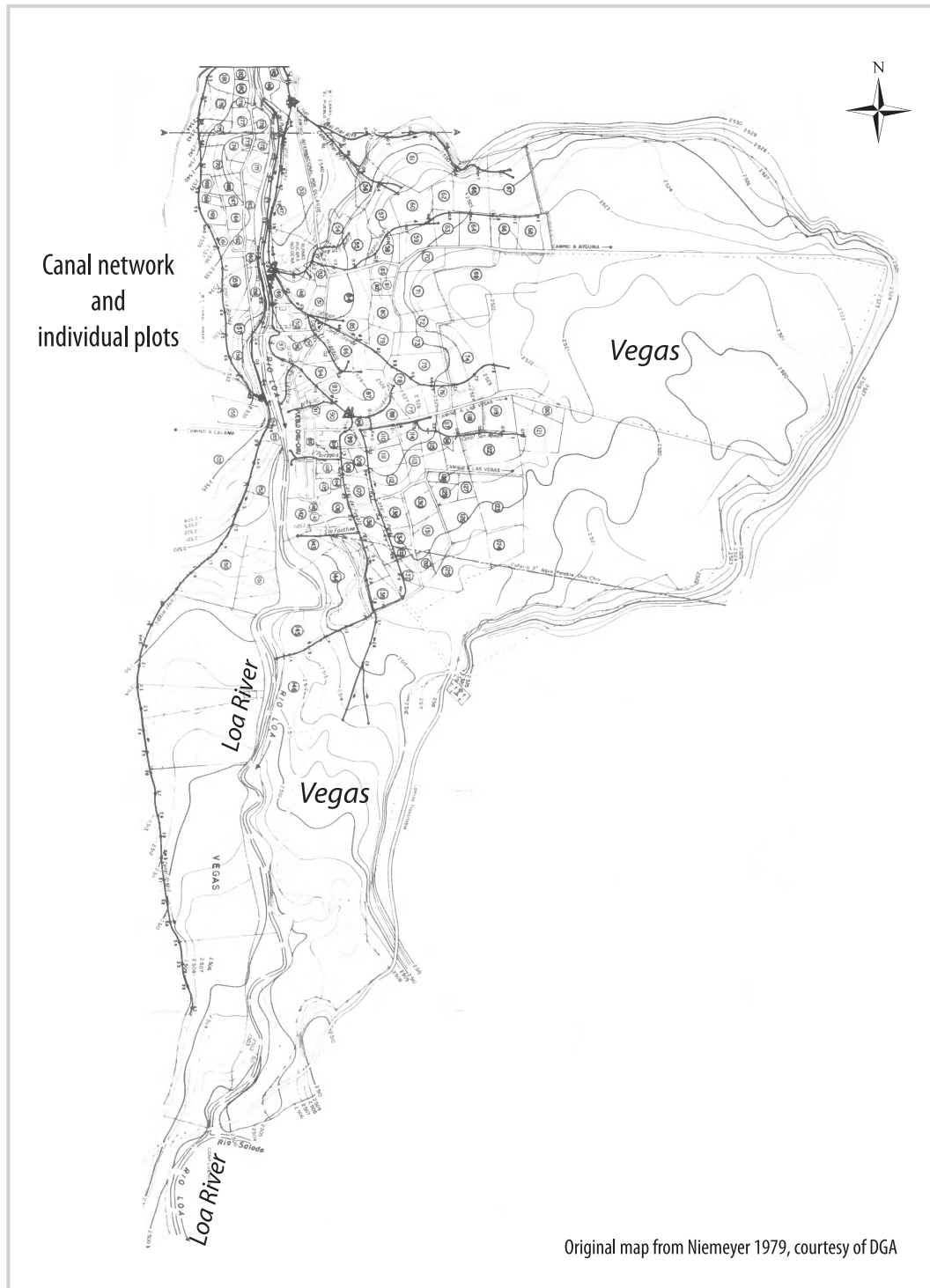
private water rights for their users. However, when I reviewed the archives at the DGA's documentation center, I found that the technical report of the privatization process explicitly recognized that Las Vegas de Chiu-Chiu were in fact irrigated (DGA 1983). When the informant said the DGA] "either did not understand anything that was happening here or they just played dumb," he was right in the second case. The DGA knew that Las Vegas de Chiu-Chiu were irrigated, but intentionally told the local people that they were naturally formed. Why?

The technical report acknowledged that "it is remarkable that the manner of use and irrigation of Las Vegas de Chiu-Chiu ... is an immemorial condition, known, and accepted by the owners" (DGA 1983: 3). The document added that in Chiu-Chiu, the entire canal network ended in the wetland, and consequently, the community received its water from that network. This is also acknowledged in the Niemeyer (1979) report, as the map in Figure 4 shows. The technical report also mentioned that the wetland had a high water table, but that water was salty and only allowed the growth of xerophytic grass. To allow the growth of pasture grass, it was necessary to dilute the salt content with water from the Loa River. This could not be accomplished with water from the other nearby river, the Salado (Figure 1), because it carried a high concentration of salt and other minerals from its volcanic sources.

Despite the report's recognition of the irrigation practices used to improve water quality in the wetland, it presented three objections to ensuring water rights for that purpose:

1. It argued that it was too difficult to measure the amount of upland waters from the Loa River needed to reduce salinity of (ie, lixivate) each hectare of the wetland, contending that this would complicate the development of the cadaster process.
2. It also argued that, because Las Vegas de Chiu-Chiu was irrigated with the unused water remaining after crop irrigation, the Chiu-Chiu canal network carried more water than was needed by planted fields.
3. Although different parts of the wetland were owned by different individuals, no fences demarcated their private property, and, in practice, the land was used as a communal grazing area to which all Chiu-Chiuguanos had access. Since it was difficult to identify formal individual owners of the plots within the wetland, it was impossible to consider them part of the water cadaster. Thus, the state framed the wetland as land belonging to no one, arguing that these factors "prevent determining the annual volume of water per hectare of wetland actually exploited; even if this volume is determined, it will be necessary to specify who will be given the rights because private pieces of land are used by the community" (DGA 1983: 3).

FIGURE 4 Cadastral map by Niemeyer (1979) of individual agricultural plots and canals in Chiu-Chiu; the *vegas* are presented as a landscape belonging to no one. The map also shows how the canal network discharges its waters into the wetland. (Map courtesy of DGA, slightly simplified for clarity)

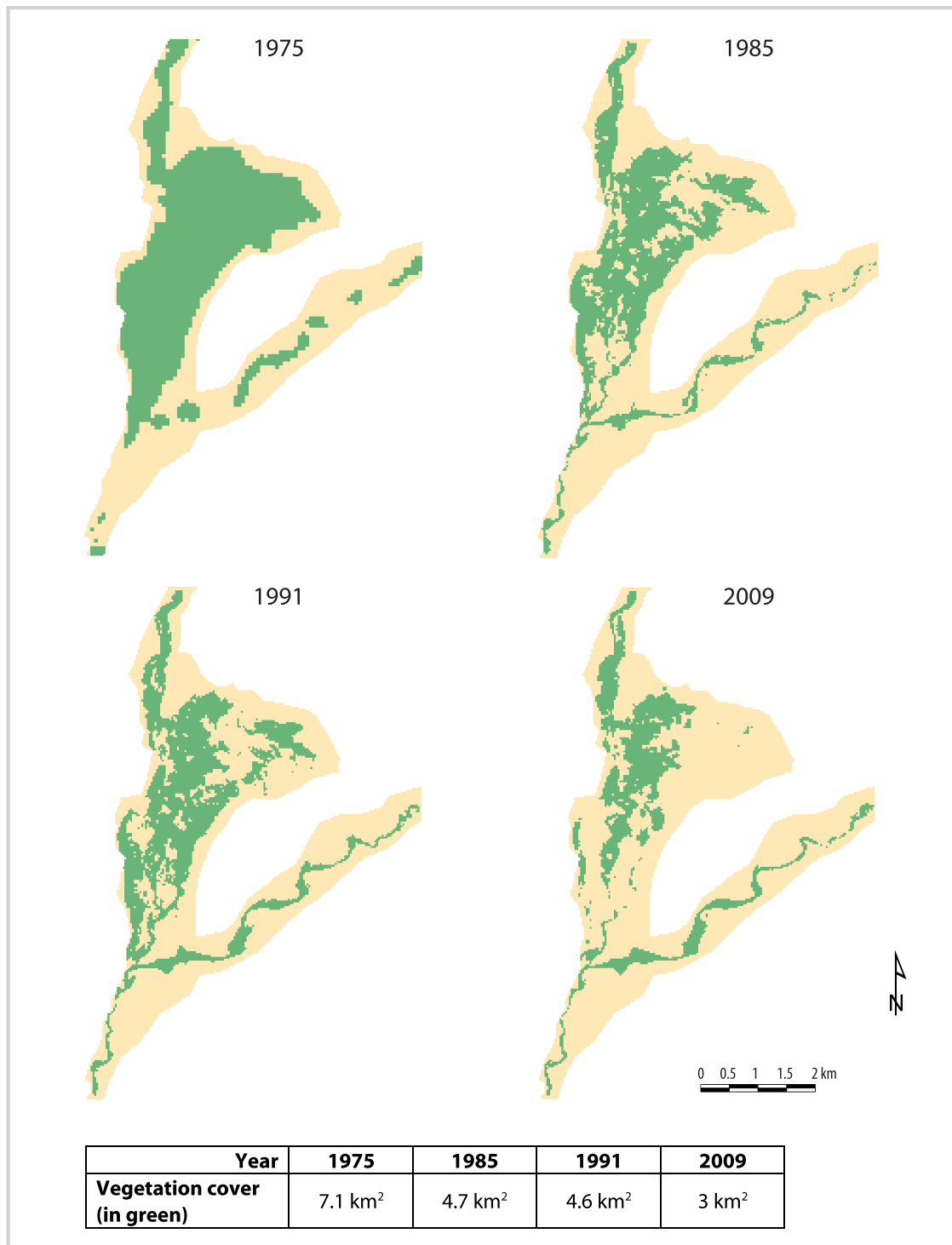


Given that the DGA did not calculate the annual volume of water per hectare, the amount of water used to irrigate the wetland was not considered part of the privatization process, and the Chiu-Chiguanos did

not receive any water rights for the irrigation of the wetland itself.

Niemeyer also recognizes that Las Vegas de Chiu-Chiu was irrigated, but criticizes this practice as

FIGURE 5 Land cover change in Las Vegas de Chi-Chiu. (Figure by I. Manríquez, A. El Vilaly, and M. Prieto)



inefficient and anarchic: “The plan gives a vision of the reigning anarchy in Chiu-Chiu’s irrigation, where the canals take all the water of the Loa River and carry it to a higher consumption than the crops require,

draining the surplus in the wetland” (Niemeyer 1979: 47).

Niemeyer saw anarchy where, in reality, the Atacameños were producing their own order according to

their knowledge. After developing a cost-benefit analysis of using the water surplus to irrigate the wetland as pasture for animals in comparison to other uses, he concluded:

The argument for not spending good quality water ... in irrigating the wetland is demonstrated by the simple economic reasoning that compares the net production between both activities [livestock and farming]. Consequently, with this demonstration, the irrigation rate or hydric demands for Chiu-Chiu do not consider the areas of the wetland that are under the canals. (Niemeyer 1979: 76, translation by the author).

The way Chiu-Chiuguanos were using water to irrigate the wetland was an obstacle to efficiency insofar as water was used for a purpose of low economic value. When faced with this scenario, the DGA declined to recognize the wetland as irrigated, as the state did not want to present it as such. This ignored the Atacameños' local knowledge and practices, and reduced the amount of water rights finally allocated to them. The resulting water surplus became available to mining and urban water supply companies, whose intakes are located upstream of Chiu-Chiu (Molina 2005). In fact, right after privatization was completed in Chiu-Chiu, the dictator Augusto Pinochet directly allocated to the urban water company SENDOS (Servicio Nacional de Obras Sanitarias), then state owned, a total of 850 liters per second upstream from Chiu-Chiu in the Loa River for ensuring the urban growth associated with the mining boom. In the same year, the DGA rejected water rights requested by the Directorate of Irrigation (Dirección de Riego) upstream of Chiu-Chiu to ensure irrigation security.

The DGA's oversimplification and production of false legitimacy ensured the copper industry's access to water resources. In consequence, the wetland almost entirely dried up. Figure 5 presents unsupervised classification on a time series of LANDSAT images which show a radical change in vegetation cover since water was privatized; only the Loa and Salado Rivers and the irrigated plots that received water rights during privatization continue to show vegetation coverage. Clearly, other factors (eg climate change and pollution of groundwater by mining companies) could be part of the desiccation process. However, the fact that communities stopped irrigating the wetland is a key factor in these negative environmental outcomes, as recognized by all those interviewed for this study.

Conclusions

Like many high-altitude wetlands in the Andes, the wetland of Las Vegas de Chiu-Chiu is a cultural artifact, produced through irrigation. In Chiu-Chiu, people had long applied their practical knowledge to create this mountain waterscape by diluting the salt content of the wetland with river water. However, under the neoliberal Chilean water model, all watersheds are considered the same and expected to be managed equally. This rationale, and the state plan for ensuring that the increased water demands of the mining industry are met, drove the DGA to deny the Chiu-Chiuguanos the water they needed to continue irrigating the wetland.

This finding contradicts the overly optimistic analyses that state that the Chilean water market has increased the efficiency of water use in the Loa River basin by allowing transactional flow from agriculture to the mining sector (Donoso 2004). Indeed, after 3 years of research in Chiu-Chiu, I only found one water rights transaction wherein an Atacameño sold his water rights to a mining company. In the Loa River basin, it is not the free market but the state that played a key role in the allocation of water, through highly centralized decisions. For the case of Las Vegas de Chiu-Chiu, it was the state that, through the simplification and exclusion of local irrigation practices, rejected the notion of the wetland as a cultural artifact and product of human labor. This dispossessed the Chiu-Chiuguanos of their water rights and resulted in the degradation of the wetland. State policy deliberately generated a water surplus for use by the copper industry and to support urban growth.

The case of Chiu-Chiu is only one example of how the Chilean model and the DGA deliberately ignored the social production of wetlands. According to interviews conducted among Aymara shepherds in 2010, the DGA continued to overlook the social production of high-altitude wetlands at the moment of privatizing their water rights. It is the responsibility of the state to recognize the productivity of these ecological management practices for producing wetlands and to stop presenting high-altitude wetlands in the Andes (such as *vegas* and *bofedales*) as a purely natural phenomenon.

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REFERENCES

- Aldunate C.** 1985. Desecación de las Vegas de Turi. *Chungará: Revista de Antropología Chilena* 4:135–139.
- Anderson T.** 1991. The market process and environmental amenities. In: Block W, editor. *Reconciling Economics and the Environment*. Perth, Australia: Australian Institute for Public Policy, pp 133–150.
- Bauer C.** 1998. *Against the Current: Privatization, Water Markets, and the State in Chile*. Boston, MA: Kluwer Academic Publishers.
- Briscoe J.** 1996. Water as an economic good: The idea and what it means in practice. Unpublished paper presented at the World Congress of International Commission on Irrigation and Drainage, World Bank, Cairo, Egypt.
- Budds J.** 2004. Power, nature, and neoliberalism: The political ecology of water in Chile. *Singapore Journal of Tropical Geography* 25(3):322–342.
- Budds J.** 2010. Water rights, mining and indigenous groups in Chile's Atacama. In: Boelens R, Getches D, Guevara-Gil A, editors. *Out of the Mainstream. Water Rights, Politics and Identity*. London, UK and Washington, DC: Earthscan, pp. 197–211.
- Budds J, Hinojosa L.** 2012. Restructuring and rescaling water governance in mining contexts: The co-production of waterscapes in Peru. *Water Alternatives* 5(1):119–137.
- Carrasco A.** 2011. *One World, Many Ethics. The Politics of Mining and Indigenous Peoples in Atacama, Chile* [PhD thesis]. Tucson, AZ: University of Arizona.
- Castree N, Braun B.** 2001. *Social Nature: Theory, Practice, and Politics*. Oxford, UK: Blackwell.
- Castro M.** 2003. Los humedales en la cultura de Aymara y Atacameños: Visión del agua dulce en las Américas: Las políticas y el marco normativo. *Electronic Conference Foro de las Américas*. pp. 54–66.
- Castro M.** 2005. Riego y cultura entre aymaras y atacameños de los Andes del Norte de Chile. *1ª Reunión de Coordinación de la Red de Riegos del Programa CYTED*. Lima, Peru: [CYTED] Programa Iberoamericano de Ciencia y Tecnología para el Desarrollo. Available as a power point presentation at: http://ceer.isa.utl.pt/cyted/lamolina/data/sesions/3-4_Milka_Chile.pdf; accessed 30 July 2015.
- Castro V, Martínez JL.** 1996. Poblaciones Indígenas de Atacama. In: Hidalgo J, Schiappacasse V, Niemeyer H, Aldunate C, Mege P, editors. *Etnografía: Sociedades indígenas contemporáneas y su ideología*. Santiago de Chile, Chile: Andrés Bello, pp 69–109.
- Cochilco [Comisión Chilena del Cobre].** 2012. *Producción Mundial de Cobre de Mina, Porcentaje y Tonelaje*. http://www.cochilco.cl/productos/base_datos.asp; accessed on 30 September 2013
- Cochilco [Comisión Chilena del Cobre].** 2013. *Producción minera por empresa*. <http://www.cochilco.cl/estadisticas/produccion.asp>; accessed on 30 September 2013.
- DGA [Dirección General de Aguas].** 1982. *Rol de regantes area agrícola de aalama*. Santiago de Chile, Chile: DGA II Región.
- DGA [Dirección General de Aguas].** 1983. *Rol de regantes de Chiu-Chiu “Vegas de Chiu-Chiu.”* Santiago de Chile, Chile: DGA II Región.
- DGA [Dirección General de Aguas].** 1984. *Distribución mensual de la tasa de riego (m3) fijada para Lasana y Chiu-Chiu*. Santiago de Chile, Chile: Departamento de Estudios, DGA.
- Donoso G.** 2004. Chile: Estudio de caso del Código de Aguas. In: CEPAL [Comisión Económica para América Latina y el Caribe], editor. *Mercados (de Derechos) de Agua: Experiencias y Propuestas en América Del Sur*. Santiago de Chile, Chile: Naciones Unidas, CEPAL, pp 25–48.
- Edgeworth M.** 2011. Rivers as entanglements of nature and culture. In: Edgeworth M, editor. *Fluid Pasts: Archaeology of Flow*. London, UK: Bristol Classical Press, pp 11–32.
- Geertz C.** 1972. The wet and the dry: Traditional irrigation in Bali and Morocco. *Human Ecology* 1(1):23–39.
- Harvey D.** 2003. *The New Imperialism*. Oxford, UK: Oxford University Press.
- Lansing JS.** 1991. *Priests and Programmers: Technologies of Power in the Engineered Landscape of Bali*. Princeton, NJ: Princeton University Press.
- Linton J.** 2010. *What Is Water? The History of a Modern Abstraction*. Vancouver, Canada: University of British Columbia Press.
- Molina F.** 2012. Competing rationalities in water conflict: Mining and the indigenous community in Chiu Chiu, El Loa Province, northern Chile. *Singapore Journal of Tropical Geography* 33(1):93–107.
- Molina R.** 2005. *El Río Loa: Reparto, usos y conflictos por el agua en el Desierto de Atacama. Comunidades atacameñas, ciudades, pueblos, y centros mineros e industriales*. Santiago, Bolivia: GIAB [Comisión para la Gestión Integral de Agua en Bolivia], Ottawa, Canada: IDRC [Centro Internacional de Investigaciones para el Desarrollo].
- Netting R.** 1977. *Cultural Ecology*. Menlo Park, CA: Cummings Publishing.
- Niemeyer H.** 1979. *Estudio de racionalización del área de riego del río Loa: II región de Chile*. Santiago de Chile, Chile: Dirección General de Aguas. Departamento de estudios y racionalización.
- Palacios F.** 1977. Pastizales de regadío para alpacas. In: Flores JA, editor. *Pastores de puna: Uywamichiq Punarunakuna*. Lima, Peru: Instituto de estudios Peruanos, pp 155–170.
- Posey DA.** 1985. Indigenous management of tropical forest ecosystems: The case of the Kayapó Indians of the Brazilian Amazon. *Agroforestry Systems* 3(2): 139–158.
- Prieto, M.** 2014. *Privatizing Water and Articulating Indigeneity: The Chilean Water Reforms and the Atacameño People (Likan Antai)* [PhD thesis]. Tucson, Arizona: University of Arizona.
- Rappaport R.** 1968. *Pigs for the Ancestors; Ritual in the Ecology of a New Guinea People*. New Haven, CT: Yale University Press.
- Robbins P.** 2011. *Political Ecology: A Critical Introduction*. Malden, MA: Blackwell.
- Squeo F, Warner B, Aravena R, Espinoza D.** 2006. *Bofedales: High altitude peatlands of the central Andes*. *Revista chilena de historia natural* 79(2): 245–255.
- Swyngedouw E.** 2004. *Social Power and the Urbanization of Water*. Oxford, UK: Oxford University Press.
- Thobani M.** 1995. *Tradable Property Rights to Water: How to Improve Water Use and Resolve Water Conflicts*. Washington, DC: World Bank.
- US Department of the Interior.** 2012. *Mineral Commodity Summaries*. Washington, DC: US Government Printing Office.
- Verzija A, Quispe S.** 2013. The system nobody sees: Irrigated wetland management and alpaca herding in the Peruvian Andes. *Mountain Research and Development* 33(3):280–293.
- Yañez N, Molina R.** 2011. *Las aguas indígenas en Chile*. Santiago de Chile, Chile: LOM Publishing.