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Community Desalination as New Hydrosocial Assemblages and Scalar Politics to Satisfy the Human Right to Water in Chile

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ABSTRACT: We propose a political-ecological approach to community desalination based on our experience installing small desalination plants in three coastal communities in southern Chile. Conceptually, we frame community desalination plants as new hydrosocial assemblages different from large-scale or extractivist desalination, discussing how social participation is key to the community's reappropriation of nature through desalination plants. We use the literature of scalar politics in water governance as a device for analysing the ongoing political struggles around water and the role that community desalination can play in satisfying the human right to water. Through a multi-method and participatory approach, we demonstrate the situated nature of community desalination development in Chile. We identify three stages in the configuration of the new hydrosocial assemblages: negotiating the installation of the plants, valuing the drinking water produced by the plants, and negotiating to finance their definitive installation as a complementary source of drinking water for these communities. We also show that the community appropriation of these plants depends mainly on the water quality and the institutional arrangements to sustain these small plants over space and time. We analyse how the community scale interacts with municipal, regional, and national scales differently. Finally, we conclude by evaluating, from a hydrosocial perspective, the pros and cons of using this community desalination process to satisfy the human right to water.

KEYWORDS: Extractivist vs. community desalination, Agua Potable Rural (APR), social participation, small desalination plants, reappropriation of nature, water commons, Chile

INTRODUCTION

Since the 1990s, desalination has been a growing source of water for both extractive activities and human consumption in Chile. As of December 2022, the country had 38 operating plants that produced 8535 litres per second and 38 projects in progress that would produce an additional 28,859 litres per second (Vicuña et al., 2022: 54). Among the currently operating plants, 6137 litres per second (71,9%) are destined for large-scale mining operations, while 1908 litres per second (22,3%) are oriented towards human consumption (Vicuña et al., 2022: 57). The latter covers the needs of around 700,000 inhabitants, 4% of the country's total population (Vicuña et al., 2022: 102-103).

Both large-scale uses of desalinated water, mining and human, are located mainly in the Antofagasta and Atacama Regions in the arid north of the country. A growing political-ecological literature explores the hydrosocial relationships between desalination and large-scale mining operations in Chile on the one hand (Campero et al., 2021; Odell, 2021) and the complexities associated with the large-scale production of desalinated water for human consumption in cities like Antofagasta on the other (Fragkou and Budds, 2019; Fragkou et al., 2021). However, desalination from a small-scale, community, and hydrosocial perspective is an under-investigated issue (Williams, 2022). To fill this gap, we propose utilising this contribution to develop a political-ecological approach (Gudynas, 2015; Swyngedouw, 2015; Williams and Swyngedouw, 2018; Leff, 2019) to community desalination for human consumption, highlighting how it could help satisfy the human right to water in coastal localities of southern Chile.

Like the entire world, this South American country is experiencing climatic, political, and socioenvironmental transformations that affect continental drinking water availability for human communities. First, since 2009, the country has been under a 'mega-drought' that has reduced precipitation by around 40% (Garreaud et al., 2019). Second, extractivisms (Gudynas, 2015) and water markets (Bauer, 2015) are worsening the situation by extracting and exporting large amounts of water through different types of commodities such as copper (Odell, 2021), avocados (Budds, 2009), lithium (Jerez et al., 2021), and lumber and cellulose pulp (Torres et al., 2022), among others. Third, these factors have contributed to a growing social and political crisis that became a social revolt in October 2019, resulting in a new Constitutional process wherein the de-privatisation of water and its declaration as both a common good and a human right were among the main demands of Chilean society (Dorador et al., 2021; Álvez et al., 2021; Torres and Álvez, 2023). Regarding this, in March 2022, Chilean President Gabriel Boric signed a reform to the Water Code, which in Article 5 introduces the human right to water, indicating that "access to drinking water and sanitation is an essential and inalienable human right that must be guaranteed by the state" (Ministry of Public Works, 2022). Several proposals have emerged to ensure this human right, including desalination (Vicuña et al., 2022: 107).

In this context, we ask: Could community desalination be a legitimate way to satisfy the human right to water in coastal communities dispossessed of this vital resource? We answer this question through a multi-method and participatory approach based on our experience implementing and assessing small-scale desalination plants in three coastal communities from southern Chile (the Biobio and Los Lagos regions). We argue that to satisfy the human right to water, the implementation of a technology – in this case, desalination by nanofiltration – needs to be accompanied by a community process of appropriation at the local scale and institutional transformations at the regional and national scales. Communities need to understand and trust that desalinated water is just as good as continental water. However, our experience shows that this is not a linear process, and communities must understand all the technical, economic, political, and socioenvironmental issues associated with the technology before accepting it as a legitimate way to satisfy their human right to water. For instance, both extractivist and community desalination bring socio-environmental impacts, but on different scales.

In what follows, we propose a political ecological approach to community desalination, framing it as new hydrosocial assemblages different from extractivist desalination. Second, we discuss how social participation is key to the community's reappropriation of nature through desalination plants. And third,

we bring in the literature of scalar politics in water governance as a conceptual device to analyse the political struggles around water. We then present our methods, based on participatory workshops, surveys, thematic maps, interviews, and secondary data analysis of current and potential regulations. The results demonstrate the situated nature of negotiating the installation and use of the small desalination plants in three coastal communities in Chile. We identify three stages in the sociotechnical construction of these new hydrosocial assemblages. We also show that the community appropriation and legitimisation of these plants depend mainly on the water quality but also on the state-led institutional arrangements to sustain these community desalination plants over space and time. In this respect, we analyse how the community scale interacts with municipal, regional, and national scales in different ways. We conclude by evaluating the pros and cons of using this process of community desalination to satisfy the human right to water.

DESALINATION FOR WHOM? EXTRACTIVIST AND COMMUNITY DESALINATION IN CHILE

Between 2003 and 2015, Latin American economies were favoured by the increase in the international prices of commodities, generating a 'commodities boom' that gave rise to the 'commodity consensus', based mainly on natural resources (Svampa, 2019). Extractivism is "a type of extraction of natural resources, in large volumes or at high intensity, that are essentially oriented to be exported as raw materials without or with minimal processing" (Gudynas, 2015: 13; cited in Torres et al., 2022: 152). The commodity boom expanded the extractivisms and began to put pressure on water resources (Gudynas, 2015; Torres et al., 2022). That is the case with copper extractivism such as in the arid Chilean regions of Antofagasta and Atacama. Copper is the main mining commodity produced by Chile, whose production increased by 17% between 2000 and 2009 and by 8% between 2010 and 2018 (Odell, 2021). This boom put pressure on the waters of the arid desert, so that in the past two decades, mining corporations have begun to incorporate desalination as a new source of water in order to expand their operations and respond to the growing global demand for copper (Vicuña et al., 2022). The increase in commodity prices alongside climate change operated as an incentive for desalination, "making the increased costs of desalination worth it for companies" (Odell, 2021: 5). This explains why 71.9% of the current desalinated water produced in the country (or 6.137 litres per second) is used by mining extractivism. Out of this, 59% is in the Antofagasta region (5.037 litres per second) and 12.9% in the Atacama region (1.100 litres per second) (Vicuña et al., 2022: 57). Along with political ecologist Eduardo Gudynas (2015), we suggest calling this top-down, corporate, and large-scale approach 'extractivist desalination'. If seawater is desalinated to be used mainly in the production process of commodities such as copper, extractivist desalination can be understood as the process of producing large-scale amounts of water to produce commodities without or with minimal processing oriented to exportation (Odell, 2021; Álvez et al., 2020).

Like the other extractivisms operating in Latin America and Chile, extractivist desalination brings socioenvironmental impacts and conflicts with local communities (Gudynas, 2015; Svampa, 2019), especially those living close to the desalination plant facilities. The first impact reported by previous research is environmental degradation because of the large amounts of brine disposal into the sea, which affects and kills marine forms of life. This can extensively affect the livelihoods of fisherman communities in coastal areas (Swyngedouw, 2013: 268; Heck et al., 2016: 102; Álvez et al., 2020: 8; Campero et al., 2021: 188). This in turn can raise fishermen's resistance to large-scale desalination plants (Odell, 2021: 5). A second impact is the CO_2 emissions coming from the thermoelectric plants (mainly coal-powered) that provide the electricity for the desalination plants, which in the Chilean case are not being assessed in a participatory way in the Environmental Impact Assessment's studies of extractivist desalination plants (Campero et al., 2021: 191). Local communities are being excluded from the decision-making process around the proposal, evaluation, and construction of extractivist desalination projects (Campero et al., 2021). Referring to a thermoelectric plant located in Mejillones, Odell (2021) indicates that there is a growing "sense within the community that it is a *zona de sacrificio* [sacrifice zone]" (Odell, 2021: 6).

This is also occurring in other extractivist enclaves in Chile (Valenzuela et al., 2021). A third impact is the prices of desalinated water oriented for human consumption, which are higher than for drinking water coming from continental sources (Álvez et al., 2020: 7; Ibrahim et al., 2021). This can increase water bills and make the desalinated water unaffordable to low-income social groups (Fragkou and Budds, 2019: 450). All these and other impacts – such as the social perception of water quality (Vicuña et al., 2022) – can generate conflicts between local communities and extractivist desalination, which interacts with local communities under a top-down, corporate-led approach (Fragkou and Budds, 2019; Odell, 2021).

Community desalination as new hydrosocial assemblages

In this paper, we argue that community desalination is different from extractivist desalination. Unlike the latter, the former offers a bottom-up, public, state-led approach to desalination, particularly oriented towards satisfying the human right to water in coastal communities within the context of the current water crisis (Vicuña et al., 2022). It brings socioenvironmental impacts as well, but according to its scale. To the extent that community desalination from a hydrosocial perspective is an under-investigated issue (Vicuña et al., 2022; Williams, 2022), we propose framing these emerging community desalination plants as new hydrosocial assemblages.

This concept, proposed by Erik Swyngedouw (2015), is sensitive to capturing the novelties that bring community desalination when compared with extractivist desalination. For instance, community desalination brings minimal brine disposal to the coast because of its small scale of operations. They also offer renewable (solar) energy sources instead of the dirtiest fossil fuels, such as coal (which is used to operate extractivist desalination plants). These technological, socioenvironmental, and legal processes involved in community desalination are emerging hydrosocial assemblages. For Swyngedouw (2015), "the hydrosocial landscape is (…) an assemblage of interwoven processes that are simultaneously human, nonhuman, material, discursive, mechanical, and organic, but ultimately driven by political forces and economic processes that aspire to turn nature into capital, a process that necessarily implies changing the social relationship to nature" (Swyngedouw, 2015: 21). The author argues that the archaeology of hydrosocial assemblages "requires constructing multiple narratives that relate material practices, representational visions, and symbolic expressions" (Swyngedouw, 2015: 21).

In this sense, Swyngedouw's approach offers three main elements for the political-ecological analysis of community desalination plants as new hydrosocial assemblages: knowledge, processes, and multiple entry points. First, he affirms that "transformative knowledge about water and the waterscape can only be gauged from reconstructing its processes of production" (Swyngedouw, 2015: 23). There are no given hydrosocial assemblages: only by excavating the historical-geographical processes of production will one be able to uncover and understand the different forces (human and more-than-human) acting on the construction of such hydrosocial assemblages. In this case, such forces include the sea and its social internalisation through small-scale desalination in coastal communities. Second, for Swyngedouw, this means focusing on the analysis of processes instead of on structures or static things. Following Harvey's relational dialectics, the emphasis is on "the understanding of processes, flows, fluxes, and relations over the analysis of elements, things, structures, and organised systems" (Harvey, 1996: 49). Under this fluid approach (Linton, 2010), in this paper we describe the participatory process involved in installing and assessing small desalination plants and their community appropriation in southern Chile. Third, Swyngedouw's approach assumes that 'anything' (e.g. material practices or discourses) can be taken as the entry point to studying specific hydrosocial hybrids. This is so because "as every quasi-object/cyborg/hybrid internalises the multiple relations of its production, 'anything' can be entered as the starting point for undertaking the archaeology of her/his/its socio-natural metabolism" (Swyngedouw, 2015: 23). The materiality of the small-scale technology and the discourses emanating from it will be our approach to presenting the community desalination plants as new hydrosocial assemblages.

Participation and community reappropriation of nature through desalination plants

Although Chilean extractivist desalination dates back only to the early 2000s (Vicuña et al., 2022), community struggles defend their territories of life from extractivisms have a long tradition in Latin American political ecology (Leff, 2014, 2019; Gudynas, 2015; Svampa, 2019; Escobar, 2020). In this context, social participation in eco-political processes oriented to protect and conserve living spaces is an opportunity to assess how local people appropriate the small desalination plants in the face of their lack of water due to the mega-drought and the ongoing water extractivism, such as forestry (Torres et al., 2022). Extractivist desalination, driven by mining corporations, does not show evidence of participatory influences in their decision-making process (Campero et al., 2021). In contrast, this exploratory research was conducted under a participatory approach that allowed communities to participate in the decision-making process of implementing and assessing community desalination plants.

Participation in the community decision-making process for desalination is also an opportunity to discuss, at the local scale, why continental water is decreasing, which brings the concept of environmental rationality to the discussion. This is relevant because the extractivist desalination in northern Chile began as a result of the depletion of continental waters by mining extractivism (Odell, 2021). For Leff, "Environmental rationality builds the future from the deconstruction of environmental degradation processes; decolonises the future by opening the channel of knowledge inscribed in the imaginaries and practices of sustainability" (Leff, 2014: 238). By discussing why continental water is decreasing, our empirical results will show that – like the rest of Chile and Latin America – both climate change and extractivist activities such as forestry are contributing to depleting continental water, to the detriment of communities living close to or in the middle of these extractivist developments.

In Chile, rural and coastal communities are supplied by artisanal water systems, the *Agua Potable Rural* (APR, meaning Rural Drinking Water). This rural drinking water programme originated as a state-led programme during the Agrarian Reform (1964-1973) and extended the drinking water provision to rural populations. It was first under the direction of the Rural Sanitation Office of the National Health Service (1964-1970), but between 1970 and 1976 the programme did not have financing, and it was transferred to the Ministry of Public Works (*Ministerio de Obras Públicas,* or MOP) in 1975. In 1977, the National Service of Sanitary Works (*Servicio Nacional de Obras Sanitarias*, SENDOS) was created, which continued the APR programme until 1990, when the Chilean Economic Development Agency (*Corporación de Fomento de la Producción*, or CORFO) assumed its functions until 1994. That year, the programme returned to the MOP through its Planning Department (*Dirección de Planeamiento*), then was transferred definitively in 2003 to another MOP organism called the Hydraulic Works Department (*Dirección de Obras Hidráulicas* or DOH) (Sandoval, 2003). In total, between 1964 and 2018 the Chilean state constructed 1875 APR systems that supply continental drinking water to 1,787,916 rural inhabitants, extending the coverage of rural drinking water from 6% in 1964 up to 52.3% in 2018 (Fundación Amulen, 2019: 30).

The APR systems operate by pumping groundwater through wells[1] and are managed by communities through Rural Drinking Water Committees (*Comités de Agua Potable Rural*) (Schuster and Tapia Valencia., 2017). However, nowadays, both extractivisms and the mega-drought are putting these sources of drinking water for rural communities at risk because the wells are drying up. In this context, small desalination plants appear to be an alternative to (re)filling these APR systems and other artisanal sources, helping to meet the human right to water already included in the Water Code (Vicuña et al., 2022). To do so, however, a social process of reappropriation of nature (Leff, 2014, 2019) must occur, which is mediated by socioenvironmental, political, and cultural processes. Following these ideas, we argue that community desalination can be an alternative pathway to reappropriating nature and

[1] Although with the current water crisis, some APR systems are extracting directly from surface water bodies such as rivers, as we have observed in some areas of the Araucanía region (Torres et al., 2022).

satisfying the human right to water in communities that lack access to drinking water but which are in close relationships with existing water supply systems such as the APRs.

THE SCALAR POLITICS OF THE HUMAN RIGHT TO WATER THROUGH SMALL DESALINATION PLANTS

One theoretical way to frame these processes – scaling up the human right to water and other associated water struggles – is through the 'politics of scale' or 'hydrosocial scales' (Brown and Purcell, 2005; Bulkeley, 2005; Smith, 2008; Swyngedouw, 2015). Applied to water struggles, the politics of scale emphasises how social mobilisation for water can begin at local levels and then be dynamically extended to the regional, national, and global scales (Bolin et al., 2008; Norman et al., 2015). In this sense, three theoretical principles orient the scalar politics research: 1) scale is socially constructed; 2) scale is both fixed and fluid, and 3) scale is a relational idea (Brown and Purcell, 2005: 609; Norman et al., 2015: 5). First, scales are socially constructed through socio-spatial struggles (Bolin et al., 2008: 1497; Swyngedouw, 2015: 30). The results sometimes produce a significant scalar reconfiguration for the actors involved in these power struggles, who seek to concretely define their political agendas. In this research, these agendas are represented by the new institutional regulations for small desalination plants. This regulation attempts to satisfy the human right to water in rural communities but also the structural struggles to de-privatise water and declare it a common good (Convención Constituyente, 2022; Torres and Álvez, 2023). The results of these struggles – whatever they are – are not "the inherent qualities of particular scales" (Brown and Purcell, 2005: 609) but the product of people's mobilisation to position their political agendas in certain areas of social activity and public policy (MacKinnon, 2011: 29). In this case, the agenda would be to regulate small desalination plants as common or community-owned property instead of reproducing the crisis through their appropriation by the water markets and extractivist desalination (Odell, 2021).

Second, because the scales are socially constructed from ongoing political struggles, 'scale' has fluid qualities; it focuses on analysing processes rather than static entities. However, the political struggles between different actors can be eventually fixed and "routinised into relatively enduring and hegemonic structures for certain periods of time" (Brown and Purcell, 2005: 610). In this context, "new scalar arrangement and configurations [develop] at the point of interaction between inherited and emergent projects and scales" (MacKinnon, 2011: 31). While these hegemonic scalar arrangements (e.g. extractivist desalination, water as a commodity) can "shape future possibilities for social action, they do not determine the possibilities" (Perreault, 2015: 117). The Chilean water market and dominant extractivist desalination is the general context in which the new hydrosocial assemblages, represented by small desalination plants, enter the scene, but the latter is not determined by the former. And third, the scales are relational, because scale analysis focuses on the relationships between scales without favouring any particular scale (for example, the local one). Each scale is related to the others, but those relationships are open to social constructions. Therefore, the analyses of scale "must examine a range of scales at once (rather than focusing on a single scale alone), and they should specifically interrogate the changing interrelationships among various scales" (Brown and Purcell, 2005: 610)

The latter is significant when analysing the scalar politics of community desalination because often it is assumed that the 'natural' scale represented by the river basin is the 'most appropriate' level of scalar analysis in relation to hydrosocial processes (Norman et al., 2015; Swyngedouw, 2015). However, the river basin's scale is influenced by smaller scales, such as those of the community and local governments. At the same time, it is influenced by larger scales, such as the national and global. In other words, "the scale of the river basin and its hydro-political configuration is a vitally important territorial form of water governance. Its contested formation and internal dynamics cannot, however, be abstracted from its position within the wider operation of the state and its relation to international water regimes and policies" (Swyngedouw, 2015: 32). The multiscalar configuration of desalination will be illustrated through the discussions over how the state could finance community desalination plants at regional and

local scales, fulfilling the human right to water (Vicuña et al., 2022) but also considering national-scale struggles to de-privatise water and transform it into a common good in the ongoing Constitutional process (Torres and Álvez, 2023).

METHODS

Our methods reflect the interdisciplinary nature of our research team, composed of social scientists, engineers, lawyers, and geographers. The engineers developed the technology of small desalination plants using the technique of nanofiltration in previous research of around 40 years at the University of Concepción, Chile (Patent UDEC-52.855, 2013-2033). Once the research grant financed by the Chilean state was granted (ANID/FONDEF/IT19I0021, 2020-2022), the technology was offered as demonstrative projects to public officials from municipalities where there were rural and coastal communities lacking a drinking water supply. The three communities selected were Chome (in the commune of Hualpén), Rumena (in the commune of Arauco), and Cheniao Island (in the commune of Quemchi). Chome and Rumena are in the Biobio region, while Cheniao Island is in the Los Lagos region. Table 1 shows some socio-demographic characteristics of the three communities, while Figure 1 illustrates their geographical location.

Table 1. Population and households in the study's communities.

Community	Population	Households
Chome	120	34
Rumena	182	70
Cheniao	83	46

Source: INE (2017)

The main economic activities developed by people living in these communities are related to the sea: artisanal fishing, shellfish gathering, and tourism during the summer season. These activities are significant because they highlight the intimate relationships that the communities have with the sea and because tourism puts extra pressure on their artisanal and rural drinking water (APR) systems during the summer. Summer (December–March) is the worst hydrosocial season: the communities need much more water than usual due to the influx of tourists, but the lack of precipitation causes their systems to dry up. These then need to be refilled with water trucks supplied by the respective municipalities but financed by the central government. The water imbalances at these sites were the primary reason for their selection as case studies, where the small-scale desalination plants would be installed as demonstrative projects. Originally, the idea was to install and operate the plants for six months in each community. However, we began the project in the middle of the pandemic in August 2020, and due to government restrictions, we could not accomplish the original idea and had to adapt the times. The first plant was installed only in January of 2022 in Chome, while the plants in Cheniao and Rumena were installed in October and December of 2022, respectively.

To proceed with the installation of the plants in the communities, we initiated a participatory process, allowing us to supply information and consult with government agents and local end-users. First, seven face-to-face and six online meetings via Zoom were developed with state water institutions. The aim of the meetings was to get a written agreement signed among representatives from the University of Concepción (led by Dr. Rodrigo Bórquez), representatives of the Regional Ministry of Public Works, led by the director and public officials of the Hydraulic Works Department (DOH), and representatives of the three municipalities. This last included their three mayors and public officials working in the Departments of Environment and Tourism (the municipality of Hualpén), Social Participation and Water Emergency

(the municipality of Arauco), and the Planning Secretary (the municipality of Quemchi). This was done to accomplish all the technical, health, maritime, legal, and other regulations involved in supplying drinking water to the population.

Second, we began a second stage in the participatory process to present the initiative to and consult with the communities. To do so, we conducted nine participatory workshops in the communities, in order to provide detailed information about the desalination plant and collect information about social perceptions of the drinking water produced by the plants. Community participants were mainly comprised of members of the Rural Drinking Water Committee (*Comité de Agua Potable Rural*), artisanal fishermen, tourist operators, and small-scale farmers.

Third, we also conducted a total of 38 qualitative semi-structured interviews oriented towards producing short documentaries.[2] The interviewees were selected at two different points: First, after the communities' participatory workshops had finished, and second, after we had applied the survey (see below), we requested that some key informants participate in the interviews for the short documentaries. Therefore, semi-structured interviews were conducted with people participating in both the workshops and the survey, including interviews with the municipalities' public officials. Table 2 summarises the participatory process according to each community and the research technique applied.

Table 2. Summary of the case study's participatory process.

Community	Number of online meetings with public institutions	Number of persons involved in online meetings	Number of face-to-face meetings with public institutions	Number of persons involved in face-to-face meetings	Number of participatory workshops with communities*	Number of persons involved in participatory workshops	Number of individual semi-structured interviews
Chome	3	21	0	0	5	110	17
Rumena	0	0	4	30	2	75	13
Cheniao	3	16	3	14	2	40	8
Total	6	37	7	34	9	225	38

(*) Public officials from the municipalities also participated in these (face-to-face) workshops. In each community, one of the participatory workshops was simultaneously the inauguration of the plant.

We also designed thematic maps to spatialise the plants' locations and socioenvironmental contexts. Finally, we designed a questionnaire with ten questions (one composed of nine items) to quantify social perceptions about the plant, its water quality, and how it could be managed and financed to keep it permanently in the community, among other themes associated with the water governance of small desalination plants. The collected information was processed and analysed in the Statistical Package for Social Sciences (SPSS). Uni and bivariate analyses were developed for the collected sample n = 58 (Table 3).

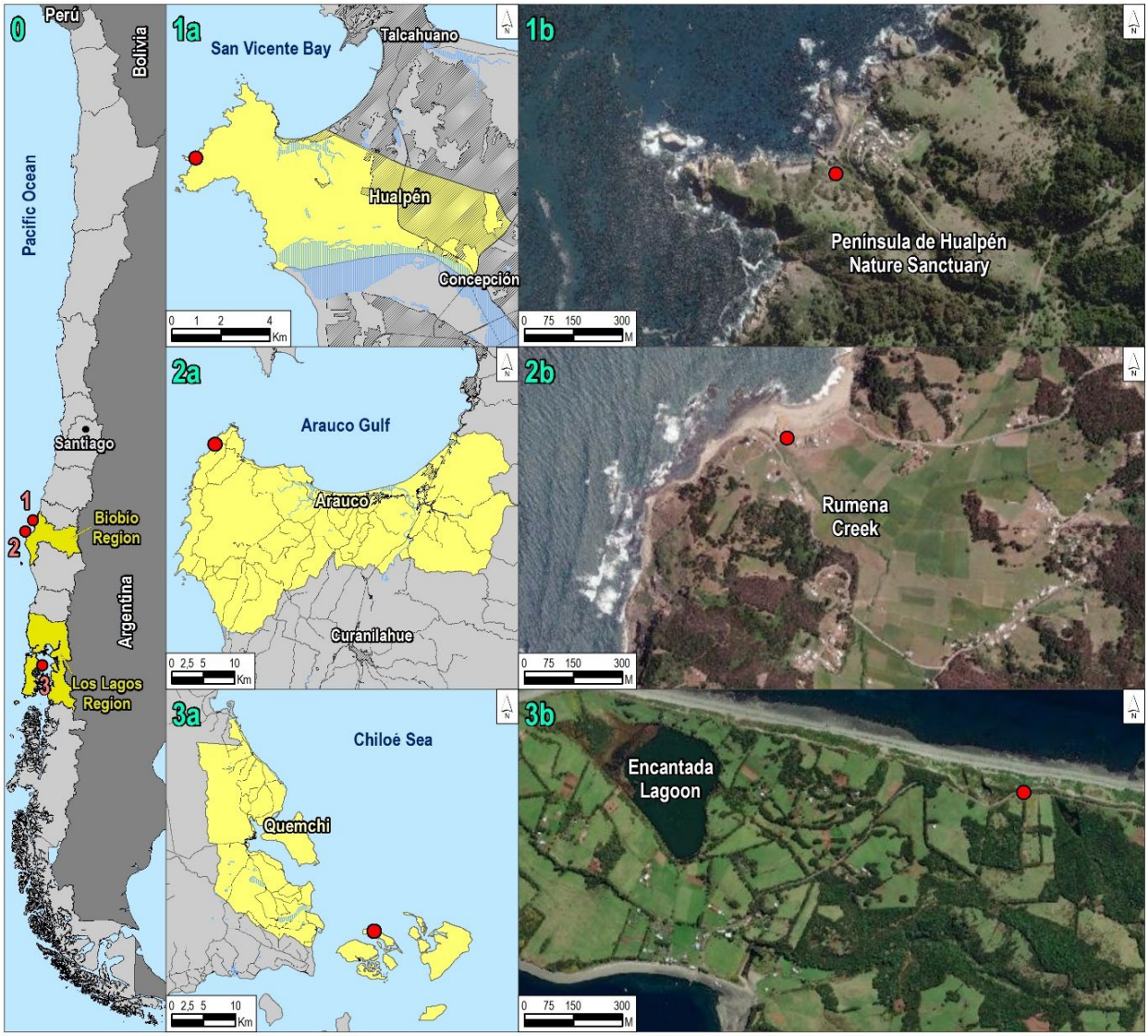
Table 3. Persons surveyed according to community and age.

Community	N	Age (Mean)	Minimum	Maximum	Standard deviation
Chome	16	57.63	25	74	15.684
Cheniao	12	56.50	31	75	12.087
Rumena	30	50.13	15*	89	20.626
Total	58	53.52	15	89	17.945

*This minor was interviewed in front of her grandmother.

[2] See the Chome case at the following link: https://www.instagram.com/p/Cey-j-lj96V/

Figure 1. Location of three coastal communities under study and intervention in Chile.



RESULTS

Bringing the sea inland: Community desalination as new hydrosocial assemblages

In this section, we describe the process of constructing new hydrosocial assemblages. The results show at least three main assemblages: a) Negotiating and installing a new source of drinking water for coastal communities, b) The process of using and valuing/assessing the new drinking water, and c) Negotiating the financing of permanent desalination plants.

First assemblage: Negotiating and installing a new source of drinking water for rural-coastal communities

The first step in constructing new hydrosocial assemblages through community desalination plants was to involve public stakeholders, represented by public officials from both regional governments and municipalities. This first stage had to be 'top-down' in this way because of the multiscale regulations

involved in providing drinking water to rural and coastal communities. It was also necessary to evaluate the reception coming from these officials. The first municipality involved in the participatory process was Hualpén, whose public officials (including the major, the director of the environmental office, and professionals working on tourism development) agreed with the project. However, they showed concern over two main issues: the regulations involved and the fact that the coast of the commune is a protected area called the Península de Hualpén Nature Sanctuary (see Figure 1). Therefore, installing the plant would mean overcoming extra environmental regulations as well as gaining the acceptance of the community, highlighting an already-established environmental rationality among political actors.

Once the first links with the public actors had been forged, we proceeded to negotiate the installation of the plant with the community. Firstly, due to pandemic restrictions, we contacted the community of Ramuntcho, an artisanal fisherman's cove located close to Chome, by email. We did so because the municipality's public officials said they had to deliver water trucks daily to that place. However, they replied to our email saying briefly that they did not want to participate. For this reason, we decided to contact the community of Chome, specifically its Rural Drinking Water Committee. Each Committee is comprised of four persons: a president, a secretary, a treasurer, and the operator of the APR system. We arranged a participatory workshop with them and the general community to present some information about the project and ask them for their thoughts. In the end we needed three meetings (in March, September, and October of 2021).

There was not enough of a quorum during the first meeting due to the pandemic, but they recognised that they had many problems with the quantity and quality of the drinking water coming from their APR system. There was a quorum in the second workshop, in September – mainly fishermen, who said that they knew desalinated water because sometimes, when they went out to sea working for large factory ships, the only source of drinking water was desalinated water produced by a small desalination plant installed on the ship. However, a main issue during the second workshop was that one of the participants, a young female environmentalist, criticised our proposal. She had read that in Northern Chile, the "desalination plants damage the marine life", and objected to the plant's installation in a protected area. The project's engineers explained that the environmental damage occurs with large-scale, extractivist desalination plants that provide water to both large cities like Antofagasta and mining companies in northern Chile (Fragkou and McEvoy, 2016; Fragkou and Budds, 2019; Álvez et al., 2020; Odell, 2021). They argued that this would not be the case in Chome, because given that the village only had 34 households (Table 1), the amount of brine to be delivered to the coast would be minimal. The brine issue was discussed alongside the energy issue, because our small desalination plants use solar panels. This is also different from the large-scale desalination plants in northern Chile, whose energy comes mainly from thermoelectric plants fuelled by coal (Campero et al., 2021; Odell, 2021; Vicuña et al., 2022).

In any case, this critique confirmed the already-existing environmental rationality among community members. After this deliberative process, our research team and the community arranged another meeting to decide whether to install the plant. Finally, during the third workshop, developed in October of 2021, they accepted the plant, but they did not agree to connect it directly to the APR system because they were afraid it would affect both the quality and the taste of the existing drinking water system. The president of the APR systems, a 75-year-old woman, said, "Drink to believe" ("Beber para creer"). We accepted the community proposal, and in January 2022, the plant was installed in Chome.

The participatory process for negotiating the installation of the small desalination plants was less complex in Rumena and Cheniao. These communities have deeper water problems than Chome, so the institutional and community participatory processes were expedited. Chome has had an APR system since 2002, while neither Rumena nor Cheniao has an APR that ensures enough drinking water to satisfy human needs. As outlined earlier, the state has financed APR systems since 1964 and, in theory, they provide clean drinking water for rural and coastal communities. In practice, however, this depends on the individual community's water source. Most get their water from aquifers and pumped up from deep wells. These simply do not have enough water in them to support the community during the summer,

and in both summer and winter, people have reported the presence of sediments that affect the colour and taste of the water. Instead of relying on an APR, Rumena and Cheniao have artisanal tanks popularly known as '*abastos*', constructed by the community, frequently with state support.

Figure 2. Assembling the community desalination plant in Chome.

In Cheniao, there has never been drinking water provided to the village by either the state or private companies. This small island, located on the longest island of Chiloé (Figure 1), has 46 households, but for geographical reasons our research project was only able to provide desalinated water to 15 of them (those located on the west side of the island; see Figure 5 below, left side). This community has an artisanal supply network, accumulating water from natural springs in a community pond that is then distributed to households in the southwestern part of the island (Figure 1, 3b). In addition, most households have rainwater storage tanks on their roofs that they boil and use for human consumption. The problem is that, with the mega-drought affecting the whole country, these natural sources have decreased drastically in summer and even during the autumn (March-June), according to people interviewed. Therefore, during our visits to the island in 2022 community members agreed with the installation of the community desalination plant. As in Chome, they expressed worry about the taste and quality of the water produced by the plant. But unlike in Chome, they did not have a choice; the municipality of Quemchi had reported a lot of problems in delivering drinking water to Cheniao by truck, mainly because of the logistic complexities implied in transporting water from the largest island of Chiloé to Cheniao via ferry. This aquatic transportation increases the expense of the water trucks significantly. For instance, in an interview with the major of Quemchi, he said the municipality pays 4.3 million Chilean pesos (CL) (around US$5461) per month per water truck, and the cost of a ferry means an extra $250.000 CL (US$317) per trip. During the summer season, they must make at least three trips per week to satisfy Cheniao's needs. In addition to the lack of water, this was another, economic reason for accepting the installation of the plant.

In the case of Rumena, the drinking water situation is better than in Cheniao but worse than in Chome. They have an organised Rural Drinking Water Committee that deliver water to 64 households, and the water source for their artisanal supply network comes from the hills' natural springs. The other five

households are supplied with a family tank, while one household has its own tank whose source also comes from the springs. The hills from which the springs come are fully planted with eucalyptus monoculture destined for forestry extractivism, specifically a cellulose production plant located in Arauco, the so-called MAPA project (Cuevas Valenzuela et al., 2022). These non-native trees consume a lot of water and, along with the mega-drought, are contributing to the drying up of the springs (Torres et al., 2022), requiring their artisanal supply network, composed of three tanks located in the middle of the forestry plantations (see one of them in Figure 3 below), to be refilled by water trucks. For this reason, the community accepted our proposal unanimously when we did a participatory workshop in September of 2022 and presented the small desalination plant as an alternative to the water trucks. However, public officials from the municipality and Biobio's Regional Health Service expressed reservations, fearing the drinking water's quality and eventual risks to the population. Our engineers told them that the nanofiltration system guarantees high water quality, but they insisted that we must do some water quality analyses at the University of Concepción. After demonstrating that the drinking water produced by the plant is high quality and thus getting approval from the Regional Health Service from Biobio, we got official permission to install the plant. However, as the artisanal tanks are filled with both natural spring waters (without treatment) and water trucks (carrying drinking water), we decided not to connect the desalination plant to the artisanal supply network. In this way, people would be able to differentiate and compare the desalinated drinking water from and to the other two.

Overall, negotiating the installation of the plants with different stakeholders and analysing the geographical, marine, hydrosocial, and other conditions necessary were the first steps in constructing the new hydrosocial assemblages. The next was the physical installation. Figures 3, 4 and 5 show the specific socioenvironmental conditions for each plant installed. Note how forestry extractivism is spatially relevant in both the Chome and Rumena sites (Figures 3 and 4).

Figure 3. The new hydrosocial assemblage in Chome, Hualpén (Biobio region).

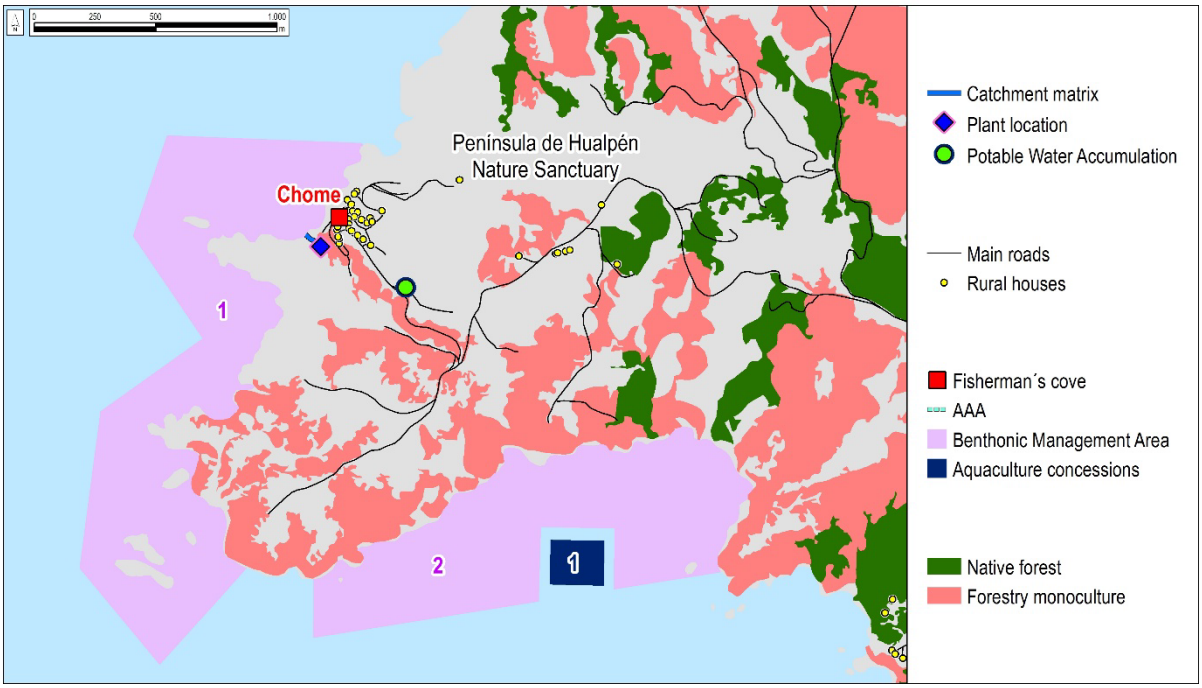


Figure 4. The new hydrosocial assemblage in Rumena, Arauco (Biobio region)

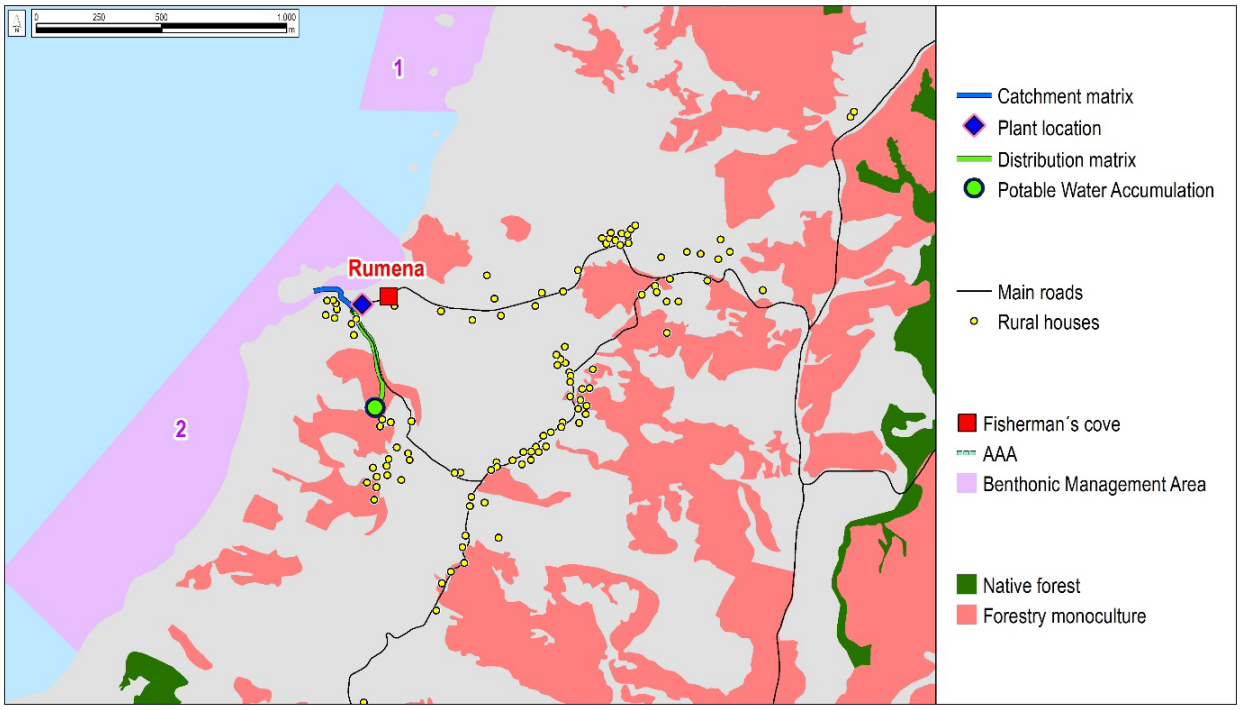


Figure 5. The new hydrosocial assemblage in Cheniao Island, Quemchi (Los Lagos Region)

Second assemblage: The process of delivering and valuing the new drinking water

As none of the plants were connected either to the distribution matrix or directly to the households, our social scientists had to distribute water in small drums of five litres so the community could drink and assess the desalinated water. We delivered one drum of five litres per person, and during the process, we explained that this was desalinated drinking water. We asked people to drink a cup of the water and then gave them the survey. In this way, we were able to evaluate their perceptions through their facial expressions as well as by how they responded to our survey in real time. According to Table 4, the three communities evaluated the water as 'very good', averaging a score of 6.59 out of a maximum of 7, wherein 1 meant 'very bad' drinking water, and 7 meant 'very good'. The best score was in Cheniao (6.92 out of 7); we interpret this as being because Cheniao has the worst water quality, including the worst-tasting water, among the three communities. This is because their main drinking source comes from rainwater stored in small tanks on their roofs. The second-best score was in Chome (6.81 out of 7), in which the community confirmed that the desalinated drinking water was better than the water coming from their APR system, which they had reported as having a lot of problems with water quality due to sediments in the water. Finally, the third best score was in Rumena (6.33 out of 7), in which most people said the desalinated drinking water was 'very good', but some said they preferred the water from the natural springs.

Figure 6. Charging water drums in a community desalination plant in Rumena.

In short, the community assessment gave a concrete indication that the communities valued the small desalination plants and considered the drinking water they produced to be high quality. The small plants were seen as a real and affordable alternative to the water trucks for refilling their APR or artisanal tanks. Therefore, the communities began to ask whether or not we would install definitive small desalination plants on the same sites. In other words, once the second stage of the new hydrosocial assemblage was done – they demanded that the small plants stay in their communities permanently. This highlighted that the community appropriation of small desalination plants depend mainly on the water quality offered by the technology.

Table 4. How do you evaluate the drinking water produced by the desalination plant?

Community	N	Mean*	Minimum	Maximum	Standard deviation
Chome	16	6.81	6	7	0.403
Cheniao	12	6.92	6	7	0.289
Rumena	30	6.33	4	7	0.844
Total	58	6.59	4	7	0.702

*1 = Very bad; 7 = Very good

Third assemblage: Negotiating the financing of permanent community desalination plants

From the beginning, our project had informed both public water institutions and communities that the small desalination plants were 'demonstrative projects'. This meant demonstrating that they were a real and cheaper alternative to water trucks to refill the APR and artisanal supplies and, in this way, to cope with the water crisis. However, we also informed both public water institutions and communities that during the process, we were going to work with all municipal and regional stakeholders to get the resources to finance the definitive plants if communities evaluated them as worthwhile or if the water crisis was so acute that there were no alternatives.

This was the case in Cheniao, which was critical because some interviewees reported that people living on the island frequently suffered from stomach-aches and even cancer, which they attributed to the low-quality water they were drinking, particularly during the last decade of mega-drought. In addition, the high costs of delivering water trucks to the island allowed room for negotiation amongst our project team members, representatives of the Regional Government of the Los Lagos Region, the major of Quemchi, and a community leader. The negotiation ended with an agreement that financed a small desalination plant with public funds to provide desalinated drinking water to 15 households. In December 2022, we inaugurated the community desalination plant in Cheniao, which is going to provide drinking water to its inhabitants for the first time in the island's history (See Figure 7).[3] In fact, it is the first time the state provides continuous drinking water to the community.

The plant and the main distribution matrix are already installed (see Figure 4), though the connections from the distribution matrix to each of the 15 households remain challenging. During the plant's inauguration, Juana, the community leader, said they did not have the economic resources to connect the houses and demanded help from the Quemchi municipality to finance the materials for this phase of the project. In response, Quemchi's major promised the community that the municipality would provide the materials, but he requested that the community provide the labour force. Juana said yes; communal work of this sort, called *minga,* is a tradition in the largest Chiloé Island and in several Latin American countries. In this way, this community is going to enjoy continuous and high-quality desalinated drinking water for the first time in its history.

As of this writing (May 2023), we have also advanced negotiations with the regional and local governments to finance permanent plants in Rumena and Chome, with a similar capacity to the one installed in Cheniao. The third stage of the new hydrosocial assemblage is on the way.

[3] The plant in Cheniao has the capacity to produce 1000 litres per hour or 24,000 litres per day. When using solar energy, the plant produces between 6000 and 8000 litres per day. Even this reduced amount should satisfy the needs of the 46 people for whom this plant was designed, who will receive between 130 and 174 litres per person per day.

Figure 7. Inaugurating the definitive community desalination plant on Cheniao Island.

The community reappropriation of nature through small desalination plants

The financing of the permanent desalination plants for the three case studies reflects their positive valuation by the communities. In this section, we analyse the reappropriation of nature by the community through the visions and perceptions created by the new hydrosocial assemblages. Table 5 shows nine items included in the survey, to which respondents from were asked to answer if they (1) Strongly Disagreed, (2) Disagreed, (3) were Neutral, (4) Agreed, and (5) Strongly Agreed. The results are presented in descending order according to the mean obtained for each item. They can be classified into two categories: a) structural and political issues (items 1, 4, and 5), and b) situated and technical issues (items 2, 3, 6, 7, 8 and 9).

Table 5. Community perception of different dimensions of small desalination plants.

Nº	Items	N	Mean*	Minimum	Maximum	Standard deviation
1	The desalination plant must be financed with state funds and become a common good.	58	4.47	4	5	0.503
2	Training programmes on the desalination plant are required for the Rural Drinking Water Committee.	58	4.36	3	5	0.520
3	Programmes are needed to strengthen the Rural Drinking Water Committee.	58	4.36	3	5	0.520
4	The water rights generated by the plant cannot be traded on the water market.	58	4.34	2	5	0.579
5	Our human right to water will be guaranteed with the desalination plant.	58	4.31	2	5	0.706
6	The municipality should finance the maintenance costs of the desalination plant.	58	4.31	2	5	0.627
7	The municipality should finance the operator's salary for the desalination plant.	58	4.24	2	5	0.757
8	The desalination plant should be connected to the Rural Drinking Water system instead of the water trucks.	46	4.13	2	5	0.909
9	I am willing to continue paying the same price I have paid for the water bill.	42	3.71	1	5	1.195

*(1) Strongly Disagree, (2) Disagree, (3) Neutral, (4) Agree, (5) Strongly Agree

a) Structural and political issues

Item 1 ("The desalination plant must be financed with state funds and become a common good") obtained the highest score with a mean of 4.47, which means 'Agree' to 'Strongly Agree'. Unlike Chilean urban areas, in which private corporations provide drinking water, this score reflects how rural-coastal communities are fully aware of the key role of the central and regional state in generating the institutional and infrastructural conditions to providing drinking water, as the Chome, Rumena, and now the Cheniao cases demonstrate. Communities know that the state plays a key role for them, and that must be the main reason why they also agree that the community desalination plants must be a common good, managed by themselves, like the APR systems. This high valuation of the public and the small desalination plant as a common good also reflects national- and regional-scale discourses deployed by water social movements and political struggles around the Constitutional process, which claims that water must be de-privatised and transformed into a common good (Convención Constituyente, 2022; Torres and Álvez, 2023). Communities approved the drinking water produced by the desalination plants during, but to the extent that they expect to be at least partly supplied by the permanent plants, they also want to maintain them within the public and community-owned domain.

Items 4 and 5 also reflect structural and highly contested political issues around water in Chile, and they were similarly highly scored by members of the communities surveyed. Item 4 ("The water rights generated by the plant cannot be traded on the water market") obtained a mean of 4.34, which means that the communities 'Agreed' and/or 'Strongly Agreed' with it. This result confirms that for communities, the desalinated drinking water must not be captured by the markets but must be managed as a common good by the communities, with state support. Item 5 explains this because when asked what they think about the statement "Our human right to water would be guaranteed with the desalination plant", they responded with a mean of 4.31, which also means 'Agree' and/or 'Strongly Agree'. As they are communities suffering from the lack of water in both quantity and quality and, therefore, their human right to water is already being ignored or outright violated, it is not surprising that they were strongly aligned with this item. Drinking water produced by small desalination plants can play a complementary role to traditional continental sources in satisfying the human right to water – a right already signed into law by the Chilean state in 2022 but set to be implemented within the next few years. This confirms that community desalination as new hydrosocial assemblages is (and should be) state-led but with local management by communities instead of extractivist desalination managed in a top-down, corporate-led approach.

b) Situated and technical issues

These are problematic issues related to existing community water management, but they also highlight problems raised by the new hydrosocial assemblage of community desalination plants. The crisis under which the communities that depend on APR or artisanal water systems are living is not only related to the lack of water (in quantity and/or quality) but also to problems with the social organisation of community water management. Item 3 reflects one of them, because when we asked about the statement "Programs are needed to strengthen the Rural Drinking Water Committee", an average of 4.36 was obtained, which means 'Agree' and/or 'Strongly Agree'. During our participatory workshops and interviews, the members of these committees said that one of their main problems is the lack of willingness to be part of the committee, which as stated before has four positions: the president, secretary, treasurer, and operator. One reason is that these positions are not paid, except for that of operator. For instance, the president of the Chome APR committee said she has been in that position since the DOH constructed the APR in 2002. The Chome APR operator, who is responsible for making the system operate (for instance, chlorinating the water and coordinating with the cistern truck when it fills the pond), is in the same situation. Although he receives a salary (at minimum wage), he has no vacations and works from 6 am until 6 pm (sometimes later when problems appear), and all this is explained as

being because he is the only one with the skills to operate the APR plant. For that reason, these communities request state support to fix these problems through public programmes. Item 2 ("Training programs on the desalination plant are required for the Rural Drinking Water Committee") also reflects these problems but brings new complexities to the fore, because now the operator will have to operate both the APR system and the community desalination plant. In this respect, our proposed technology is easy to operate; with other engineers, we have developed an application that allows you to turn it on or off from a smartphone. But even so, it is going to be impossible for the operator and community to fulfil all the requirements to sustain both complementary systems. In this respect, there is a high willingness from the communities to appropriate the technology, learn and create new water-related knowledge, and be part of this new hydrosocial assemblage to sustain their rural and coastal ways of life. However, Items 2 and 3 show the community limits and shed light on the directions in which public water policies from municipalities and regional and central governments must go.

Items 6 and 7 only confirm these problems. Item 7 ("The municipality should finance the operator salary of the desalination plant") scored 4.24 ('Agree' and/or 'Strongly Agree'). This can be explained because the new Law 20.998 (2017) of Rural Sanitarian Services states that once the state (DOH) constructs the APR's infrastructures and transfers its management to the communities through the APR Committee, the system should be financially sustainable. In practice, each household pays their monthly water bill to the treasurer, one of the four committee members. The collected money is supposed to pay the APR operator's salary and other spending needed to maintain the operation of the APR or artisanal system (for instance, pump repairs or other improvement work). However, on average, each household pays around $3,000 CL to $5,000 CL (around US$3.75 to US$6.25) per month. In Chome (34 households), this means a fund of money from around $102,000 CL to $170,000 CL (around $127.50 to $212.50 US dollars) per month. By 2022, the minimum wage in Chile will reach $410,000 CL (US$512.50) per month. This means that the money collected from the water bills – even if all households pay them – is not enough to cover even half of the operator's salary. The situation is worse in smaller systems such as Cheniao (which only has 15 households). But even in the biggest systems such as Rumena (64 households), the president of the APR system, an artisanal fisherman, has said that they cannot sustain the operator's salary, and every month they must take money from other sources (e.g. their artisanal fisherman union's fund) to pay the operator.

Finally, Item 9 ("I am willing to continue paying the same price I have paid for the water bill") scored an average of 3.71 (between 'Neutral' and 'Agree'), which makes the situation even more uncertain because this could show that members of the communities have little willingness to pay even the current price of their water bills. This was particularly marked in Cheniao (where they have never paid a water bill) and Rumena, where the interviewees reported many conflicts on this topic. In short, if the APR and artisanal systems cannot pay the operator salary for their current water supplies, how could they ever pay the salary for the operator of the community desalination plants? Thus they request help from municipalities and/or the regional government. In fact, they need help to make their systems economically sustainable over time and space.

Complementarily, Item 6 ("The municipality should finance the maintenance costs of the desalination plant") also scored high, 4.31 (between 'Agree' and 'Strongly Agree'). It only extends the previous problem with the operator's salary. If they do not have money to pay for the operator and the maintenance on the current systems, how could they pay the costs for maintaining the new hydrosocial assemblages represented by the community desalination plants? An additional problem is that spare parts for small desalination plants are unavailable in the local market, at least for now, when the technology has not yet become widespread. However, to the extent that the technology increases in use, it could be expected that the spare parts will be offered in the local market, while the University of Concepción, as a technology developer, could generate these spare parts at low cost. Communities will need public financial resources and enablement, however, to appropriate the technology fully and sustainably.

Finally, Item 8 ("The desalination plant should be connected to the Rural Drinking Water system instead of the water trucks") scored 4.13 (between 'Agree' and 'Strongly Agree'), which is completely opposite to the communities' perception before installing the plant. After having tasted and tested the water and having recognised its quality, the communities agree that the plants must be connected to their current APR or artisanal systems to complement their continental waters, ensuring a continuous service to enforce their human right to water and sustain their rural-coastal forms of life and economies. This would also save millions of dollars for the central and regional governments, as they would no longer have to pay for the private provision of water trucks (CIPER, 2017).

Overall, the community reappropriation of nature through small desalination plants appears to be socially and culturally feasible but economically uncertain. This also demonstrates that the apparent technical issues are fully political.

Rescaling hydro-governance and the potential role of community desalination plants to satisfy the human right to water in Chile

Current water regulations and their practical implications

Despite previous records dating back to 1977,[4] the United Nations (UN) standards for the human right to drinking water were only established in 2010,[5] and after 11 years of political struggle and parliamentary discussions to reform the neoliberal Water Code (Bauer, 2015; Budds et al., 2020), in March of 2022, the human right to water was introduced in the Chilean Water Code (Ministry of Public Works, 2022). However, the Water Code applies only to continental waters and was reformed recently by the Chilean Climate Change Law (N°21.345),[6] establishing that the use of water for human consumption, domestic use, and sanitation will always prevail in water rights (for continental or inland waters).[7] Considering that "all waters, in any form, are national goods of public use", [8] but also that desalinated drinking water could come from inland brackish water, and even though the existing rule of Article 1 places seawater outside the scope of the Water Code, is there any reason to exclude this public reasoning when it comes to human consumption through community desalination?

The regulation of rural drinking water systems in Chile – raised with the agrarian reform during the 1960s (Schuster Olbrich and Tapia Valencia, 2017) – was recently reformed by Law N°20.998.[9] This establishes a new framework called the Rural Sanitary Services (*Servicios Sanitarios Rurales* or SSR), which was approved by the Chilean Congress in 2017 and went into force in November 2020.[10] Aligned with the Water Code reform of 2022 that includes the human right to water, the SSR includes rural drinking water and sanitation services (Vicuña et al., 2022). In addition, in December 2022, Congress approved the reform contained in Law N°21.520,[11] which mainly refers to the process of institutional transition and

[4] See the UN Water Conference in Mar del Plata, Argentina. Its Action Plan contains the first mention within the universal human rights system of the right to drinking water in sufficient quantity and quality to meet people's basic needs. Document signature: E/CONF.70/29.

[5] Based on the International Covenant on Economic, Social and Cultural Rights, articles 11.1 and 12; Economic and Social Council, General Comment N°15 (2002), document E/C.12/2002/11 on the right to water (Arts. 11 and 12 of the International Covenant on Economic, Social and Cultural Rights); Resolutions of the General Assembly A/RES/64/292 (2010) and the Human Rights Committee A/HRC/RES/15/9 (2010); UN Office of the High Commissioner for Human Rights, UN Habitat & World Health Organization (2010). "The Right to Water". Fact Sheet N°35.

[6] Published in the *Diario Oficial* 6 April 2022, https://bcn.cl/2zm0a

[7] Water Code, 2022, Article 5 bis.

[8] Water Code, 2022, Article 5. In fact, new article 147 quarter allows the President to exceptionally stablish water rights of use even when there is no water availability, only with the purpose to assure human consumption, sanitation, or domestic subsistence use.

[9] Law 20.998 (2017) of Rural Sanitarian Services. Link: https://bcn.cl/3bj23

[10] Decree N° 50 (2020) of the Ministry of Public Works, Regulation of the Rural Sanitarian Services. Link: https://bcn.cl/2lxdm

[11] Law 21.520 (2022).

implementation of the new framework and its procedures. This includes an orientation to making communication requirements more flexible between communities and public institutions. This reform, unanimously approved in record time by Congress,[12] reveals the common diagnosis for the difficulties in implementing the new governance for rural drinking water and sanitation at the community scale.

The reason for the difficulties is simple: all the SSR reforms were made without public participation. This highlights the significance of deploying participatory processes at all scales when enacting water reforms, as exemplified in this research. The non-participatory nature of Chilean water reform for rural areas – similar to extractivist desalination projects in the north (Campero et al., 2021) – reflects how the neoliberal model of water governance still privileges the 'technical' over the social and political nature of water (Budds, 2009; Odell, 2021), maintaining intact the neoliberal agenda over water resources in Chile but now extending its scope to community rural drinking water, which until now has been 'protected' from the water markets.

In practice, this is expressed in the 'technical advising' provided by private water corporations operating in urban areas (such as ESSBIO in the Biobio Region) to the regional governments through the DOH and, through it, to the APR systems operating at a regional scale. For instance, during our visit to Rumena in September 2022, a public official told us that the DOH has a contract with ESSBIO that reached the amount of 3000 million Chilean pesos (around US$3,810,000) for 2022. This is for technical advising that includes APR systems (Sandoval, 2003). This transference of large amounts of public resources has been denounced as corruption and investigated in the Deputy Chamber[13] but has been openly recognised by private water corporations in other regions such as Ñuble.[14] In addition, empirical evidence from the Ñuble and Araucanía regions shows that the above-described financial problems that structurally affect the APR systems are being used as an argument to transfer the APR systems to private water corporations. They are constructed with public resources, but to whatever extent that communities have a lot of problems sustaining them economically, there is a growing participation of private water corporations in their management and property. In other words, there is an emergent tendency to privatise the last bastion of community water management outside the water markets.

This would put the community desalination plants, still without clear regulation (Vicuña et al., 2022), at the risk of being captured by private water corporations operating from a market-oriented approach that broad social and political actors of Chilean society have criticised. Although private corporations can easily satisfy the human right to water (Bakker, 2007), there are political agendas beyond the markets to be considered in the Chilean context.

The water commons agenda in the constitutional process and beyond

The context of ongoing political struggles around water in Chile raises the question of whether the drinking water produced by community desalination plants should be a common good managed by local communities or a commodity sold by large-scale corporations, like the extractivist desalination in the arid north of the country (Fragkou and Budds, 2019; Odell, 2021). The last decades have witnessed how emerging water social movements and other political actors in Chilean society have deployed the counter-hegemonic agenda of de-privatising water and declaring it a common good. Under a general

[12] The project started its lawmaking process as Bill N° 15364-09 by message from the Executive Power 27 September 2022 and ended two months later. In the Chamber of Deputies, 128 voted in favor out of 128. The vote outcome was reached at the 104th Ordinary Session of 30 November 2022. In the Senate, 35 out of 35, the vote outcome being at the 76th Session of 16 November 2022.

[13] See OFICIO N° 75358 de la Cámara de Diputados de Chile, September 2021, https://www.camara.cl/verdoc.aspx?prmTIPO=OFICIO&prmID=175684&DESTINOID=131613

[14] See the website of the ANDESS Chile or Asociación Nacional de Empresas de Servicios Sanitarios AG (National Association of Sanitary Services Companies of Chile), which brings together private companies that provide drinking water and sanitation services in urban areas of the country, https://www.andess.cl/118-comites-apr-de-nuble-seran-beneficiados-por-convenio-entre-doh-y-essbio/

context of anti-neoliberal social struggles, mobilisations peaked in the national rebellion that exploded on 18 October 2019 in the so-called *estallido social* (social outbreak) (Ganter et al., 2022). This national rebellion against the markets in general and the water markets in particular gave life to the Constitutional process carried out between 2020 and 2022. On 7 July 2021, after 152 constituents were democratically elected, the Constitutional Convention began to deliberate, and the final text was delivered a year later, on 4 July 2022 (Torres and Álvez, 2023).

In that text, the counter-hegemonic category of 'natural common goods' was proposed. They were defined as "elements or components of nature over which the State has a special duty of custody in order to ensure the rights of nature and the interest of present and future generations" (Convención Constituyente, 2022: 46). In particular, the text established that

> the territorial sea and its seabed are natural common goods; beaches; the waters, glaciers, and wetlands; geothermal fields; air and atmosphere; the high mountains, protected areas and native forests; the subsoil, and the others that the Constitution and the law declare (...) Among these assets, *water in all its states, air, territorial sea and beaches, natural commons recognised by international law, and those declared as such by the Constitution or the law may not be appropriated* (...) In the case of natural common goods that may not be appropriated, the State must preserve, conserve and, where appropriate, restore them. It must also manage them in a democratic, supportive, participatory, and equitable manner (Convención Constituyente, 2022: 46, *italics are ours*; Torres and Álvez, 2023).

In the case of drinking water produced by community desalination plants, introducing the 'natural commons' in the proposed Constitution would have ensured its community ownership and management because it included both continental water and the sea as a common good. In addition, it would have been supported by the state in a participatory way, remaining outside the water market, as sought by the communities of Chome, Rumena, and Cheniao, according to our survey results. However, the proposed Constitution was rejected in September 2022, and now there is an uncertain future for water in general and drinking water produced by community desalination plants in particular. Nonetheless, the debate continues in a new Constitutional process to be developed during 2023, in which the water commons agenda, mobilised by broad social groups, is more alive than ever (Torres and Álvez, 2023). Rescaling Chilean hydro-governance from the markets to the commons is still a work in progress, so the role of community desalination plants, as a legitimised way to satisfy the human right to water in Chile, remains highly important. At least in our three case studies, communities believe that their human right to water can be satisfied, in a complementary way, by the drinking water produced by small desalination plants (Table 5, item 5). But who owns the property or the means of production, water infrastructures and management to provide this right: a hybrid public-community desalination system? Or will they be subsumed under open markets and extractivist desalination? This remains both an open research question and a practical political struggle. The counter-hegemonic agenda of water commons versus the hegemonic water markets frames the ongoing scalar politics of water governance in Chile.

CONCLUSION

Our evidence, obtained by installing community desalination plants in three rural-coastal communities in Chile, points to the creation of a new configuration of hybrid hydrosocial assemblages that complement traditional (continental) drinking water supplies like APR and artisanal systems with new technology. In this respect, this unconventional, new source of drinking water is not an absolute replacement for the traditional sources but a complementary system that can help rural-coastal communities to cope with their lack of water, save large amounts of public money that are being spent on private water trucks, and ultimately enforce their human right to water.

The new hydrosocial assemblages represented by community desalination have their pros and cons. On the positive side, desalination offers a new source of quality drinking water to satisfy the needs of coastal and rural communities that have been dispossessed from their continental sources. Also, after

realising the quality of the water produced, the communities' perception of the technology changed from negative to positive, facilitated by participatory processes. Both institutional and community participation are highly relevant to the successful implementation of community desalination plants. On the negative side is that like extractivist desalination but on a smaller scale, the socio-environmental impacts brought by community desalination plants should be considered. Also, this new drinking water source must enter the hydrosocial scene under precarious socioenvironmental and economic conditions, making its sustainability uncertain. However, rescaling hydro-governance through institutional reforms could create programmes and public support at a regional and municipal scale that will help to fill these gaps and improve the processes of installing the hybrid assemblages of community desalination plants sustainably. Unlike extractivist desalination, community desalination is state- and community-led.

Past and ongoing reforms to different legal bodies (the Water Code, SSR Services, the Constitutional process) maintain and reinforce the extractivist and market-oriented hegemonic structures that govern water resources in Chile. However, Chilean society and water movements, mobilising the water commons programmes, are disputing this hegemonic agenda. The future of the property and management of community desalination plants hangs between the water commons agenda and the extractivist water markets. Our empirical research demonstrates that communities want the new hydrosocial assemblages represented by small desalination plants to be a common good because these new assemblages can satisfy their human right to water – but so can the market, via private water corporations. Therefore, reassembling them using a community (anti-neoliberal) approach remains an open research question and a key political affair for Chilean society. On the matter of neoliberal water governance, Chile remains a significant case study that is in the process of reframing water from a commodity to a common good, in which the new assemblages represented by community desalination can serve as an illustrative example of broader water struggles.

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