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Exploring the challenges to sustainable rural drinking water services in Chile

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Abstract

Many countries around the world now face the dual challenges of closing the remaining gaps in access to drinking water in rural areas while further addressing the issues of equity, quality, and sustainability outlined in the new Sustainable Development Goals (SDGs). Our research explores the key factors for sustainability in rural drinking water services in Chile, an important example not only due to its success in rural water access but also because of the new directions the country is taking to achieve the SDGs. Drawing on results from a Delphi study of Chilean rural water experts, we discuss the most important issues identified, including water availability and investment in community water organizations, as well as disagreement among experts, particularly around roles of private service providers and the national government. We leverage these results to assess Law No. 20.998 passed in 2017, which aims to address problematic variation in rural water services by introducing a stronger role for central government and conferring more responsibility on rural water organizations. The work presents insights for challenges countries closer to universal coverage will face as they work towards the SDGs and provides an analysis of the new rural drinking water governance landscape in Chile.

Keywords: Chile; Delphi Method; Latin America; Sustainable rural water services; Water governance

1. Introduction

Research on functionality and sustainability of rural water systems often focuses on countries with lower rates of coverage. Yet, countries with nearly universal access in rural areas still face issues with intermittent services, adequate tariff collection, equity, and sustainable practices to maintain the water supply. Chile is one such case that is further on the continuum of service provision. The case merits attention given the country's salient debate on the role of state and private actors in drinking water services as well as the passage of a sweeping policy change around rural water governance passed in 2017. The impetus for the new law is to address the lingering variability in the quality of

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rural water service. These changes in the governance landscape in Chile have direct implications for improving equity, quality, and sustainable infrastructure, with indirect implications for addressing the sustainability of water resources in the future.

The new law in Chile stands in contrast to many other Latin American countries that have moved toward decentralization by elevating the role of local government. Instead, Chile's law weakens the role of private actors and builds the responsibilities and regulatory capacity of the central government. With a 3-year window to implement the law, there is pressure on the government to transition the landscape of rural water services to defend the viability of the law's approach, especially given the contention among some that the best approach would be to further rely on private stakeholders in rural areas to shore up and support community-managed systems. This article shines a light on the changes in progress during this tenuous window in Chile, comparing opinions of water sector experts with the directions of the new law.

We draw our insights from a Delphi analysis conducted in 2016, prior to the passage of the new law asking Chilean rural water sector experts to identify factors that influence the sustainability of rural water service delivery in Chile. The study allows us to uncover areas of consensus and areas of division and debate. We use the analysis of the results to discuss the implications and challenges of the new law as implementers strive to reform the governance structure of rural water services in Chile. Our findings suggest disparate ideas about the role of water availability and climate change and the direction the country should pursue in terms of which actors should take lead roles in addressing deficiencies of rural water systems. It also draws attention to the challenges of policy implementation associated with rolling out a sweeping policy change to address problems in rural water systems.

2. Progress and challenges ahead in rural water services

The Millennium Development Goals (MDGs) helped to coordinate actors across the world to reduce by half, between 1990 and 2015, the proportion of the population without access to safe drinking water. Specifically, in rural areas, the proportion of the population with access to improved drinking water sources climbed from 62% to 84% (WHO & UNICEF, 2015). Despite the inclusion of the words 'sustainable' and 'safe' in the MDG water target, actors focused primarily on access, leading many efforts to be principally focused on the construction of new infrastructure. Meanwhile, scholars and practitioners continued to draw attention to the issues of equity, water quality, sustainability, and functionality – issues that plagued rural water systems well before the articulation of the MDGs (Herrera, 2019).

The 2015–2030 UN Sustainable Development Goals (SDGs) expand the charge for governments to not only reach unserved populations but also improve service levels and sustain existing infrastructure. This emphasis on service continuity and quality is justified by the experience in rural Latin America where, by 2015, 84% of people living in rural areas had access to improved drinking water but experienced irregular supply, breakdown, and variable water quality (WHO & UNICEF, 2015). Triana Soto (2013) estimates that 60% of rural populations in Latin America receive an irregular supply of water, which reaches 95% in some countries. Indeed, during the MDG era, evidence shows a marked regression in service functionality and reliability of existing infrastructure due to a multitude of complex environmental, institutional, economic, technical, and political externalities (Walters & Javernick-Will, 2015; Walters *et al.*, 2017).

The focus on sustainability and quality places the communities who rely upon and manage rural water systems at the heart of the discussion. Reforms, implemented in many countries throughout the 1990s, shifted governance approaches away from a state-led centralized service structure to place communities in charge, making local ownership and responsibility the most prevalent management approach across the world (Chowns, 2015; Hutchings *et al.*, 2015). The underlying tenet of this management strategy, known in the international water sector as community-based management (CBM), operates under the assumption that communities have the capacity to organize and carry out the operation, administration, and maintenance of water systems once they are built. Yet, the delegation of primary responsibility to local communities with limited human and financial resources to adequately maintain water systems has led to failure, and a call to expand the analysis of how to achieve sustainable rural water systems to a wider governance structure that includes the entities and structures which support communities (Vásquez, 2013; Nelson-Nuñez & Pizzi, 2018), particularly with respect to post-construction support (Whittington *et al.*, 2009).

There are various angles through which scholars categorize and assess the wider governance structures supporting water systems. Some debates focus on private versus public management (Bakker, 2010) and others on the benefits of decentralized governance (Wilder & Romero Lankao, 2006; Herrera & Post, 2014), or the fragmentation of water governance across ministries and government levels (Akhmouch, 2012). Meinzen-Dick (2007) argues that there are no panaceas in water institutions and critics of the search for optimal institutional arrangements point out that the iteration of policies is more likely to improve outcomes than whole-sale renovation or adoption of new institutional structures (Pritchett & Woolcock, 2004). Yet, few have followed such iterative policy change to assess the degree to which shifting institutional structures address the existing weaknesses of CBM. Moreover, contexts of poor coverage of rural water services have garnered more attention among scholars than those further along in the continuum of service provision with high coverage and relatively robust or functional governance structures but still challenged in achieving sustainability and quality for rural water services.

2.1. Case of Chile

Chile is further in the continuum of service provision than most Latin American countries. In 1964, only an estimated 6% of Chilean rural inhabitants had drinking water access (Donoso, 2018). At present, 53% of the rural population has access to rural water systems, totalling over 1,900,000 beneficiaries, 88% of which are located in concentrated or semi-concentrated rural towns (Donoso *et al.*, 2015; Fuster *et al.*, 2016; Donoso, 2018). Like many countries, Chile struggles with access among dispersed rural populations, but the Joint Monitoring Programme reports that Chile has reached 100% coverage of basic drinking water services for communities with more than 15 houses per linear kilometre of distribution line, compared to 85% across Latin America (WHO & UNICEF, 2015). More localized Chilean sources, however, show that these figures decrease to between 50% and 70% coverage when considering more dispersed rural communities (Hearnea & Donoso, 2005; Donoso, 2018).

The foundation of this success was laid in 1964 when Chile implemented the Rural Potable Water programme (APR) with help from the Inter-American Development Bank. To date, 1,736 APR systems exist throughout the country, each with the mandate of providing drinking water to rural communities that meets standards for quality, quantity, and continuity in accordance with the Chilean Drinking Water Standard No. 409 (SISS, 2006). Another 234 APR facility are to be installed in semi-concentrated locations in the coming year. As more water systems are installed, the institutional burden of maintenance increases, presenting challenges for resource allocation and strategies for management (Donoso, 2018).

Chile is known as a paradigmatic case of privatized approaches to drinking water and water resource management (Bauer, 1997; Baer, 2014). The primary water code was established in 1981 under the Pinochet dictatorship. It implemented private water rights that can be traded with minimal restrictions and limited state regulation. Most research on Chile's water challenges and successes is focused on the effect of water rights on agricultural actors and the privatized urban utilities (Bauer, 1997; Hearnea & Donoso, 2005). While many scholars have documented issues in rural drinking water around water rights, the challenges of the functionality and sustainability of rural water systems have garnered less attention.

Chile relies heavily on the CBM approach with support from the central government and local private actors. Community water organizations (CWOs) – comprised of water committees and water cooperatives – have responsibility for water system operation and maintenance. The Department of Water Works (DOH) and the Ministry of Public Works (MOP) supervise the operation and management and water quality assessment by CWOs through the use of regional water supply operators called 'technical units', with visits from these specialists every 6 months (Donoso, 2018). Initial capacity building efforts for new CWOs are provided by the Sub-Directorate for Rural Potable Water (SAPR), focusing on helping communities propose new projects, budget existing ones, and monitor and evaluate their services. Follow-up involvement from SAPR exists to support minimal water quality standards.

There is variation in the level of service and functionality of APRs. Most rural water systems 'reported at least one unscheduled water outage in the past 6 months' (Fuster *et al*., 2016). The monitoring of drinking water quality also varies with 1 in 10 failing to conduct bacteriological tests over a 5-year period (Donoso *et al*., 2015). While larger water systems are more likely to collect tariffs large enough to maintain operations, smaller systems struggle to afford maintenance and upgrades. Moreover, water supply is increasingly a concern. In 2015, 6% of rural water systems were supplied by water trucks (Donoso, 2018). Overall, an estimated 200,000 people living in rural areas likely receive an insufficient amount of water as per OMS standards (Donoso, 2018).

To address these challenges, the government passed the most sweeping changes to rural drinking water governance since the 1981 Water Code. The Regulation of Rural Water and Sanitation Services Law No. 20.998 was passed in 2017. The new law was collaboratively developed by the MOP through the DOH with the collaboration of other ministries and leaders of APRs. It is intended to help committees and cooperatives regulate programmatic aspects related to APR service implementation, technical support, regulation and norms, tariff collection, and maintenance, both for drinking water and for the collection and treatment of wastewater. The new regulation aims to strengthen the management capacity of community organizations, address deficits in tariffs through implementing a tariff structure covering service operation, establish stronger rights and obligations for CWOs and operators, and strengthen the ability of the central government to enforce norms. Figure 1 depicts the governance structure before and after the new law.

The implementation of a new water governance structure presents many challenges. With the new law, DOH and SAPR are faced with the task of developing guidelines for the selection, financing, and implementation of new projects, and for the management of existing services for drinking water supply systems in rural Chile. As our discussion below explores, the increasing responsibility of CWOs to comply with new standards as overseen by the SAPR will require significant training and coordination. Given many voices would prefer a policy that reduces government regulation and increases the role of private stakeholders, the window of implementation is a critical juncture. Among the most pressing challenges are endemic externalities that may confound the success of the

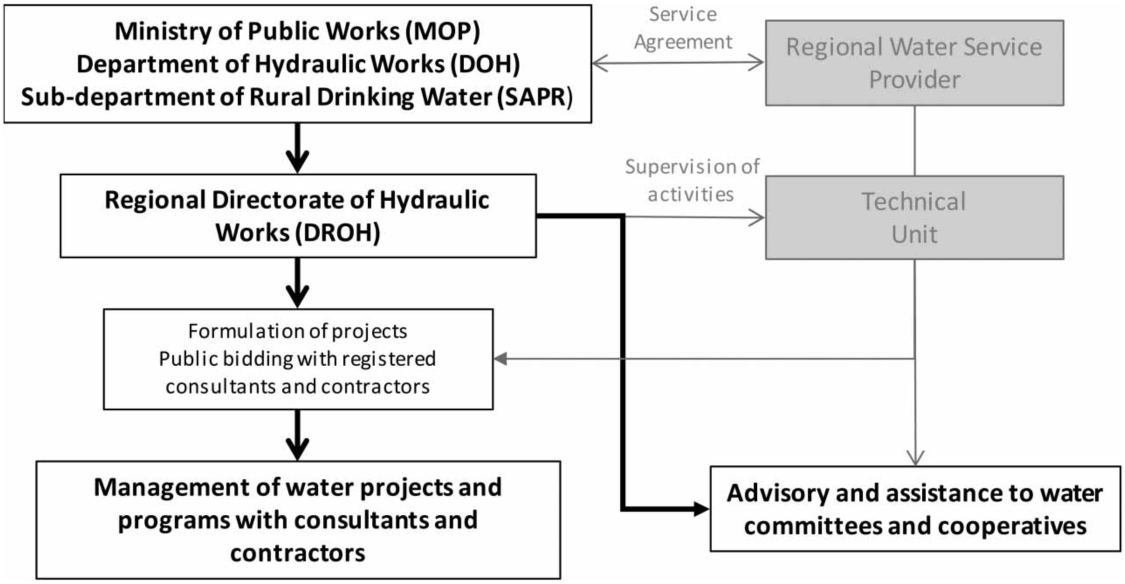

Fig. 1. Law No. 20.998 organizational APR restructuring. The previous privatized structure slated for removal is shown in grey.

new APR regulation framework, including (1) an aging APR system infrastructure, where the average system age is 23 years old (Donoso *et al*., 2015); (2) water committees or cooperatives lack the skills to operate and maintain their system; (3) the potential for cultural opposition to increased water user fees; (4) administrative challenges with shifting from water service provision to full 'in-house' provision of training and technical services to water committees by the MOP, and (5) policy resistance from opposing stakeholders. Given these issues that can influence APR programme success in the future, our study presents a timely analysis of the governance challenges and conflicts at hand.

3. Method

We employ a Delphi approach with a panel of Chilean rural water sector experts to identify consensus on the importance of drivers that influence rural water service delivery in Chile. The Delphi Method is a research technique used to facilitate consensus within an expert group regarding underlying relationships among causal drivers (Linstone & Turoff, 1975). It has been used as a policy sector analysis approach for a wide array of sectors including water (Mayor *et al*., 2016; de Carvalho *et al*., 2017). The consensus is pursued through a multi-round survey whereby, in each subsequent round, panelists are presented with the aggregate group responses from the previous round to allow reconsideration of choices in light of the other participant responses and provide opportunities for experts to clarify their reasoning for either staying with or changing their response. The approach follows an iterative process: (1) the identification and selection of experts; (2) the design of remote questionnaire; (3) the participation of experts within survey rounds; (4) the evaluation of consensus for each ground; (5) the communication of results back to experts; and (6) the generation of consensus or non-consensus results (Hallowell & Gambatese, 2010). The process offers a structured and systematic means to arrive at a consensus on a complex topic.

We base consensus on a set of non-parametric measures, absolute deviation, range, and interquartile range (IQR) to improve the granularity of results. Here, the consensus of a factor was met if it had an absolute deviation of less than 0.5, an IQR of less than 1.0, and a range less than 3. Drivers that did not meet these criteria became non-consensus factors. Next, factors are prioritized by summing the factor score across experts.

3.1. Expert panel selection

As per the suggestion of Hallowell & Gambatese (2010), we used set criteria to minimize bias on expert characteristics. We required three points for inclusion based on the following criteria:

- Author of scholarly articles on rural water service in Chile (one point per article, maximum 3), or sustainable rural water service planning, implementation, and management (one point per article, maximum 2)
- Author of non-scholarly articles on rural water service in Chile (one point per article, maximum 2) or sustainable rural water service planning, implementation, and management (one point)
- Member or chair of a nationally recognized committee focused on rural water service planning, implementation, and management in Chile (one point)
- Five years of professional experience with rural water service in Chile (three points)
- Graduate degree in engineering, sociology, and/or economics (two points)
- Conference presentation on rural water service in Chile (one point)

Using these criteria, we identified 23 experts, 14 of whom agreed to participate in the study. The participants included four academics, one lawyer in rural water rights, two water consultants in private water service, one water committee member, and five government officials working on rural water service development and regional planning.

3.2. Delphi process

We elicited expert opinion on drivers and their importance in four survey rounds. Round 1 required expert to list and define the drivers that influence the sustainability of rural water services in Chile. To ensure experts also considered the common drivers from the literature, we included a generalized list of eight common drivers identified by Walters & Javernick-Will (2015): Management, Finances, Government, External Support, Technology, Construction & Materials, Environment & Energy, and Water System Functionality. Round 2 required experts to rate factor importance on a Likert scale of 1 (not important) to 5 (very important). We then generated a rating score per item and presented all consensus and non-consensus factors along with median scores to experts for Round 3, asking them to reconsider their responses given the group's ranking results in an attempt to reach consensus. After repeating the process for Round 4, we deemed drivers that did not reach consensus as non-consensus drivers and summed and ranked consensus drivers for each expert.

4. Results

Round 1 yielded 34 unique drivers identified by the experts, including the eight common drivers we included. Table 1 presents the ranking for each factor based on the sum number of points each issue

Table 1. Drivers that influence sustainability of rural water systems.

Rank	Factor	Sum	Med.	Abs.	IQR	Δ	Consensus round
1	Availability of water resources	67	5	0.214	0	1	2
2	CWO: management	65	5	0.357	1	2	2
3	Water service providers	64	5	0.429	1	1	2
4	Capacity of operators	63	5	0.357	1	1	4
5	CWO: finances	63	5	0.5	1	2	2
6	CWO: education	61	4.5	0.5	1	1	3
7	Support network	60	5	0.357	1	1	4
8	Adequate tariffs	60	4	0.286	1	1	2
9	Adequate maintenance	60	4	0.429	1	2	2
10	Regulatory/legal framework	59	5	0.429	1	1	4
11	Future water demand	59	5	0.5	1	2	4
12	Water system functionality	59	4	0.357	1	2	4
13	Source management and water rights	59	4	0.5	1	2	2
14	Studies of source	58	4	0.5	1	2	4
15	Quality of construction practices	58	4	0.286	0	2	3
16	Financial audits	57	4	0.357	0	2	2
17	Availability of materials	57	4	0.5	1	2	2
18	Source contamination	57	4	0.357	0	2	3
19	National government support	56	4	0.214	0	2	4
20	Community participation	56	4	0.286	0	2	3
21	Appropriate technology	55	4	0.357	1	1	4
22	Number of household connections	55	4	0.429	0	2	4
23	Continuity of CWO leaders	55	4	0.5	0	2	3
24	Users: training and education	55	4	0.357	0	2	3
25	Electrical infrastructure	51	4	0.5	1	2	4
26	Climate change	51	4	0.5	1	2	3
27	Behaviour of users	48	3	0.429	1	2	3
28	NGO support	47	4	0.5	1	2	4
29	Capacity of the municipal government	46	3	0.429	1	2	2
30	CWO: training	46	3	0.429	1	2	3
31	Agricultural water use	40	3	0.214	0	2	4

received by all participants. We report three measures of consensus, including the absolute deviation measure capturing how much responses deviate between experts, the IQR evaluating the range of dispersion between ratings, and the delta, which is the maximum score difference between participants. The latter measure is the most difficult test of consensus, and we find only three issues scored above the threshold of two to indicate a lack of consensus. The final column of Consensus Round indicates the first round when the consensus of all participants using the same score of importance for a measure was reached.

5. Discussion

In this section, we highlight factors with the most importance, factors without consensus, and themes that emerge. We also relate our results to the new law that will reshape many aspects of rural water governance.

5.1. Water resources

We bundle a few of the factors identified by experts together relating to water resources: water availability (ranked 1), future water demand (ranked 11), source management and water rights (ranked 13), studies on water sources (14), source contamination (18), climate change (26), and agricultural water use (31 – last). The fact that one aspect scores the highest, one the lowest, and the others spread throughout points to the multidimensionality of water resource issues in Chile and perhaps to the disagreement around their gravity and how best to address them.

The availability of water resources ranked first in our findings, reaching consensus in the second round. The availability and allocation of water resources in Chile are regulated by the Water Code from 1981, with a modification in 2005 that added new regulation and restrictions but limited these to apply only to new water rights, which constituted a small minority of water rights (Bauer, 2015). Under Article 73 Letter N of the new law, the SAPR can buy water rights to ensure water supply to communities. Yet, whether to legally prioritize human consumption in water rights is an area of fierce debate and has been a political football across presidential administrations. The first Bachelet administration proposed constitutional reform of water rights, which was withdrawn at the start of the more fiscally conservative Piñera administration in 2010. In 2016, the second Bachelet government sought to address this issue introducing Bulletin 7543-12 to amplify the right of human consumption and limit perpetual private water rights. The change has been contested this year, however, when the returning Piñera administration introduced a revision guaranteeing perpetual rights.

Future water demand, ranked 11, is related to this concern but is also related to issues communities face with the timely expansion of connections to reach new households in growing communities. The expansion issue is partially addressed through the new law, which requires CWOs to include expansion plans in their planning and financial reporting. The new law also helps alleviate problems CWOs faced in the past by accessing money for expansion by giving more power to cooperatives to access subsidies for projects of expansion.

Interestingly, climate change was ranked low by our study participants. This discrepancy in our results about the importance of the possible impact of climate change versus the importance of water availability is intriguing and consistent with other studies such as that by Connolly *et al.* (2018) which finds that water experts in Africa ranked concerns over climate change lower than increasing demand for limited supplies. Part of the perceived distinction among our experts may be related to information. To this point, studies of source, specifically 'the need to invest resources in hydraulic and hydrogeological studies to identify sources of supply that give sustainability to projects, including considering drought scenarios and predictions', ranked at 14. On the one hand, there is attention to this issue, as every year, each region has invested in initiatives to identify *new* sources. For example, in 2018, $1,235,611 million pesos were invested in such studies, and another $1,744,469 million pesos have been committed for 2019. On the other, water users in Chile operate in a context lacking meaningful monitoring of groundwater supply or adequate supervision and data collection of ground water withdrawal (Bauer, 2015), which is a prerequisite for the sustainable management of aquifers. This information gap could, at least partially, explain why the relevance of climate change to water availability is not equally pressing in the minds of our experts.

Another possibility is that experts' views are shaped by the context in which they have worked. Drought and climate change have impacted some regions more intensely than others. For example, Coquimbo, Valparaiso, El Maule, and Metropolitan Regions total 86% declarations of water shortage from 2011 to 2014 (Bustos *et al*., 2015). Yet, in these areas, extensive scholarship establishes that the gravity of crises is not simply a function of the drought but also the ability of institutions to adapt and respond to crises (Clarvis & Allan, 2014). Indeed, one expert explained, 'climate change is not yet a determining factor, but rather how water is used in the basin', implying that the issue is not a lack of water, rather how it is used. Another argued 'the concept of "climate change" has been known for a long time, so it is the duty of the users to be able to efficiently manage the resource'.

Agricultural water use ranked last, despite high-profile conflicts such as in the region of Petorca where accusations that avocado plantations have dried up sources for drinking water systems made international news.[1] One expert in our study pointed out that 'conflicts of the APR with the organizations of irrigators are frequent and relevant', while another defended the low importance. The expert argued that the problem is not 'the over exploitation of water in agriculture, which I do not observe'. Again, the discrepancy between the high ranking of water availability and the lowest ranking of agricultural water use could lie in the lack of adequate data around agricultural water withdrawals and the health of aquifers.

5.2. The roles of community water organizations

The second highest factor in our results is CWO management, specifically the strength and capacity of the CWOs to manage the operation and maintenance of water systems. The sustainability of rural water systems, both in Chile and in most developing countries, as discussed above in relation to CBM, rests most heavily on the shoulders of the CWOs. Yet, there is disagreement in our results about the roles of CWOs. On the one hand, CWO management and the education levels of the members of CWOs (ranked 6) place in the top 10 factors, indicating a consensus around the critical importance of CWOs to have the capacity to carry out administrative and management roles. On the other hand, training of the CWOs, which is ranked low at 30, and the technical capacity of CWOs, which does not even reach consensus, indicate mixed opinions on how to fortify the rural water system sustainability and what roles CWOs ought to play. This debate surfacing in our results is now more salient in Chile given the new law, which elevates the importance and responsibility of CWOs, rather than lessening their burden through prioritizing local government or private actors, such as the technical units.

Some scholars point to the weaknesses of CWOs as evidence their responsibilities should be limited and instead delegated to outside entities, such as private contractors. These weaknesses are more likely for CWOs that serve a smaller number of households or connections. Systems with fewer household connections have smaller economies of scale, translating to a higher cost per connection. Fuster *et al*. (2016) found that the biggest hurdles in complying with the new law will be faced by committees managing smaller water systems, but that the law presents compliance challenges even for the larger water cooperatives. One expert who rated the technical capacity of the CWO low in importance argued that the actual technical capacity of many CWOs had been limited for years as most committees do not even have professional knowledge about sanitation nor access to studies. That expert attributes the successes in services to other factors, suggesting that it is more important to invest in operators and private technical units.

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[1] See, for example: 'Chilean Villagers Claim British Appetite for Avocado is Draining Region Dry' in *The Guardian*, May 17, 2018. https://www.theguardian.com/environment/2018/may/17/chilean-villagers-claim-british-appetite-for-avocados-is-draining-region-dry.

Instead, the new law expands the responsibilities of CWOs and enhances the central government's ability to strengthen and regulate CWOs to ensure compliance and address variation in performance. The new law will require CWOs to obtain licences valid for 5 years. In order to acquire a licence, CWOs must demonstrate the possession of water rights, sufficient service quality, the availability of reserve funds, the existence of an investment plan, pricing schedules, and financial statements, which must be approved by the SAPR (Donoso, 2018). The new law also increases the accountability of CWO operators, now giving the government the ability to ensure operators take the necessary steps to conduct proper maintenance and maintain quality. Thus, both CWOs and operators have greater liability now, implying a critical need for training and a limited window during the 3-year implementation for the government to carry out the training.

5.3. Finances

Finances are of critical importance in rural water systems. Two finance-related factors placed in the top 10 factors: adequate tariffs (ranked 8th) and CWO finances, specifically the management and administration of resources to finance the operation and the maintenance and eventual replacement of water systems (ranked 5th). In rural water systems, adequate tariffs to cover the costs of management and repairs are rare in most developing contexts (Harvey, 2007). In Chile, Fuster *et al*. (2016) found that only 29% of APRs stated they were able to cover administration, equipment replacement, and system expansion. This issue is pronounced for water systems with fewer connections, serving smaller populations. For example, Navarro *et al*. (2007) find, in 2007, 63% of APRs that served under 250 connections had limited ability to generate even sufficient revenue to recover ongoing costs pertaining to operating systems.

Rate increases present political dilemmas for whatever organization is running the system. For community water committees, increasing tariffs within the community implies pressing friends and neighbours for higher contributions (Fuster *et al*., 2016). Regarding this pressure, one expert commented, 'In the rural sector of Chile, there is great distrust among neighbors … In that sense the state is fundamental'. Yet, when decision-making authority to set or increase tariffs includes elected leaders or political figures, such mayors or public service employees, tariffs are still likely to be set 'below a financially sustainable level' out of political pressure to avoid alienating supporters (Krause, 2009). In some Chilean cases, municipal governments manage rural water systems. In these instances, tariffs can represent fungible accounts for political actors. Given the poor political visibility of investing in the maintenance of rural water systems, political actors have incentives to repurpose tariff-based income to public goods with more politically visible outcomes that can aid in elections (Mani & Mukand, 2007). However, the new law has intervened and now only allows municipal management as an exception and further requires that municipalities create formal cooperatives, creating barriers for mayors to access funds from water tariffs.

The new law will partially address inadequate tariffs, but some argue that is does not go far enough. The law creates a pathway for the increase of tariffs to address those that are below the costs of operation. This increase is scheduled to occur gradually, mediating the impact on users yet helping to achieve more sustainable systems in the long run and removing the burden of initiating rate increases from CWOs. Yet, some argue that the increase to merely address sufficient recuperation of operation costs is still too low to address needs for replacement (Donoso, 2018). Others argue that relying on tariffs to create long-term sustainability is misguided. As one expert in our study phrased it, 'waiting for the community members to replace or pay back for the system installation is unrealistic'. While the increase through tariffs may be insufficient, the law does, at least, create a mandate for the federal government to maintain ongoing financial investments in rural water systems.

Our experts further identified financial audits as an important factor for rural water sustainability. While audits ranked only 16 in our results, having timely accounting audits to correct financial errors provides financial accountability for CWOs. Fuster *et al*. (2016) found that while most CWOs were providing balance sheets and financial information to their assemblies, many presented outdated information and 56.7% of CWOs relied on technical units to conduct audits. The new law creates more regulation and requirements for financial reporting and accounting, upping the standards for CWOs of all sizes. For example, CWOs will be obliged to submit a financial plan, including detailed information about tariff income and costs as well as plans to address future needs in the system. The law further aims to create more uniformity in billing and oversight by the SAPR. Under Article 40 Letter F, CWOs must issue bills and invoices and keep accounts in accordance with Chilean tax regulations, and large and medium operators must prepare balances annually and share them with the SAPR.

5.4. Governance structure

The governance structure is also a theme in our results. For example, support networks and the regulatory framework received high ratings. This aligns with the water sector literature that emphasizes the importance of formal and informally structured post-construction support systems that includes a robust and consistent network of highly skilled operators and personnel to help committees keep their water systems running (Whittington *et al*., 2009). As one expert indicated, 'A good support network can help the self-sustainability of services', where another expanded upon this logic, stating:

> *'The establishment of work networks between organizations of APR and other organisms, both public and private, fills technical gaps and gaps of formal support. Most committee members have been in their position long enough to know how it all works but considering their educational level … external support is necessary to improve efficiency, quality of service, and other aspects of management such as the effective use of technology.'*

The entities involved in the support network and the authority to enforce the regulatory framework, however, garner lower scores and represent areas of disagreement in Chile. National government support only scores a 4, ranking 19. Municipal government ranks strikingly low at 29, which contrasts to many other contexts with responsibility decentralized to local government levels. Article 1 of the new law establishes that local governments only have a role in exceptional cases. They can operate water systems only with authorization for extraordinary situations, such as localities, where dispersed populations and rugged geographies make it impossible to establish a water committee. In these cases, the municipality must comply with all the requirements of the law and operate under a framework of its own regulation, beyond the interest of the political authority in office.

The support from NGOs also received a low ranking. Many experts commented on their importance, arguing that they can 'supply support to [offset] the shortcomings of the state', 'provide more impetus to [rural] systems', and 'supplement the limited capacity of the state'. Yet, some of these same experts acknowledge that it is difficult to ensure the continuity of NGO support, limiting their efficacy as important actors. One expert commented, 'an NGO will not be more relevant than the government entities that take charge of the APR issue. There is legislation, and an NGO will not work better than the DGA or municipality because there are deadlines and stages that must be passed when an APR system is built, maintained or extended'.

Other critical actors in the governance of rural water systems generally are the community members and users themselves. These, too, rank low in our results. Community participation, specifically in 'community-wide meetings, CWO member elections, or any other type of communal activity influencing water service management', ranked 20. The training and education of users ranked at 27. Contradictorily, user participation has been elevated to an SDG target, encouraging countries to 'support and strengthen the participation of local communities in improving water and sanitation management'.

Overall, the actors ranked the highest in governance issues are the CWOs, discussed above, whose role is augmented by the new law, as well as the private service providers, an area of debate in Chile with the changes in the new law. Although water service providers, as in the formal technical engineering consultancies that help CWOs operate and maintain water systems, ranked third in our results, their relevance has been substantially changed with the new law, representing an area of contention. Before the new law, water service providers had a more pivotal role in the administration of water systems, in training of the CWOs and in providing technical support. In the new law under Article 73 Letter F, private consulting companies can be contracted to conduct studies, provide designs, and carry out infrastructure projects, but they must be registered through the MOP and hired through a public bidding process. Thus, these actors are not disappearing, but their roles are shifting considerably. Some disagree with this change, arguing that CWOs rely on these secondary entities and have been largely satisfied with their services (Fuster *et al.*, 2016; Donoso, 2018). Yet, many smaller CWOs have limited capacity to pay for the support of these water service providers. This ties into the debate about how capable CWOs will be in assuming more complex roles in the provision of both water and sanitation services and also represents a step away from relying on private actors in rural systems, a significant departure for a country known as the textbook case of privatized water institutions. This disagreement, along with the new presidency in Chile that is more supportive of private approaches to service provision, creates a significant amount of pressure for the DOH and SAPR to successfully implement the law in the brief 3-year window slated for the transition.

5.5. Non-consensus issues

In our study, three items failed to achieve consensus, meaning that experts could not come to an agreement about how important each of these factors is for sustainable water systems: water quality, a service functionality database, and the technical capacity of CWOs. The database factor received widely differing opinion due to the administrative demand it would impart. One expert indicated that 'information is key to making good decisions', while another mentioned that 'today there are greater urgencies'. Another expert failed to see the value of a database, commenting 'I do not consider it of relevant importance that a database with easy access improves the delivery of drinking water, which is based on a system of water collection, chlorination, and distribution'. The disagreement around the importance of monitoring and evaluation is inconsistent with water sector literature that argues monitoring is critical to ensure water services are properly delivered to users. One reason for the disagreement may be rooted in the underlying opinions about who ultimately has responsibility for poor performance. For those that favour more privatized approaches with a limited role for central or local government, the collection of data seems less consequential relative to direct investment in systems. For those that see an important role for the state in ensuring citizens have access to well-managed water systems, information on functionality is instrumental in creating upward accountability mechanisms to hold operators and committees responsible.

The importance of water quality also divided our expert participants. According to one expert who ranked water quality as the most important, ‘One of the greatest deficiencies in the supply of rural drinking water is the lack of control over the quality of water supplied. The consequences for the health of the consumers remains masked especially when dealing with pollutants with chronic effects’. Another argued ‘Water quality controls are carried out with low frequency, and if they do not meet a parameter, the appropriate measures are not taken in time’. Others did not see water quality as an issue, stating that it ‘depends on the geographical area’ and ‘the quality of the water itself is not a preponderant factor that prevents water supply, in fact, water can be supplied without any regulation given that water purification systems must comply with the regulations’. Again, the lack of consensus appears to be influenced by whether one agrees that the central government must play a stronger role in the enforcement of the regulations.

Prior to the new law, the standards of water quality were established in Chilean Regulation No. 404, which articulates the obligation to: (1) measure chlorine in the network at three points every day and record results; (2) conduct at least two monthly bacteriological examinations for larger water systems; and (3) conduct tests of physical chemistry at least once a year. The Health Authority oversees auditing. These rules, however, now have more bite given the addition of Article 89 of the new law, which establishes sanctions and fines for non-compliance. The new law also stipulates that water quality samples must be sent to duly certified laboratories and that each operator must have the results available in their offices so any authority can review them.

6. Conclusion

This research presents findings of a Delphi study of rural water service experts in Chile around the drivers of sustainable water services. Our work reveals incoherent views about the roles of water scarcity, water rights, climate change, and agricultural use, such that experts are primarily concerned about water availability, but the role of climate change in shaping availability is less concerning. We also find experts placed a stronger emphasis on CWOs and private water service providers than government entities, which points to the possible resistance to the implementation of the new law that increases the role of the central government and increases the responsibility of CWOs, despite rural water experts’ beliefs that they lack the necessary technical capacity.

Our review of the Law No. 20.998 in light of these findings suggests some areas of concern in the coming years. First, despite the impetus in the law to increase tariffs and address insufficient savings, the ability to save for full infrastructure replacement is limited. More gravely, while water availability is the top concern in our study, the new law does not reshape the ability of government or community stakeholders to compel more efficient behaviour or safeguard water supply in conditions of drought. However, the law does create more information and accountability mechanisms in order to identify, track, and address problematic variation in services.

While our Delphi study presents interesting insights as to the perceptions of rural water experts in Chile, we do not interpret these findings to be representative of all water experts in Chile. Given the constrained number of observations and limitations in broader representation from all regions of the country or from a wider array of experience including more water board members, we treat our data as an opening for dialogue about the mechanisms to address the remaining gaps for Chile to achieve the SDGs in rural water services. Further research to trace the implementation of Law No. 20.998 and identify the conditions under which CWOs are more likely to be in line with the new law will help to provide insights for countries that, like Chile, want to address the inequities of quality and challenges of sustainability in rural water services.

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