



# Opportunities and limits to ecosystem services governance in developing countries and indigenous territories: The case of water supply in Southern Chile

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## ARTICLE INFO

### Keywords:

Collective action  
Political ecology  
Indigenous rights  
Indigenous knowledge systems  
Water

## ABSTRACT

Limited evidence exists on the a priori feasibility of implementing ecosystem services (ES) governance arrangements, to simultaneously ensure nature conservation, human wellbeing, and equity. Using a multiscale institutional approach, we explore rules, property rights, and stakeholders' values and the extent to which such institutions may entail or prevent governance innovations around ES. We focus on water supply and a Southern municipality of Chile as an apt illustration. Results show that the concept of ES and ES mechanisms are exempt from formal norms (e.g., national laws). The formal institutional setting is generally weak with respect to nature conservation and a fragmented view prevails, where the management of land, water, forests and protected areas is separately handled by a myriad of agencies. The presence of highly concentrated water rights may impair benefits appropriability by ES beneficiaries, as long as any potential buyer can acquire water rights. Furthermore, incompatible values regarding nature create tensions across different stakeholders, particularly between hydroelectricity companies and indigenous communities. In this scenario of multiple rationalities, moving towards ES-based environmental governance seems problematic. In light of the evidence, it is clear that the ES approach does not necessarily fit in every local reality and seems to face obstacles, such as achieving equity and justice, particularly in contexts wherein local and indigenous knowledge systems have not been adequately considered by states within their institutional arrangements.

## 1. Introduction

Environmental policies relying on intrinsic value arguments have produced unsatisfactory outcomes in terms of jointly enhancing nature conservation, human wellbeing and equity (Chaudhary et al., 2018; Primmer et al., 2015). As a result, new policies worldwide have started to encompass the concept of ecosystem or environmental services (henceforth ES), which has led to a paradigm shift in the ethical and political grounds of environmental governance, from biocentrism to an emphasis on anthropocentric values (Gejzendorffer et al., 2017; Loft et al., 2015). In this new paradigm, environmental governance involves “the set of regulatory processes, mechanisms and organizations through

which political actors influence environmental actions and outcomes” (Lemos and Agrawal, 2006: 298) ES-based governance in turn, encompasses the formal and informal rules and values that configure how natural resources are used, how problems and opportunities are solved, what social behaviors are considered acceptable regarding ES transactions, and what incentives and sanctions are implemented to affect the pattern of ES use by a range of stakeholders (Muradian and Rival, 2012). The multiplicity of actors with various underlying value systems (ideas, ideologies, attitudes, values or beliefs) and interests shape individual use preferences and decision-making over ES (Brockhaus et al., 2014).

ES governance has recognized limitations regarding institutions,

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policy mixes and property rights, balancing actors' interests and values, and designing inclusive decision making processes (Beaumont et al., 2018; Loft et al., 2015; Saarikoski et al., 2018; Schröter et al., 2014). Yet, few evidence exists –beyond ex post evaluations of payment mechanisms — on how such limitations manifest on the ground. Most studies have focused on the outcomes of particular arrangements in defined spaces (e.g., Dougill et al., 2012; Kabisch, 2015) or on normative assessments (to some ideal or external conception), such as studies on protected area governance (e.g., Palomo et al., 2014). But few have addressed the feasibility of moving towards an ES-based governance (see for example Beaumont et al., 2018; Greenhalgh and Hart, 2015; Rode et al., 2015; Saarikoski et al., 2018), particularly in regions characterized by significant cultural differences, expressed as distinct worldviews.

Ignoring the ex-ante conditions that determine feasibility in such contexts may limit the comprehension of the factors influencing ES interventions, the range of practicable governance modes, as well as their efficiency, equity, and possibilities of progress (Bachev, 2016; Paavola and Adger, 2005).

Particularly in developing countries with contrasting worldviews, achieving new modes of environmental governance that ensure equitable outcomes, requires overcoming persistent barriers such as historical injustices, social inequalities, violence, and economic inefficiencies (Chaudhary et al., 2018; De Castro et al., 2016), which can make ES-based governance unattainable.

Building on the insights of New Institutional Economics, the purpose of this study is to explore structures and institutions that may entail or prevent governance innovations around ES, focusing on water supply as an apt illustration. The ecosystem services approach (ESA) to conservation (Beaumont et al., 2018) is meant to achieve two critical goals: (1) to help solve the tension between economic development and environmental conservation; and (2) to influence the decisions made by users of a resource base, so that they align their practices with the interests of ES beneficiaries (Primmer et al., 2015). This complexity ensures that the political economy of ecosystem conservation will encompass not just efficiency and effectiveness criteria, but also equity, justice and legitimacy criteria together with other ethical concerns (Paavola, 2005; Paavola and Adger, 2005; Sikor et al., 2014).

To better integrate ES in decision making, the New Institutional Economics perspective has emphasized the role and importance of institutions (Paavola, 2007), understood as collections of rights, rules and relationships that establish what can or cannot be done, and guide social practices and interactions among those who engage in them (Schlager and Ostrom, 1992). Institutions can be hierarchical (command-and-control coordination), non-hierarchical, building on consensus mechanisms (in market situations), trust (in cooperation or networks), and/or hybrid modes (Loft et al., 2015; Muradian and Rival, 2012).

This study focuses on three institutional dimensions that may facilitate or prevent ES governance innovations from emerging: i) the extent to which the concept of ES is included and operationalized through specific agreements in formal legislation and informal rules, from national to local levels; ii) the structure of existing property rights, since human benefits generated by ES are both private and public goods, associated with (or hindered by) a variety of property rights and other institutional arrangements; and iii) the meanings and values that different stakeholders place on ES.

In this context, we question the feasibility of new ES-based governance modes in developing countries, particularly in territories facing growing indigenous claims; a subject that has been scarcely addressed empirically and represents a challenge in ES implementation (see Chaudhary et al., 2018; Jackson and Palmer, 2015; Rode et al., 2015). Therefore, our research contributes to advance knowledge on this topic in light of serious findings affecting local, traditional or indigenous groups involved in environmental management following ESA.

## 2. Study context and research methodology

### 2.1. Case study

Governance studies usually require a multi-level and multi-actor analysis (Loft et al., 2015), including national to local scale inquiries. Chile, and its Southern territory in particular, provides a relevant context for environmental governance studies for at least two reasons. In the first place, Chile was the first Latin American country to engage with neoliberalism under the dictatorship regime (1973–90), which largely left environmental governance to the free market (Budds, 2013; Holmes, 2015). Likewise, municipality of Panguipulli in Chilean Patagonia, is representative of strong socio-environmental conflicts surrounding water claims in the whole country, where indigenous communities and hydroelectricity plants are the key confronting actors (Carruthers and Rodriguez, 2009).

Panguipulli, located in the Andes Range of Los Ríos region (region XIV of 16 administrative regions; 38°30' - 40°5'S and 71°35' - 72°35'W), is the largest municipality in the region, covering an area of 3292 km<sup>2</sup>, less than 0.5% of which is classified as urban land. It comprises 20.7% of the region's total native forest area. Population reaches 32,617 inhabitants, 30% belonging to the Mapuche ethnicity (INE et al., 2005). Although the remaining 70% declare themselves as Chileans not belonging to indigenous groups (INE et al., 2005), Mapuche ethnic influence is significant in this area given their particular cosmivision of the world and nature, as is the case with many other indigenous groups worldwide (Aguilar et al., 2010).

The municipality comprises about 6000 private properties ranging from 0.02 ha to more than 30,000 ha. Circa 5% of the municipality's area is protected by the Villarrica National Park and the Mocho Choshuenco National Reserve (16,968 ha), and 14.7% is protected by privately owned conservation areas (48,938 ha; Fig. 1).

### 2.2. Research design, data collection and analysis

The study is part of a 5-year project (2013–2018) aimed at mainstreaming ES in landscape planning, applying ESA. An ESA can take various forms and include numerous methods (Beaumont et al., 2018) as in the present case, but they have some common characteristics: i) the exploration of socioecological dynamics including the governance subsystem; ii) ES measurement and mapping; iii) ES integral valuation; iv) assessment of tools and strategies to mainstream ES.

Specifically, the study at hand involved the following steps. Firstly, we conducted a thorough revision of secondary sources of information to construct the formal and informal institutional context of Chile and the municipality regarding ES. Analysis of secondary information contemplated the reading of specific legal documents and national policies, regulations and agencies profiles, searching for the formal inclusion of ES, environmental service or ecological services, and to what extent documents and agencies specified ES implementation mechanisms.

Secondly, we applied in-depth, open-ended interviews to selected stakeholders, chosen from an actor map previously constructed. The interview covered the following aspects: i) social networks, including questions regarding date of creation and perceived effects on natural resources management, trust, and power relations; ii) presence and role of NGOs in the protection of natural resources, water and social rights, and NGO relations with local communities; iii) property rights including knowledge of the water markets, access to land and water over time, conflicts, and social relations across social actors regarding natural resources; iv) visions, definitions, and values on nature and human-nature relations and threats to natural resources; and v) participation in decision making regarding natural resources.

The interviews took place in 2015 and 2016 and were conducted by three of the authors. State representatives included one interviewee from each of the following regional and municipal offices: Regional Office of the National Commission for Indigenous Development

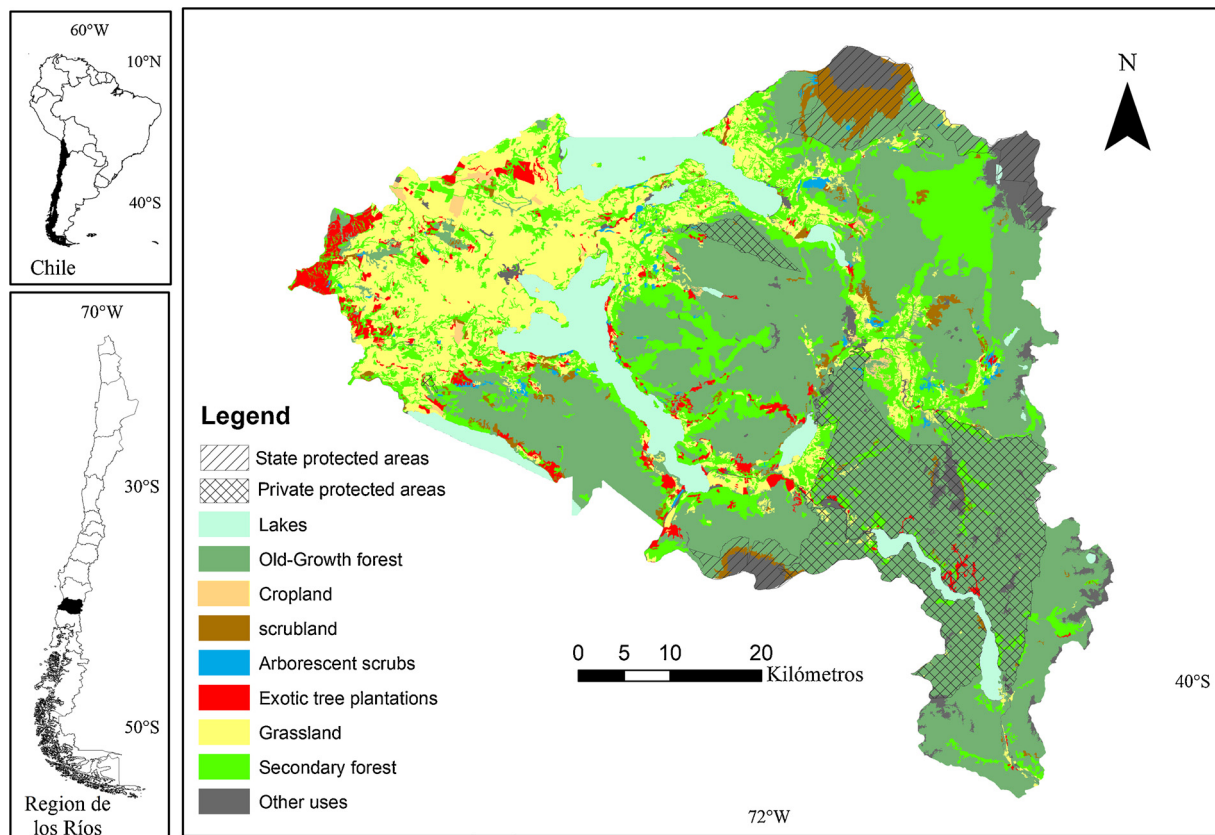


Fig. 1. Location of Panguipulli municipality in Southern Chile showing current land covers, state protected areas and private protected areas.

(CONADI); Panguipulli Office of the National Forest Commission (CONAF); Regional Office of the General Water Directorate (DGA); Rural Development Office at Panguipulli Municipality; Emergencies Office at Panguipulli Municipality; and Municipal Council at Panguipulli Municipality.

Civil society actors included representatives from several associations and communities (numbers of interviewees are indicated in parentheses): Coz Coz Mapuche Parliament (1); Liquiñe Neighborhood Association (1); Puwinkul rural tourism network (1); rural drinking water committees (5); indigenous communities (1); small farmer organizations (1); indigenous organizations (2); elder indigenous community members (2); and the Panguipulli Environmental Coalition (1). The private sector was represented by a water utilities provider (1) and a small ecotourism enterprise (1). Finally, two informants from the Panguipulli Model Forest were interviewed. Representatives from forest companies, hydroelectricity companies and private protected areas could not be engaged despite several attempts.

Although a multi-level approach to governance should include actors from different relevant territorial and political scales, at the empirical level, we chose a sample of actors with direct territorial incidence, which allowed us to understand the complex interactions that occur at that scale. The visions and perspectives of actors operating at the national level – mainly agents of the central government – were analyzed from the secondary and documentary sources in general. In this framework, a remarkable alignment of visions is observed in one and another level. For example, the vision of the National Forestry Corporation on the premises of native forest management is one on both levels, and the same is true for the General Water Directorate (See SI 1).

Finally, the study also involved participant observation in over 10 meetings of Panguipulli Model Forest and the implementation process for the watershed certification voluntary agreement.

Interviews were transcribed and their content examined using qualitative content analysis, in which data analysis commences reading all data repeatedly, to achieve immersion and obtain a sense of the whole. Then, codes are derived to organize large quantities of text into much fewer content categories (Weber, 1990). The analysis also considered the triangulation of qualitative data, to collate information from field notes, interviews and secondary sources.

### 2.3. Dimensions of analysis

Consistently with the definition of environmental governance, as stated in the introduction, adopting an institutional perspective for the analysis of ES helps understand the structures behind the complex coordination and cooperation processes within socioecological systems. Governance structures concretize in institutions that organize processes, define objectives, set standards, influence motivations, initiate or reduce conflicts, and resolve disputes between stakeholders (Eden and Hamson, 1997). Based on this, the following analysis dimensions were chosen:

## 3. Results

### 3.1. Ecosystem services and water supply in the country's institutional setting (formal and informal institutions)

Details of the agencies, organizations, and formal rules (R) and sub-rules (SR) at the state (SL), regional (RL), local (LL) and autonomous levels (AL), are provided in Table SI1 (supplementary information). Formal rules comprise laws, policies and specific regulations. A total of 25 agencies and organizations, mostly governmental and one autonomous (AL1), have competence and interest in environmental and natural resources matters, from the national to the local level. These

agencies and organizations comprise five different Ministries and six technical units (e.g., General Water Directorate; SL3.1) which separately handle the management of land, water, forests and protected areas, through diverse laws and specific regulations at the national, regional and local level. For example, whereas water affairs (mainly distribution) are administered by the Ministry of Public Works, forest management and protected areas are handled by the Ministry of Agriculture, through CONAF, and the National Biodiversity Strategy is managed by the Ministry of Environment. Agencies and organizations also comprise a water utilities provider (RL3), a research center (RL4), a customary Mapuche organization (LL5), and community organizations (LL4).

We found few specific norms and decrees from different agencies that include the concept of ES, but in an incidental manner. Among them is the Rule of Procedure of the Law N° 19,300 of the 1994 General Environmental Basis, which makes a single mention to ES stating the following: “It will be understood that a territory has environmental value when it corresponds to a territory with no, or low anthropic intervention and provides local ecosystem services relevant to the population”. In the remaining documents, the concept of ES is only used to acknowledge the importance of an ecosystem as provider of ES.

Specifically, the concept is absent from national water resource policies and spatial planning and zoning instruments such as the Regional Plan of Territorial Zoning (see Table S11, R1, R17).

In terms of the Judiciary, the concept of ES has been acknowledged in judicial decisions in Chile, as a recent study using data from Chile and Canada suggests, showing that specialized environmental courts and tribunals (AL1 in Table S11), as well as general courts, seem to include ES in judicial decision-making (Pastén et al., 2016). The indirect references include for example that “the environment or ecosystems are at the service of society” or that “a loss of ecological services” is an example of environmental damage, while other rulings refer to ES directly by stating, for example that “proof of environmental damage requires showing how ecosystem services have been damaged”, “harm to ecosystem services constitutes environmental damage”, or by discussing “the habitat services provided by the area regarding application for the reproduction of a given species” (Pastén et al., 2016). Regarding the jurisdiction governing the municipal level in Panguipulli, the Third Environment Court of Chile has acknowledged the concept of ES explicitly in more than one decision (Pastén et al., 2016)<sup>1</sup>. However, in these rulings, the use of ES is conceptual, still far from considering empirical data on ES value in terms of determining a judicial decision, although it has been considered in strengthening a decision (Table 1).

At the local level the best known initiatives involved in resource management are the Panguipulli Model Forest (LL2) in the case of forests, and the watershed certification voluntary agreements (R21), in the case of water. Yet, although both initiatives have a local expression, they are highly dependent on the central administrative level and they do not yet align their mutual efforts regarding resource conservation and planning.

The Panguipulli Model Forest focuses on environmental education regarding native forests and forest biodiversity to promote conservation. In turn, the watershed certification voluntary agreement in Panguipulli is one of six pilot cases at the national scale, oriented to engaging stakeholders in specific voluntary actions that lead to the sustainable use of water. Thus, for instance, government agencies could engage in increasing audits on water rights, whereas private stakeholders could promise to conserve a portion of their riparian forests. The agreement was signed in January of 2018.

<sup>1</sup> The decisions referring to the term ES are: Montoya Villarroel Carlos Javier c. Superintendencia del Medio Ambiente (Rol R2-2014); Jaque Blu v. Inmobiliaria Quilamapu Ltda (Rol D5-2015); Municipalidad de Río Negro c. Seimura Carrasco Valdeavellano (Rol D3-2014); and Superintendencia del Medio Ambiente con Gobernación Provincial de Magallanes (Rol S7-2015), which can be accessed on <https://3ta.cl/fallos/>.

Regarding informal organizations, the role of customary local groups has recently become a topic of widespread interest in Southern Chile, as elsewhere in the world (Virtanen, 2002). One of such organizations in Panguipulli is the Coz Coz Mapuche Parliament, which is inspired by the indigenous parliament held in the locality of Coz Coz, in Panguipulli, on January 18th of 1907, and which is undoubtedly the most important assembly that the Mapuche people have undertaken after their invasion and displacement by the State of Chile (Díaz Meza, 2006). On its 100th anniversary, indigenous communities of Panguipulli decided to revive this traditional political organization, which at present does not count with legal recognition from the Chilean State.

Customary organizations such as this define collective goals and safeguard community rights, like the rights to water, land, and self-determination, recognized by the Indigenous and Tribal Peoples Convention of 1989 at the International Labor organization (ILO) (ILO No. 169). Chile ratified the convention in 2007 and enacted it in 2009, which dictates an obligation for the Chilean State to consult with indigenous communities on legislation that would directly affect them. It establishes appropriate procedures of consultation for the interested groups, with the final goal of achieving settlements in different proposals.

Coz Coz participants are aligned with the emergent discourse of the *Buen Vivir* (Vanhulst and Beling, 2014). The novel *Buen Vivir* approach (roughly translated as ‘living well’ or ‘good living’), which has arisen in various parts of Latin America in the last decade, may offer an alternative paradigm. Despite being born in the Andean region of indigenous cultures, it has repercussions throughout Latin America from two trends: The *Buen Vivir* as recovery and the *Buen Vivir* as a proposal that is open or under construction (Villalba, 2013). As one interviewee explained: “the good living — the *Küme Mogen* for the Mapuche — is to have a good life...it is the horizon that moves us finally, which is not a great production of things, but a production on a human scale, a production that has to do with self-support, food sovereignty, with quality food, and local production” (translation by the authors from Spanish).

The fact that the State does not give legal recognition to customary organizations is a matter of concern from the interviewee’s perspective. For instance, one person said that “the State has not supported the initiatives of the organizations, provided training or articulated the debate around who will manage the water, or given any workshop on this topic...the workshops that have been organized about water rights within the municipality have been self-managed by the communities” (translation by the authors from Spanish).

The concept of ES is foreign to indigenous communities in Panguipulli and has not served to enable different stakeholders to develop a common language around conservation of forests and water and respectively integrate and derive knowledge relevant to their interests; some indigenous representatives reject the use of the term ES based on notions of commodification of nature and their concern regarding implications related to their current claims.

### 3.2. Existing property rights and water transactions

A wide amount of literature (see Bauer, 1997; Dourojeanni and Jouravlev, 1999) supports that the most relevant nationwide formal rule safeguarding the distribution and access to water is the Water Code enacted, in 1981 (R4). The legal definition for the use of water is based on water rights (SR9), which is the underlying principle of the Water Code. Water rights are divided into those referring to actual water consumption (consumptive uses, mostly irrigation and drinking uses) and those in which the user simply utilizes water to produce something else (non-consumptive uses), such as industrial and hydroelectric uses.

Incentive-based water rights acquisitions and transactions have been featured prominently in other countries as a market-oriented policy approach to enhance the supply, regulation, and sustainability of freshwater ES (Garrick et al., 2009). However, it becomes uncertain how in the case at hand existing property rights can be aligned with the

**Table 1**  
Institutional dimensions analyzed, which are asserted to influence the feasibility of ES-based governance.

Dimension	Description
a. Inclusion of the concept ES in the institutional context	ES arrangements are possible within the existing formal and informal rules. Laws and regulations are a fundamental aspect of governance at all scales, one that can also offer possibilities of local adjustments (Greenhalgh and Hart, 2015; Lebel and Daniel, 2009).
b. Structure of existing property rights regarding water transactions	Property rights as specific types of institutions are key to ES governance, regarding both ES supply and access to its benefits. Whether ES supply depends on private or public agents, will make a substantial difference in management practices (Lebel and Daniel, 2009; Schlager and Ostrom, 1992).
c. Stakeholder definitions and values	The material life of any society is permanently influenced by values and definitions, which are reflected in normative, formal and informal bodies, and vary from one social space to another (Escobar, 2008).

**Table 2**  
Meanings and values attributed to water supply by interviewed stakeholder groups reflecting the different “models of nature”.

Actor		Principal meaning	Secondary meaning
Community	Parliament of Coz Coz	Life; Consumptive right; Tourism	Right; Common benefit; Natural resource (scarce); Productive resource
	Indigenous communities		
	Rural water committees		
	Rural tourism networks		
	Liquiñe neighborhood association		
Private business	Panguipulli Environmental Coalition	Business	Energy; Drinking water / sewer
	Hydroelectric companies		
State	Water distribution and sanitization companies	Public/ private good; Natural resource; Water resource; Cultural identity	Productive resource; Conservation; Public/ private good; Protection
	Panguipulli Municipality		
	Ministry of Environment		
	Water authorities		
	National Forest Corporation		
Nonprofit sector/ organisation	National Corporation of Indigenous Development	Environmental sustainability; Human right	Social participation; Indigenous cultural heritage
	Panguipulli Model Forest		
	NGOs and other nonprofit organizations		

notion of ES governance and the ES framework, due to two related reasons. The first one is the uncoupling between land and water property rights; this is to say that in the large majority of cases farmers are owners of the land but do not possess the rights to the water (superficial or ground) in their farms. The second reason (and an implication of the former) is that potential increases in water supply resulting from appropriate land management (the principle of the Payments for Ecosystem Services, PES, schemes labeled as “conditionality”) may be appropriated by anyone capable of buying the water despite his/her condition of current beneficiary. Both situations impair appropriability of the benefits arising from improved ES supply.

As the interviews show, many rural inhabitants in the study area have been deprived from access to water (consumptive and non-consumptive) given the concentration of water rights since the enactment of the Water Code in 1981. Data from the General Water Directorate indicates that by Spring of 2017, 49% of the total non-consumptive rights (576 in total) belonged to hydroelectricity and fish farm companies and 14% of the total consumptive rights (1172 in total) belonged to water sanitization plants. Indigenous communities and local water committees held only 33 consumptive rights, which represent 2.8% of this type. These figures translate in a Gini coefficient of 0.9 for aggregated rights, 0.84 for consumptive rights, and 0.92 for non-consumptive rights, indicating very high inequalities.

Unequal access to water in Chile is one of the most frequent problems raised by the interviewees. A local spokesperson expressed the following: “We are not free to capture [water] from any tributary of Lake Panguipulli [...]. In the Upper Neltume Lake area, we depended on ENDESA [currently ENEL Generation Chile, an Italian transnational company] selling us water rights to supply rural communities in the sector” (translation by the authors from Spanish).

In addition, another local stakeholder indicated that “today we have problems asking for [water] rights, because they no longer exist. To pursue regularization, it is necessary to prove that people use that water since at least five years ago” (translation by the authors from Spanish).

These narratives suggest that rural communities and indigenous

peoples in the South of Chile are usually excluded from water management. Furthermore, the testimonies suggest that they are not well positioned to negotiate or purchase water rights: “we had no knowledge before [the 90s...], we did not know that water had to be bought. Because according to our beliefs, or specially the Mapuche people, we do not separate; water cannot be separated from the land, or from the trees, or from anything, that is, they are a whole entity. And, in that moment, we realized that the water had been separated” (translation by the authors from Spanish).

In this state of affairs, ILO 169 has encouraged indigenous communities in Panguipulli and elsewhere for their claims to customary rights to be acknowledged. A testimony evinces the status of ILO 169 at the local level: “There are still indigenous communities who maintain their autonomy, who need to use the water; its use is ancestral in a certain way, also they have realized they are covered by Convention 169, thereby legitimizing their use” (translation by the authors from Spanish).

### 3.3. Stakeholder’s meanings and values

Table 2 shows the “epistemic distances” and contrasts between “models of nature” (Escobar, 2008) across stakeholders in the case of water. The contrast between community and business reflects the major possible semantic distances, which are revealed in the interviews. For instance, the following testimony explains that “one cannot imagine a life without water; civil organizations see water as a human right, and that is the way it arises in other advocacies, but the Mapuche people see water as much more than that; it is not a resource, not a right, nor could it ever be, yet is essential because without water, life would not exist, and therefore there would be no rights to it” (translation by the authors from Spanish).

The secondary meanings (third column) reveal other attributes and social senses that co-exist with the main meaning (second column). This link is clearly exemplified in a testimony: “the water is linked in some way to agriculture, the issue of tourism, through which we can do

business; people who come from other places to fish, to swim, to enjoy, to observe nature” (translation by the authors from Spanish).

The complexity of the statutory framework surrounding rights in Chile is also recognized by one interviewee: “although it goes against the Mapuche worldview, if one wants to preserve water, they must care for it. We must enroll [the water rights]; it is difficult for the elderly, but we must make them understand that it is a necessity” (translation by the authors from Spanish).

In the case of indigenous communities, nature is recognized as their livelihood, providing material and spiritual benefits; “nature is important, because we have our blessings, such as firewood, products such as mushrooms and herbs, we have our blessing that is water...and have our blessing that is freedom” (translation by the authors from Spanish). This type of narrative enhances the vision of ecosystem integrity, specifically the relation between forest and water. In addition, it suggests potential collective action in order to defend the local model of nature, based on experience and the indigenous worldview.

#### 4. Discussion and conclusions

ES management requires governance systems that can accommodate the complexity of socio-ecological contexts, diversity of institutions, actors, levels and scales, and values and needs (Ban et al., 2013). This case study has served to explore these complexities deeply, as well as the opportunities and challenges they portray for the implementation of new forms of environmental governance based on ES, using the case of water supply as an illustration.

Whereas state-centered interventions to incorporate ES are potentially varied and some of them have been implemented in Latin American countries (e.g. land use regulations, economic instruments, conditional payment schemes), our results show that in the case of Chile such measures have not been tested. Furthermore, the evidence reveals that transforming existing policies (water, land, forest, protected areas) and the institutional context towards ESA implementation and ES-based governance is confronted with several rigidities, such as centralization and “sectoralism”. The results coincide with those reported in cases such as Australia (Pittock et al., 2012) in that: i) the country lacks effective institutions to consider human–environment interactions holistically and strategically; ii) the term ES is used superficially; and iii) the term has not been systematically included in decision making and management.

Chile’s institutional framework is generally weak with respect to the comprehensive conservation of ecosystems; as in other developing countries (Lyon, 2009). Only two rules (R10 and R11; see Table SII) relate to the protection and sustainable management of forests, whereas none of them relate directly to watershed protection. A prevailing view is that water is a natural resource disconnected from other components of the socio-ecological system, as can be inferred from the large number of rules handled by an equally large number of sector agencies (e.g., CONAF in the case of forests; DGA in the case of water; SNASPE in the case of protected areas; see Table SII).

Achieving cooperation and effective coordination in such a fragmented context is a core problem for environmental governance and ESA implementation as reported in other studies (Greenhalgh and Hart, 2015; Kim et al., 2015; Pittock et al., 2012).

Within the current water market structure, the administrative focus is on access to water and its most efficient use. On the contrary, no formal rules regard the protection of forests or watershed heads as key ecosystems to maintain water provision and regulation. The vision of ensuring access has led to a very high concentration of rights by energy, forestry, agricultural and water utility companies. This market structure may become a critical issue for the implementation of ES-based arrangements, such as for example PES (likely to be promoted once the National System of Biodiversity and Protected areas is enacted). PES and similar institutions require benefit appropriability to be achievable by recognized users and beneficiaries, which cannot be guaranteed in a

market system where any capable buyer can acquire rights despite his/her status as recipient of ES benefits. In this case, the possibility for unwanted exchange (market, private) is great, and protection costs (safeguarding, disputing) of private rights very high (Bachev, 2009).

Under the country’s current governance structure, PES mechanisms can further increase distributional inequities, already created by water market concentration since the 70s. Indeed, accompanying new REDD + and PES mechanisms, there have been strong debates around how such devices impact equity, and thereby either entrench or successfully address existing inequalities and structural causes of poverty (McDermott et al., 2013; Sikor et al., 2014).

Regarding values and meanings, results clearly reveal that as in other countries (see Aguilar-Støen, 2017; Jackson and Palmer, 2015), the primary agents of environmental management have largely been unable to accommodate the needs or values of indigenous communities. This situation depicts what scholars refer to as the homogenization of world views and constructions of reality through environmental policies, which can lead to the loss and commodification of indigenous knowledge (MacDonald, 2011).

In this scenario of multiple rationalities and deep inequalities, moving towards ES governance seems problematic without reformulating formal rules. However, ESA implementation requires law formulation to safeguard equity and justice, paying attention to plurality of values, forms of participation, and how decisions are made for equitable outcomes (Gustavsson et al., 2014), as well as recognizing who or what is considered in decision-making processes, in terms of respecting differences and avoiding domination (Bohman, 2007; Chaudhary et al., 2018). In this regard, Chile is taking some steps forward with the discussion of two bills in Congress, the first regarding water code reform and the second on the creation of a state agency in charge of managing biodiversity and protected areas, as well as a national system of protected areas (Mensaje N° 161–362, Senado de Chile, 2015); both projects include a discussion around concepts related to ESA. However, to the best of our knowledge, none of them involve a discussion on customary models of governance, and their role in the envisioned changes in ESA governance arrangements.

Another avenue of action along Law reformulation, consistent with accepting plurality, involves the recognition that other forms of governance can co-exist with western approaches and should also be supported. Proposals such as *Buen Vivir* contemplate a fundamentally different ontology of nature and are exemplified in Chile by customary organizations such as the Coz Coz Mapuche Parliament. These new proposals forward a perspective of environmental governance that dissents openly from the view of nature as a provider of services (Borie and Hulme, 2015; De Castro et al., 2016). However, policy implementation that could lead to models such as *Buen Vivir* requires profound changes that follow a range of complex transitions (Mattioli and Nozica, 2017; Villalba, 2013). This implies, among others, acknowledging the historical, environmental and social contexts of indigenous peoples, continuously shaped by political struggles, environmental change and contested values of nature over time (Miller, 2007). Even so, indigenous rationalities could be coincident in their practical expressions (and not only discursive, which are always more idealized) with an ES approach. On the one hand, there is no doubt that an instrumental appropriation of nature by indigenous people exists (albeit commercial), yet on the other hand, this appropriation presupposes a certain inclination that would fit in an indigenous form of environmental governance, as shown in other studies that document examples of “indigenous PES” (Jackson and Palmer, 2015).

The case of Chile, and its southern territory, provides timely evidence which, if correctly considered in policy-making, could enlighten decision-makers in their quest to mainstream ESA in environmental management, which could involve all stakeholders in a fruitful dialogue, or at least in one that is coherent to local visions. However, at this stage of research, data is limited in terms of proposing ways in which ES-based mechanisms may be harnessed by indigenous peoples

seeking ways of preserving, extending, adapting and benefiting their own land management practices and related livelihoods.

Further research on the topic of ES governance involving indigenous populations worldwide is necessary to fill this gap, while current evidence must be taken into consideration in ESA governance assessments (ex-ante and ex-post) and design, at least in terms of identifying risks and collecting suitable information.

## Acknowledgments

This research was funded by FONDECYT Grant N° 1151187 (CONICYT-Chile), Grant from the Inter-American Institute for Global Change Research (IAI)CRN3 095 supported by the US National Science Foundation (Grant GEO- 1128040), and FONDAP Grant N° 15150003 (CONICYT-Chile). We thank Dr. G. Blanco and Dr. R. Arriagada for valuable comments to early versions of the manuscript.

## Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.envsci.2018.04.012>.

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