Sustainable Lithium Production in Chile
Phase 1

Baseline Study

GIZ Project: 69.3071.3-002.00

Partners Cristobal Giradi, Fundación Chile
Angela Oblasser, Fundación Chile
Carolina Cuevas, Fundación Chile
Victor Andres Garzón, GIZ Chile
Arnold Quadflieg, Germany (lead)

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Preface

In the forthcoming years, the mobility and traffic transition to electric cars will be necessary to meet the objectives of climate protection. Lithium will be a key component in lithium-ion based batteries of the e-mobility. In the coming years, the increasing Lithium-market expects high annual growth rates in demand on lithium.
Chile and Australia accounts for almost 80 % of the global supply on the primary production of lithium. The Salar de Atacama, Chile, is one of the mayor source of lithium resources, which have been extracted from groundwater brines since the 1980ies.

The German automobile industry is highly committed to the principle of sustainability. However, less known are the environmental and social effects related to the lithium mining activities in the water basin of the Salar de Atacama.
Volkswagen and Daimler have commissioned the GIZ (Gesellschaft für Internationale Zusammenarbeit) to undertake a feasibility study to get more information on the environmental and social aspects and effects of lithium mining especially on the relationship between the lithium mining companies and indigenous communities and the local authorities of San Pedro de Atacama.
During a 2-week appraisal mission the relevant actors and stakeholders like indigenous communities, governmental institutions, lithium mining companies, local authorities, non-governmental organizations (NGO) and academy were interviewed in Chile (Santiago de Chile, San Pedro de Atacama).
Stakeholders mapping and Analysis on the relevant actors have been of principal significance to understand the role, position and acting of the different players to go ahead initiating a stakeholder dialogue (Chapter 4).
The Baseline Study will give an overview on the environmental and socio-economic situation of the lithium production in the water basin of the Salar de Atacama and the willingness of the interviewed stakeholders to cooperate towards more sustainable lithium production.

1 - Executive Summary

The current supply of lithium comes mainly from five countries: Australia (from minerals such as spodumene), Chile (salt groundwater brines), Argentina (salt groundwater brines), China (minerals and brines) and the USA (brines). Chile supplies around 39% of the global lithium market.

In Chile, lithium reserves are concentrated in the Salar de Atacama, representing 81% nationwide and 22% worldwide. The mining property of these lithium reserves in the Salar de Atacama belongs to the Chilean State.

Today, two private companies, Albemarle and SQM, are operating in the Salar de Atacama, linked to contracts signed and modified by the governmental institution

The Chilean Mining policy estimates that by 2025 both companies would be producing a volume of up to 200,000 tons / year and 230,000 tons / year of LCE, representing 45% of the global demand for lithium.

Actually, groundwater, surface water and water dependent ecosystems in the water basin of the Salar de Atacama are under high anthropogenic pressure by water abstractions of mining companies, public water supply and irrigation purposes.

Increasing the lithium extraction rates by 2025 would increase the demand of the mining companies for more quantities of brine and fresh groundwater. The result could be a collapsing of the deeper “fossil” brine groundwater aquifer, damages on the fresh groundwater as important source of drinking water supply and the water dependent ecosystems (e.g. lagoons).

Until now, there is a fundamental lack of participating and involving the indigenous communities into the decision-making procedure of the lithium extraction policy which leads to high controversial issues.

Analyzing the environmental and social risks of the lithium production in the water basin of the Salar de Atacama the baseline study identifies the opportunities to develop a common vision and understanding of the relevant stakeholders in a first step and to initiate a multi-stakeholder dialogue, secondly.

The international accepted instrument of Integrated Water resource Management (IWRM) will lead to a sustainable production of Lithium sustainable management of water and will encourage the active involvement of all interested parties in finding joint solution to balance the ecological, economic and social issues of all actors.

2 Lithium Supply and Demand Balance in Chile and Internationally

To meet the objectives of global and national climate protection policies such as UN Sustanable development Goals 6, 7, 9, 11, 12, 13, and 17, it will be essential for Germany to shape actively the transition procedure from traditional gasoline or petrol powered cars to electric cars (green energy, green economy). The electrification of the automobile passenger transport will strongly increase the demand for Lithium in the coming years.

In this context, the application of rechargeable batteries in e-mobility (g.e. Battery-Electric-Vehicle -BEV-, Plug-in-Hybrid-Vehicle) will play an increasingly important role in the coming up of the e-mobility market. Lithium will continue to be a key material in the lithium-ion batteries for the coming next years and decades (DERA, 2017; see: Figure 1).

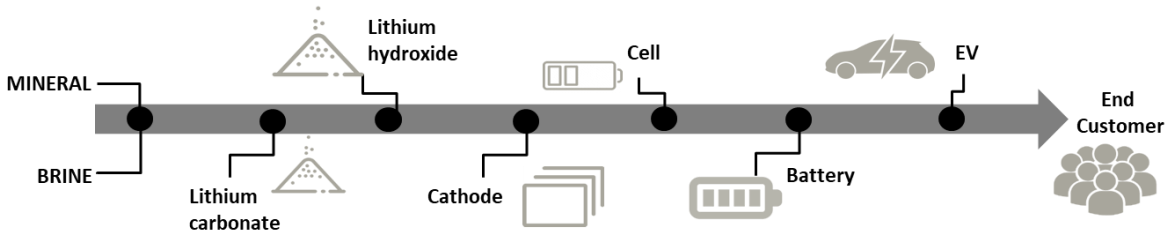


Figure 1: Lithium supply chain basics. Source: DERA, 2017.

Currently, Chile and Australia are dominating the supply of lithium accounting for almost 80% of global supply. This situation will not significantly change until 2030 (Figure 2).

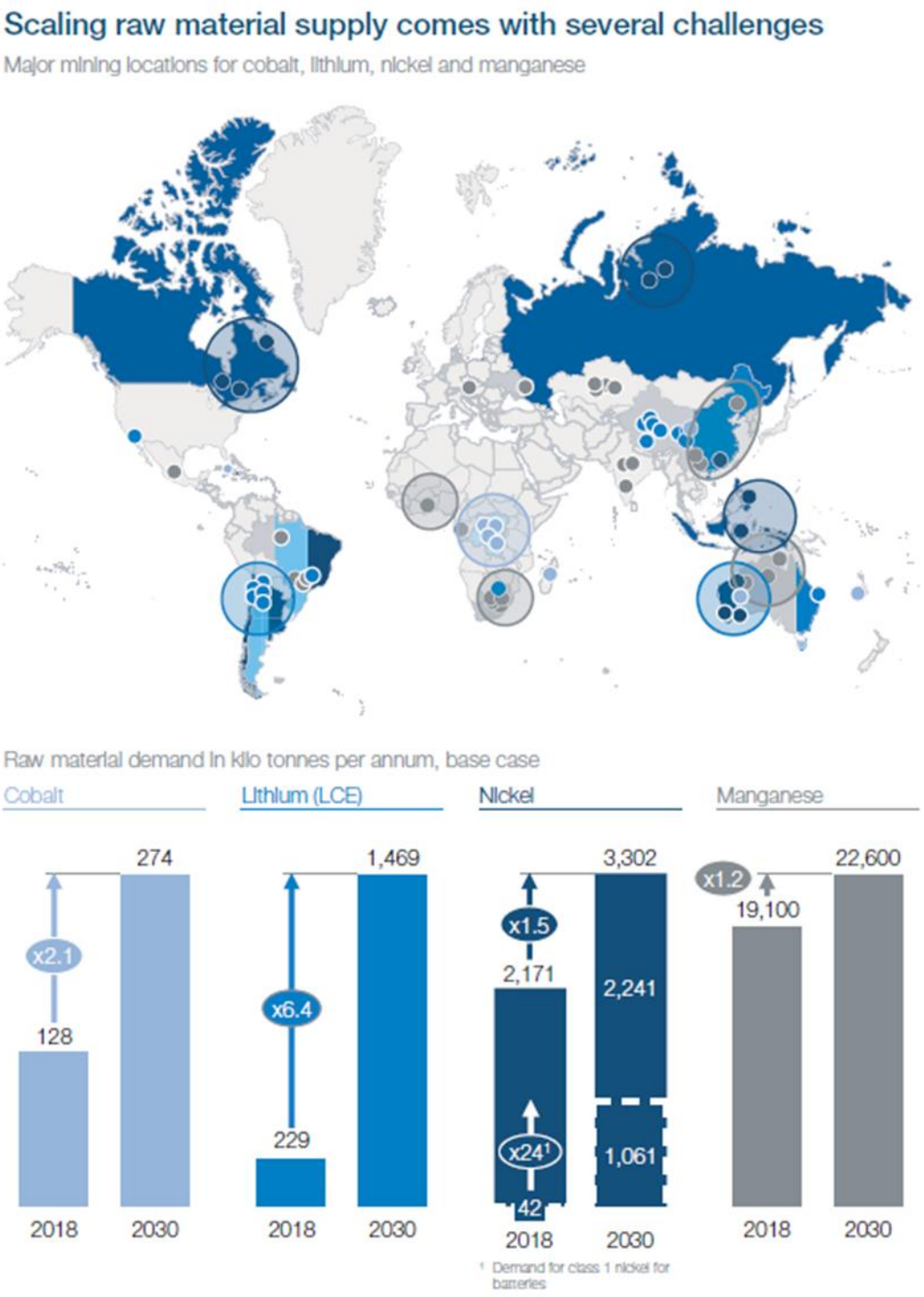


Figure 2: Demand for cobalt, lithium and manganese by 2030 (source: USGS, 2019; McKinsey analysis; expert interviews).

In 2017, Chile produced about 80.417 tons of Lithium carbonate equivalents –LCE- (COCHILCO, 2018). Traditionally since 1980, the Chilean Lithium mining sector extracts Lithium resources from deeper high-mineralized groundwater brines (dissolved lithium chloride) in the Salar de Atacama region. The extracted groundwater brines (0,15 % Lithium concentration) get concentrated up to 6,0% Lithium

concentration as basis for battery grade quality in large consecutively constructed artificial evaporation basins by using nature solar energy in the Atacama desert. The nature sun-based evaporation process lasts up to 18 months (DERA, 2017).
Accordingly to the expansions announced by the mining companies Albemarle y SQM, the production is going to increase 3 times, reaching 240.000 tons of LCE, approximately by 2025 (COCHILCO 2018).

Forecasting future supply volumes beyond 2025 are not useful due to many uncertainties (f.e. scientific research in exploration activities, new technologies in producing Lithium components, coming up of a secondary recycling Lithium-battery industry).

In Chile, Lithium is a national material of strategic interest (Material of Nuclear Interest, Chilean Nuclear Energy Commission and CCHEN). Lithium reserves are administrated by 3 public institutions, CORFO, CODELCO and ENAMI (see: Chapter 4). In 2017, the governmental institution CORFO (Corporación de Fomento de la Producción), supported by Invest Chile (Ministry of National Assets) has started the „Lithium call“ programme to improve the chain of value added of Lithium exploration and production by setting new frame conditions for innovating the Lithium industry in the north of Chile. The overall objective of the Lithium call is to stabilize or to upgrade the Chilean market share of Lithium in the next years and decades.

3 Characteristics of the water basin Salar de Atacama

a. General description of the characteristics of the water basin (location, boundaries of water bodies etc.)

The Salar de Atacama water basin is located in the El Loa province, Antofagasta region, covering an area of 15.260 km^2 (Figure 3; DGA, 2004), at an altitude of 2.400 amsl. It is an endorheic or closed basin, in which water contributions drain to the lower part, where a salt flat of important dimensions is formed and from which water is evaporated into the atmosphere.

Corenthal et al. (2016) indicate that the area of the water basin of the Salar de Atacama is about 17.257 km^2. Dimensions of the water basin are 210 km N-S, and a maximum of 110 km E-W. The Salar of Atacama itself has an area of 3000 km^2.

The water basin has a population of 10.996 inhabitants (CENSO 2017).

Water evaporation rate from Salar is 10 l/m^2/d, one of highest in the world (Jerez et al. 2018).

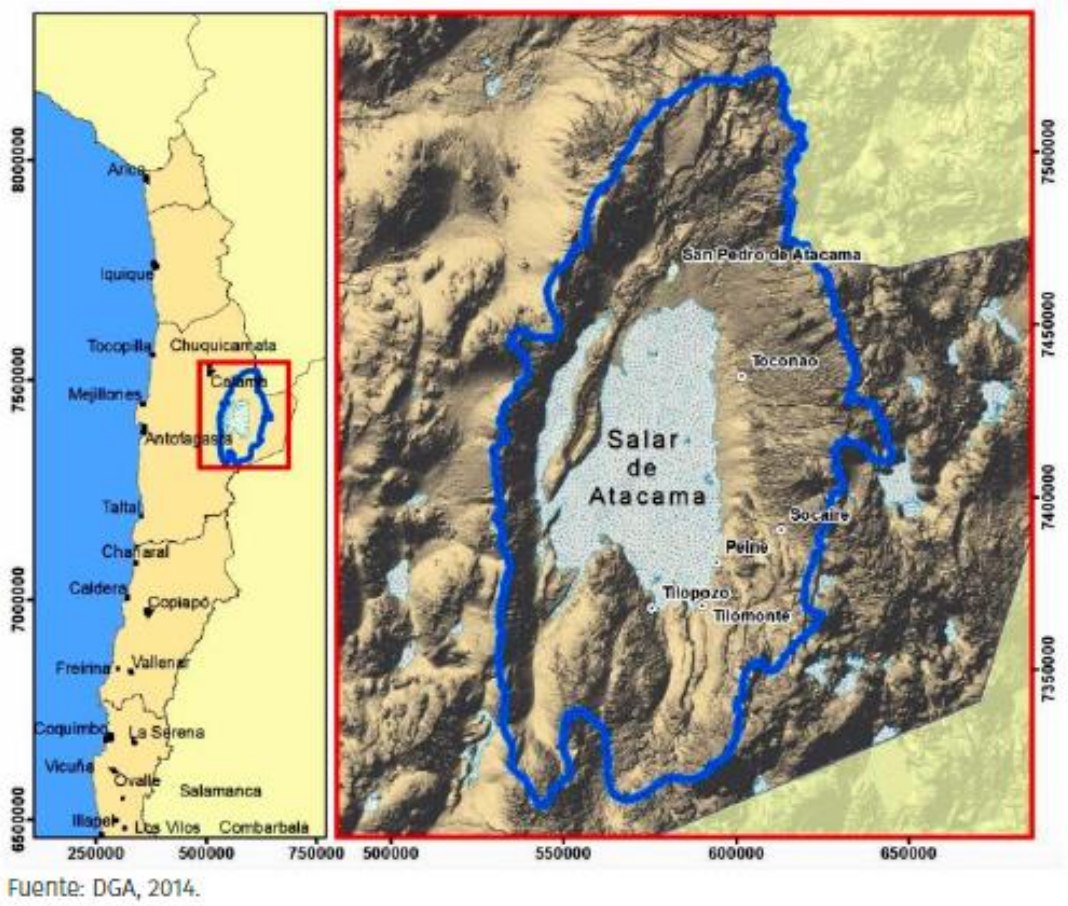


Figure 3. The Salar de Atacama (light blue) and its water basin (dark blue). Source: DGA, 2014a.

According to the report „Evaluación de los recursos hídricos subterráneos del acuífero del Salar de Atacama (Informe técnico N° 324, DGA, 2012)“, the main contributions have their origin in the precipitations on the summits that limit the basin by the north and east, from where they run towards the Salar de Atacama through numerous stream systems. A smaller number of water courses have permanent flow, while the majority are characterised by temporarily runoff during precipitation periods. These main river systems are San Pedro river with an average flow of 1 m^3/s and higher discharge rates up to 25 m^3/s during torrential episodes and Vilama river with an average flow of 0,2 m^3/s. However, both stream systems enter into the northern margin of the Salar de Atacama: the San Pedro River forms a delta, while the Vilama, which is under heavy anthropogenic water use pressure and it flow has been declared exhausted in 2017 by DGA, infiltrates and disappears at the south of San Pedro de Atacama. Maximum flows are recorded between January and March, coinciding with the maximum rainfall events associated to the altiplanic winter phenomena. On the east margin of the Salar de Atacama, a series of brief streams circulate through ravines (Figures below) whose headland areas are located in the Andean highlands (Salas, J. et al., 2010). These small streams are feeding some oases, among which are Toconao, Socaire and Peine. The total Run off entering the Salar de Atacama is about 5,6 m^3/s (CPH Consultores).

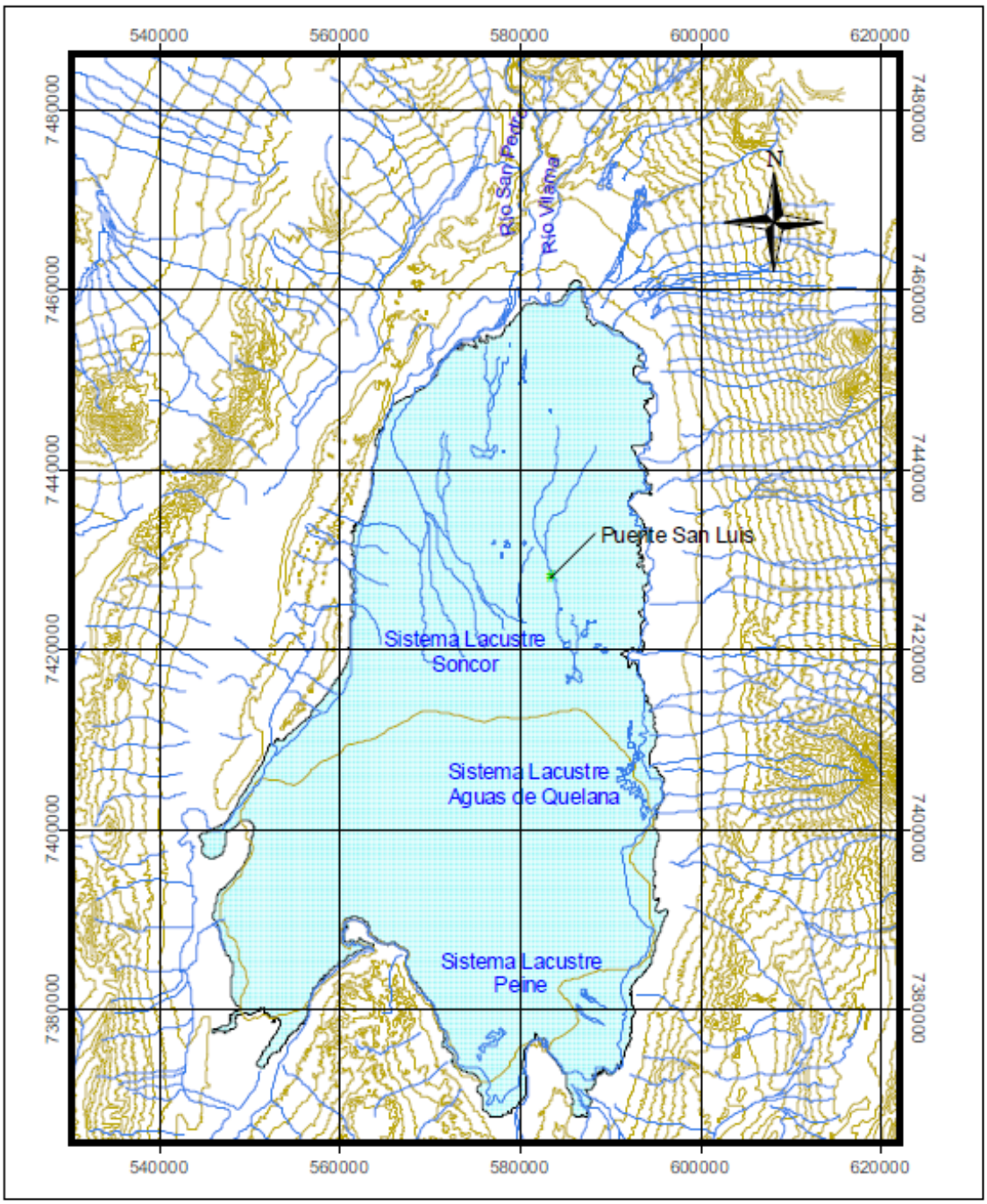


Figure 4. Drainage system in Salar de Atacama. Source CPH Consultores.

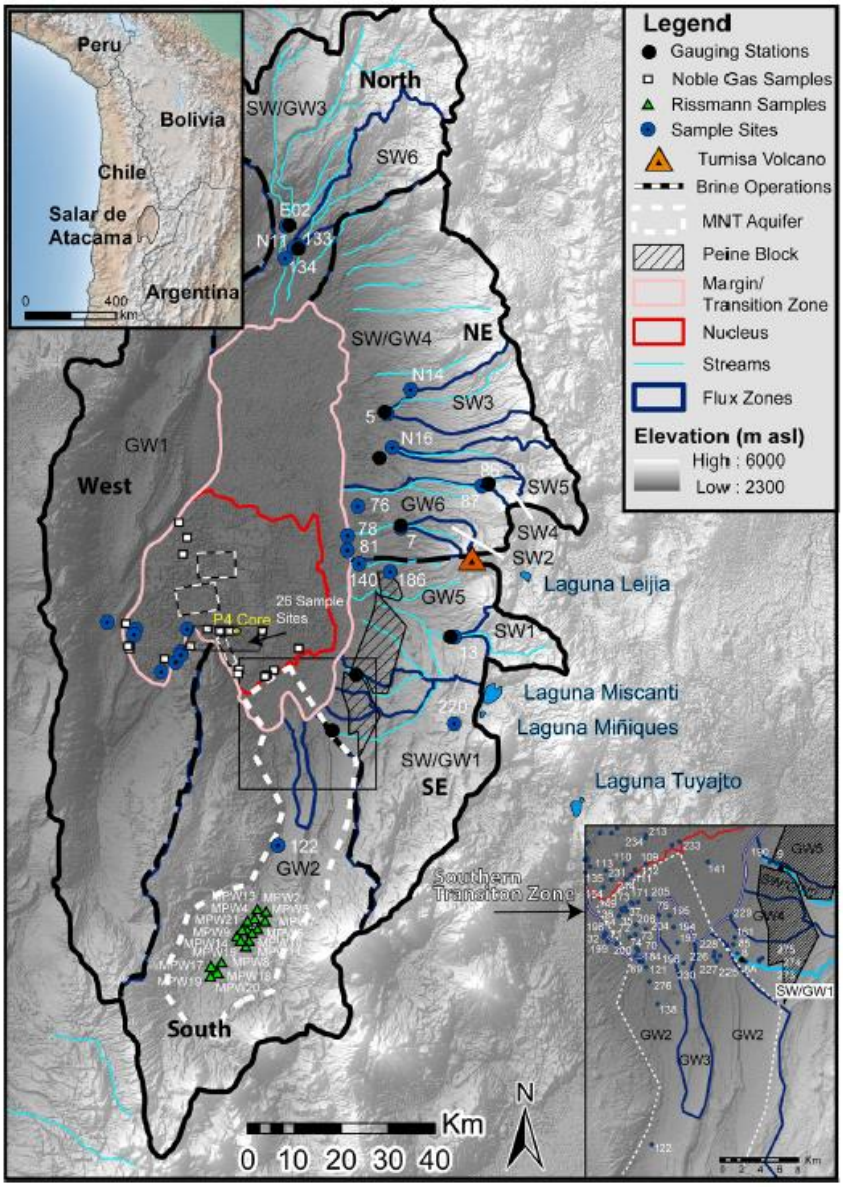


Fig. 1. Digital elevation map of the Salar de Atacama, Chile basin illustrating the topographic watershed, the five watershed regions defined in this study (west, north, northeast, southeast and south) and the surface and groundwater flux basins (ie. SW, GW) within each. The sample locations are also shown. The MNT aquifer, brine production facilities and other important features are highlighted.

Figure 5. Digital elevation map of the Salar de Atacama. Source Munk et al. 2018.

b. Hydrogeological characteristics of the groundwater systems (aquifers)

According to the DICTUC 2004 report, in the Salar de Atacama it is possible to recognize two aquifers, the high-mineralized core aquifer of the Salar de Atacama and the freshwater aquifer in the marginal zone of saline deposits.

The aquifer of the Salar de Atacama covers an área of about 4239 km^2 (DGA, 2014b). Groundwater flow paths converge into closed basins and discharge through evapotranspiration, concentrating and precipitating solutes into evaporite minerals and high-conductivity brines (Munk et al., 2016).

Salar de Atacama began accumulating a massive halite deposit before ~6–10 Ma. Extensive Plio-Pleistocene ignimbrites provide laterally continuous hydrostratigraphic units from the Altiplano-Puna plateau to the SdA subsurface (Jordan et al., 2002). The stable isotopic composition of fluid inclusions in halite is consistent with a groundwater source originating on the plateau (Godfrey et al., 2003). Evapotranspiration (ET) is the only natural mechanism of surface water discharge from the basin. ET at the elevation of the Salar varies between 0 and 2.8 mm/d depending on the land surface characteristics.

The response of the lagoon levels is similar to the surrounding groundwater systems (marginal zone and lower part of east boarder of the aquifer) and both highly different from those observed in the brine wells. This fact indicates that there is a kind of retardant factor governing the hydraulic connection between both zones has, which is explained by the presence of longitudinal geological faults across the salar sedimentological and the characteristics of the materials that are recognized in the marginal zone, that is plaster, silt, clay, organic sludge and semi-compact and compact halite. All these deposits correspond to semipermeable units (gypsum, compact halite). On the other hand, in the marginal zone there is a fairly flat salt wedge that acts as a barrier, forcing fresh (less dense) water to flow over the brine.

This semi-impermeable barrier was also verified by DICTUC (2004) through geological records of drillings carried out in the Soncor (GD-1) and Quelana Waters (GD-2) sectors, which included measurements of hydraulic conductivity carried out in the laboratory. These results indicated the existence of semi-impermeable materials (compact halite, clay, plaster, organic sludge). Hydraulic conductivity tests indicated values in the range of 5.4×10^{-3} m/d, which correspond approximately to twice the hydraulic conductivity of the terrain.

The most notable aquifer due to its size is the Monturaqui-Negrillar (MNT) system in the south (Munk et al. 2018).

Aquifer geometry:

According to SQM, in the core of the salt flat 3 hydrogeological units are identified, formed by scabs of sodium chloride (NaCl), irregular relief, fractured, jagged and brittle, which covers the central and western part of it. The porous halite core has an area of approximately 1100 km^2, and more than 1200 m thickness in some zones and is

impregnated with an interstitial brine very rich in Lithium (Li), Potassium (K), Magnesium (Mg) and Boron (B) (SQM interview 2020; Alonso y Risacher, 1996).

According to reports from DICTUC (2004), GCF Consultores (2009), and CPH consultants, in the core of the Salar a top layer is distinguished, up to approximately 100 m deep with high porosity and high hydraulic conductivity. This top layer is composed of salt of granulated texture; and constitutes the main mineralogical reserve. Under this layer a unit of lower hydraulic conductivity formed almost exclusively by porous crystallized halite can be observed.

The halite nucleus is bordered by a transition zone where sulphate, carbonate, and diatomaceous deposits interfinger with siliciclastic alluvium and volcanic deposits.

According to the available geophysical information, DICTUC (2004) concluded that the average value of the saturated thickness in the Salar de Atacama is about 256 m, although this information was obtained at the eastern and western edges can be extrapolated to the total basin, and the associated error can be estimated at + - 20%. Likewise, it can be established that the upper aquifer is of the phreatic or free type but also confined units are also distinguished below the unconfined one it. The aquifer systems presents in general heterogeneities both vertically and horizontally.

Eastern margin of the Salar de Atacama

A hydrogeological conceptual model of the Eastern margin of the Salar de Atacama (Chile) is proposed by Salas et al. in 2010 taking into account climatic, geological, geomorphological, piezometric, chemical and isotopic data. The study establishes the processes that explain the hydrochemical evolution of waters from salty groundwater in the alluvial aquifer located in eastern part of basin until brines at the saline aquifer of the Salar. The main processes associated with this hydrochemical evolution are evaporation and mixing, but water-crust interaction in the discharge areas of the alluvial aquifer associated with the saline wedge also modifies groundwater composition, and plays a role in the dynamics of the evaporitic crusts in the Salar. The existence of low permeability materials near the surface explains the existence of the permanent surface water bodies in the water basin. Three different mechanisms are identified regarding the main sources of water to the lagoons: (1) discharge of saline groundwater from the detrital and volcanic aquifers of the E margin, (2) discharge of surface waters associated to the N area (Burro Muerto channel), and (3) a combination of both.

The east margin of the Salar de Atacama is characterized by the interaction of two aquifer units. According to SQM (Interview 2020), in the freshwater aquifer of the eastern margin, two hydrogeological units are distinguished, an unconfined aquifer and a confined aquifer below.

Among the foothills of the Andes and the margin itself, a powerful detrital-volcanic aquifer is observed. Its waters are saline but with low densities in the vicinity of 1.00 g/cm^3. This aquifer is located on top of the volcanic formations that make up the regional base. Towards the center of the Salar (saline core), groundwater are brines having densities near n the vicinity of 1.23 g/cm^3.

The interaction between the salt water from the east margin and brines of the salt core occurs by means of a wedge type of interface saline, similar to that developed in coastal aquifers (Custodio and Llamas, 1996). This relationship between water of different densities and the topography determine saline water coming from the east margin rises and come to the surface flooding large areas of the edge region of the Salar (Muñoz-Pardo et al., 2004). This sector coincides superficially with the slope rupture zone generated between the distal regions of the alluvial cones and large plain of the Salar. Upwelling of these flooded areas they are located near the boundary area between the detrital-evaporite, scabs and carbonated sulfated.

Hydraulic parameters

According to the results of pumping tests performed in 1985 and 2001 (SCL) the hydraulic conductivity varies between 3x10^{-2} and 1x10^{-4} m/s in the salar core (0-40 m deep), while low permeability strata were detected at the edges of the core, with K around 1x10^{-6} and 1x10^{-8} m/s (GCF, 2009).

Another study (DICTUC 2004), developed with large amount of information provided by SQM, observed a spatial distribution of transmissivities, whose measurements were mainly concentrated in the nucleus of the Salar. The values in the core of the Salar vary approximately between 0,01 m^2/d and 500.000 m^2/d while on the eastern edge, transmissivities vary between 300 m^2/d and 1500 m^2/d (Figure 6).

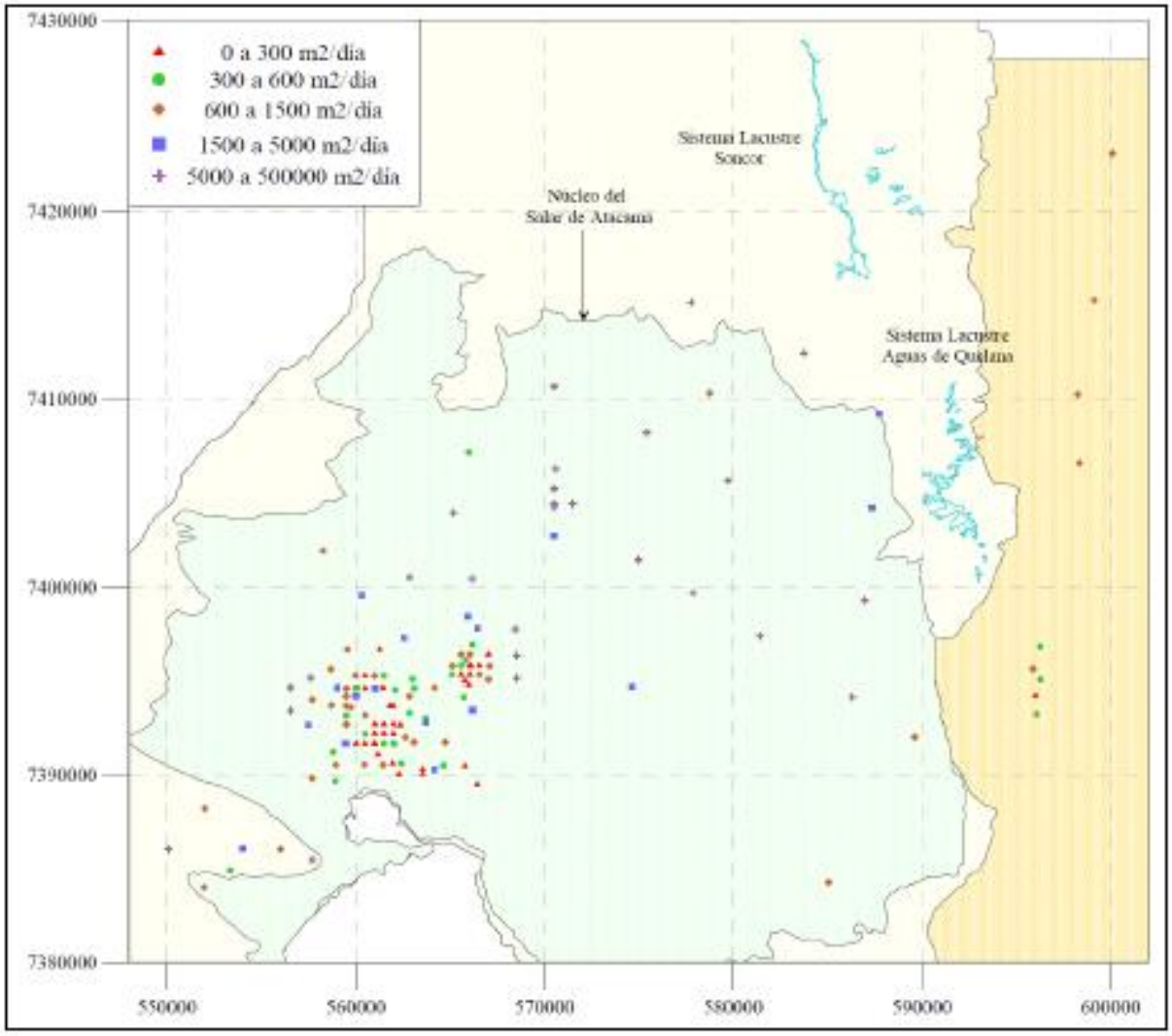


Figure 6. Transmissivity values in the Salar de Atacama. Source: DICTUC 2004.

Aquifer Water Balance

Two rivers and nine streams exist at higher elevations along the plateau margin but lose all surface water flow through infiltration into the alluvium formation before reaching gypsum and halite facies. In previous work, Godfrey et al. (2003) estimate that groundwater inflow to Salar de Atacama is ~2–5 times streamflow.

Mean annual precipitation in the water basin of the Salar de Atacama from 1998 to 2009, including the wetter than average 2001, is approximately 48 mm with a range of 0–340 mm. This is equivalent to 26,5 m^3/s of precipitation in recharge zones in the topographic watershed.

Estimate of 0,9 m^3/s of GWRCH and average infiltration rate of 3.5% within the topographic watershed (Figure 7).

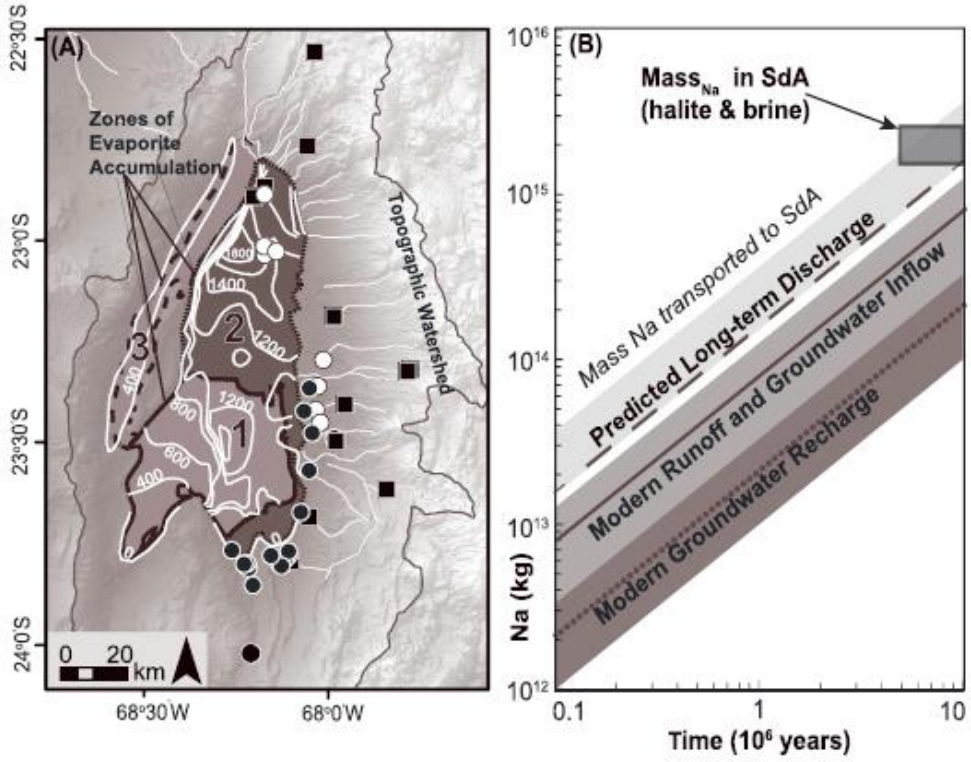


Figure 7. (a) Isopachmapderived from contours by Jordan et al. [2007] used to estimate Na mass in halite. Groundwater sites (black circles) and surface water sites (black squares) are measured as part of this study, while additional groundwater sites (white circles) are compiled from Compañía Minera RioChilex S.A. [1997] and DICTUC [2010]. (b) Projected Na accumulation based on modern loading to the SdA compared to total accumulated Na in halite and brine since 10 Ma. Na concentrations (mg/L) and water discharge rates (m3/s) used to determine the best estimate for each slope are 657.6 mg/L × 0.9m3/s for GWDIS, 522 mg/L × 4.8m3/s for modern inflow, and 522 mg/L × 9.5m3/s for predicted discharge. Bars show ±1 standard deviation for Na concentration and a range of potential estimates to close the steady state budget for predicted discharge. MassNa includes uncertainties in the amount of Na in halite and brine and the time period of accumulation. Source: Corenthal, 2016.

c. Register of protected areas (RAMSAR, national)

RAMSAR sites are identified in the water basin of the Salar the Atacama, including the Salar de Pujsa, the Salar de Tara, the Soncor Hydrological System and the Aguas Calientes VI Salar in the contiguous area at the south of the Salar de Atacama (Jerez et al. 2018).

According to the report „Evaluación de los recursos hídricos subterráneos del acuífero del Salar de Atacama. Informe técnico N° 324 (DGA, 2012)“, the following environmentally sensitive areas are detected (Annex 1):

- Vegas, bofedales, lagoons, SNASPE sites, RAMSAR sites and crops or irrigation areas.
- Ramsar sites: Soncor Hydrological System (5016 Ha protected).

- SNASPE: Reserva nacional los Flamencos, divided in Salar de Atacama, Lagunas Aguas de Quelana, Valle de La Luna y Tambillo.

Vegas and bofedales are recharged by runoff surface waters and groundwater.

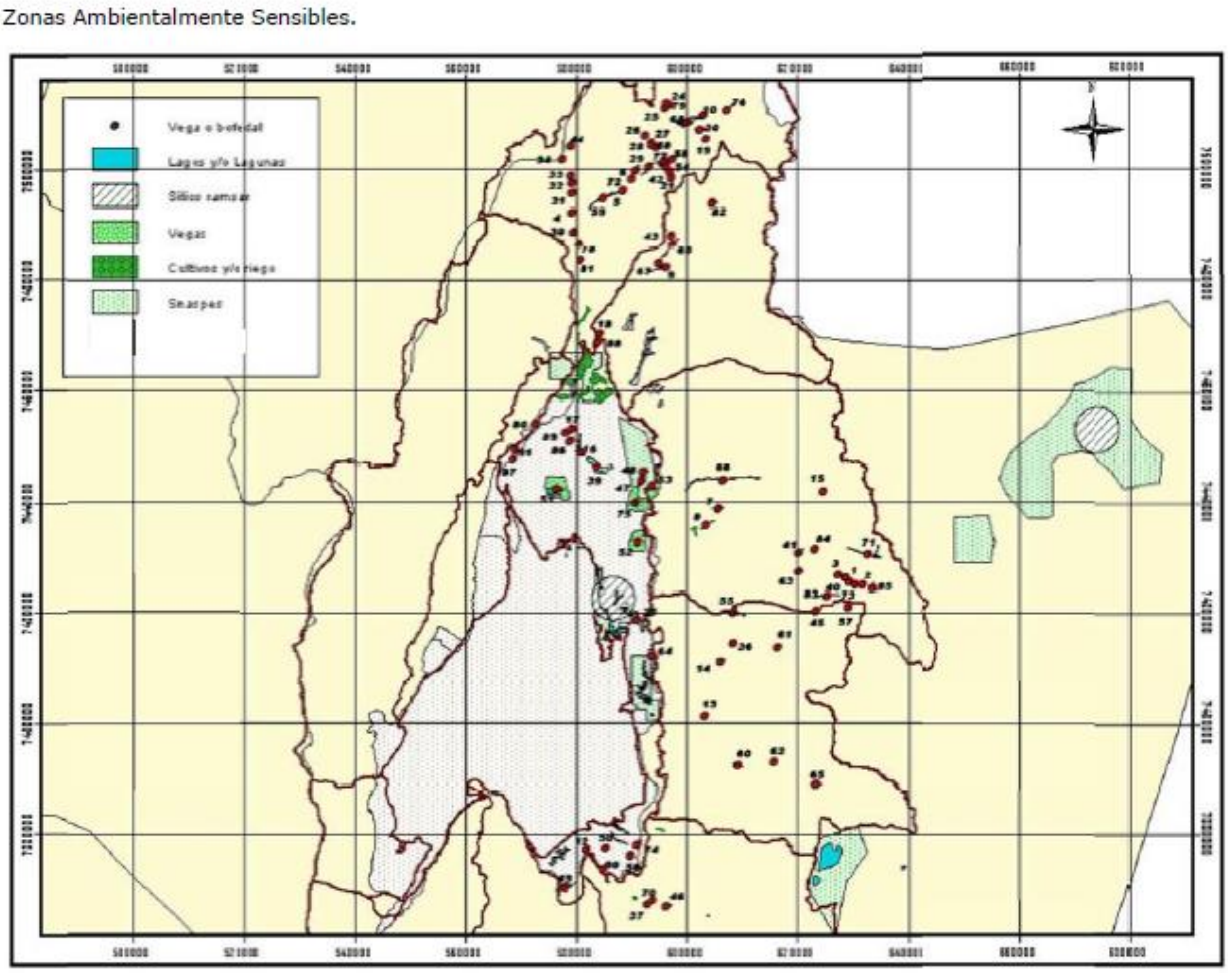


Figure 8. Environmentally sensitive zones. Source: DGA, 2012.

Áreas de Riego y Cultivos.

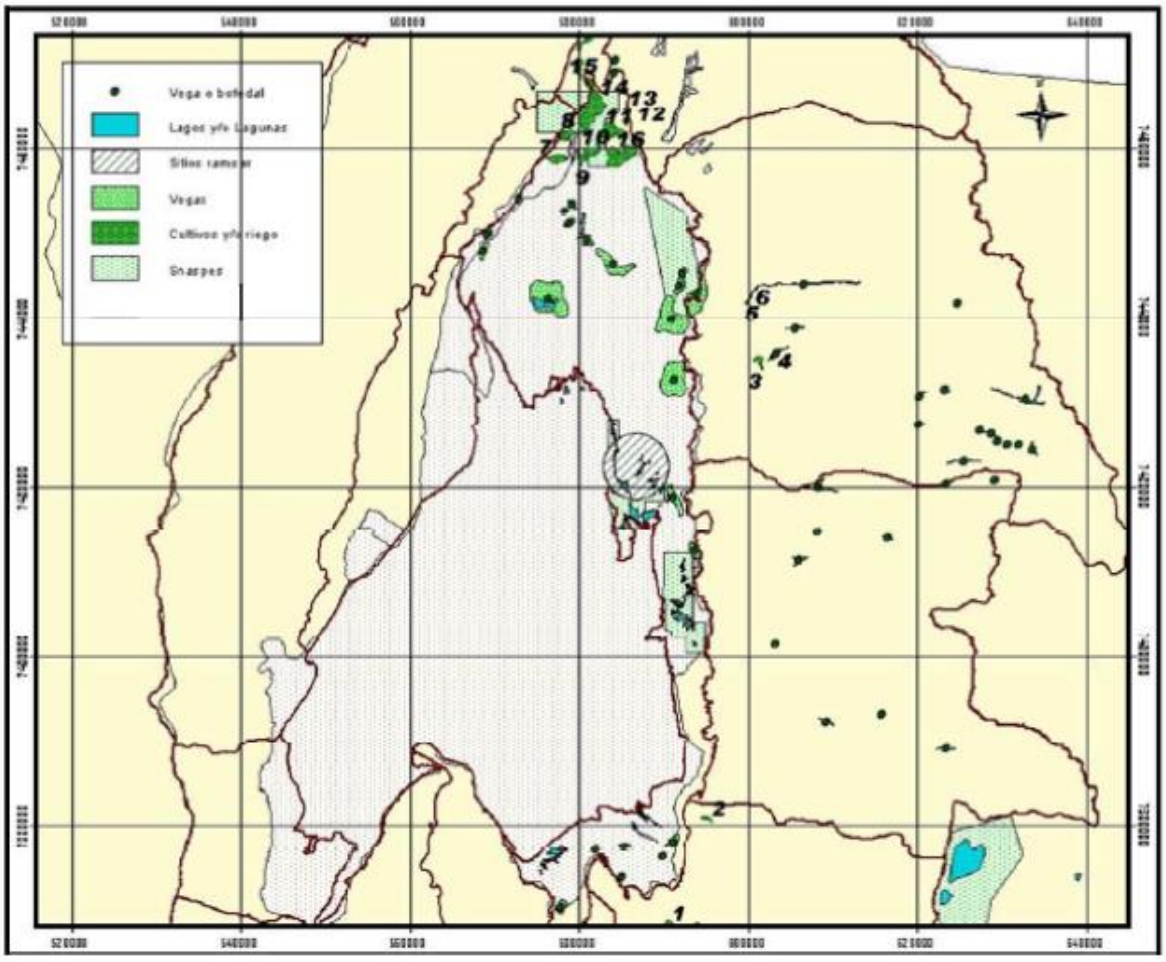


Figure 9. Irrigation and crop areas. Source: DGA, 2012.

d. Land use and economic activities in the water basin

The main economic activities in the water basin are non-metallic mining activities dominated by the exploitation of lithium, sodium, borax and potassium located in the southern sector of the water basin and close to the towns of Toconao and Peine (DGA, 2004).

Different land uses are identified in the water basin of the Salar de Atacama (Annex 1) according to previous figures and the following table.

Table 4. Land use in the Salar de Atacama basin. Source: DGA, 2004.

Area of Salar de Atacama Basin (Ha)	Land use	Area (Ha)	Percentage of total área for each land use (%)
1562000	Meadows	100311	6
	Crop fields	264	0,02
	Forest plantations	3371	0,2

	Urban and industry areas	‹156,25	0
	Industrial mining	‹156,25	0
	Native forest and mixed forest	0	0
	Other uses (Scrub, Scrub land, rotation between meadow and crops, not recognised areas, water bodies, snow, glaciers and wtlands.	362970	23,8
	Areas without vegetation	1095084	70

According to (Jerez et al. 2018), the Atacameños community (Lickanantay) were founded in the Salar basin thousands of years ago, mainly in the sectors at the east border of the Salar, i.e. Peine community (600 inhabitants approx.), Toconao community (800 inhabitants approx.) and the small communities of Camar, Socaire and Talabre, that are mostly affected by mining activities of Lithium. The communities and ayllus of Solor, Séquitor, Cucuter and Solcor are part of the basin, too.

Although in recent years the High Andean agricultural and livestock activities have been significantly declining, it is still central to the local economies. Agricultural activity includes cultivation of corn, quinoa, vegetables and an important fruit activity in the stream of Jere developed by the community of Toconao. There is also a small cattle ranch focused on raising high Andean camelids like llamas and alpacas, in addition to goats and sheep; that satisfy self-consumption and generate local commerce.

An important part of the communities population works in the mining sector that exists in the Salar of Atacama, especially in the mining of lithium that has been exploiting the area for more than twenty years, but also in the copper mining which is located nearby, belonging to Minera Gabriela Mistral, Minera Zaldívar, Minera Escondida and Chuquicamata.

Referring to other activities that exist in water basin, tourism is undoubtedly the most important today. The municipality of San Pedro de Atacama is the main international tourist destination of Chile receiving more than one hundred thousand annual visits, who arrive attracted by the altiplanic and saline landscapes among which the lagoons, vegas, gorges, mountains and hot springs stand out, as well as the cultural wealth of the atacameños communities. For this reason, it has been declared as a Tourist Interest Zone (ZOIT).

Chapter 4. Stakeholders Mapping and Analysis, Institutional Framework

Below, a summary of the main actors analyzed during the month of January 2020 is presented.

Lithium in Chile

In Chile, lithium is a strategic mineral of national interest, whose ownership is exclusive to the State (Decree No. 2886 of 1979). Its property is under the control of 3 state institutions: Corporación de Fomento de la Producción (**CORFO**) in the Salar de Atacama, Antofagasta Region; the Copper Corporation (**CODELCO**) in the Salar de Pedernales and Maricunga in the Atacama region and the Empresa Nacional de Minería **(ENAMI)** in the Salar de Aguilar in the same region. These institutions directly deliver special lithium operation contracts (Contratos Especiales para la operación del Litio) **(CEOL)** or administrative lease contracts for the extraction of certain amounts in a certain period of time to private companies.

Two companies are currently operating lithium in Chile: **SQM**, that locate its extraction in the eastern sector of the Salar de Atacama (San Pedro de Atacama, Antofagasta Region) and the American mining company **Albemarle** (ex Rockwood and ex Chilean Lithium Society, SCL) which is also exploiting lithium in the southeast sector of the Salar de Atacama[1].

There are 6 alternatives for the exploitation of Lithium in Chile (**see Annex 2**). **CORFO** currently has two leases and exploitation of lithium and potassium in the Salar de Atacama with the company Albemarle and SQM (With concession according to mining code of 1932)

SQM operates in the salar since 1993 and has a lease until 2030 and **Albemarle** operates in salar since 1980 his contract was modified in 2016 with **CORFO** setting the year 2043 as the end date[2] (see the table below)

Albemarle	SQM
● Production capacity: 100.000-120.000 ton/year LCE (estimated to 2025). ● Product: Li_2CO_3; LiCl; LiOH. ● Operating Surface in the salar: 167 km^2. ● Contracts and agreements with Corfo allow operations up to 2043.	● Production capacity: 105.000- 115.000 ton/año LCE (estimated to 2025) ● Product: Li_2CO_3; LiOH ● Operating Surface in the salar: 819 km^2. ● Corfo-SQM lease contract end date: December 31, 2030.

For the exploitation of lithium in the Salar de Atacama you must have 3 permits:

[1] On the other hand, the Canadian company Wealth Minerals has lithium exploration projects in the northern sector of the Salar de Atacama and the Talison mining and the Wealth mineral group are in the process of starting the lithium exploration in the Pedernales and Siete Salaeres in the Atacama region. In these salt flats the registered companies CODELCO and ENAMI (Salar de Aguilar) have mining property, which are having tenders to begin the mixed exploitation of ore.

[2] This contract was approved by all relevant public bodies for that matter, that is, the Council of Ministers of Corfo - in which the Ministerio de Economí, Hacienda, Relaciones Exteriores,Agricultura y Desarrollo Social, plus two private representatives appointed by the President of the Republic-, Comisión Chilena de Energía Nuclear y la Contraloría de la República.

1. Mining property, belonging to **CORFO**
2. Environmental permit, requested from the **Servicio de Evaluación Ambientale, SEA** (see **Annex 3**)
3. Lithium sale and storage permit, granted by the **Comisión Nacional de Energía Nuclear, CChEN**

At present, **CCHEN, CORFO, SERNAGEOMIN** and the **Dirección General de Aguas (DGA)** are the public bodies involved in the exploitation and control of lithium in brines. However, **CCHEN** is the agency responsible for the control of the commercialization of lithium.

CCHEN: La Comisión Chilena de Energía Nuclear (CCHEN) It was created in 1965 by Law No. 16,319. In the field of lithium, it must fulfill the roles assigned by the specific legal provisions for lithium; that is, it represents the State in everything related to the state reserve of natural atomic materials and lithium, for which it exercises **control over the extraction and commercialization of these minerals**. In practical terms, CCHEN must exercise in the first instance the option to purchase the State over lithium if it is of national interest and authorize the commercialization of the rest of the lithium for expressly non-nuclear purposes (nuclear fusion). Currently, this public body keeps a record of the lithium sales of the two companies authorized to exploit it in Chile, and the corresponding control so that they do not exceed the limits established for each of them.

CORFO: The Corporación de Fomento a la Producción (CORFO) **owns concessions in the Salar de Atacama prior to 1979**, which are currently operated by the Albemarle and by SQM, under specific contracts with limits to the extraction of lithium in the Time and / or quantity. The role of the corporation in lithium is basically to safeguard their rights in contracts and collect agreed payments.

SERNAGEOMIN: El Servicio Nacional de Geología y Minería (SERNAGEOMIN) fulfills the role on property, safety and mining production assigned by its organic law, considering the specific characteristics of concessions to exploit lithium. It also corresponds to identify the location and characterization of lithium resources in the national territory. In this context, it collects information on the amount of brine extracted from the salt and the production of potassium and lithium salts, and boric acid.

DGA: The General Water Agency (DGA) athorises and manage water rights and brine reservoirs, considering their sustainability and their compatibility with the rights of other users of the basin, mainly local agricultural communities.

<u>Other relevant actors in the Salar de Atacama</u>

Indigenous communities

In the sectors that border the salar, the communities of **Peine** (600 inhabitants approx.), **Toconao** (800 inhabitants approx.) and the small communities of **Camar, Socaire and Talabre** now live. The communities and ayllus of **Solor, Séquitor, Cucuter and Solcor** are also part of the river basin. The local economies are related to high Andean agricultural and livestock activity, linked to the cultivation of corn, quinoa, vegetables and an important fruit activity in the stream of Jeré by the community of Toconao. However, this activity has been declining, given that a good

part of the population of the communities works in the mining activity that exists in the salar, especially in the mining of lithium that has been exploiting the area for more than twenty years, but also in deposits of copper that are located nearby, belonging to **Minera Gabriela Mistral, Minera Zaldívar, Minera Escondida and Chuquicamata.**
The comunidades atacameñas play a relevant role in the administration of the territory, as is the case of the Los Flamencos reserve that they co-administer with the **CONAF** (Corporación Nacional Forestal). On the other hand, there are actors such as the ***Comité de regantes***, which brings together *atacameños* and non-*atacameños* users from the San Pedro and Vilama River, which is part of the Atacama Salar Basin, who have also claimed against the authorization of lithium extraction quotas increase in the salar whose speech is very focused on the serious water situation of the rivers that encourage the salar.
El **Consejo de Pueblos Atacameños (CPA)**[3] is an indigenous association that was born in 1994 with legal personality under the protection of the Indigenous Law. It currently brings together 18 indigenous communities of the Atacama la Grande Indigenous Development Area, who through their presidents choose their board that unifies them as a people. One of the objectives established by its organizational Statute is to preserve and promote the development of the culture and values of the *Atacameños* people, ensuring the strengthening of the spirit of community and solidarity among its members.

Albemarle currently has a Cooperation, Sustainability and Mutual Benefit agreement with the **CPA** signed in January 2016. Through this agreement, Albemarle undertakes to deliver 3.5% of the sales of Lithium Carbonate and Potassium Chloride produced in the Salar Plant already to establish a joint work for the monitoring and surveillance of the environmental resources of the Salar de Atacama.
BHP through its work Minera Escondida and **Antofagasta Minerals (AMSA)** through Minera Zaldívar, are the two copper companies that operate near the Salar de Atacama and have water rights in the basin. Both have developed a common hydrogeological model.
The Municipalidad de San Pedro de Atacama in its current and previous administration has maintained a close relationship with both the Lickatantay communities and the lithium mining companies.

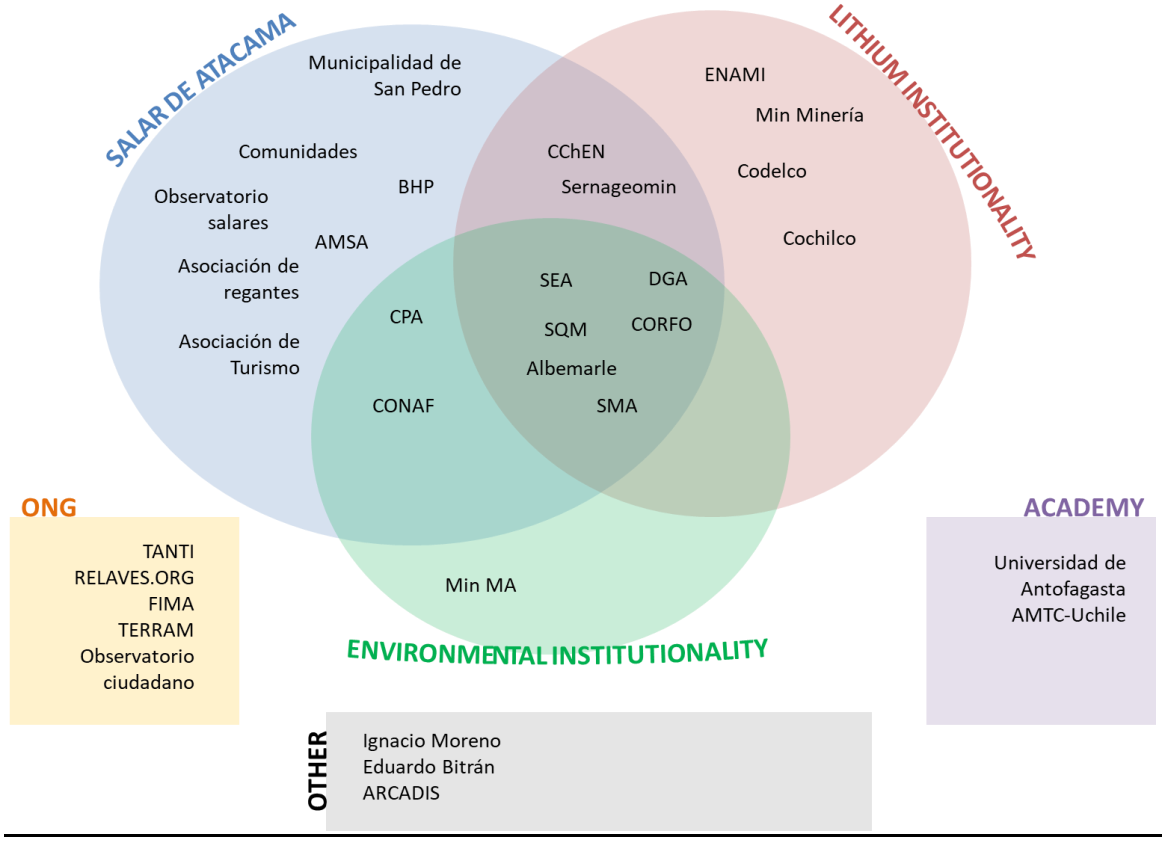
<u>Non-governmental organizations and academy</u>
There are several institutions of non-governmental and academic that currently maintain an active interest and participation in the Salar de Atacama, is the case of the **Fundación Local agroecológica Tantí**[4] and the NGO **FIMA** whose last year, together

[3] Lickanantay.com
[4] Fundación Tantí, meanwhile, is an organization formed a year ago by members of the Colectivo Chañar that is dedicated to promoting agroecology and sustainability in San Pedro de Atacama, manages projects with government and external sources to carry out activities in San Pedro de Atacama, and has supported the mobilization against mining companies in the area, forming part of another resource for protection from environmental damage to the salar against the recent agreement between CORFO and SQM to extend the quotas for the extraction of lithium, which also is in process.

with the communities of the Salar, the **CPA** and other organizations such as the **Comité de Regantes del río San Pedro** presented two protection appeals at the *Corte de Apelaciones de Santiago* for environmental damage to the salar and for no prior, free and informed indigenous consultation on the agreement concluded between CORFO and SQM to triple the production of lithium, transgressing territorial rights and further jeopardizing the precarious water situation of the salar (OCMAL, 2018).
Other organizations such as the NGO **Terram**, whose main role has been to work more in copper mining, are becomming interested in the impacts of Lithium production in Chile.
From the point of view of research and academy, there are experts currently working both in the hydrogeological characterization of the salar and in the study of its ecosystems. At the **Universidad de Antofagasta** several scientists are developing studies associated with lithium production, including studies of saline deposits and also studies of biodiversity of microorganisms in salt flats and their adaptations to live in extreme conditions. On the other hand, at **the Universidad de Chile**, scientists from **AMTC** unit is studying non-evaporative lithium extraction processes.

There are other researchers and experts in the field, but they could not be reached during the January interviews.

Stakeholders Diagram (own elaboration)



Summary of Role and functions of public institutions in Chile

Institution	Role and Funtion
Ministerio de Minería	Support the **growth of mining activity** and investment in our country, both private and public. Position Chile internationally as a quintessential mining country. Support the development of small and medium-sized mining through specific policies for the promotion and development of markets. Implement specific actions to promote public-private collaboration that will enhance the activity of the industry at all stages of the productive, labor, environmental and commercial chain. Design the **strategic guidelines** that allow improving the performance of the companies and public addresses in charge
CChEN	It is responsible for overseeing all minerals of nuclear interest, includes Lithium, and **imposes on SQM and Albemarle how much lithium to exploit, setting annual quotas for that purpose.** Its function is to act instead of the State and exercise its rights. Also analyze and study the possibility of increasing the exploitation of lithium taking care of compliance with the standard. Through agreements of its board of directors and to the tests of the comptroller general of the republic **authorizes the sale of Lithium in the country**.
Ministerio de Medio Ambiente	Responsible for environmental policy and regulation. Lead sustainable development, through the generation of efficient public policies and regulations, promoting good practices and improving citizen environmental education.
Superintendencia del Medio Ambiente (SMA)	**Environmental oversight/auditing, sanctions and monitoring** Decentralized public service, with legal personality and its own assets, subject to the supervision of the President of the Republic through the Ministry of Environment. The SMA fulfills a supervisory and sanctioning role on the environmental management instruments in force in the country (Law 19,300): **Qualification Resolutions (RCA),** Emission Standards, Quality Standards and Plans for Prevention and / or Environmental Decontamination, and of all those other instruments of an environmental nature established by law.
Servicio de Evaluación Ambiental (SEA)	It is a functionally decentralized public body with legal personality and its own assets. It's in charge of the administration of **the environmental management instrument called "Sistema de Evaluación de Impacto Ambiental" (SEIA),** whose management is based on the environmental evaluation of projects adjusted to what is established in current regulations. In addition, it must standardize the criteria, requirements, conditions, background, certificates, procedures, technical requirements and environmental procedures established by the relevant ministries and other State agencies in order to ensure the protection of the environment.
Corte suprema y tribunales ambientales	Access to environmental justice and dispute resolution.
CORFO	Owner of the Salar de Atacama. Modifications to the SQM and Albemarle lease agreements are approved through its council of ministers.
Dirección general de aguas (DGA)	Manage, verify and disseminate the country's water information, especially regarding its quantity and quality, the natural and legal persons that are authorized to use them, the existing hydraulic works and their safety; with the aim of contributing to greater market competitiveness and the protection of legal and water certainty for the sustainable development of the country. It is the responsibility of the regular DGA or to approve the rates of brine extraction in the aquifer of the Atacama salt flat, but they do not have any

	permits. That is, they participate in the SEIA but, finally who signs the permits is not DGA.
COCHILCO	Advises the Government in the preparation, implementation and evaluation of policies, strategies and actions that contribute to the sustainable development of the national mining sector (metallic and non-metallic, except coal) and to strengthen its contribution to the rest of the economy. Also, safeguard the interests of the State in its mining companies, supervising and evaluating its management and investments. It is apart of the Ministry of Mining.
SERNAGEOMIN	Update and online access to geological maps: Digital version of the National Geological Mining Archive. Small and medium-sized mining development. Fulfills the role on property, safety and mining production assigned by its organic law, considering the specific characteristics of concessions to exploit lithium. SERNAGEOMIN delivers permits associated with the safety of the operation and is responsible for the closure of lithium mining facilities It also corresponds to identify the location and characterization of lithium resources in the national territory.
ENAMI	Develop proactive legislative agenda to promote materials that promote development of the sector and exploitation of minerals other than Copper (nitrates, iodine, lithium). Boost innovation. It is part of the Ministry of Mining
Comisión Nacional del Litio	It was created in 2014 through the Committee of non-metallic mining (and salt governance). It was proposed to respond to the demand for greater sectoral coordination; Design of a national policy for salt or lithium governance; boost the sector and protect salaries; promote the generation of value; improve project control. The commission made a suggestion of a development plan for the salaries, however during the government of President Piñera the commission stopped working.
Comunidades Indígenas	Atacameño people established in the Salar de Atacama and its surroundings. They develop agricultural and livestock activities, although it has been declining due to mining activity. They are the main affected by local water stress. They have not participated in the negotiation of CORFO's contracts with SQM and Albemarle, but they currently receive incomes by agreement agreed with Albemarle. They participate in the Environmental Assessments whenever there is a significant impact on the project (as indicated by the EIA). However, their opinion is not binding.
Municipalidad de San Pedro de Atacama	Political administrator of the territory that includes the Salar de Atacama.

5 Administrative and legislative arrangements for Lithium exploration and water rights

Administrative and legislative arrangements for Lithium (State conventions)

In the Salar de Atacama, lithium is extracted by drilling wells and pumping high mineralized groundwater (fossil groundwater of deeper aquifers) to the earth surface and discharging into different one after another constructed artificial basins to start the evapotranspiration process. The average depth of the exploration wells is between 30 and 50 m, the deepest wells up to 200 m; the exploration basins have dimensions between 500 m and 1 km of lateral length.

The Chilean state is the owner of the natural lithium resources in the Salar de Atacama (Decreto Nº 2886, 1979).

The governmental institution CORFO (Corporación de Fomento de la Produccion) which belongs to the Ministry of Economics Affaires, granted licenses to the following mining companies:

- SQM (Sociedad Química y Minera de Chile, ex: SOQUIMICH: Sociedad Química y Minera de Chile)
- Albemarle Corporation, US chemical groups (ex: Rockwood and ex: Sociedad Chilena del Litio).

SQM

Before 2017, SQM was in charge to extract up to 180.000 t lithium as metallic equivalent (LME) or in other terms 950.000 t LCE (Lithium carbonate equivalent) until 2030.

In 2018, CORFO updated the permit to SQM. Since 2018, SQM got a permit to extract in total up to 349.553 t lithium as metallic equivalent (LME) until 2030. Additionally, CORFO granted SQM a permit to extract 112,000 t under the precondition that SQM shall produce 100.000 t lithium of battery grade (Sichel R., Sebastián, 2018).

Albemarle

Before 2017, Albemarle hold a permit to extract 200.000 t LME until 2043. Additionally in 2017, CORFO granted Albemarle a permit to extract between 26.000 t and 82.000 t lithium of battery grade (carbonate of Lithium battery grade). Integral part of the convention between CORFO and Albemarle is the permission given to Albemarle to

use a territory about 167 km^2 in the southern sector of the Salar de Atacama for mining activities (CORFO, 2018).

Water rights

Mining companies

According to DGA data, Lithium mining companies (SQM and Albemarle) have 263.5 l/s of drinking water from the upper freshwater aquifer (8.35 million m^3/a) and 2142 l/s (67,5 million m^3/a) from the deeper lithium rich groundwater body (deeper high mineralized aquifer). Additionally, Minera Escondida (copper mining company) has water rights of about 3190,8 l/s at the southern border of the water basin.

In the Atacama water basin, the mining sector as a whole (copper and lithium) exploits water resources up to 4.768 l/s (of the 5.400 l/s entering the Salar according to previous estimates) (Jerez et al. 2018).

According to interviews performed in January 2020, the mining industry owns water rights of 3145 l/s in the water basin of the Salar de Atacama (SQM 450l/s, Albemarle has 23,5 l/s, BHP and AMSA 2000 l/s, and 645 l/s other mining companies). Tourism, drinking water supply and agriculture use 2268,7 l/s.

Public water supply for municipalities and communities:

The public water supply mainly uses surface waters (streams, small lagoons, salt flats and springs) and, to a lesser extent, groundwater (Jerez et al. 2018).

The 18 communities within the water basin of the Salar de Atacama abstract surface water and groundwater from the upper aquifer according to the following rights. In total they have water rights corresponding to 2622,95 l/s but only Solor, Toconao and Catarpe have water rights to use groundwater up to 48,9 l/s.

According to DGA website, in total, 7272 l/s of groundwater rights have been granted in the water basin of the Salar de Atacama

It is important to mention that springs are categorized as surface water.

Brine pumping permits

According to interviews performed in January 2020, SQM and Albemarle are pumping 1700 l/s and 442 l/s of brine respectively.

Surface water (DGA, 2020, https://dga.mop.gob.cl/productosyservicios/derechos_historicos/Paginas/default.aspx)

Owner	Q (l/s)	Use	Source	N° derechos solicitados
COMUNIDAD INDIGENA ATACAMEÑA DE PEINE	10 (5x2)	NI	Vertiente Tilocalar	2: **NR-0202-5045/1** **NR-0202-5048/1**
COMUNIDAD ATACAMEÑA DE PEINE	43	Other	Rio Tulan	**NR-0202-1383/4**
COMUNIDAD ATACAMEÑA DE PEINE	1,7	NI	Vertiente Tarajne	**NR-0202-1383/3**
COMUNIDAD ATACAMEÑA DE PEINE	18	Other	Vertiente Ossa y Vilte	
COMUNIDAD ATACAMEÑA DE PEINE	2,3	Other	Vertiente Chaquisoque (lagunas Miñique-Miscanti)	**NR-0202-1383/3**
COMUNIDAD ATACAMEÑA DE PEINE	18,6	Other	Vertiente Ossa y Vilte	NR-0202-1383/1
PRELATURA DE CALAMA	20	Irrigation	Quebrada Cuno de Socaire	ND-0202-2743/1
SENDOS II REGION	0,47	Bebida/Uso Domestico/Saneamiento	Quebrada Cuno de Socaire	ND-0202-2741/1
COMUNIDAD ATACAMEÑA DE SOCAIRE	0,33	Other	Vertiente Tuyajto	
COMUNIDAD ATACAMEÑA DE TALABRE	35	Other	Vertiente Chamaca	NR-0202-2138/1
NR-0202-2138/2	100	Other	Rio Negro	NR-0202-2138/2
COMUNIDAD ATACAMEÑA DE SOCAIRE	130	Irrigation	Quebrada Cuno de Socaire	NR-0202-1389/1
COMUNIDAD ATACAMEÑA DE SOCAIRE	5	Irrigation	Vertiente Quepe	NR-0202-1389/2
COMUNIDAD ATACAMEÑA DE CAMAR	3,2	Other	Vertiente Camar	NR-0202-1385/1

COMUNIDAD ATACAMEÑA DE CAMAR	10,4	Other	Vertiente Camar	NR-0202-1385/2
COMUNIDAD ATACAMEÑA DE CAMAR	6,9	Other	Vertiente Turbaca	NR-0202-1385/5
COMUNIDAD ATACAMEÑA DE CAMAR	3,4	Other	Vertiente Corcacte	NR-0202-1385/4

6. Environmental pressures and impacts resulting from Lithium extraction and production

The overall environmental objective is

- to manage the surface water and groundwater bodies sustainable
- to protect the bodies of surface water and groundwater and
- to ensure a balance between abstraction and recharge.

Fresh groundwater is an important source of water supply for the indigenous communities. Additionally, a special protection for the conservation of habitats and species of the ecosystems (e.g. international and national protected areas like RAMSAR and Reserva Nacional „Los Flamencos“) directly depending on groundwater is part of the overall environmental objective.

Consequently, Chapter 6 has to review the significant anthropogenic pressures on water bodies (1st step) and to assess their impacts on the status of surface water and on groundwater bodies (2nd step).

Identification of pressures on the quantitative status of water bodies

Significant anthropogenic pressures on the bodies of surface water and groundwater are coming from the following installations and activities

- water abstraction of the mining companies (SQM, Albemarle, BHP, Antofagasta Minerals)
- water abstraction for drinking water services of the municipality of San Pedro de Atacama and its 18 communities (including water demand of the tourism)
- water abstraction for agricultural uses (irrigation).

<u>Lithium-brine groundwater and fresh groundwater abstractions of the mining companies</u>

SQM (lithium mining)
Deeper brine aquifer: 1.700 l/s (53,6 Million m^3/a)
Upper drinking water aquifer: 240 l/s (7,6 Mil. m^3/a)

Albemarle (lithium mining)
Deeper brine aquifer: 442 l/s (13,9 Million m^3/a)
Upper drinking water aquifer: 23,5 l/s (0,74 Mil. m^3/a)

BHP (Copper Mining, Escondida)
Drinking water aquifer 1543 l/s (48,6 Million m^3/a)

Antofagasta Minerals (Copper Mining, Zaldivar)
Drinking water aquifer 625 l/s (19,7 Million m^3/a)

Surface water abstractions of drinking water services incl. tourism (human consumption)

Public water supply 2.622,9 l/s (82,7 Million m^3/a)

Water abstraction for agricultural uses (irrigation)

Significant water abstraction for agricultural uses is located in the north of the water basin on both sides of the river systems of Río San Pedro including tributaries (e.g. Rio Grande) and Río Vilama. Between the 1940ies and 2014, the mean run-off regime of the river San Pedro decreased nearly up to 50 % from 1127 l/s (1940ies) to 620 l/s (2014). Referring to the river Vilama the decreasing of the mean run-off situation is more dramatically from 332 l/s (1940ies) to 76 l/s (2014). The effects of climate change (reduction of humidity cells from Amazonia, la Niña) are the main reason for changing the surface waters run-off regime of both rivers, dramatically (Sepulveda et al, 2015).
Accordingly to the decreasing of the media run-off of the rivers San Pedro and Vilama is was necessary to reduce the agricultural areas of irrigation from 1210 ha (1964) to 709 ha (2014). The water authority DGA (Dirección General de Aguas) has classified the Río Vilama as exhausted („agotado“; DGA, 2016).
Another point of concern for irrigation activities of the both irrigation associations (Asociación de Regantes de San Pedro de Atacama, Asociación Atacameño de Regantes del Río Vilama) is the geogenic qualitative situation concerning the concentration on boron and arsenic of river San Pedro and Vilama (2,5 mg/l to 17,0 mg/l boron, 0,13 to 0,62 mg/l Arsenic).

Review of the impact of human activities on groundwaters

The groundwater level regime is the crucial parameter to identify the impacts on the quantitative status of the groundwater bodies. The level of groundwater in the groundwater bodies should be such that the available groundwater resources are not exceeded by the long-term annual average rate of abstraction.
Accordingly, the level of groundwater should

- avoid any significant damages to terrestrial and aquatic ecosystems which depend directly on the groundwater bodies (e.g. international and national protected areas like RAMSAR and Reserva Nacional „Los Flamencos“)
- not cause saltwater „brine“ intrusions into the fresh drinking water aquifer.

Review of the impacts of mining activities on groundwater resources

The monitoring programme of SQM to measure the effects of groundwater brine abstractions demonstrates that the groundwater level of the brine aquifer is constantly decreasing. Between 2007 and 2018, the downward trend of the groundwater level is up to 5 m in the western part and up to 1 m in the eastern part of the pumping activities of SQM (SQM-Monitoring, January 2020).

It can be estimated that the Lithium-brine pumping activities of Albemarle will have the same negative effect by decreasing constantly the groundwater level of the deeper brine aquifer. The continuation of Lithium brine abstractions or even their raising up will increase the risk to impact the high sensitive interface between “sweet” fresh groundwater (density: 1,0 g/cm^3) and salty (saline) groundwater resources (density 1,23 g/cm^3). Modifications of the sensitive sweet/salt groundwater interface could have the effect on reducing the groundwater reservoirs for drinking water purposes. Additionally, damages on water dependent aquatic ecosystems (Lagoons) and terrestrial ecosystems could not be excluded.

Additionally, the effects of fresh groundwater pumping (upper aquifer) leads to a lowering of the groundwater table between 0,25 m and 2,0 m in the alluvial regions of the water basin.

Knowing the characteristics of the fresh-saline groundwater interface is crucial to prevent salty groundwater intrusion into the fresh groundwater aquifer. Increasing the lithium-brine extraction by the mining companies will intensify the pressure on the fresh groundwater aquifer even more.

Until now, it is not clear if fresh groundwater levels in the marginal areas of the water basin are stressed by lithium-groundwater abstractions of the mining companies.

Constant monitoring of the vulnerable fresh-salt water interfaces is necessary for an integrated management of groundwater resources to avoid impacts on the drinking water supply.

Experts of different administration authorities informed on earth subsidence up to some meters because of extensive brine abstractions (Interviews in January 2020). This information has to be checked.

Review of the impacts of mining activities on aquatic and terrestrial ecosystems

The main purpose of the self-monitoring programs of Albemarle and SQM is to develop an early-warning system to avoid any modification of the water level of the lagoons by abstracting Lithium-brines and fresh water. Albemarle operates the activities of its monitoring program on water resources, soil and on water dependent ecosystems of the lagoons (ecosystem functions) in an exemplary way in close co-operation with experts of the indigenous communities.
However, up to now the requirements of water dependent terrestrial ecosystems are still unknown. This open question on the ecosystem functions for example of the Tamarugo biotops (groundwater level should be 20 m, 30 m or 40 m under earth ground) has to be answered by ecologists. Albemarle and SQM will pay more attention on the water demand of other special Chilean flora species like Tamarugo (Prosopis tamarugo) and Algarrobo (Prosopis chilensis).

One important part of the monitoring programs of Albemarle and SQM is to measure and preserve the good ecological status of the lagoons. Concretely, the composition and abundance of phytoplancton, aquatic flora and benthic invertebrate fauna as eco-indicators are part of the biological elements of the monitoring programs of SQM and Albemarle.
Chemical and physico-chemical elements like transparency, thermal conditions, oxygenation conditions, salinity and acidification status are supporting the biological elements.

The observation wells of SQM, which are part of the early warning system, are manually measured only one time daily. Information technology should be used to improve digital recording and transfer of the quantitative monitoring data to a central IT-platform. Digital online monitoring is necessary to avoid any over-exploitation of the deeper and upper aquifers.

SQM and Albemarle provide all monitoring data to the water and environmental authorities (DGA, MMA, CORFO).

Neither SQM and Albemarle nor the competent water and environmental administration are planning to offer online-information services to the municipality of San Pedro de Atacama, its 18 indigenous communities and interest groups (NGO´s).

SQM and Albemarle should install an IT-platform to make public all monitoring data and results to involve actively the interested groups and parties as part of public information, participation and consultation. The monitoring data should be make available for comments to the members of the municipality San Pedro de Atacama and the indigenous groups (e.g. Consejo de Pueblos Atacameños –CPA-) and the public as one important communication element to rebuild confidence between water users (e.g. Albemarle, SQM) and public (Municipality San Pedro de Atacama, indigenous communities, CPA).

Additionally, an area-wide mapping of the species of flora and fauna (Flora-Fauna-Habitat) in the groundwater depression cones caused by SQM and Albemarle pumping activities of lithium-brine and fresh groundwater resources should be realized as an important factor to identify and protect all habitats and species and to improve the sustainable management of water resources.

The objective is to identify the sensitivity of the landscape ecology within the groundwater depression cone and to derive the ecological significance of the different Flora and Fauna species. Another objective of the area-wide mapping of Flora-Fauna-habitats will be to determine the potential of regeneration to improve the ecological situation within the groundwater depression cones of SQM and Albemarle.

Albemarle, SQM, BHP and Antofagasta Minerals are using modelling techniques like numeric groundwater models to identify the effects and impacts of pumping activities and to improve the water management referring to the protection of ecosystems like lagoons (Interviews with mining companies, January 2020).

Unfortunately, a regional groundwater model is missing to integrate the sectoral numeric groundwater models of the four mining companies. A regional „integrated“ groundwater model would be necessary to calculate overlapping and accumulating pumping effects and impacts of the four mining companies on surface and groundwater resources within the water basin of the Salar de Atacama.

To promote a sustainable management of groundwater resources it is essential that first the requirements of water dependent ecosystems (lagoons, flora and fauna) should be identified as limiting factors. Secondly, considering the limiting factors of the water dependent ecosystems the abstraction rates of brine could be calculated by using the numeric groundwater model.

Review of possible impacts coming from surface water abstractions of drinking water supply services incl. tourism and for agricultural uses (irrigation)

Referring to opinions of different expert (expert judgement) the question is still open if there are risks or impacts coming from water abstractions of the urban and agricultural sector on water balances and on the terrestrial and aquatic ecosystems depending directly on the groundwater bodies. Nevertheless, it is necessary to complete the monitoring network to get more data and information on the effects of water abstractions of the public water supply companies and the both irrigation associations (Asociación de Regantes del río San Pedro de Atacama, Asociación Atacameño de Regantes del Río Vilama).

7 Impacts on the socio-economic situation of the indigenous municipalities

The water basin of the Salar de Atacama has a total population of about 10.996 inhabitants (CENSO 2017). Besides the municipality of San Pedro de Atacama (5.600 inhabitants) the indigenous communities of Peine (600 inhabitants), Toconao (800 inhabitants) and small communities (ayllus) like Camar, Socaire and Talabre are located near the mining plants and installations of Albemarle and SQM. Farther away are located the ayllus of Solor, Séquitor, Cucuter and Solcor.

The major part of the total population identifies themselves as indigenous or descendant of the origin Atacameños or Likanantay people, living since 1500 years in the water basin of the Salar de Atacama.

With the change of the political regime (from dictator to democracy) at the end of the 1980s an indigenous policy was started. One result of this process was the Indigenous Law, putting into force in 1993. The Indigenous Law recognizes the Atacameño communities as an ethnic group. Because of the Indigenous Law, the Atacameños communities are addressing demands involving reclamation of their territory and water resources based on their historical ownership to the Lithium mining companies.

Using water of the main streams of San Pedro and Vilama and of the streams from the east side of the water basin (e.g. Toconao, Peine, Solcor) has been an essential sociocultural and economic factor in the historical development of the communities (ayllus) in order to practice traditional sustainable livestock and agricultural irrigation with elementary Andean technology to harvest traditional crops like maize, quinoa, potatoes, beans and pumkins.

Irrigation management and cooperation of agricultural areas is of major relevance for the working and social life of the indigenous communities (ayllus). The different ayllus (indigenous communities) prefer to manage the run-off of both rivers in an integrated way and independent of the downstream or upstream location of their territory. The model of the ayllus is that land, soil and water resources are indivisible and one unit to manage.

For this reason, the indigenous communities put themselves in contrast to the neoliberal Chilean Constitution and Water Law (Código de Agua, 1981) to privatize water rights and to decouple the property of water rights from the landowner.

Basically for the sociocultural understanding of the Atacameños people is that the ayllus (communities) are built by traditional social units of families or small collectives.

Each ayllus is living more or less autarkically and has a self-sustainable approach considering the management of water, the production of crops, the breeding of livestock, the management of pasture and forest in an integrated way (agroecosystems).

Since 1940 the runoff of the rivers San Pedro and Vilama have been decreasing due to climate change (reduction of humidity cells from Amazonia, la Niña). Consequently, the ayllus communities are forced to adapt their water management and technics to continue with the agricultural irrigation systems (Sepúlveda et al., 2015).

Additionally to the effects of climate change effects, the lithium mining started in 1984, investing in large-scale Lithium mining projects located in the center of the Atacama Desert. The Lithium water abstractions of SQM and Albemarle require large quantities of salt groundwater (salmueras) and fresh groundwaters (upper aquifer). Obviously, the Lithium mining industry has become - beside the copper mining near the southern border of the water basin – the greatest water consuming sector.
Most of the mining plants and installations are overlapping nature conservation areas, biodiversity protection sites and communal lands claimed by the indigenous peoples.
Another pressure, which is until now not monitored, could be the increasing public water demand of the tourism sector.

The indigenous communities consider SQM, Albemarle, and the Lithium mining activities as invaders and competitors producing the following negative impacts on environmental and social issues (Gundermann, H. & Göbel, B., 2018):

<u>Social impacts</u>

- The Atacama area of the water basin belongs to the indigenous Atacameños people. According to the sociocultural spirit of the Atacameños, the using and maintenance of the land should happen in an open system. Fragmentation and separation of territory done by SQM and Albemarle are completely unknown activities offending the unique biological and cultural diversity of the water basin.

- Beside the subsistence farming of the ayllus the upcoming tourism offers an additional earnings for indigenous communities. However, tourists will come to see

the bio-diversity of the natural sites of the Salar de Atacama without any anthropogenic contamination caused by the Lithium mining companies.

- The economics of the mining and tourism sector is changing the social-cultural and ancient traditions of the indigenous communities. Additionally, the monetary compensation of Albemarle (see: Chapter 8) is creating social conflicts among the local indigenous ayllus and communities.

Environmental and health impacts

- SQM and Albemarle have constructed plants and installations (e.g. large evaporation ponds, housing of the workers) in a pristine natural landscape of the Salar de Atacama. Mining activities (e.g. roads, transportation, noisiness, machinery) will have an effect on the ecosystems and is blocking the biological corridors and the passageways of livestock.

- Groundwater abstractions of SQM and Albemarle will have impacts on flora and fauna (e.g. flamingos, birds, vicunas, insects and microorganisms), the water dependent ecosystems (lagoons), the drinking water sources (surface water, groundwater) and on traditional irrigation practices of the ayllus-communities.

- Lithium mining produces clouds of dust depositing on cultivated areas, crops and protected areas (e.g. RAMSAR). The Lithium enriched dust could cause health problems and will contaminate soil and water (Figueroa, L.T. et al, 2014).

To sum up,

1. in the light of a dramatically decreasing of the media run-off of both rivers San Pedro and Vilama during the last 70 years, the indigenous communities are under high pressure to adapt constantly their irrigation management to safeguard their traditional small scale subsistence farming without market-orientation and without profit-orientation (DGA, http://snia.dga.cl/observatorio/).
2. Since 1984, the Lithium mining companies SQM and Albemarle received state permissions to use territories of the Atacameños communities and water rights for abstracting salt and fresh water without any information, consultation or participation of the indigenous societies (ayllus). Social or environmental concerns

of the indigenous communities were not respected (Bolados Garcia. & Bebidge, , 2016).

3. SQM and Albemarle are producing environmental, resource and social costs (negative external costs) to the indigenous societies without any state obligation to minimize or compensate the negative external costs (polluter pays principle). Policymakers (Buyung A. et al., 2018) do not anticipate the potential of such negative externalities of lithium mining activities.
4. Several times since 1984, governmental institutions allocated higher Lithium extraction quotas and water rights to SQM and Albemarle without any consultation or participation of the indigenous societies. The indigenous communities lost any confidence in cooperation activities with state institutions. Nowadays, the indigenous communities pave the juristic way to Chilean tribunals and courts of justice to gain right.

8 Negotiated environmental and socio-economic agreements

The Lithium Mining in the center of the Salar de Atacama, one of the driest deserts in the world, generates ecological and economic impacts. Referring to the international state-of-the-art of Integrated Water Resource Management (IWRM) negative external cost (externalities) should be minimized and compensated by economic instruments (so called: internalization of environmental and resource costs).

Albemarle and SQM prefer private enterprise solutions by negotiations directly with the indigenous communities (e.g. Peine), the Consejo de Pueblos Atacameños (CPA) and the municipality of San Pedro de Atacama. Both mining enterprises are choosing different approaches to find solutions with the indigenous institutions (e.g. CPA) to reduce or avoid conflict situations. Since the amendments to the contracts in 2018 it is obligatory that both mining companies have to support financially the communities, the municipality and the regional government by 1,7 % of the sales (CORFO, 2018)

Agreement between Albemarle and Consejo de Pueblos Atacameños (CPA)

In 2016, Albemarle signed an agreement (contract) with CPA. CPA is a kind of an umbrella organization including 18 indigenous communities as members. Albemarle has committed to pay 3 % annually of the annual sales to CPA. The CPA decides that each of the 18 communities should get the same budget.

The fact is welcome that the negotiation procedures between Albemarle and the indigenous communities (CPA) are headed in a communicative and constructive manner on the same level of both actors.

In 2017, Albemarle transfers 130 million Chilean pesos (correspond to 151.000 €) via CPA to each of the 18 communities (one or more ayllus). Considering the different population of each community (more than 600 inhabitants, less than 50 inhabitants), the method and chosen form of financing the indigenous communities and the municipality San Pedro de Atacama by Albemarle differ extremely and is less transparent.

Beyond that, CPA is self-dependent to decide which institutions, which activity and which measures should be promoted. Standing rules or promotional programs to provide and initiate projects to improve or develop rural infrastructure doesn´t exist. Only in a very general way CPA as umbrella organization of the 18 indigenous

communities' reports on the investments, the communities made in the last year, and prepares a list of projects to be financed in the next year.

Additionally to CPA, the municipality San Pedro de Atacama has signed a special bilateral agreement (contract) with Albemarle. The application of Albemarles´ funding to the municipality of San Pedro de Atacama is not published.

The special CPA´s decisions to manage and administrate the annual 3% transferred budget of Albemarle seems not to be transparent. Another weak point is that not all ayllus or communities within the water basin of the Salar de Atacama will get a benefit of the financing compensation by Albemarle. This leads to dissonance and frictions inside the indigenous communities (ayllus) and associations.

Relationship between SQM and Consejo de Pueblos Atacameños (CPA)

With regard to Albemarle, SQM refused in the past to sign agreements (contracts) with CPA or the indigenous communities (ayllus). According to the new contract SQM signed with CORFO in 2018 (CORFO, 2018), the indigenous communities or CPA has to tender project proposals to SQM to the following topics:

- historical heritage (local games, local festivities, promotion of local production, live heritage)
- education and culture
- social development.

At least, SQM or a third involved party decides which of the project proposal should be accepted and should get a funding.

The relationship between SQM and the indigenous communities appears to be more of a paternalistic approach (Pan Para el Mundo, 2018; Gundermann, H. & Göbel, B., 2018). Until now, the indigenous communities are refusing their approval on this element of the contract between SQM and CORFO.

9 Follow-up and sustainability, risks and opportunities to establish a multi-stakeholder partnership

With reference to the interviews with the stakeholders during the January mission the topics of this chapter are:

- identifying problems and risks regarding to sustainable lithium production in the Salar de Atacama,
- specifying opportunities for a multi-stakeholder dialogue as an participative instrument regarding sustainable lithium production in the Salar de Atacama to minimize risks and to strengthen the findings for joint solutions,
- identify frame conditions (tools) to implement a multi-stakeholder partnership.

To begin with, the risks to establish a multi-stakeholder dialogue are the following:

1. Currently, Chile is facing a drastic political change. The neoliberal Chilean Constitution that was put into force during the military dictatorship could be significantly changed. President Piñera has scheduled the date for the Referendum to vote pro or contra the revision of the Chilean Constitution on 26th April, 2020. One of the principal topic will be to amend the Water Law (Código de Agua, 1981), which has privatized water rights. Privatization of water rights (mining companies are the greatest owner of water rights) and decoupling water rights from land ownership has benefitting the mining sector as the most important export sector of Chilean economy. Political uncertainties on the results of the Referendum and how to implement it could lead to a moratorium especially of the fragmented and often inconsistent operating governmental institutions until the results of the Referendum will be implemented.

2. The granting of rights to SQM and Albemarle to use land and groundwater resources for Lithium production in the Salar de Atacama took place in the 1980ies during the period of the dictatorship without any information, consultation and participation of the indigenous communities. Until now the affected indigenous society is hardly involved in governmental decisions on water and land owner rights within the water basin of the Salar de Atacama. Multi-stakeholder dialogue on the basis of transparent communication, consultation and participation will be a new instrument leading to a paradigm change for all actors and stakeholders.

3. In 2017 and 2018, the responsible governmental institution (CORFO) increased the quota to abstract Lithium-containing groundwater to SQM and Albemarle without any active involvement of the indigenous communities. The Environmental Impact Assessments (EIA) and the Resolutions of Environmental Qualification (RCA) are done subsequently, confirming generally the quota allocated by CORFO. The indigenous communities have appealed the compliance program of SQM to court. The Court for Environmental Affairs rejected the compliance program of SQM. Until now, the juristic procedure is open. The ongoing legal conflict between the indigenous communities and SQM as the two principal actors could put a strain on initiating a multi-stakeholder dialogue.

4. Generally spoken, the mining industry generating up to 60 % of the total Chilean export trade take legally and operationally precedence over environmental and social aspects (Gundermann, H; 2013). Mining law overrides environmental laws and social or civil laws (e.g. Ley de Indigenas). On the other hand, the responsibilities and law implementation of the national and regional environmental institutions and administrations (DGA, MMA, SermaGeomin) are weak and often unclear. Oftentimes it remains unclear who – if more than one environmental and water authority is involved – has the leadership. Governmental control and supervision of the implementation of environmental laws – for example groundwater level control to avoid over-exploitation - are marginally or because of missing experts did not take place.

5. The local actors like municipality San Pedro de Atacama, the indigenous communities, the umbrella organization (Consejo de Pueblos Atacamanos), the irrigation associations (Associaciónes de Regantes) and local ONG´s have lost any confidence in the acting of environmental and water state institutions and administrations. Additionally there is a lack of confidence between the communities and the mining companies, between the indigenous communities and the non-indigenous community and within the different indigenous communities.

6. The quantitative status of the bodies of groundwater could have an impact on the ecological quality of surface waters and terrestrial ecosystems associated with these groundwater bodies. It is highly appreciated that Albemarle and SQM have

elaborated conceptual and numeric groundwater models to calculate the impacts of groundwater abstraction on water dependent ecosystems and on drinking water resources (upper groundwater aquifer). Unfortunately, both groundwater models are elaborated separately. A coordination and harmonization of both groundwater models is missing. Consequently, it is not possible to calculate and evaluate overlapping and cumulative impacts of both activities to avoid damages on ecosystems and on saltwater inflow into the upper fresh groundwater aquifer.

7. Surface water and groundwater are in principle renewable natural resources. The deeper Lithium mineralized acquirer (Brine) seems to be even a kind of fossil groundwater resources with long retention periods. A good status of the deeper mineralized aquifer requires early actions and stable long-term planning of protective measures, owing to the natural time lag in its formation and renewal. The significant and sustained downward trend in groundwater level of the deeper aquifer indicates an over-exploitation. „Business as usual“ could lead to collapsing of the brine aquifer systems.

8. Achievement of the environmental objectives and in particular of Programs of Measures should be coordinated for the whole of the water basin of the Salar de Atacama in respect of surface water and groundwaters belonging to the same ecological, hydrological and hydrogeological system. Unfortunately, an approach of integrated water management (IWRM) including coordination between the different water users (Lithium and copper mining, drinking water supply, irrigation) are missing. Another weak point is that governmental institutions don´t set guidelines or input requirements at local level for information, consultation and involvement of the public and indigenous parties including water users.

To continue with, the opportunities to establish a multi-stakeholder dialogue regarding sustainable lithium production in the Salar de Atacama are:

1. During the two weeks mission in Santiago de Chile and San Pedro de Atacama, all institutions and interviewed persons were open-minded, straightforward and of high integrity giving their opinions on the different topics.

2. All interviewed institutions didn´t raise any concern over the GIZ proposal to establish multi-stakeholder partnership.

3. The indigenous communities and the municipality San Pedro de Atacama as one of the principal players of a multi-stakeholder dialog have more confidence in international organizations like GIZ than in the Chilean environmental and water administration. Additionally, SQM and Albemarle as the second principal player will support a multi-stakeholder dialog, which could lead to a multi-stakeholder partnership, finally.

4. SQM and Albemarle as well as the indigenous communities as the two principal actors agree jointly to the approach of an integrated water management in the water basin of the Salar de Atacama as an international state-of-the-art standard to meet sustainability.

Finally, the following frame conditions (tools) are identified to start preparing first a common vision of sustainable lithium production and a multi-stakeholder dialogue in a second step:

1. Communication design

The objective is that the different public and private actors shall participate and cooperate actively into the planning procedure and decision-making process.
A communication design should identify and support the way to integrate the different stakeholder groups into a transparent dialogue procedure. Regarding the really very different approaches of the relevant stakeholders groups, specific formats, which are tailored to the target group's specific requirements, are necessary to start and generate the dialogue procedure, efficiently. One element of the communication design should focus on the participation procedure; the other element has to look at the organizational steps to set up the Stakeholder dialogue procedure.

2. Overall methodological concept

The approach on Integrated Water Resource Management (IWRM) is international highly approved and respected. IWRM will pave the way for an efficient, fair and sustainable development and management of water resources to find solutions for conflicting approaches of the different stakeholder groups. Finding solutions under the

roof of IWRM would be a principal contribution for the water basin of the Salar de Atacama and the sustainable development of the northern Region (for the Chilean approach to IWRM; see: Annex 3).

Both principal actors (indigenous communities, mining companies) agreed to elaborate in a first step a comprehensive groundwater model as an important instrument to identify impacts coming from Lithium mining abstractions, to improve the monitoring programs on water resources and ecosystems and to identify measures to avoid damages on water dependent ecosystems, drinking water supply and irrigation. Precondition to perform the procedure to elaborate a joint groundwater model should be an open communication and collaboration. Both actors based on a common vision of sustainable lithium production should agree all steps and milestones to develop the groundwater model.

10 - References

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11. Annexes

Annex 1: Environmentally sensitive and irrigations areas (DGA, 2012).

Tabla 2. Vegas y Bofedales Identificados.

Nombre	Tipo	Número	Sup. (Ha)	Sector	Área protegida DGA
ESTANCIA VIEJA	Bofedal	1	4,12	3	Si
HECAR	Bofedal	2	2,12	3	Si
LAMPASAR	Bofedal	3	8,90	3	Si
YERBA BUENA	Vega	4	3,29	1	Si
PAILA	Vega	5	10,85	1	Si
ENVIDIAS	Bofedal	6	39,59	1	Si
ENVIDIAS	Bofedal	6	1,49	1	Si
QUEB. SILAPETI	Vega	7	11,44	3	Si
TOCONAO	Vega	8	24,66	3	Si
PURIFICA1	Vega	9	6,74	2	Si
TOCORPURI	Bofedal	10	4,42	1	Si
LA PUNTA	Vega	12	18,77	12	Si
CAS	Vega	13	0,08	4	Si
CAMAR	Vega	14	48,29	4	Si
HORNAR	Bofedal	15	2,88	3	Si
CEJAR	Vega	16	114,68	12	Si
BALTINACHE	Vega	17	33,84	12	Si
CALAR	Vega	18	19,92	2	Si
CHITA 2	Bofedal	19	7,40	1	Si
INCAHUASI 2	Bofedal	20	53,30	1	Si
CONAPUJYO	Bofedal	21	15,98	1	Si
CHITA 4	Bofedal	22	7,12	1	Si
VEGAS 5	Bofedal	23	21,89	1	Si
COYAPUJO	Bofedal	24	0,87	1	Si
JAUNA	Bofedal	25	1,23	1	Si
JAUNA	Bofedal	25	3,93	1	Si
LAGUNITA	Bofedal	26	1,90	1	Si
CHUCURATE	Bofedal	27	1,69	1	Si
GUAYTIQUINA	Bofedal	28	1,15	1	Si
GUAILLAR	Bofedal	29	30,61	1	Si
COCHA	Vega	30	1,99	1	Si
LICAN	Vega	31	10,39	1	Si
MATANCILLA	Vega	32	2,37	1	Si
JONES	Vega	33	0,64	1	Si
JONES	Vega	33	2,29	1	Si
CUTA	Vega	34	0,11	1	Si
CARVAJAL	Vega	35	320,01	12	Si
ALLANA	Vega	36	2,31	4	Si
TARAJNE	Vega	37	47,59	5	Si
TARAJNE	Vega	37	1,40	5	Si
YUTO	Bofedal	38	13,04	1	Si
YONA GRANDE	Vega	39	474,24	12	Si
VOLCANCITO	Bofedal	40	11,61	3	Si
VILACO	Bofedal	41	8,30	3	Si
VEGA GRANDE	Bofedal	42	21,03	1	Si
TURIPITE	Bofedal	43	5,72	2	Si
TURIPACO	Vega	44	17,25	1	Si
TUMBE	Bofedal	45	1,46	4	Si
TULAN	Vega	46	9,07	5	Si
TUJIREA	Vega	47	143,79	12	Si

Nombre	Tipo	Número	Sup. (Ha)	Sector	Área protegida DGA
LOS PANTANOS	Vega	48	93,35	12	Si
TILOPOZO	Vega	49	130,46	12	Si
TILOCALAR	Vega	50	70,59	12	Si
TEBINQUINCHE	Vega	51	1.421,18	12	Si
TAPAR	Vega	52	1.004,27	12	Si
TAPAR	Vega	52	15,38	3	Si
TAMBILLO	Vega	53	292,02	12	Si
TAMBILLO	Vega	53	562,67	3	Si
TCHITA	Bofedal	54	12,05	1	Si
SONCOR	Vega	55	90,67	4	Si
SILOLAO	Vega	56	11,86	12	Si
SALTAR	Bofedal	57	7,14	4	Si
RIO QUEBRADA	Bofedal	58	16,08	1	Si
RIO GRANDE	Vega	59	82,73	1	Si
QUIUSUNA	Vega	60	3,25	4	Si
QUIUSUNA	Vega	60	3,73	4	Si
QUERICO	Bofedal	61	2,93	4	Si
QUEPE	Bofedal	62	4,28	4	Si
QUEMALA	Bofedal	63	4,51	3	Si
QUELANA	Vega	64	154,54	12	Si
QUELANA	Vega	64	2,99	4	Si
QUEB. YACIMIENTO	Bofedal	65	11,68	4	Si
QUEB. ZAPAR	Vega	66	119,72	3	Si
QUEB. DE GUANTEN	Vega	67	28,94	2	Si
QUEB. DE GUANTEN	Vega	67	16,19	2	Si
PUTANA	Bofedal	68	215,18	1	Si
PURITAMA	Bofedal	69	11,63	2	Si
PURISELTE	Vega	70	31,45	5	Si
POTOR	Bofedal	71	153,45	3	Si
PENALIRI	Bofedal	72	7,11	1	Si
PENA COLORADA	Bofedal	73	2,61	3	Si
PALAO	Vega	74	144,19	12	Si
OLAR	Vega	75	1.092,05	12	Si
OJOS DE PUTANA	Bofedal	76	23,12	1	Si
CHITA 3	Bofedal	77	9,47	1	Si
SAN BARTOLO	Vega	78	4,45	1	Si
PURIFICAN	Bofedal	79	8,77	1	Si
OYAPE	Vega	80	9,52	12	Si
Sin nombre12	Vega	81	3,60	1	Si
JORQUENCAL	Bofedal	82	6,32	2	Si
CATARAPE	Bofedal	83	21,08	3	Si
MARI	Bofedal	84	5,03	3	Si
MARI	Bofedal	84	0,80	3	Si
Sin nombre8	Bofedal	85	38,26	3	No
Sin nombre15	Vega	86	80,20	12	No
Sin nombre14	Vega	87	102,53	12	No
Sin nombre11	Vega	88	9,86	12	No
Sin nombre16	Vega	89	40,23	12	No
Sin Nombre17	Vega	90	21,29	12	No
Sin nombre13	Vega	91	0,87	10	No
Sin nombre13	Vega	91	88,51	12	No

Tabla 3. Áreas de Riego y Cultivos.

Nombre	Número	Sector	Superficie (Há.)
Tilomonte	1	5	36,75
Toconao	3	3	69,41
Toconao	4	3	12,65
Zapar	5	3	5,51
Zapar	6	3	10,84
San Pedro de Atacama	7	12	144,00
San Pedro de Atacama	8	12	127,41
San Pedro de Atacama	9	12	78,93
San Pedro de Atacama	10	12	135,08
San Pedro de Atacama	11	12	376,57
San Pedro de Atacama	12	12	23,74
San Pedro de Atacama	13	12	14,14
San Pedro de Atacama	14	1	0,03
San Pedro de Atacama	14	12	920,66
San Pedro de Atacama	15	1	56,68
San Pedro de Atacama	16	12	545,86
San Pedro de Atacama	17	1	159,27
Peine	2	5	38,87
Peine	18	5	38,87

ANNEX 2:

Alternativas para la explotación del Litio en Chile

Debido a las restricciones que impone la ley de concesiones mineras al litio por el hecho de ser considerado un material de interés nuclear, existen 6 alternativas que permiten la explotación del recurso (ver figura A1)

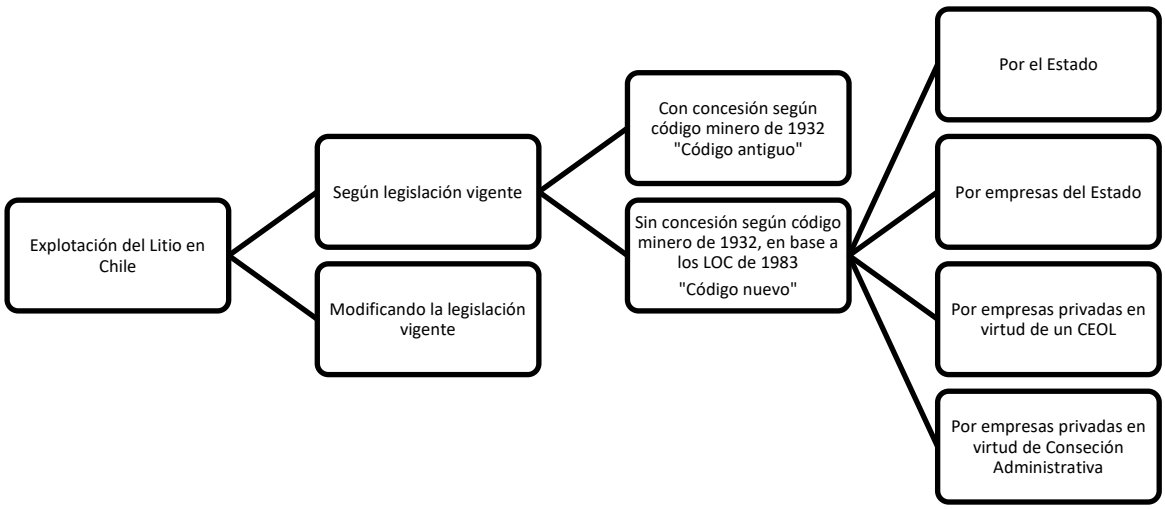


Figura A1: Alternativas de explotación del Litio en Chile

La primera de ellas, permite que empresas con concesiones constituidas antes del 1º de enero de 1979 puedan explotar el litio de acuerdo a lo indicado en el Código Minero de 1932 (ver tabla A1)

Tabla A1: Empresas que mantienen concesiones constituidas antes de 1979 en los 15 salares con potencial de explotación de litio. Fuente: Cochilco (Cochilco, 2012)

SALAR	Tenedor de concesiones entre 1932 y 1979
Salar de Atacama	Corfo
Salar de Maricunga	Codelco Salvador; SImbalink; Minera Kanita; Otros
Salar de Pedernales	Codelco Salvador
Salar de Quisquiro	Minera Fénix
Salar de Aguilar	Empresa Nacional de Minería (ENAMI)

Para concesiones constituidas después de del 1º de enero de 1979, el litio podrá ser explotado por: a) el Estado, b) Por empresas del Estado, c) por empresas privadas en virtud de un CEOL (contratos especiales de operación de Litio) o, d) Por empresas privadas en virtud de Concesión Administrativa.

El sexto mecanismo y más complejo de implementar es la modificación de la Ley Orgánica Constitucional de Concesiones Mineras, la cual requiere de un quorum de cuatro séptimas partes de los diputados y senadores en ejercicio para su aprobación.

ANNEX 3: Institucionalidad ambiental en Chile

Figura B1: Diagrama institucionalidad ambiental de Chile[5]

Ministerio de Medio Ambiente: Liderar el desarrollo sustentable, a través de la generación de políticas públicas y regulaciones eficientes, promoviendo buenas prácticas y mejorando la educación ambiental ciudadana. Su visión es alcanzar el desarrollo sustentable para el país con el objeto de mejorar la calidad de vida de los chilenos, tanto de esta generación como de futuras.

El Consejo de Ministros para la Sustentabilidad (CMS), es presidido por el Ministro del Medio Ambiente e integrado por los Ministros de Agricultura, de Hacienda, de Salud, de Economía, Fomento y Reconstrucción, de Energía, de Obras Públicas, de Vivienda y Urbanismo, de Transportes y Telecomunicaciones, de Minería y Planificación.

Serán funciones y atribuciones del Consejo:

- Proponer al Presidente de la República las políticas para el manejo uso y aprovechamiento sustentables de los recursos naturales renovables.
- Proponer al Presidente de la República los criterios de sustentabilidad que deben ser incorporados en la elaboración de las políticas y procesos de planificación de los ministerios, así como en la de sus servicios dependientes y relacionados.
- **Proponer al Presidente de la República la creación de las Áreas Protegidas del Estado, que incluye parques y reservas marinas, así como los santuarios de la naturaleza y de las áreas marinas costeras protegidas de múltiples usos.**
- Proponer al Presidente de la República las políticas sectoriales que deben ser sometidas a evaluación ambiental estratégica.
- Pronunciarse sobre los criterios y mecanismos en virtud de los cuales se deberá efectuar la participación ciudadana en las Declaraciones de Impacto Ambiental, a que se refiere al artículo 26 de la ley Nº 19.300, sobre Bases Generales del Medio Ambiente.

[5] **Fuentes:** Decreto Afecto N° 3, de 2017, aprueba nuevo reglamento orgánico del Ministerio del Medio Ambiente deja sin efecto el Decreto N° 62, de 2014.- Resolución Exenta N° 269, de 2017, establece nuevas Estructura de oficinas bajo dependencia directa del Subsecretario del Medio Ambiente.- Resolución Exenta N° 268, de 2017, establece y aprueba estructura y organización interna para las Divisiones del Ministerio del Medio Ambiente. - Resolución Exenta N° 198, de 2015, aprueba estructura para la Secretaría Regional Ministerial de la Región Metropolitana del Ministerio del Medio Ambiente.

- Pronunciarse sobre los proyectos de ley y actos administrativos que se propongan al Presidente de la República, cualquiera sea el ministerio de origen, que contenga normas de carácter ambiental señaladas en el artículo 70.

Servicio de Evaluación ambiental, SEA: es un organismo público funcionalmente descentralizado con personalidad jurídica y patrimonio propio. El SEA fue creado por la Ley N°20.417, publicada en el Diario Oficial el 26 de enero de 2010, que modificó la Ley N°19.300 sobre Bases Generales del Medio Ambiente.

Su función central es tecnificar y administrar el instrumento de gestión ambiental denominado **"Sistema de Evaluación de Impacto Ambiental"** (SEIA), cuya gestión se basa en la evaluación ambiental de proyectos ajustada a lo establecido en la norma vigente, fomentando y facilitando la participación ciudadana en la evaluación de los proyectos.

Este Servicio cumple la función de uniformar los criterios, requisitos, condiciones, antecedentes, certificados, trámites, exigencias técnicas y procedimientos de carácter ambiental que establezcan los ministerios y demás organismos del Estado competentes, mediante el establecimiento, entre otros, de guías trámite.

La tecnificación del sistema apunta a establecer criterios comunes para evaluar cada tipo de proyecto, con el objeto de asegurar la protección del medio ambiente de manera eficiente y eficaz

Superintendencia de Medio Ambiente, SMA: es un servicio público descentralizado, con personalidad jurídica y patrimonio propio, sometido a la supervigilancia del presidente de la República a través del Ministerio del Medio Ambiente, y cuyos cargos directivos son provistos de acuerdo al sistema de Alta Dirección Pública. Se creó en virtud de la Ley Nº 20.417.

En el contexto de la institucionalidad ambiental actual en Chile, la Superintendencia del Medio Ambiente cumple un rol fiscalizador y de sanción sobre los instrumentos de gestión ambiental vigentes en el país (Ley 19.300): Resoluciones de Calificación (RCA), Normas de Emisión, Normas de Calidad y Planes de Prevención y/o de Descontaminación Ambiental, entre otros.
Tribunales Ambientales: El Tribunal Ambiental de Santiago es un órgano jurisdiccional especial, autónomo e independiente, cuya función es resolver las controversias medioambientales de su competencia y ocuparse de los demás asuntos que la ley somete a su conocimiento (artículo 1, Ley N° 20.600). Si bien no forma parte del Poder Judicial, está sujeto a la superintendencia directiva, correccional y económica de la Corte Suprema. Su creación se origina en la Ley N° 20.600, que establece la instalación de tres tribunales ambientales; en el norte, centro y sur del país.

Sistema de Evaluación de Impacto Ambiental (SEIA): es uno de los principales instrumentos para prevenir el deterioro ambiental. Este instrumento permite introducir la dimensión ambiental en el diseño y la ejecución de los proyectos y actividades que se realizan en el país; a través de él se evalúa y certifica que las iniciativas, tanto del sector público como del sector privado, se encuentran en condiciones de cumplir con los requisitos ambientales que les son aplicables.

El SEIA entró en vigencia el 3 de abril de **1997**. A más de dos décadas de su aplicación, más de 24.700 proyectos o actividades se han aprobado en el SEIA, lo que ha permitido que el país haya logrado un cambio sustancial en la forma de construir el futuro, al poder prevenir los impactos que pueda generar las inversiones públicas y privadas, o hacer que, cuando se generan impactos adversos significativos, exista una mitigación.

Proceso de evaluación ambiental

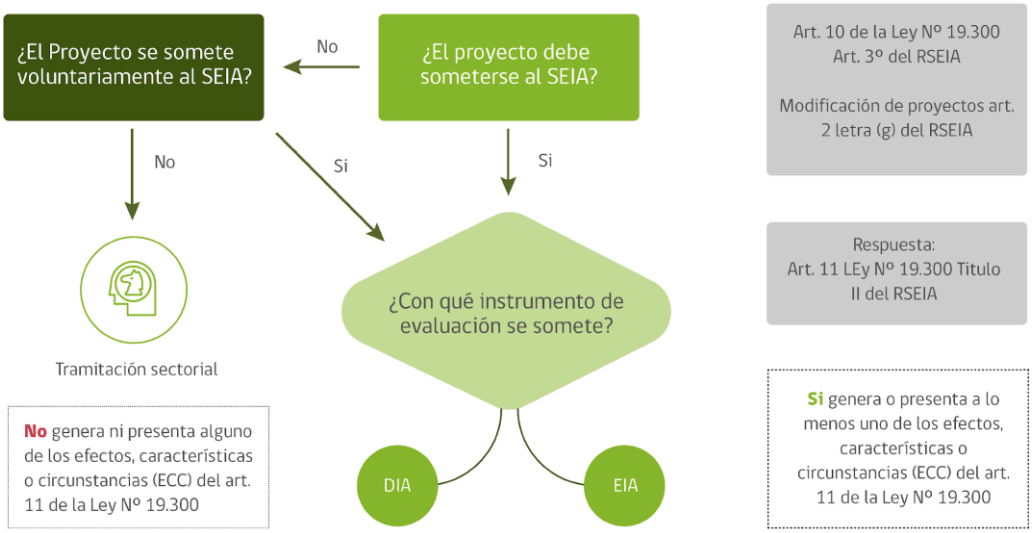


Diagrama de flujo de un Estudio de Impacto Ambiental (EIA)

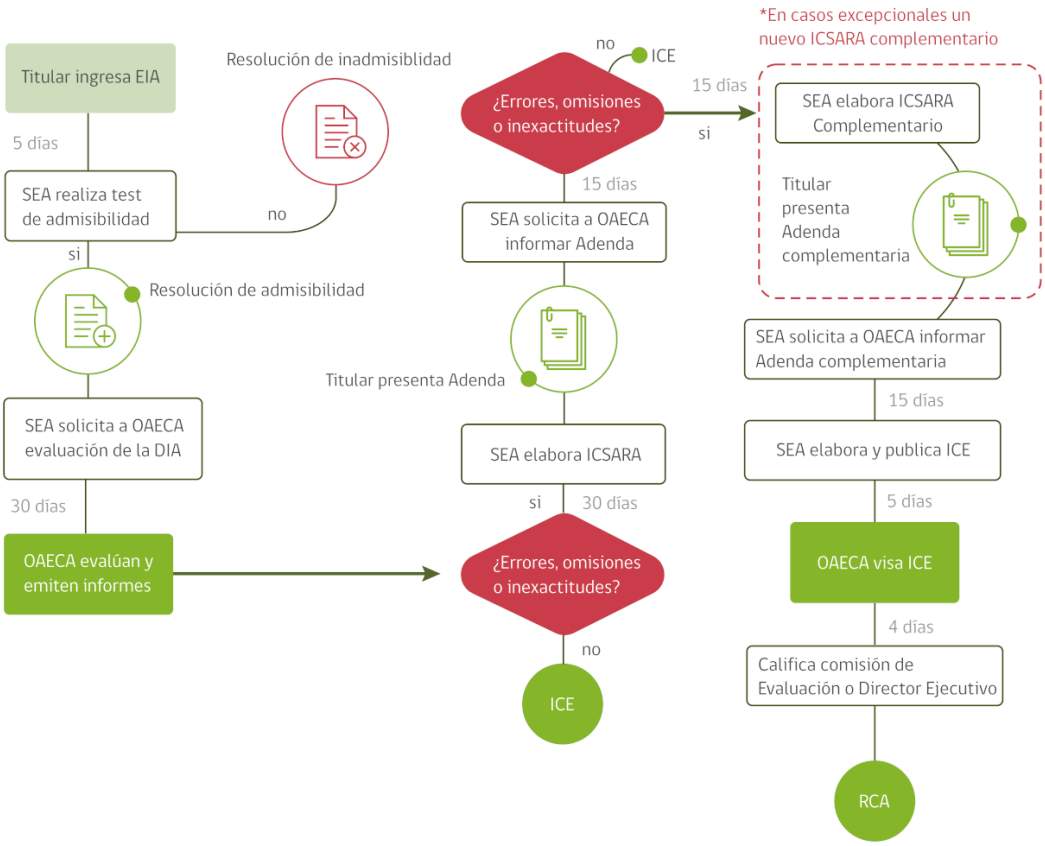
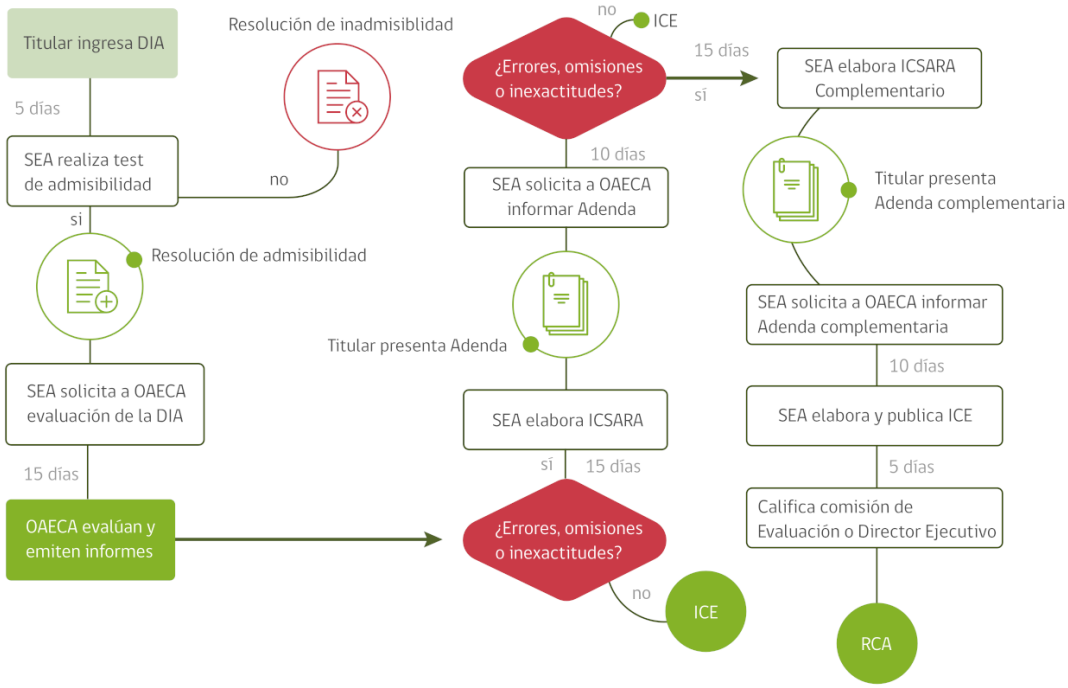


Diagrama de flujo de una Declaración de impacto Ambiental



Diferencia del procedimiento de evaluación entre una DIA y un EIA:

Materia	DIA	EIA
Plazo de evaluación	60 días	120 días
Ampliación del plazo de evaluación	30 días	60 días
Participación ciudadana (PAC)	Solo si el proyecto genera cargas ambientales y la PAC es solicitada	Siempre
Consulta indígena	No aplica	Aplica cuando hay impacto significativo a grupos humanos pertenecientes a pueblos indígenas
Recurso de reclamación	Ante Director Ejecutivo del SEA	Ante Comité de Ministros