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Global Changes and Economic Globalization in the Andes. Challenges for Developing Nations

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1. Introduction

Global changes are a very relevant issue for the whole world, but especially for developing countries that depend mainly on their natural resources to sustain their economic and social development. In the case of the Andes, most of the Latin-American countries source their raw materials, biological goods and environmental services from this mountain chain (IGM, 1983). Before the Spanish colonization that started in XV century, natural resources were used for the development of local territories, but with the establishment of colonial centres they were sent to the metropolis, thus forming the first economic and cultural globalization process.

Today for the first time global changes, such as climate change and economic globalization, challenge simultaneously the subsistence of many ecosystems, regions and places in Latin America. The Andes is a very diverse, complex and fluid environment. In this essay we deal with the Chilean part of this mountain chain, i.e. a section of the Central Andes (Northern Chile) and Southern Andes (Chilean Patagonia). These regions could be understood as a good representation of the present interaction between global changes and global economy that is taking place.

Chile is one of the longest countries in the world, extending for more than 4.500 km, from subtropical (18 ºS) to temperate and sub-Antarctic latitudes (56 ºS). The northern section of Chile contains the Atacama desert, one of the driest ecosystems and regions in the world (Romero, 1983). The availability of water is the most critical natural resource for the development of this part of the country. Paradoxically, however, the Atacama desert is, at the same time, the most important reserve, on a global scale, of highly sought minerals for industrial development, like copper and molybdenum. Chile supplies almost 40 % of the global demand for copper, and in order to produce this amount of ore and to satisfy the increasing international market, enormous amounts of water quantities are required. Providing them is almost impossible in this very arid environment (Ibañez & Pizarro, 2003).

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Difficulties for development that affect Northern Chile are typical for the environmental constraints that sustainable development is confronted with in many developing countries. Chilean society is expecting the international scientific community to contribute to finding a solution to these challenges.

Patagonia in Southern Chile represents different environmental conditions from those in the Atacama Desert. There the Andes reach the Pacific Ocean at latitudes where westerly winds predominate throughout the year. High rates of annual rainfall are responsible for the extraordinary quantity and quality of water which is stored in many glaciers and in two immense glacier fields or deposited along thousand of rivers, streams and lakes. Temperate rainforests, clean air, soils and waters, and a high biodiversity, located in orographically complex landscapes have been maintained up to now far away from human influence. Pristine ecosystems abound, especially in remote areas that were declared nature conservation areas many decades ago.

Clean water in Chilean Patagonia becomes a critical resource for future sustainable development, taking into consideration the generalized scarcity of resources in the country. Climate change is already reducing the annual mean rainfall by 50% in the southernmost section of Chilean Patagonia, mean and minimum temperatures are increasing, snowlines are rising and glaciers are retreating. These days economic activities, such as aquaculture and salmon farming, tourism and hydropower generation are competing for the control and appropriation of the most productive regional watersheds.

In both cases, mining installations and operations in Northern Chile and the competition for water from several economic sectors in Southern Chile, scientific knowledge is required to support the decision-making process. Unfortunately, scientific knowledge is a social resource that is currently not available, at least as a public good that could be accessed by the general people and the local communities.

An erroneous decision strongly supported by economic drivers could result in severe damages and devastation of natural and cultural landscapes. Probably, when Chile will suffer the most relevant effects of climate change in the future, its environmental landscapes will have already become completely devastated.

2. The Chilean Andes

The Chilean Andes illustrate the extraordinary ecological diversity of this mountain chain. In the Atacama desert, aridity and water scarcity is a general pattern, but with

many differences according to ecological altitude belts, aspect and exposition to air masses. Even under the most arid conditions, oases, valleys, salt lakes and lagoons can be found, playing an important role in terms of habitability, concentrating available waters. Biological and human traditional communities have developed long-term spatial structures to complement natural resources and cope with ecosystem services diversity, and seasonal and annual uncertainties.

Available ground water – which is increasingly the most important source in Northern Chile – was stored under different climate, soil and vegetation conditions and at different places. While the core of the desert has always been a very arid environment, the highlands have experienced large climatic variations over time. Today these interannual changes in rainfall are mainly controlled by the El Niño-La Niña/Southern Oscillation. It is difficult to expect large climate changes in the future in this already arid environment. Ground and superficial waters will become a more critical constraint for the survival of biological species and native people. The current issue for the survival of Andes highlands in many areas is the persistent and increasing establishment of mining projects that need increasing amounts of water to sustain their production, but also to maintain all the related economic activities, such as urban functions and services that need to be provided by modern large cities.

The Chilean government has tried to protect the mountain sources of water, establishing national parks and nature reserves around the highland's main lakes and lagoons. For people concerned about nature conservation, these areas are not sufficient to represent the variety of highland ecosystems of the arid Andes. On the other hand, in many of these conservation areas, native people have settled for thousand years, and have developed their cultural and social practices. Native people have steadily complained against governmental appropriation of lands and water resources that they consider have always belonged to them. Many public authorities think that water is misused by native and traditional farmers and should be assigned for more profitable activities such as mining and urban consumption. Historically, the capture and diversion of water sources have forced local populations to emigrate once they had lost control and ownership of water in the middle of the desert. New mining development has added a very powerful actor to the conflict over land and water property and management in the north-Chilean Andes.

During the Pinochet dictatorship (1973-1990) a special water code was passed and water became a commercial good. From 1981 water rights could be purchased and sold without public restrictions in Chile. Although theoretically water rights

keep the public ownership, in fact they constitute private property because they are perpetually allocated, even if they have never been used or never will be used. On the other hand, these water rights could be exchanged separately from the land. As a consequence, between 1981 and 1990 many local communities lost their water sources. It was not until a new law was passed under a democratic regime in 1991 and aimed at protecting native people, that the complete sell-off of water rights in this part of the Andes was stopped. Only an adequate exchange of knowledge about the high social, ecological, cultural and environmental costs that have been paid by local communities could avoid a repetition of this practice in other Andean places.

An extraordinary diversity of mountain landscapes can also be found in the Southern Andes, especially between slopes exposed to or protected from rainfalls. While Western slopes receive and accumulate large amounts of precipitation resulting in a very wet landscape, there is a clear leeward gradient towards substantially reduced humidity across a very short distance, resulting in a semi-arid region. Glaciers and snow cover most of the Andean peaks and many rivers and lakes connect highlands with numerous lowlands of valleys, fjords and canals.

At the beginning of the 20th century, hundreds of thousands of hectares of rainforest and shrubs were burned in an attempt to introduce livestock and agriculture in unsuitable lands, resulting in soil erosion. Limited available resources and degrading of ecosystems, together with the isolated location have limited the small and autarchic population that lives in concentrated and unconnected settlements. 95% of the regional land belongs to the state and 50% is under nature protection, either as national parks, natural reserves or national monuments. However, most of these conservation areas are completely abandoned and unconnected because the scarce material, human and technological resources made available by public institutions. The Chilean Patagonia that administratively belongs to the Aysen (or XI) region remains mainly as near-natural landscapes, and in some areas, even as virgin ecosystems (Borsdorf 1987).

As a result of the small population that inhabits this region, clean air, water and soils could be found in most places. In fact, the regional slogan used by the authorities and people to promote development, has been "Aysén, a life reserve for humanity".

However, today, like in the case of Northern Chile, water is becoming a strategic resource, especially water coming from glaciers and ice fields, which, even if they are retreating, would still support heavy and stable discharges compared with other Chilean reserves. Currently Chile is confronting a serious lack of energy because

this country lacks oil deposits and has not invested enough in the development of alternative energy sources such as wind and solar power that are very abundant in its longer coastal zones and in the Atacama desert, respectively.

Foreign and national hydropower companies are interested in establishing a series of projects in natural landscapes of Patagonian rivers such as Baker and Pascua, with many others to follow. On the other hand, the salmon farming industry – Chile is the second most important producer worldwide – is also interested in the use of lakes, rivers, fjords and canals in the coastal zone. The pressure from the salmon industry is rather bigger because currently several diseases are affecting farms concentrated further north. The industry needs new locations in isolated and pristine landscapes such as those offered by this southern region.

Apart from the potential conflict between nature conservation, hydropower installations and salmon farms, tourism is another economic sector afraid that their expectations are in jeopardy. International tourism is beginning in these isolated regions. An increasing number of tourists are looking for natural places to satisfy their interests, such as fly fishing, ecological safaris, adventures, rafting, trekking, or simply nature observation. One controversial point relates to the conflict between the goals and features of unique natural places of national parks and natural reserves, and dams or transmission lines for hydropower generation and transportation. This controversy has been especially voiced by international environmental organizations and by foreign entrepreneurs, like Douglas Topkins, who has bought several hundred thousand hectares of regional lands for nature conservation and tourist development purposes.

Conflicts between public and private use of resources can be observed all over Chile after thirty years of extreme application of liberal economic and political ideas. Unlimited exploitation of natural resources and increasing threats to nature conservation areas are important and controversial issues. Public policies seem to be more interested in attracting productive investments than to protect natural goods and services. The privatization and commoditization of territories and their natural resources, fiercely pursued by global economic financial and economic organizations, and the strict adherence to corporate objectives, are powerful obstacles for public policies and institutions that try to protect local ecosystems and social communities.

The high priority given to economic and financial objectives in Chile is preventing an alternative look at nature and the environment from a non-exploitative point of view. As long as economic aims are considered the only accepted public aims, with

priority over social objectives and values, the destruction of ecological integrity or the lack of sustainable development are, at worst, not even recognized by society. At best, they are considered necessary environmental externalities.

3. Geographical patterns in the current occupation of the Andes

The regional distribution of key variables for economic, social and environmental development in Chile is shown in figure 1. Figure (1a) shows that the northernmost (Atacama Desert, I and II) and southernmost (Patagonian, XI and XII) Chilean regions, are the largest regions in terms of land surface. However, considering that the former are arid lands and the latter cold landscapes, the population in both zones is fairly small, reaching densities below 1 inhabitant per square km.

In Central Chile, with mediterranean climate types and a concentration of agriculture and industry, live near 80% of the Chilean population (Fig. 1c). It means that mineral northern regions and wildlife southern regions are largely uninhabited. Chile is a very centralized country with near 40% of its total population living in

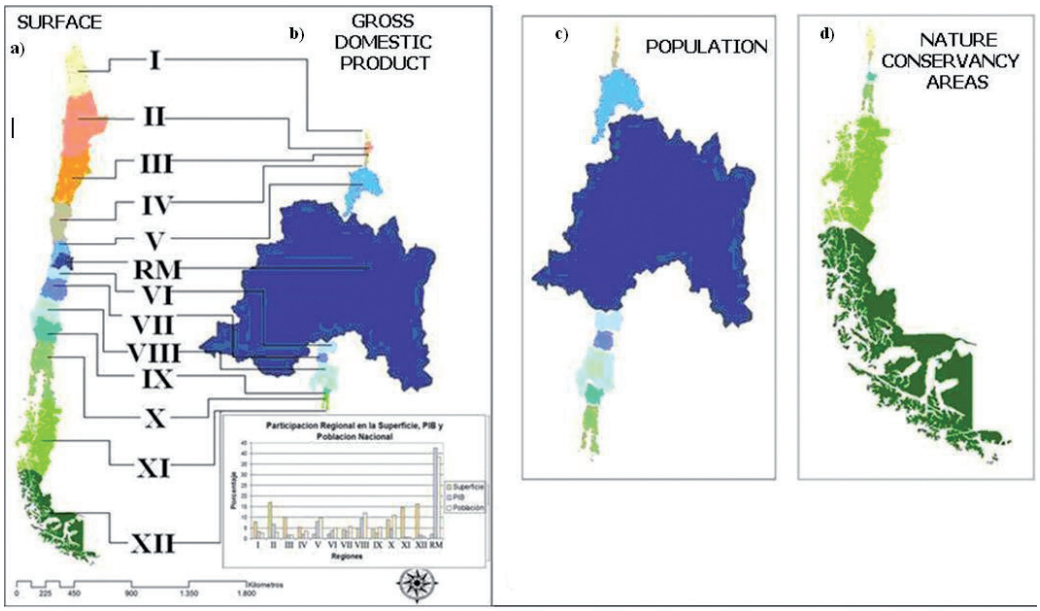


Fig. 1: Comparison between surface area and the distribution of economic, demographic and nature conservation areas in Chile. Source: Authors' own calculations.

its capital Santiago. While in Central Chile population, services and goods are available without restriction in the lowlands; social development is clearly constrained in marginal geographical regions, especially in Andean mountain areas.

The distribution of nature conservation areas (Fig.1d) forms a completely different pattern from that of socio-economic centres. In northern regions, national parks and natural reserves are concentrated in the highlands, while in the southern regions (Fig. 1d). they can be found anywhere. In Patagonia, nearly 95% of the land is in public ownership and 50 % of Aysen regional surface is occupied by the public system of wild protected areas.

The geographical representation of domestic economic product and population differs greatly from the spatial concentration of nature conservation zones. Socio-economic geographical patterns are becoming very unequal in Andean countries. Inequalities are even more marked between large metropolitan and modern urban areas and the location of economic enclaves and marginal and traditional mountain areas (Fig.1b). Public policies and private investments, even if they are significant in some mountain enclaves, are not able to produce a more even distribution of sustainable development factors and elements.

Mountain areas with extreme orographic complexity severely reduce accessibility, transforming physical distances into rather higher cost distance and time distance. Increasing costs seriously diminish comparative opportunities for socio-economic development in such mountain regions. Compensating these territorial inequalities requires particular public policies to mitigate the impacts of mountains barriers and conflicts. However, the liberal and global economic concepts applied everywhere in Chile disregard these geographical differences, which in turn explains lower levels of development in Andean areas, such as Chilean southern Patagonia. Figure 2a shows physical distances between the main Chilean cities, and

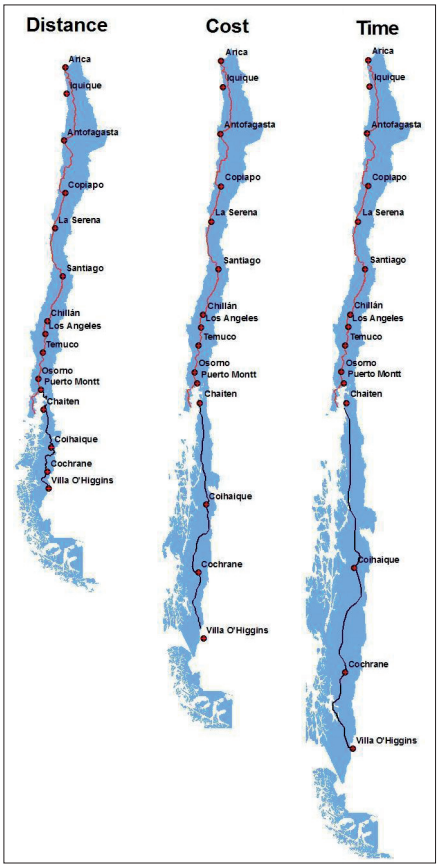


Fig. 2: Absolute and relative distances (in km.) in Chile. Source: Authors' own calculations.

figure 2b, the equivalent of physical distances in terms of economic costs. Figure 2c shows the time that is required to move within and outside the region.

Figure 3 shows the distribution of mining and related investment projects in the Atacama desert and its surrounding areas, including Andean highlands and semi-arid regions located further south. Economic investments form complex clusters and corridors that severely impact on whole landscapes. Apart from mining that forms dotted interventions and are mainly located in inland areas of intermediate height, gas pipes and roads are creeping up and crossing Andean peaks. Some of the new large mining projects like Pascua Lama have sites at both the Chilean and Argentinean slopes of the Andes, creating a sort of new frontier between the two countries.

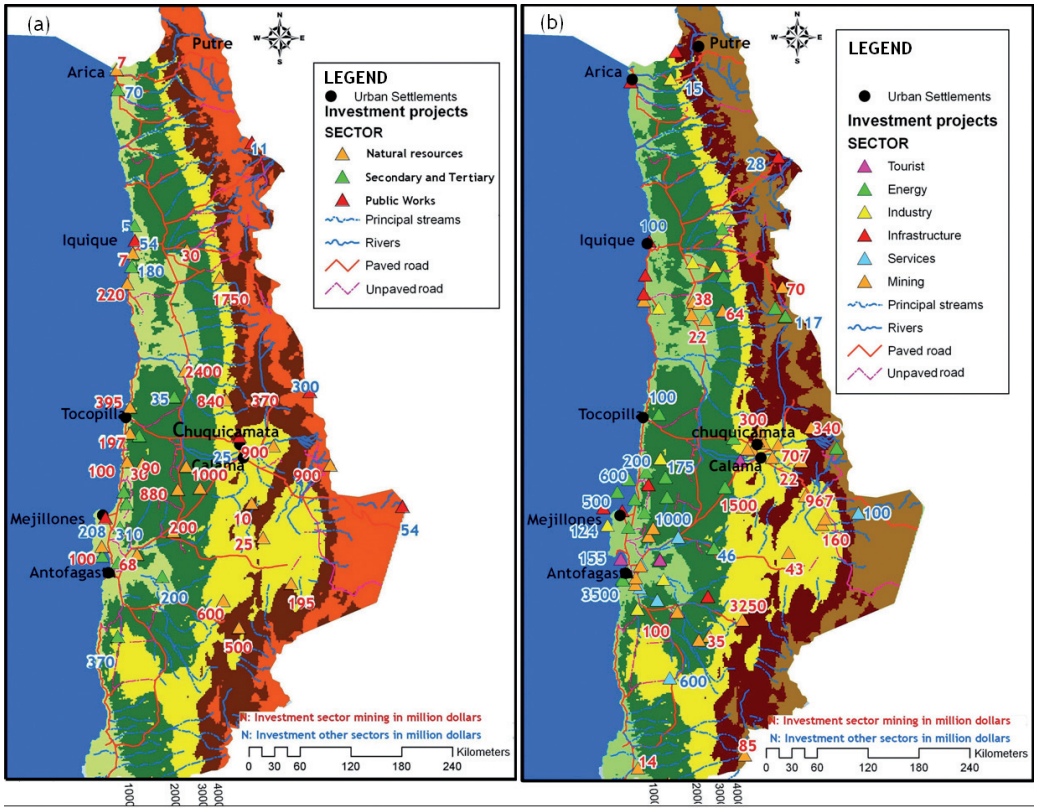


Fig. 3: mining and related investment projects in the Atacama desert and its surrounding areas. (a) 1990 – 2000 and (b) 2006 – 2008. Source: Authors' own calculations.

Figure 3a shows investment projects implemented between 1990 and 2000 in and around the Atacama desert. Mining is connected with power plants and harbours installations to import industrial necessities and export raw materials. They are also connected with cities, where the labour force lives and where they obtain local goods and services. All the necessary water must be captured at Andean highlands lagoons, salty lakes and rivers. Given the extraordinarily arid conditions of the Atacama desert, most of the thin rivers and streams disappear down water by evaporation, where they cross the core of the arid lands.

Water sources are located at the highlands, where native people live and where nature conservation areas have been declared, as can be seen in figure 3a. There is an increasing and unresolved conflict between local communities, conservation authorities, and mining companies, about the ownership and management of water sources. Local communities formed by native farmers are trying to enforce their ancestral rights to use and control the highlands as their historical heritage, against the government and private companies' interests. Conservation authorities are always confronted by pressure from local communities and by public and private mining companies to decertify large areas currently under the protection of the State. National and international mining companies are increasingly interested in using as much as possible superficial and ground water which is needed for their production processes.

Chile is the main producer of copper and associated minerals in the world and the demand is continuously increasing, especially as a result of recent Chinese industrialization. Copper has reached its highest historical price in recent years and this has triggered many new investments. Figure 3b presents an update of mining projects that have been or will be implemented in 2008. 60% of the total national mining investment is in the Atacama desert. In year 2000 it was already evident that available water in some of the most important Andean watersheds was completely allocated. To secure the supply of these resources water was reallocated to the different economic activities (mining, agriculture, and drinking water companies), facilitating the function of water markets, reassigning water used by farmers and native people, and extracting water from lakes and ground sources. Water was even imported from neighbouring Bolivia.

In the year 2000 the first cluster of mining and related installations was located at Iquique latitude (20ºS) and was clearly spatially organized by Doña Ines de Collahuasi, a large copper mine that also produces molybdenum, located at more than 3000m altitude in the Andes. Main spatial interaction related to harbour facilities,

services and housing for the work force, situated in the nearby towns of Iquique and Patache, and energy plants located in the latter place. Doña Inés de Collahuasi is one of the most productive and successful companies operating in the Atacama desert. It belongs to companies linked to Anglo American (USA, 44%), Xstrata (Switzerland, 44%) and Mitsui (Japan, 12%). This company extracted 19,1 m^3 of water in 2003 and has increased that figure to 29,1 m3 in 2005. Its rate of consumption was 0,66 m3 per ton of concentrated mineral in 2005, which is obtained from the nearest salt lakes ground water. The growth of the installations and production depends in large measure on a proposed uptake of ca. 1000 l/sec of water from wells located in Huasco Salar, the largest salt lake in the region.

The second cluster was located at Antofagasta latitude (23ºS) and was mainly organized by a spatial corridor from Escondida Mining to the sites of CODELCO (the Chilean State Company) near and above Salar de Atacama, at between 2000 and 3000m altitude. In the year 2000 this mining cluster and corridor was the most important in the country and included a vigorous development of the coastal border due to the establishment of thermoelectric energy plants, harbour facilities and urban services.

La Escondida is the largest copper producer at world scale. In 2006 it produced 1,256,000 metric tons or 8,1% of the total world production. 57,5% of this company is owned by Australian BHP Billington, 30% by Rio Tinto (U.K.) and 10% by the Japanese Jeco Co. Japan (Mitsubuchi Corporation and Nippon Company of Mining and Metals). In 2006 its water consumption was 0.80 m3 per ton of sulphured copper and in 2007 0.69m3/ton.

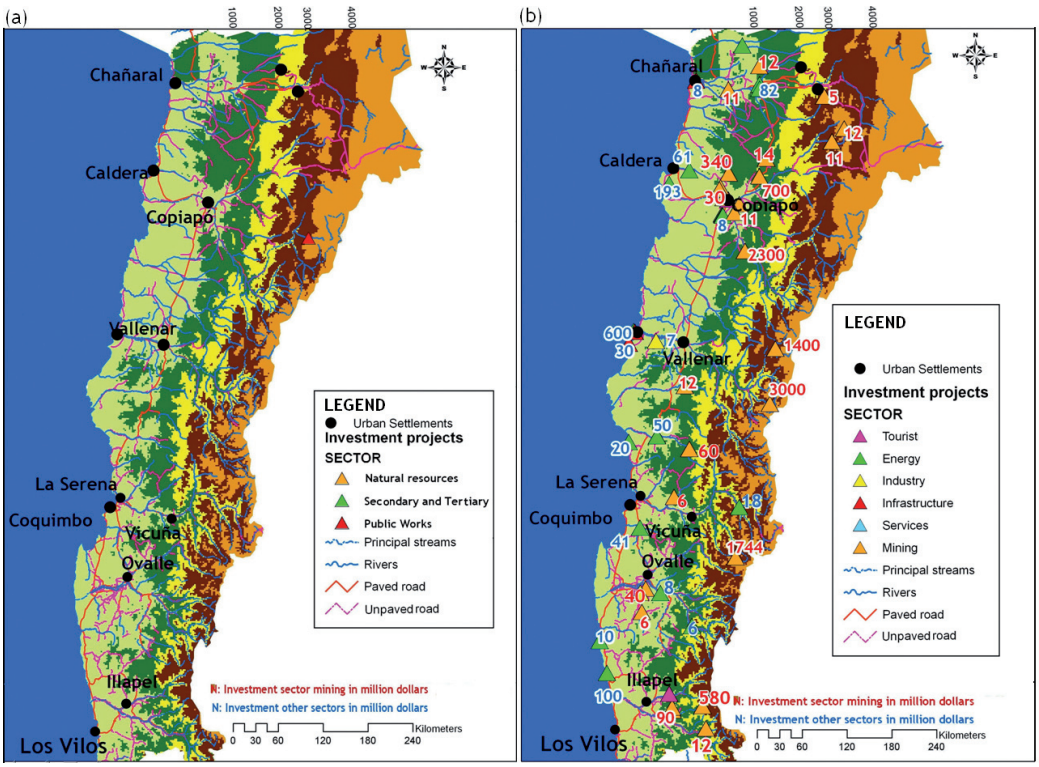
Water used by La Escondida is obtained from deep wells located in salt lakes and watersheds in the upper Andes. 1,318 l/sec is extracted from Salar de Monturaqui, located at 3,200m. It is estimated that 196,901,804 m3 of water has been extracted from this ecosystem since the plant started operation. Other mountain sources of water are deep wells located at Salar de Punta Negra, and proposed extractions in Pampa Colorada watershed, all of them situated in the Andes highlands, in the zone called Puna de Atacama, where most of the rivers and streams have their origin (Fig.3a).

The extraction of ground water in salt lakes and other water bodies located at the higher Andes lands is an increasing matter of concern for Chilean society that is expecting scientific inputs than can sustain the right decisions. Andean water sources are the recharge areas of aquifers that support rivers and streams, which finally emerge in the lowlands, where agriculture and urbanization take place. Romero and

Kampf (2003) have demonstrated that ground water tables are sinking in the central and coastal areas of the Atacama desert.

Figure 3b shows the distribution of mining in 2007 in the northernmost section of the Atacama desert. The main cluster of mining projects is in and around Salar de Atacama, the largest salt lake in the region, where a series of highland rivers and streams converge. But on the whole there is a migration of the larger mining investments further south, towards semi-arid regions (figures 4a and b). Water scarcity in the North and the discovery of new mineral reserves further south contribute to this trend.

In the semi-arid Chilean regions (figures 4) that extend from 27 to 32ºS Chile has its narrowest section. The distance between the mountain peaks and the coast is less than 120km. Several Andean rivers reach the coast here and have created fertile agricultural valleys in the Norte Chico ("Small North") or region of transversal valleys.



Figures 4: mining and related investment projects in semi-arid regions. (a) 1990 – 2000 and (b) 2006 – 2008. Source: Authors' own calculations.

Figure 4a shows that the Copiapó river has supported modern agricultural development in recent decades. Earlier this valley was mainly involved in small-scale mineral production, but has recently shifted to producing table grapes and other fresh fruit for export to North American, European and Asian markets. To sustain this agricultural production, the irrigation infrastructure must capture water in the highlands and transport it along canals. In the Copiapo valley, annual rainfall is around 10mm and climate change promises a reduction. In the map, which represents the situation in the year 2000, a projected gold mine was the only relevant investment located in the highlands.

The southern valleys Huasco, Elqui, Limarí and Choapa have also strongly specialized in the production and export of fresh fruit, taking advantage of permanently clear skies and more abundant water coming down from Andean highlands. In the Huasco valley annual rainfall is around 50mm, in Choapa around 200mm. In intermediate and lower mountains, rain-fed traditional farming communities have sustained local settlements since colonial times. These communities still practice livestock (especially goats) transhumance, using grasslands in the Andes highlands during summer and at the coastal lowlands in the winter season.

However, as observed in year 2007 (Fig. 4b), several mining installations have been or are going to be located in upper and intermediate lands. Cerro Casals, with an investment of 2,300 million dollars, is the largest project in Copiapó valley and leads to a dispute with modern farmers and the urban population, because they are extracting water in the uplands that had been used for rural and urban purposes before. The Copiapó river has been completely dry in recent years.

Cerro Casals is an open copper and gold mine that belongs to Star Arizona. This company owns 51% of Arizona Star, 49% belongs to the Kinross Gold Corporation, both Canadian companies. Currently they are exploring and getting water extraction licences to withdraw 1,237 l/sec from 17 deep wells located in Piedra Pómez, an aquifer in the highlands, 121km upwards of the mine. Another water source is Pedernales, situated in the highlands, 210km north of the mine.

The environment of the Copiapó valley is threatened by the establishment of numerous other mining projects that compete with several other economic and social activities for the use of water. One of the other largest mineral investments was made by Caserones Pan Pacific Copper (700 million US dollars), owned by the Japanese company Lumina Copper (Fig. 4b). This large open mine is located at 4,600m a.s.l. and its expected production will be around 160-220 tons per day. When they have extracted 6,000 million tons of mineral, the open mine would have reached a depth of 610m, a length of 1.7km and a width of 1.6km.

Another very relevant and typical water conflict has arisen between traditional farmers, highlands local communities and the Canadian company Barrick Gold, which is trying to establish the largest project (more than 3,000 million US dollars) called Pascua Lama. This company has attempted to relocate Andean highland glaciers to a place far away from its proposed ore to facilitate its installation. This action was strongly resisted by Chilean society, and the Canadian company eventually decided to postpone this project. They offered a lot of money to modern farmers in the lowlands as compensation for extracting the required water from the river, but they did not reach an agreement with poorer rural communities living at medium and higher lands and depending much more on livestock. Apart from this unresolved water conflict, the situation has become more complicated because recently new mining projects like El Morro, owned by the Swiss Xstrata company, are also planning to extract water from the upper Huasco watershed. According to existing information there is a series of proposed mining projects to be built at highlands that were previously only used as grasslands, water reservoirs and nature conservation areas.

Pascua Lama is an open gold, silver and copper mine, situated above 4000m altitude at Andes highlands shared by Argentina and Chile. This location has required a special international agreement between both countries to facilitate the transport of industrial inputs, outputs and labour. This agreement creates a de facto international free territory and has been postponed several times because of difficulties with setting up custom and tax systems. Argentina and Chile want to receive as much money as possible from this investment.

The time frame for this project of mineral exploitation is up to 23 years and the estimated reserves are 18 million ounces of gold and 731 million ounces of silver as well as 662 million pounds of copper. Water requirements are 370 l/sec provided by the Andean Argentinean river Las Taguas, and 42 l/sec from the Chilean Estrecho river, a highland tributary of the Huasco river. Main concerns are not only water uptake but also water pollution that could affect irrigation schemes.

In the same valley Swiss company Xstrata Coppers is setting up El Morro. Falconbridge holds 70% of the company and Metallica Resources Limited 30%. The estimated life-cycle of this project is 16 years and the mineral resources are estimated at 489 million tons of copper containing 0.52 gold grams per ton.

Similar large mining investments are currently taking place along the Choapa river, a traditional agricultural and small mining valley that is situated in the southernmost part of the Chilean semi-arid region, near the Mediterranean climate type of the Central Chile landscapes. Around 200mm of annual rainfall have supported a

substantial rainfed and irrigated agricultural development for many centuries.

In Choapa Valley, Los Pelambres, 40% of the largest mining project is owned by Chilean capital (Luksic family) and 60% by Japanese investors. Estimated reserves of copper reach 4,000 million tons of ore and are situated in the Andean highlands, near the Chilean border with Argentina. The most impressive investments in connection with this project are the construction of two large dams to contain mineral wastes. These dams are going to flood 4,000 ha of land and will be connected by a canal of 15km length. Another canal will transport the mineral from the neighbouring Salamanca valley.

Table 1 presents a synthesis of the most important existing or proposed mining investments in the Atacama desert and its surroundings. It is clear that the environmental sustainability of the Northern Chile Andes highlands is increasingly at risk.

Figure 5 presents the complex geographical and environmental structure of Chilean Patagonia and the present situation in terms of natural environments, land uses and spatial organization.

Table 1: Synthesis of the most important existing or proposed mining investments in the Atacama desert and its surroundings. Source: Authors' own calculations based on SOFOFA.

COMPANY - PROJECT	Status	Total Investment	Investment Balance	Country
Compañía Minera Nevada (Barrick Gold Corp.): Proyecto Pascua Lama	Pending	3000	1500	Canadá
Minera Estrella de Oro (Arizona Star Resources - Kinross): Proyecto Minero Cerro Casale	Pending	2300	2300	Canadá
Minera Esperanza (Antofagasta Minerals): Proyecto Esperanza	Pending	1500	1500	Chile
Minera Falconbridge (Xstrata Coppers): Proyecto El Morro	Potential	1400	1400	Suiza (70%) Canadá (30%)
Codelco (División Codelco Norte): Minera Gabriela Mistral (ex Gaby)	In Progress	967	36	Chile – Estatal
Codelco (División Codelco Norte): Chuquicamata Subterránea	Potential	707	707	Chile – Estatal
Pan Pacific Copper: Proyecto Caserones (ex Regalito)	Potential	700	700	Japón
Minera Los Pelambres (Antofagasta Minerals): Proyecto Tranque de Relaves El Mauro	In Progress	580	19	Chile
Minera Carmen de Andacollo: Proyecto Hipógeno (Andacollo Sulfuros)	Pending	350	350	Canadá (70%) Chile (30%)
Codelco (División Codelco Norte): Expansión Mina Ale Alejandro Hales (ex Mansa Mina)	Potential	340	340	Chile – Estatal
Compañía Minera del Pacífico: Hierro Atacama, Fase II - Cerro Negro Norte	Pending	340	340	Chile
Minera Falconbridge (Xstrata Coppers): Extension Lomas Bayas	In Progress	335	168	Suiza
Antofagasta Minerals: Proyecto Antucoya	Potential	300	300	Chile
Codelco (División Codelco Norte): Extracción y Movimiento de Minerales Mina Radomiro Tomic	Pending	300	300	Chile – Estatal
SQM Salar: Cambios y Mejoras de la Operación Minera en el Salar de Atacama	In Progress	234	176	Chile
Codelco (División Codelco Norte): Minera Gabriela Mistral (II Fase)	Potential	160	160	Chile – Estatal
Atacama Minerals Chile: Ampliación Aguas Blancas	In Progress	100	67	Chile

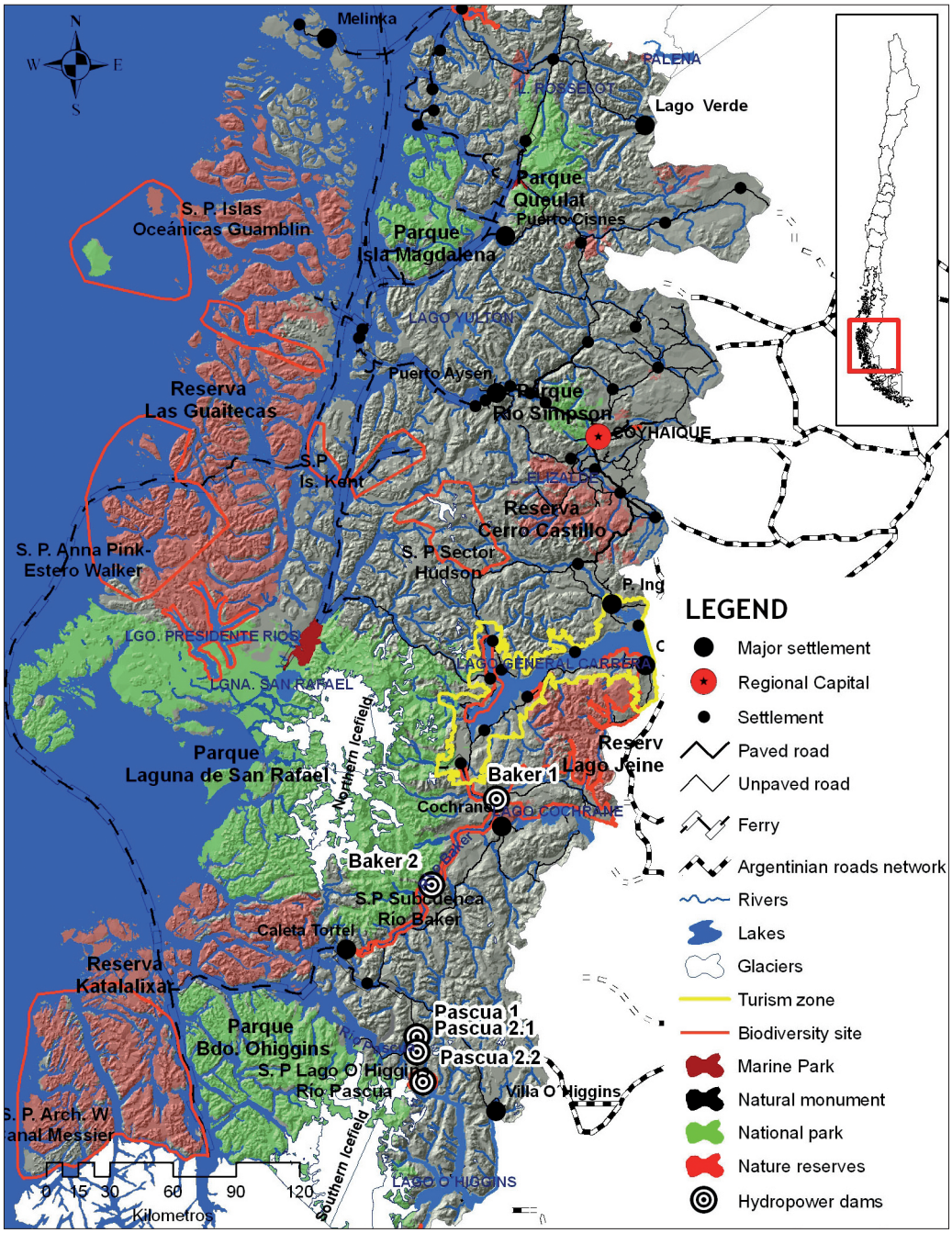


Fig. 5: Geographical and environmental structure of Chilean Patagonia and the present situation in terms of natural environments, land uses and spatial organization. Authors' own calculations based on PRDU.

First of all, Chilean Patagonia is the most Andean Chilean region, and mountains dominate everywhere. In the eastern section the mountainous landscape is broken up by numerous lakes and narrow river valleys, the western archipelagic part contains fjords and sea canals.

The spatial organization is controlled by large watersheds: Cisne valley in the North, Simpson in the Centre, General Carrera lake and Baker river in the South, and Pascua river in the extreme South, link the mountain chains with the sea coast. The Northern and Southern ice fields drain glaciers and waters towards the continental eastern side and towards the maritime western coast. In the Aysén region all the landscape features are strongly interconnected and the environmental and ecological integration explains the presence of the cleanest air, water and soils, plus an extraordinary biodiversity.

Taking into account this high environmental complexity, diversity and quality, most of the region is public land and 50% of its territory is made up of nature conservation areas. These public protected areas form a continuum in the western section, from Las Guiatecas Nature Reserve and Magdalena Island National Park in the North to Laguna San Rafael National Park in the Centre and Katalalixat Nature Reserve and Bernardo O'Higgins National Park in the South.

On the eastern side there are important nature conservation areas, but this region is also used extensively for animal husbandry and forestry. Important ecological transects and corridors can be found in the northern section, including Queulayt National Park, and at the Centre, in Río Simpson National Park and in the Cerro Castillo and Jeinimeni Natural Reserves.

To ensure connectivity between conservation areas and to protect some biodiversity hotspots, environmental authorities have introduced Biodiversity High Priority Sites, e.g. Islas Guamblin in the North; Anna Pink-Estero Walker, Islas Kent and Sector Hudson in the Centre and Baker and Pascua watersheds, O´Higgins Lake and Canal Messier in the South. Although these priority sites are not equivalent to protected areas that belong to the National System of Wild Protected Areas, they constitute necessary land to link up the whole system designed to promote the conservation of many pristine zones.

Human settlements are isolated and self-sufficient places and situated along rivers and around Lake General Carrera, the binational (Argentinean-Chilean) and largest Chilean lake. All the land that surrounds this lake has been declared a tourist zone in an effort to protect nature and cultural goods and services. Given the topography and climate, roads and human settlements can only occupy very specific places. As

a consequence, Aysen has only a small population; around 100,000 inhabitants live in a territory of approximately 100,000 km2. Most of the region is unpopulated and many nature reserve areas are inaccessibly by road.

Ice fields are especially relevant to supply abundant and permanently high discharges to Baker and Pascua rivers. These rivers, together with many others, constitute the principal Chilean hydropower reserve. For decades this region was not considered for hydropower generation. Nature conservation priorities, difficult access and the distance to the areas of major demand (industrial urban centres in Central Chile are located in a distance of 2.000 km, and the Northern mines are located in a distance of 3.000 and 4.000 km) were strong arguments against building any hydroelectric power stations.

Over the last ten years Chile has doubled its domestic and its energy consumption has increased threefold. The country must import all the oil that it needs and the Argentinean natural gas import has been completely reduced. As long as public authorities show no real interest in developing alternative sources of energy, the national society is forced, without any real and serious debate, to accept the establishment of foreign-owned installations in Chilean Patagonia to produce some of the energy that is needed.

Table 2 shows the amount of money that will be invested by national and foreign companies in the construction of the first five hydropower dams and the respective transmission line. However, there is a long list of new projects which are expecting the construction of the transmission line to be installed in several large rivers.

Table 2: Amount of money that will be invested by national and foreign companies in the construction of the first five hydropower dams and the respective transmission line. Source: Authors' own calculations based on HidroAysén.

COMPANY - PROJECT	Status	Total Investment
Transelec: Nuevas Líneas de Transmisión entre la XI Región y Santiago (Proyecto HidroAysén)	Potential	1.600
HidroAysén (Endesa Chile-Colbún): Proyecto Hidroélectrico Aysén (Pascua 2.1)	Potential	820
HidroAysén (Endesa Chile-Colbún): Proyecto Hidroélectrico Aysén (Baker 1)	Potential	710
HidroAysén (Endesa Chile-Colbún): Proyecto Hidroélectrico Aysén (Pascua 2.2)	Potential	550
HidroAysén (Endesa Chile-Colbún): Proyecto Hidroélectrico Aysén (Pascua 1)	Potential	510
HidroAysén (Endesa Chile-Colbún): Proyecto Hidroélectrico Aysén (Baker 2)	Potential	410

As in the case of mining in Northern Chile, energy production seems able to change the environmental conditions of Chilean Patagonia abruptly and definitively. In the current debate only economic priorities seem to count. Again, environmental and ecological values are completely subordinated to decisions that are going to be made by national central services in coalition with foreign transnational companies.

The following tables illustrate the current situation in what can only be interpreted as a general abandonment of public responsibilities for nature protection. The first table (Table 3) demonstrates the capacity for managing the environment of the five municipalities in the area. Municipalities are the main local government institutions in the country. Seven out of nine do not have any person, office or unity in charge of environmental issues. Only one of nine municipal governments has set up an environmental agenda or environmental management plan and uses some financial resources for the protection of the environment. Only two of them have introduced some local legal instruments to control environmental issues in their territories. The only municipality that has some complete environmental management institutions is Coyhaique, the main city and regional administrative capital.

Table 3: Environmental management capacity of Southern Aysen municipalities. Sources: CONAMA-CAS, 2007. Encuesta sobre Capacidades Municipales en Gestión y Planificación Ambiental.

Municipality	Environmental management office, unit or person	Environmental strategy, plan or agenda	Environmental management financial resources	Environmental management Municipal legal instruments
Provincia de Capitán Prat				
▪ Cochrane	No	No	No	No
▪ Tortel	No	In preparation	No	No
▪ O'Higgins	No	No	--	No
Provincia de General Carrera				
▪ Chile Chico	Yes	No	-No	No
▪ Río Ibáñez	No	No	No	No
Provincia de Aysén				
▪ Aysén	Yes	In preparation	Yes	Yes
▪ Cisnes	No	No	Yes	No
▪ Guaitecas	No	No	No	No
Provincia de Coyhaique				
▪ Coyhaique	Yes	Yes	Yes	Yes
▪ Lago Verde	No	No	No	No

However, the lack of local governance is not the only deficiency that confronts the environmental protection and management at Chilean Patagonia. Table 4 illustrates the institutional capacity of the national public services to plan, manage and control regional protected areas and natural resources. The service in charge of wildlife protection has more professionals and technicians because it is also responsible for animal health. However this public service does not have the financial and information resources to play its important role. In the National Forestry Commission – which in Chile is the public service in charge of protected areas – most employees are devoted to control summer forest fires but not to protect national parks or nature reserves. In fact there are no park rangers in regional protected areas and nor do they seem to have any financial or technical information to play their fundamental role in this area.

Money that is available for promoting tourism in the region is there because of a one-off international loan ring-fenced for this purpose. However, the tourist service does not provide any information or technical resources. The lack of professionals, information and techniques and of financial resources is typical for the situation of environmental management in the Chilean public services. Under theses institutional conditions it is very clear that environmental protection and control are not a public priority.

Table 4: Capacity of public national institutions to protect and manage protected areas and natural resources in the Aysén region. Source: Based on field interviews.

Institution	Competences	Professionals and technicians	Financial resources (in '000 US dollars)	Information and technology	Location
Servicio Agrícola y Ganadero (wildlife protection)	Natural resources and wildlife protection	23 professionals and 25 technicians	No data	No	Coyhaique, Puerto Aysén, Chile Chico and Cochrane
Corporación Nacional Forestal (National Forestry Comission)	Protection of conservation areas	18 park rangers and 147 workers	No data	No data	4 national parks and 12 nature reserves and national monuments No park rangers in the region Offices at Cohayque, Puerto Aysén, Chile Chico, Cochrane, Puerto Tranquilo, La Junta, Tortel, Villa O´Higgins
Servicio Nacional de Turismo (National Tourism Service)	Tourism development and promotion	8 workers	700	No	Offices in Cohayque and in the municipalities
Gobernación Marítima (maritime authority)	Marine environmental protection	No data	No	No	Capitanías de Puerto en Melinka, Puerto Cisnes, Chacabuco, Chile Chico, Caleta Tortel & Puerto Aguirre
Servicio Nacional de Pesca (National Fishing Service)	Fishing and marine environmental protection	30 workers	No data	No	Puerto Aysén & Melinka
Dirección General de Agua (National Water Authority)	Water quantity and environmental quality control	8 professionals	No data	No	Coyhaique
Ministerio de Bienes Nacionales (Ministry of National Assets)	Fiscal properties inventory and administration	21	100	No	Coyhaique

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