"GLACIER RESOURCES LAW AND POLICY: A CASE OF TRANSBOUNDARY MANAGEMENT"

Research Paper.

Event: XVth IWRA World Water Congress
Author: Mauricio Riesco
Email: mauricioriescot@gmail.com
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1 Abstract.

The effects of the interglacial period on the Earth are depicted on a clear reduction of the cryosphere and hence glaciers. The latter geological elements provide ecological services of vital importance for the maintenance of human settlements and the habitat of a large part of the flora and fauna. Glaciers have also an important economic, social and cultural value; enabling the development of relevant activities such as agriculture, power generation, tourism, conservation, among others. Notwithstanding their key ecological function, there are no international law instruments establishing minimum standards for the protection and conservation of glaciers, leaving these ice masses only subject to the general protection of environmental rules and in a few rare cases, to specific local regulations.

2 Abbreviations.

- EIA Environmental Impact Assessment
- EIAS Environmental Impact Assessment System
- GEFL General Environmental Framework Law
- IACS International Association of Cryospheric Sciences
- IPCC Intergovernmental Panel on Climate Change
- UNCBD UN Convention on Biological Diversity of 1992
- NRC National Research Council
- NSIDC US National Snow & Ice Data Center
- NSPWA National System of Protected Wildlife Areas
- RAMSAR Convention on Wetlands of International Importance especially as Waterfowl Habitat.
- UN United Nations
- UNCED UN Conference on Environment and Development
- UNECE UN Economic Commission for Europe
- UNFCCC UN Framework Convention on Climate Change
- UNWC UN Watercourses Convention
- USGS United States Geological Survey

3 Introduction.

More than two thirds of the fresh water of the world is contained in solid structures (Shiklomanov, 1993) located on Polar Regions or high mountains. However, the current interglacial period jointly with anthropogenic processes and the global warming are causing the fast recoiling of the cryosphere on earth (IPCC, 2014).

Glaciers are masses of ice of vital importance for the ecosystem because of being natural reservoirs (NRC, 2012) that regulate and purify water, allowing the development and maintenance of their habitat for a significant part of the existing flora and fauna (Hambrey, 2004). Glaciers also have an important economic, sociocultural value, being a source of fresh water for human consumption and enabling the development of relevant activities such as agriculture, tourism, conservation, and power generation.

It has been investigated and written extensively about the effects of the recoiling process of glaciers in the Himalayas (NRC, 2012), the Andes Mountains in South America (Carey, 2010), the Canadian Rocky Mountains and the Columbia Glacier (Comeau, 2009), among others. However, it seems that the work of these authors and the worrying conclusions reached by them and by international organizations like the IPCC –whose latest report estimated global sea-level rise in this century at 18–59 cm due to thermal expansion of the oceans and melting of inland glaciers and large ice sheets– have had no echo for the development of an international framework for the protection and conservation of glaciers.

Notwithstanding the presence of several international instruments that partially refer to glaciers influencing their treatment in some aspects (e.g. UNFCCC, RAMSAR, etc.), there is neither an instrument that specifically regulates the status of glaciers in international law nor a convention nor multilateral treaty that expressly refers to glaciers by providing principles or minimum legal regulations for their conservation or environmental protection.

There are 24,114 glaciers covering 23,641 square kilometres in the Chilean Andes (Glacier Cadastre, 2013) and many of them are part of transboundary hydrological systems shared with Argentina. However, Chile lacks a specific legal framework for their protection, conservation and use. Furthermore, there are no joint working initiatives regarding glaciers between both countries that share important basins throughout their more than 6,600 kilometres of Andean border (CIA, 2015).

The aim of this work is to understand in general terms the phenomenon of glaciers and decipher the challenges that international law faces to tackle the protection and conservation of these glaciological elements. They were also revised the Chilean and Argentine regimes and their approach to the regulation of transboundary ice masses to finally outline some suggestions of possible improvements to the prevailing binational system.

4 Nature of Glaciers.

First of all it is necessary to understand the technical meaning that science gives to the concept of "glacier". In this regard, it is necessary to consider three of the most accepted technical definitions developed by specialized agencies:

IACS/UNESCO: *"A perennial mass of ice, and possibly firn and snow, originating on the land surface by the recrystallization of snow or other forms of solid precipitation and showing evidence of past or present flow"* (Cogley, 2011).

IPCC: "*A perennial mass of land ice that originates from compressed snow, shows evidence of past or present flow (through internal deformation and/or sliding at the base) and is constrained by internal stress and friction at the base and sides. A glacier is maintained by accumulation of snow at high altitudes, balanced by melting at low altitudes and/or discharge into the sea"* (IPCC, 2013).

USGS: "*A large, perennial accumulation of ice, snow, rock, sediment and liquid water originating on land and moving down slope under the influence of its own weight and gravity; a dynamic river of ice. Glaciers are classified by their size, location, and thermal regime"* (USGS, 2013).

From these definitions it is possible to extract some main common features to all glaciers:

- Object: Ice mass
- Temporary nature: Perennial
- Location: Continental crust
- Mobility nature: In flow

It is also possible to find other characteristics that may be called secondary because of not being present in all glaciers such as, the fact that often glaciers not only contain ice but also snow and rocks. Some of them are located at high altitudes on mountains and drain into aquifers or surrounding rivers or lakes, while others are at low altitudes and often flow directly into the sea. Some of them have their white masses of ice uncovered and others have a layer of detrital rocks and ashes that covers them totally or partially.

Bearing in mind this broad idea of the physical features of a glacier, it behoves referring to the importance of these geological formations at the eco-systemic level as well as its socio-economic role in relation to the human population that surrounds them.

In this regard it must be taken into account that more than half of the human population on earth depends on water that is captured and purified in the mountainous

regions, where glaciers act as natural reservoirs regulating the flow of freshwater that is drained into the surrounding rivers, lakes and aquifers (Grêt-Regamey, 2012).

Regarding its environmental functions, glaciers play an extremely important role that is accentuated to the extent that these are closer to the tropics where they can be found mostly alongside the highlands of arid or semi-arid regions. In the latter locations they face a fragile eco-systemic equilibrium and their exposure to global warming has dramatic effects. For example, the Colombian Institute of Hydrology, Meteorology and Environmental Studies reported that the loss of the total Colombian glacier area had reached almost 80% since 1850 (Ruiz, 2008). This is the reason why the areas where glaciers are located are usually classified as fragile mountainous ecosystems (Agenda 21, Ch. 13), since their functions of water regulation and purification not only serves for the human consumption of settlements but also allows the maintenance of wetlands that works as hotspots of biodiversity (Grêt-Regamey, 2012).

As it was outlined previously, glaciers also have an important economic role enabling the development of relevant activities such as agriculture, hydroelectric power generation and mining (Hambrey, 2004), latter industry that maintains an unfortunate historical precedent regarding its relationship with glaciers. Recent examples of that are the cases of the Centerra Gold "Kumtor" mine in Kyrgyzstan and the Barrick Gold "Pascua-Lama" mine in Chile.

From a sociocultural perspective, glaciers also play a significant role in allowing the realization of spiritual, sporting and tourism activities. There are many examples of said sociocultural services provided by glaciers, from those it can be mentioned the case of Mount Kailash in the Himalayas (6714 meters), a pilgrimage destination where every year thousands of Hindu, Buddhist, Jain and Bon religions go for spiritual purification.

5 International Law and Glaciers.

It is necessary to start clarifying that there is neither an instrument that specifically regulate the status of glaciers in international law nor a convention nor multilateral treaty that expressly refers to the glaciers providing principles or minimum legal regulations for their conservation or environmental protection. However, there are some international instruments that somehow refer to glaciers influencing their treatment in some aspects.

The most relevant regulatory instruments identified in this regard are:

5.1 UN Framework Convention on Climate Change (UNFCCC).

This convention recognizes in its preamble the special vulnerability of mountain ecosystems, which definitely includes glaciers, when it states that "*recognizing further that low-lying and other small island countries, countries with low-lying coastal, arid and semi-arid areas or areas liable to floods, drought and desertification, and developing countries with fragile mountainous ecosystems are particularly vulnerable to the adverse effects of climate change*" [emphasis added].

Article 4 of this Convention expressly refers to the commitments acquired by the signatory countries and point 8 letter g) states that to implement the commitments that the article refers to, the Parties will study the actions necessary to adopt under the convention, to meet the specific needs and concerns of developing countries, especially those of "*countries with areas with fragile ecosystems, including mountainous ecosystems*".

5.2 UN Watercourses Convention (UNWC).

The scope of action of this convention refers to transboundary or international watercourses that have purposes other than navigation. The definition of watercourse established in UNWC refers to a *"system of surface waters and groundwaters constituting by virtue of their physical relationship a unitary whole and normally flowing into a common terminus"*. Then the concept of international or transboundary watercourse is defines as *"a watercourse, parts of which are situated in different States"* (Articles 2(a) and 2(b)).

Despite the UNWC only mentions water in its solid state when referring to the prevention and mitigation of harmful conditions in Articles 27 and 28, the UNWC Users Guide provides a helpful explanation of the scope of the "systems of surface waters" concept, stating that it covers *"major and minor watercourses and their tributaries, and connected lakes and aquifers, glaciers, reservoirs, canals, wetlands and floodplains"* (Rieu-Clarke, 2012) [emphasis added].

In the same vein, it was addressed by the UN International Law Commission (ILC) when referring to the scope of the Convention with regard to groundwater systems, noting that *"groundwaters refers to the hydrologic system composed of a number of different components through which water flows, both on and under the surface of the land. These components include rivers, lakes, aquifers, glaciers, reservoirs and canals"* (Rieu-Clarke, 2012). The criterion used to arrive to this conclusion is based on the interrelation between different components of the watercourse.

5.3 UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes.

The only context in which the UNECE Watercourses Convention allude to water in its solid state is when it refers, in Article 11 number 1), to floating ice in the context of monitoring programs for general cooperation between riparian countries, prescribing that *"the Riparian Parties shall establish and implement joint programmes for monitoring the conditions of transboundary waters, including floods and ice drifts, as well as transboundary impact"*.

Even though the Convention refers to water in solid state in a very restricted context, subsequent explanatory documents as the Guidance on Water and Adaptation to Climate Change, whose objective is to *"support countries in their implementation of the Water Convention and its Protocol in the context of climate change"*, raises the issue of glaciers as one of the factors that should be included in the Climate Vulnerability Index.

5.4 Convention on Wetlands of International Importance especially as Waterfowl Habitat (RAMSAR).

This Convention aims to the conservation of wetlands and their flora and fauna, understanding that these constitute a resource of great economic, cultural, scientific and recreational value.

Notwithstanding the fact that the Convention focuses on promoting conservation of wetlands without mentioning glaciers, is important to highlight that at the Conference of the Contracting Parties held in Valencia, Spain in 2002, it was issued the Resolution VIII.12, which aimed to improve the rational use and conservation of mountain wetlands. This resolution states that mountain and highland wetlands include a wide range of lakes, rivers, streams, peatlands, karstic systems "*including the meltwater channels flowing from glaciers and snowfields*" [emphasis added]. This resolution also expresses concern about the effect that climate change is generating "*resulting in the shrinkage of snowfields and glaciers*" [emphasis added], leading to rapid changes in the distribution and functioning of wetlands at higher altitudes. It also refers to the negative impacts that occur on river systems downstream.

This finding allows us to imply that even though the RAMSAR Convention does not mention or regulate expressly the relation between wetlands and glaciers, is in the aim of the instrument to do so from the perspective of the protection of wetlands and so have been assumed by the contracting parties.

5.5 UN Convention on Biological Biodiversity.

The Convention is the first global agreement on all levels of biological diversity: genetic resources, species and ecosystems. It explicitly recognizes that the conservation of biological diversity is a common goal of humanity as well as the foundation for the development process.

Despite the fact that it does not refers particularly to glaciers, its Article 20 number 7 prescribes that the condition of developing countries with mountainous areas, would be considered by the signatory States as a differentiator factor for the allocation of financial resources.

This could be seen as a useful tool for the protection of glacier ecosystems if the programmes and the funding are allocated appropriately.

5.6 Agenda 21 of the Rio Declaration on Environment and Development.

The Agenda 21 is a United Nations non-binding, voluntarily implemented action plan, adopted in the context of the UN Conference on Environment and Development (UNCED), also known as the Rio Conference or the Earth Summit. This Agenda contains an exhaustive action plan that includes the indirect protection of glaciers without mentioning them expressly.

It is possible to arrive to the latter statement through a comprehensive understanding of the specific objectives of the Agenda 21 for the management of fragile ecosystems. In this regard, they can be found strong focuses on sustainable development of mountain ecosystems and the protection of the quality and supply of freshwater resources.

Examples of said focuses can be found in both Chapters 13 and 18 of the Agenda 21, transcribed below:

Chapter 13: Managing Fragile Ecosystems: Sustainable Mountain Development. *13.1. Mountains are an important source of water, energy and biological diversity. Furthermore, they are a source of such key resources as minerals, forest products and agricultural products and of recreation. …hence, the proper management of mountain resources and socio-economic development of the people deserves immediate action* [emphasis added].

Chapter 18: Protection of the Quality and Supply of Freshwater Resources. *(…) Actions 18.12. All States, according to their capacity and available resources, and through bilateral or multilateral cooperation, including the United Nations and other relevant*

organizations as appropriate, could implement the following activities to improve integrated water resources management: …b) Integration of measures for the protection and conservation of potential sources of freshwater supply, including the inventorying of water resources, with land-use planning, forest resource utilization, protection of mountain slopes and riverbanks and other relevant development and conservation activities; [emphasis added].

5.7 Antarctic Treaty and its Protocol on Environmental Protection.

Almost 90 per cent of Earth´s ice mass is located in the Antarctic Continent (NSIDC) mainly shaped as ice sheets and glaciers. Hence the importance of protecting and conserving the vastest reservoir of fresh water in the world.

The conservation argument along with others concerning geopolitics and global strategy, were considered by the signatories to the Antarctic Treaty and its Protocol on Environmental Protection. In this regard, Article 2 of the aforementioned instrument states "*the Parties commit themselves to the comprehensive protection of the Antarctic environment and dependent and associated ecosystems and hereby designate Antarctica as a natural reserve, devoted to peace and science*".

It is necessary to take into consideration that there are no transboundary water issues in the Antarctic Continent since there are no official boundaries but only territorial claims. Meanwhile it seems that the reigning principle is of Total Sharing for scientific and peaceful purposes, and it is interesting to note that most of the principles of the UNWC have application in the Antarctic Continent.

Despite the fact that most of the ice mass in Earth is located in the Antarctic Continent it is necessary to make a difference between Polar glaciers (USGS, 2013) and the rest of them when it comes to the development of protection and conservation policies. This distinction should be made primarily because of the degree of direct affectation that glaciers have on the population of inhabited continents and also because of the existence of international instruments –as the Antarctic Treaty– that already focuses in some of them.

Finally, it is possible to state that the abovementioned multilateral international instruments –jointly with other instruments that are indirectly related because of dealing with environmental issues or climate change– have somewhat relevance regarding glacier protection and conservation. However, none of them contains a comprehensive framework nor establishes minimum standards for the protection and conservation of glaciers, leaving the latter geographic elements only safeguarded by the general umbrella of environmental instruments.

6 Management and Protection of Transboundary Glaciers: Chile-Argentina Case.

This chapter focuses in the specific case of Chile and Argentina analysing their national regulations regarding glacier protection and then addressing their bilateral experience regarding transboundary water resources as well as the way it could influence the development of a transboundary glacier protection initiative.

6.1 Chilean National Regime.

The Chilean law does not have a statute or regulation addressing glaciers in a specific and comprehensive manner. The main regulatory body for water in Chile is the Water Code, an instrument that does not refer to water in its solid state nor establishes rules regarding the relation of watershed and transboundary water issues, whether involving surface or underground water. However, they can be found related provisions with somewhat impact regarding glacier protection, in laws and regulations concerning National Protected Areas as well as the System of Environmental Impact Assessment in relation to the implementation of projects that could mean an impact on glaciers.

6.1.1 Juridical Nature of Glaciers.

There is a particular combination of public-private legal realities that come together in the Chilean legal framework for water resources. This particular system has worked acceptably during normal hydrologic periods but started to show some shortcomings in periods of water scarcity like the present.

As provided in Articles 5 of the Water Code and 595 of the Civil Code, Chilean fresh waters are national goods for public use thus becoming part of that category of goods whose domain belongs to the entire nation. However, along with that declaration of national good, the Water Code itself and the Constitution of the Republic conferred on individuals the possibility to request the establishment of use rights over waters, which once assigned can be transferred in accordance with market forces that operates as a secondary way for resource allocation.

The broadly described framework has advantages and disadvantages, whose analysis escapes from the scope of this topic. However, for the purpose of this work it is necessary to state that there is no mention regarding the physical state in which water can be found and therefore competing theories have emerged regarding the possible application of the general regime of water to those found in solid state, as the case of glaciers. This doctrinal discussion becomes very relevant depending on the stance to be adopted because, for example, it could be argued that glaciers as water are also subject to the allocation of private use rights - with the consequent precarious situation in which they would remain - or that their

solid state leaves them out of the rules governing the allocation of water rights.

Such relevance has taken this discussion that there have been several attempts to settle this uncertainty by introducing legislative initiatives that seek to regulate the treatment of glaciers, which are described later in this paper.

6.1.2 Institutions related to Glacier Research and Conservation.

Although in Chile there is no institution specifically mandated in order to ensure the protection and conservation of glaciers, different institutions involved in the management and protection of water resources and natural heritage have partially addressed the issue of glaciers within the framework of its powers.

Below a brief review of some of the institutions that relate in some way to the protection of the glaciers in Chile:

6.1.2.1 Ministry of Environment.

Is the public body responsible for collaborating with the President of the Republic in the design and implementation of policies, plans and programs on environmental matters as well as the protection and conservation of biological diversity and renewable resources, promoting sustainable development, environmental integrity policy and its legal regulation.

6.1.2.2 Environmental Assessment Service.

Is the public body responsible for the administration of the System of Environmental Impact Assessment, encouraging and facilitating public participation in the context of the environmental assessment of projects. In particular it is the Environmental Assessment Service who decides on the Environmental Impact Statements and Environmental Impact Studies that projects need to carry out when they are susceptible of generating environmental impact, which could eventually involve glaciers such as in some mining projects.

6.1.2.3 General Water Directorate.

The General Water Directorate is the state agency responsible for promoting the management and administration of water resources in the country. As part of its monitoring responsibilities regarding water systems

in the country it is also in charge of build the cadastre, monitor and study the behaviour of glaciers through the Glaciology and Snow unit.

6.1.2.4 Environment Superintendence.

Is the public service responsible for implementing, organizing and coordinating the monitoring and supervision of the Environmental Qualification Resolutions of the projects as well as all those other instruments of environmental compliance specified by law.

6.1.2.5 National Forestry Corporation.

In the context of its mission to contribute to the conservation, increase and management of forestry resources and protected wildlife areas of the country, the National Forestry Corporation is responsible for the administration of the National System for Protected Wildlife Areas, within which they are located an important part of the country's glaciers.

6.1.3 Regulations related with Glaciers.

According to what is stated above, Chile has no specific legislation for the protection and conservation of glaciers. Notwithstanding the latter, there are certain standards that indirectly regulate some aspects of glacier protection, of which below they are selected those that seem most relevant:

6.1.3.1 Environmental Impact Assessment System (EIAS).

Article 10 letter a) of the General Environmental Framework Law states that those projects or activities susceptible to cause significant alteration to natural water bodies or waterways, should be subject to an EIA study. Meanwhile, Article 3 letter a) of the Regulation of the EIAS specifies the scope of the previous rule by stating that it include all glaciers that are incorporated as such in the public inventory in charge of the General Water Directorate, adding in subparagraph a.5. that it means "significant alteration" when the execution of works or activities involve alteration of the characteristics of the glacier.

6.1.3.2 Officially Protected Areas.

Approximately 20% of Chile's continental territory is under some kind of official protection within the framework of the National System of Protected Wildlife Areas (NSPWA). The aforementioned system is made

up of 36 National Parks, 49 National Reserves and 15 Natural Monuments, which together cover an area of approximately 145,000 square kilometres. To the foregoing they must be added those areas that are covered by other types of protection as the Private Protected Areas, the RAMSAR sites, the Biosphere Reserves, among others.

If all the previously mentioned categories are taken and confronted with the Glaciers Cadastre, the result is that 54.7% of Chilean glaciers are located in sites with some degree of protection. Although this number is encouraging, it should be noted that the geographical distribution of protected glaciers is marked by a strong inclination to the south, being underrepresented the mountain glaciers of the centre and north of the country.

It must be mentioned that the enactment of Law Nº 18,362 that creates and regulates NSPWA is still pending to the enactment of its Regulations. Notwithstanding the foregoing, it can be stated that the mentioned law is operating as a customary practice for the management and administration of Chilean natural heritage. Additionally, in accordance with the provisions of Articles 34, 35 and 36 of the GEFL, glaciers located within the perimeter of the protected areas, are understood to be part of them and hence subject to State management through the NSPWA.

6.1.3.3 Native Forests Law.

Paragraph 1 of Article 17 of Law Nº 20,283 regarding Native Forest Recovery, set a ban on logging, destruction, disposal or impairment of native trees and shrubs at a distance of 500 meters from glaciers.

6.1.3.4 International Instruments.

Chile has ratified some of the most relevant international instruments involving glacier protection as explained before in this work. Those instruments are the RAMSAR Convention ratified by Chile on September 4, 1981; the UN Convention on Biological Biodiversity ratified by Chile on September 9, 1994; and, the UNFCCC ratified by Chile on December 24, 1994.

6.1.4 Legislative Initiatives Regarding Glaciers Regulation.

As from 2005 they have been entered to the Chilean Congress four legislative initiatives with different nuances but all of them with the aim of establishing a legal framework for the protection of glaciers. Two of those initiatives were archived for not having further progress. A third initiative

launched in 2006 had a greater discussion, however it remains at a standstill in his first constitutional stage since October 2013.

The fourth initiative entered in 2014 and then underwent a parliamentary agreement by which they requested the Executive to introduce a replacement note, which was materialized on March 31, 2015. This last initiative, which seems to have greater parliamentary support than previous, briefly includes the following aspects:

6.1.4.1 Definition: The text proposed by the replacement note provides a definition of the generic concept of glacier noting that they are constituted by *"any mass of solid terrestrial water flowing by deformation of its internal structure and by the slipping of its base, enclosed by topographic elements that surrounds it, comprising of different ecosystems, whatever be their form, location, size and condition."* Then it also adds a number of definitions of specific types of glaciers, their environment and eco-systemic services.

6.1.4.2 Juridical Nature: It is proposed the express designation of glaciers as national goods of public use, clarifying that they cannot be subject of appropriation nor of the constitution of private use rights.

6.1.4.3 Strategic Reserve: It establishes a new protection category for glaciers named "Strategic Glacier Reserve" jointly with the basic procedure rules for a glacier to be declared as so.

6.1.4.4 Prohibition of Activities in Protected Areas: It is removed the possibility of any commercial activity both in glaciers and its surroundings when they are located within a protected area.

6.1.4.5 Allowed Activities: They are described the allowed activities such as scientific investigation, mountaineering and rescue.

6.1.4.6 Sectorial Environmental Permit and Fines: It is established the requirement for a specific environmental permit for activities susceptible to cause impact on glaciers. This permit needs to be issued by the General Water Directorate and empowers such institution to impose fines for noncompliance.

6.1.4.7 Review process for current environmental permits: One of the most controverted measures proposed in the initiative is the obligation of projects and/or activities already awarded with an Environmental Qualification Resolution, to inform if they could have an impact on glaciers jointly with the presentation of mitigation measures. This measure has been largely discussed because of been seen as a change of the game rules by the industrial sector.

Notwithstanding that the initiative could be subject of improvements and /or clarifications regarding the scope of certain provisions, it represents a step forward in the protection of these geographical elements as well as the fragile ecosystems that depends on them.

6.2 Argentinian National Regime.

Regarding the Argentinian regime is necessary to highlight the enactment in 2010 of the Law Nº 26.639 that sets the "Regime for minimum standards for the preservation of glaciers and periglacial environment". This is the first case of a national comprehensive framework for the regulation and protection of glaciers and was followed by the Kyrgyz Republic whose Parliament passed a law in April 2014 that prohibits activities affecting glaciers.

A brief review of the main aspects of Argentina Glacier Law, concerning the definition of glacier, prohibitions on use, environmental impact assessment, accountability system, competent authorities and inventory, is done below.

6.2.1 Glacier Definition and Functions.

Article 2 of the Law 26.639 defines glacier as *"any mass of perennial ice whether stable or slowly flowing, with or without interstitial water, formed by recrystallization of snow, located in different ecosystems, whatever their form, dimension and conservation state"*. Thereafter the law establishes that *"they are constituent parts of each glacier the rocky detritus material as well as the internal and surface waterways."*

According to the provisions of Article 1 of the law 26.639, the functions of glaciers are human [water] consumption, agriculture, watershed recharge, protection of biodiversity, source of scientific information and tourist attraction.

6.2.2 Activity Prohibitions.

The legal framework for glacier protection contemplates a series of prohibitions designed to discipline the permitted activities in a more

strictly way. These prohibitions exclude the possibility to develop certain activities at these sites.

Article 6 of Law 26.639 establishes specific prohibitions for the exercise of certain economic activities. In this regard, it states that they shall be prohibited those activities that may affect the natural condition of glaciers or their functions specified in Article 1. Subsequently, it expressly prohibits certain specific activities such as the disposal of polluting substances, the construction of infrastructure, mining, energy and any industrial activity.

6.2.3 Environmental Impact Assessment System.

Article 7 of Law 26.639 establishes that planned actions in glaciers and the periglacial environment, which are not prohibited, are subject to the system of environmental impact assessment, except for scientific, sports and rescue activities.

6.2.4 Administrative Responsibility System.

Article 11 of Law 26.639 establishes a special system of administrative responsibility for sanctioning infringements of regulations. This system is based on the Argentinian federal structure, hence delegating the sanctioning regulation to the competent jurisdictions of each State and designating a default regime in the absence of State regulations.

6.2.5 Competent Authorities.

Since everything related to procedural law and natural resources is a matter of provincial regulation, Law 26,639 distinguishes two types of authorities depending on the relevant level:

6.2.5.1 Enforcement authority: According to Article 9, the enforcement authority corresponds to the higher national hierarchical level organization with environmental competence.

6.2.5.2 Competent authority: According to Article 8, each province determines the competent authority. However, in the case of protected areas covered by Law Nº 22.351 on National Parks, Natural Monuments and National Reserves, the competent authority is the National Parks Administration.

6.2.6 Glacier Inventory.

Article 3 of Law 26,639 creates the National Glacier Inventory, where all existing glaciers acting as water reserves in the country will be individualized.

6.3 Bilateral Perspective.

Chile and Argentina share over 6,600 kilometres of border over Andes Mountains and since the Boundary Treaty of 1881 the two countries agreed to use "*the highest peaks of these ridges that divide the waters and pass between the slopes that flow to either side"* as the mechanism for defining their border. Nonetheless, the geography of high mountains in many cases means that the referred demarcation technique cannot be translated into a system of automatic delimitation. Thus, in many basins it was necessary to agree on a conventional delimitation and consequently, many hydrological systems became transboundary.

Subsequently in 1971, it was signed the Santiago Agreement on Hydrological Basins in which both countries recognize the right of each other to use, within the respective territories of both countries, the waters of shared rivers and lakes by reason of their needs, as long as that do not cause significant damage to the other party. The content of this Act was later ratified after being mentioned as a reference in subsequent bilateral instruments.

Later in 1991 Chile and Argentina signed the Bilateral Treaty on Environmental Protection in order to undertake coordinated and joint actions for the protection, preservation, conservation and environmental sanitation. This treaty established as a priority the protection and rational use of water resources (Article 2 No. 3).

Along with the signing of the treaty referred to in the preceding paragraph, the signatory countries agreed two protocols, one on the protection of the Antarctic environment and other on shared water resources.

In the Specific Additional Protocol on Shared Water Resources, the Parties agreed that the actions and programs relating to the use of shared water resources would be taken according to the concept of integrated management of watersheds. They also pointed out that the use of water resources in the territory of a Party, belonging to a common basin shall not cause damage to shared water resources, to the common basin or to the environment (Article 1).

This rule is very important because it allows either party to request from the counterpart a non-harmful use of the watershed referred as a whole. Thus, it could be stated that parties imposes each other a more demanding standard than the principle of not causing significant harm, committing to a duty of care not

only in the sense of no harm but to preserve and ensure the use of the shared basin.

Is worth noting that the referred Protocol defines what the parties understand by the concept of shared water resources, prescribing in Article 4, that "…*shared water resources are those that flowing naturally, crosses or coincides wholly or partially with the Argentinian-Chilean international boundary".*

This definition seems to be weak for two reasons: for not incorporating the progresses available at the time in relation to the concept of integrated watershed management; and for failing to cover both aquifers as glaciers, that are fundamental elements of mountain hydrological systems.

With regard to the Protocol on Protection of the Antarctic Environment, a general framework is established in the sense of "promoting the conservation of Antarctic natural and cultural values" (Article I), and the exchange of information on Antarctic activities, in order to avoid any adverse impact on the Antarctic environment and dependent and associated ecosystems (Article II). It is also established the possibility of implementing joint monitoring programs in order to detect, quantify and identify the likely causes of observed air quality, snow and water changes, as well as other essential features of the Antarctic environment and biodiversity (Article III).

According to information published by the Chilean Ministry of Foreign Affairs, the Bilateral Committee on the Environment conformed under the Bilateral Treaty on Environmental Protection has held 10 meetings alternately in Buenos Aires and Santiago, which are chaired by the Director of Environment of the respective chancelleries. However, there is no relevant information about specific issues relating to transboundary basins that have been discussed and eventually agreed to in the context of these meetings.

In sum, like the protocol on shared water resources, the Antarctic Protocol establishes a kind of letter of intention between the two countries regarding the use, study and environmental protection of a shared territory, with no major signs of concretion or joint action. In the same vein, both protocols establish joint working groups with supposed regular meetings that began in 1996, but from that date onwards there is no greater information or record of their periodic performance.

Is relevant to mention the existence of a bilateral Mining Integration Treaty signed in 1997 between Chile and Argentina. This treaty was born as an instrument for the promotion of the economic and political integration between the two countries and its purpose is to establish a regulatory framework and an environment conducive to the development of transboundary mining projects.

The mentioned instrument is relevant because of the close relationship between the development of mining in the Andes Mountains and possible impacts to

glaciers. To have an idea, a study developed by the Chilean Mining Council estimates that 53% of the untapped mineral resources have some relationship with glaciers as a result of the geomorphological conditions of the country.

With regards to the potential environmental impacts of transboundary mining projects as well as any impact of them related with glaciers, Article 12 of the Mining Treaty states that parties shall "apply their national legislation on environmental protection, subjecting the mining activities to the EIAS in Chile and the EIAS, as appropriate."

In short, it can be stated that both countries maintain an important history of agreements relating to transboundary water resources as well as a structure that could be used as a common base for the treatment of shared glaciers. However it is possible to state that this bilateral system requires an update of its concepts and a new impetus to its working groups that should ideally become permanent bodies, at least in those basins of greater relevance.

It is noteworthy that Chile and Argentina hold a pending border demarcation in the Southern Ice Fields, who represents one of the largest glacier extensions outside the poles. The dimension of this issue is beyond the scope of this work, hence it is only enunciated.

7 Conclusions.

In the same path as followed by the international community to reach agreement for regulating the protection of the wetlands on RAMSAR Convention, it would be desirable that efforts were focused on regulating the protection and conservation of glaciers or their explicit incorporation to the international instruments related to water management.

Regarding the Chilean legal framework, it seems that this issue is being discussed with high-mindedness in the Chilean Congress and the current bill of law would be a great contribution. It would also be advisable to introduce some clarifications to the mentioned bill of law, regarding the scope of certain provisions. The latter could lead to a double effect by providing a legal framework to the protection of glaciers at the same time of bringing certainty regarding the possibilities for the development of projects in areas surrounding glaciers.

In relation to the management of transboundary ice masses, it is optimistic to see how Chile and Argentina have addressed this topic in relation to transboundary waters. Glaciers may join to the same scheme together with the introduction of the necessary adjustments according to the lessons of 133 years of application of the Treaty of Limits of 1881.

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