

The Human Right . . . to *Glaciers*?¹

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Yes. *The right to glaciers.*

The very title of this presentation already begins to create a sense of discomfort for some legal experts, much like the discussion about the “right to water” did several years ago. This discomfort is intentional. Hopefully, by the end of this presentation, the reader will agree that, at the very least, we *do* need to have a discussion on the role glaciers play in terms of human rights realization and maybe that will lead us to deepen this discussion on the human rights dimension of glaciers.

Glaciers are melting. We know that, and climate change, including natural ecosystemic millenary cycles of climate change, is causing glacier melt. But so is *anthropogenic* climate change, which is accelerating natural melt at alarming rates. Glacier melt will lead to both flooding in greatly populated areas—particularly downstream from rivers born in the Himalayas—and the disappearance of massive water reserves in our glaciers and polar icecaps, which will in turn cause sea levels to rise and flood many low-lying island states. Some entire populations in the South Pacific, like islanders on Tuvalu, are in fact already looking for a new nation. They simply have to move or be submersed by the sea.

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Glacier melt is also an enormous risk to the stability of massive ice bodies in high mountain altitudes. As these bodies start deforming, (as often occurs due to melt) they can collapse and come rushing down-mountain with ice blocks as large as skyscrapers, sometimes pounding into glacier lakes formed by natural dams (formed in turn by moraines left by receding glaciers). These impacts can cause tsunami waves many meters high, taking out anything in their path. In the not-so-distant past, glacier tsunamis have taken thousands of lives in the mountainous areas of Peru, in parts of the Himalayas, and in certain parts of Europe.

We read and hear about such predicaments in the media daily and are pretty much desensitized to this issue, although we know very little about the specifics or technical aspects of glacier melt. Most of us envision huge polar ice sheets breaking off into the oceans, becoming massive, floating icebergs, eventually melting off as they flow into warmer water. We imagine, with some stretch of the imagination, that this ice melt will *somehow* raise the sea level, although many of us have a hard time accepting just how this impact will play out and with what magnitude. Can the melting of a big iceberg really raise the ocean level? Yes it can!

Regardless of just how this will occur, most of us will generally conclude that glaciers today are a vulnerable natural resource and that because of what is happening to glaciers, we will likely be faced with catastrophic tragedies. We conclude in this context that our priority should be to avoid glacier melt, which naturally takes us to a discussion about global climate change. Industry is contaminating the environment and, more specifically, the air. Carbon Dioxide (CO₂) emissions cause global warming, and its impact is that ice warms and melts. A lesser-known impact of growing CO₂ emissions is that the miniscule CO₂ carbon particles emitted into the air are deposited on ice. This darkens the glaciers and, just as when we wear a black shirt on a hot day we immediately feel the heat, glaciers likewise melt faster when they are stained by CO₂.

So in 2013, the year in which this presentation is being published, we are concerned about climate change, and we would like to see CO₂ emissions reduced. We know that a warming climate is melting our glaciers and that this is impacting our renewable ice bodies. We generally think of glacier melt as an indicative variable proving climate change, but we actually talk little or nothing at all about *glacier protection*. In fact, even the few cases we have seen linked to climate change talk about communities or animals (like the polar

bear) whose habitats are affected by a changing climate. No one seems to be talking about the need to protect glaciers or even linking glacier melt to the direct consequences it brings for affected communities. The closest the argument comes is the emerging link between polar ice cap melting, sea level rise, and endangered populations.

The Tuvaluans have surely already understood this linkage in terms of the human rights implications of glacier melt. Other more affluent communities like California coastal property owners will surely take up this agenda as soon as their multi-million dollar homes begin to collapse due to sea-level rise and unusually adverse weather.

But these circumstances seem not yet to have generated a human rights discussion about glaciers, or more specifically, “the *right* to glaciers.” The rationale for this discussion nonetheless is as colossal as the ice we’re talking about.

A staggering fact that we sometimes overlook is that nearly all of our water is in the oceans and is very salty. In other words, most of the planet’s available water is not drinkable unless we invest lots of resources in desalination plants. Only two to three percent of our planet’s water is actually freshwater. That’s a miniscule—but very precious—amount. And further, this alarming and largely ignored statistic, seventy-five percent of this available drinking water is in the form of ice in our glaciers, mostly in the polar icecaps but also in mountain glaciers. *All* of this ice is presently melting due to climate change. *That’s alarming.*

One would think that such a rare resource would be closely protected. One would think that most countries would have very strict water laws and that water protection would include the protection of ice, which we generally think of as water in one of its forms (liquid, ice, or gas). One would think that most countries would have long ago established a human right to water. Some have. Most have not. And one might even think that somewhere in all of this legislation, there may surely be at least a mention of glaciers, and why not, even a law to protect glaciers. Wrong.

Until very recently (2010), there were absolutely no laws to protect glaciers anywhere in the world! It’s actually quite remarkable that with so many other laws focused on natural resources—on flora, fauna, national parks, sensitive ecosystems, etc.—that no laws existed anywhere to protect our most important natural resource, particularly when glaciers hold three-quarters of that most precious resource, water. In our research, we have not even been able to find a water

law, or any other law, that mentions the word “glacier” or refers to glacier ice. (If the reader knows of any, please send the author such information as we are compiling resources to protect glaciers, and such legislation would be exemplary.)

When this author first started researching glaciers in 2007, he presumed that the Swiss, the French, the Norwegians, the Swedes, the People of Greenland, the Russians, the Icelanders, the Kyrgyzstans, the Chileans, the Argentines, the Peruvians, the Bolivians, the Canadians, the Americans, the Pakistani, the Nepalese, the Chinese, the Mongolians, the Japanese, or the Tanzanians, would either have glacier laws or regulatory frameworks that included glacier protection, since all of those countries (and several others) all have important ice reserves. They don't.

Not a single country in the world had a glacier law in 2007. The first glacier law was passed by the Argentine National Congress in 2008 and was vetoed just a few days later due to pressure from a large mining company operating on the border between Argentina and Chile whose project is surrounded by hundreds of glaciers. In 2010, that law came back, stronger and more stringent than its earlier version, surviving a presidential veto on its second appearance and becoming the world's first national glacier law. A few local provincial governments had anticipated the national law, and in fact, the province of Santa Cruz in Argentina's Patagonia region introduced the planet's first glacier legislation. Argentina's national glacier law protects glaciers as a public good, for their water storage and water basin regulation value.

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So how do we get to the point where we consider that we need to establish a *right* to glaciers? Is this just some arbitrary decision we make because one day someone realized that glaciers are at risk and that they need legal protection? Let's consider a few related issues and take the right to water as a corollary, in part because some might say that the right to glaciers is comprised within the right to water. Ice is, in the end, *water* in one of its forms, and the right to water, for many reading this article, may seem to have the necessary substantive doctrinal underpinnings to suffice for glacier protection.

As a global society, we are pretty convinced (although we were not just a few years ago) that collectively, individually, and in specific communities, we have a right to water. This collective and progressive recognition was not the product of an arbitrary decision or

a spontaneous proposition. It came alongside a global awakening which took several decades to mature over the awareness of our worsening anthropogenic impact on natural resources. We were and we are, in many instances, destroying our natural planet in an unsustainable way, and along with it, we are contaminating our water.

We are ninety-eight percent water by some estimates (a number that is curiously identical to the amount of salt water available to us in the natural environment), and hence water is a fundamental ingredient to our existence; not to mention that in liquid form, we need a significant daily intake of water to survive. Without it, in mere days we would shrivel up and cease to exist.

When discussions on the right to water surfaced in the early 2000s, there was much resistance to the concept in the sphere of international law, mainly from corporate actors who commercialize water and from states that tend to resist any advancements on globally-recognized rights, mostly over the concern of losing national sovereignty over the management of their natural resources.

But the discussion on the need to establish a right to water was both rational and logical, and thanks to initiatives by many civil society groups, supported by institutions such as the United Nations Office of the High Commission on Human Rights. Specifically through the help of General Comment 15 on the right to water, today we are pretty much in global agreement that consolidating and establishing the right to water was a good thing. The understanding of this right and the necessary substantive characteristics of policy needed to realize this right is still evolving, and while we haven't yet sorted out all of the concerns that the debate warrants, we are on the road to substantively defining and fully consolidating this fairly new right.

To begin our discussion on the right to glaciers, we should remember that law follows cultural or social custom. Societies exist, people interact, their actions have consequences, and when we collectively realize that those actions begin to have an undesired impact on the collective well-being (on the public good) or if they begin to infringe upon individual or community rights, we establish rules about how we want to coexist. Many of these rules evolve into formal norms, regulations, or laws to formally control the social behavior that is having the undesirable consequence.

It is important to stress the origin of laws and regulations because we tend to forget that laws do not appear arbitrarily; they exist because we are witnessing a behavior that we would like to change

for the good of everyone. Even laws that appear spontaneously by the will and initiative of some legislative actor are generally a response to something that the legislative representative has seen in society that she or he would like to modify, presumably for some public benefit. Laws are acts of formal governmental power that wish to avoid or change a behavior that is damaging the public good. In the end, they are intended to protect the public good, the community, and the individual from harm.

This brings us to the discussion around glaciers and the “human right to glaciers.” We hence propose three sets of questions to address in the discussion around the need (or not) for a right to glaciers addressed in the following sections:

1. Aren’t glaciers water? And as such, wouldn’t a right to water already comprise an implied right to glaciers? This question also leads to another basic question: “what are glaciers?”
2. What is the relationship between glaciers and society? If melting glaciers are one of the most visible consequences of climate change, and if they are so important to society, and if there is so much fresh water in glaciers, why haven’t we enacted a law before to protect them? Or are water laws sufficient for this protection?
3. Are glaciers suffering some specific impact or risk that would make them especially vulnerable so that we need a law to protect them? If that vulnerability exists, is it different from the sort of vulnerability of water resources? We mentioned general climate vulnerability, but are there other more specific vulnerabilities stemming from anthropogenic action resulting in impacts to glaciers that we *can* and *should* address?

I

WHAT IS A GLACIER AND WOULD THE “RIGHT TO WATER” ADEQUATELY COVER GLACIER PROTECTION?

First, we consider the definitional issue and the relationship of glaciers to water, which is a beginning to our discussion.

Glaciers are comprised of water in one of its forms, ice. We recall that water comes in three basic varieties: liquid, gas, and ice. In this sense, we could say simply that—if glaciers are made of ice, and ice is one of the forms of water—glacier protection would be covered by a right to water. This is not exactly correct, however.

Technically speaking, water in liquid form is not exactly the same as water in a solid ice state. Lots of self-evident characteristics that most of us know about differentiate ice from water; ice floats on water, ice takes up more room than its equivalent in liquid state (it is eight percent less dense than water); ice is considered a mineral due to its crystalline structure; ice is colder than water (it only exists below zero degrees celsius); and from a molecular standpoint, the relationship between the Hs and the Os (hydrogen and oxygen molecules) in ice is different than the relationship in water. So scientifically, there is some argument to suggest that ice is not actually a form of water and, as such, merits special consideration. From a legal standpoint, at the very least we should consider if the technical differences between water and ice merit differentiated legal considerations.

When we consider the risks faced by water sources and the measures needed to protect them, we quickly realize that they are indeed different than the risks faced by ice and measures needed to protect it. When we talk of water protection, we're usually concerned over the quality of the water we drink in our home, the accessibility of that water in our home, the contamination of this water from industrial effluents, and the transport and fair pricing of this resource.

We can guess that most of these dimensions of discussion in relation to glaciers would be quite different. We don't usually bring glacier ice into our home. We are not generally transporting glaciers (although some mining companies have proposed this). We don't usually consider the price of ice (maybe if we are on vacation at the beach), and we generally do not think about ice as affected by industrial effluents (although it sometimes is). Generally, the only risk and dimension we usually hear about in regards to glaciers is risk due to climate change. Conversely, we don't usually talk about our right to water in relation to climate change.

As we delve into understanding glacier ice, the context for our discussion and treatment of glacier protection takes on a very different path. Glaciers exist in places different from those where we generally come into contact with our water. These places are generally not very hospitable to human life (high altitudes or very extreme planetary latitudes, such as the poles). Our relationship with ice in its natural and permanent state (glaciers) is quite unique and for most people, very rare. It is different than our relationship with water, which we can easily interact with in our home, in our garden, at our

place of work, or practically anywhere we carry out our daily lives. Water is everywhere around us. Glaciers are not.

Some of these differences, including the alienated nature of natural perennial ice, have conditioned the way in which we have organized ourselves in terms of water conservation, which is very particular to the location of our water reserves. Conversely, this has also resulted in our disregard for the need to protect natural ice reserves, which are generally at different locations and in different form.

A. What Is a Glacier?

In very simple, very basic, and very vernacular terms, a glacier is ice that survives in the natural environment through the summer months; in fact, it survives for the entire year and generally for several years, even hundreds of years.

We can get much more specific about this definition, and scientists definitely do, because we need to distinguish and categorize this surviving ice that can exist in many forms, some of which are considered by scientists as glaciers, and some of which are not. But basically, a glacier is formed from snowfall when the snow accumulates, compacts, turns into ice, and if the conditions are right (generally if the temperature of the outside environment remains below zero degrees celsius for most of the year), then this ice will survive the warmer summer months even though some portion of the ice may melt off during the warmest days. When winter comes back around, the ice body receives more snow, and the cycle begins all over again. Pretty cool, huh? Pun intended.

Over time, the glacier may grow, (if more snow falls on it than melts away) or decrease, (during especially dry years) in size and it may actually be moving if it is on an incline (such as a mountainside). Parts of the glacier generally melt as it moves downhill and the front end reaches a warmer environment, because part of the glacier may be in contact with water, (as in icebergs) or because the ambient temperature surrounding the glacier warms as is occurring with climate change. What makes the glacier ice different than other surrounding seasonal snowfall is that, for some ecological reason having to do with the glacier's immediate ecosystem, the snow that falls where the glacier is located has the necessary conditions to survive beyond the summer. At that location, the winter snowfall *recharges* the glacier so that it doesn't actually lose any mass.

Glaciers form over many seasons of snowfall and seek equilibrium with their surroundings. As long as an outside force (such as global

warming or an especially long dry spell) doesn't affect the glacier, it will survive over time: for tens, hundreds, and even thousands of years.

One critical aspect of the process, which is very important to the natural environment, is the *cyclical recharging* and *slow melting* of part of the glacier. This is actually one of the most important aspects of glacier ice for many dry ecosystems. Glacier ice stores water, and the slow melting of the ice during dry and very warm summer months is a critical feature of the natural environment that ensures water provision during the driest parts of the year. If the year happens to be especially dry, or if there is an extended drought in the area, the glacier may be the *only* active source of water for much of the ecosystem. This is particularly the case in the central Andes region of Latin America, well known for its especially dry climate, such as that in the Atacama Desert of Chile, the driest place in the world.

We will see later when we discuss Argentina's glacier law that the legislation protects precisely this glacier feature, that is, glaciers as "regulators of water basins." This means that glaciers "regulate" the flow of water into the ecosystem.

We sometimes use the image of a water faucet to describe this function. We can imagine that the mountain has a very large water faucet in the glaciers and when it is especially dry and warm, such as in the summertime or during a drought, the faucet (the glacier) is slightly open. The ice begins to melt with the heat but doesn't melt right away as seasonal snowfall would melt. It is cold enough at the high altitude where the glacier is located that the melt is slow. As such, the ice melt from the glacier provides a slow and steady flow of water into the streams and rivers. Without glaciers, in a dry year once the winter snow melted, the mountain would be dry and water would cease to flow into the ecosystem.

There is one other dimension to this discussion that we will not get into too deeply, which has to do with permafrost, or permanently frozen grounds. The Argentine national glacier law also protects what are called "periglacial environments" in which permafrost is located. Periglacial environments act like glaciers in terms of water provision. Permafrost is earth (which can also have a high water content) that freezes and, just like glaciers, conserves ice ready to be used as water when the temperature changes and the ice melts. Permafrost in high mountain altitudes can be very extensive. Entire mountains can be at temperatures well below zero. Any humidity which is contained in the mountain is converted to ice, (and should be considered water in

storage) ready to be used as a “regulator of water basins” when the environment needs the water feed. As such, along with glaciers, permafrost zones are very significant water reservoirs in our natural ecosystems and also need protection. A more extensive discussion is necessary to address permafrost, relevant to the discussion we are engaging in here, since permafrost areas are just as important, (or even more important) than glacier cover for water basins. Such a discussion is necessary, and a “right to permafrost” can be considered a corollary to the “right to glaciers” discussion and should be the focus of future work.

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Hence, we have understood the importance of the role glaciers play in conserving water. They are natural water reservoirs or dams that Mother Nature has created to conserve water and make it available when rain is short and the weather is hot and dry.

In some cases, snow and water make their way into the ground, through gaps, crevasses, etc. When the water is frozen into ice, the ice expands, breaking the ground and creating new gaps, which are in turn refilled with water and new snow. Rock debris from mountainsides can also cover the ice and in some very special cases, a very large ice glacier can form *below* the visible surface of the earth. In the dry and hot summer months, the rock cover protects the ice from warm temperatures, and the ice may in fact survive below the surface of the earth for many years, even hundreds or thousands of years. Parts of that ice, generally the parts that are closer to the surface of the earth or at lower altitudes, may have active layers that melt and freeze in cyclical fashion, providing regular water flow into the ecosystem. Other parts of the ice buried further under the surface of the earth may be permanently conserved. These natural phenomena are commonly referred to as “rock glaciers” or “debris-covered glaciers.” In the middle of summer, you might be standing on top of a rock glacier with billions of cubic feet of ice below you and not even realize it as there may be no visible snow or ice anywhere in the area!

B. Does the Right to Water Suffice to Protect Glaciers?

So, now we know what glaciers are, they are bodies of ice that survive throughout the year, storing and providing water to us all year long.

Hence, does the “right to water” adequately protect glaciers? Or do we need a specific “right to glaciers”?

Society derives its laws from cultural practice that merits consideration of the protection of the public good. We collectively act in a certain way and, when that way of acting places our individual or public safety at risk, we take measures to protect that good. The discussions around the “right to water” appeared only very recently, as we began to realize that human activity was degrading the quality and availability of our water.

With the intent to protect this inalienable right to a natural resource as important to us as air and food, we must begin to discuss the risks to our water resources and then begin to discuss ways to ensure its protection. Once we realize that we need to establish a right or a law, we must then proceed to think about the specific elements necessary to effectively ensure that protection.

At about the same time the right to water discussion was in full force, our global society awoke to our critical climate problem. We were pushing for the “right to water” in the mid 2000s at forums like the World Social Forum or the World Water Forum, when Al Gore, then Vice President of the United States, started his crusade on climate change.

Melting glaciers all over the world were identified by the Nobel Peace Prize winning International Panel on Climate Change as one of the most visible features indicating that our planet has a fever. Glaciers are melting fast and much of the reason for this is our growing industrial expansion based on the burning of CO₂ emitting fossil fuels.

Surprisingly, however, no one ever mentioned the need to “protect” glaciers; we have simply remarked that it is a given fact that they are melting. We do not speak of *protecting* the ice, but rather we focus on the need to revert the practices that lead to that ice melting. We talk of reducing CO₂ to stop global warming. There is nothing wrong with this conclusion. In fact, the objective of eliminating fossil fuels may be one of the most important challenges of our time. But let us focus for a moment on the implications of this trend on the natural resource victim, glaciers. We only speak of glacier melt as a visible fact of life and the hope that we can somehow stop glacier melt. But nobody speaks of glaciers as vulnerable resources that need direct protection, nor do we talk about glacier melt in terms of increased vulnerability to “other” potential glacier impacts. Finally, we do not talk about

stopping glacier melt, regenerating glaciers, or repairing damage to glaciers.

Perhaps this omission is simply because it seems impossible to detain glacier melt. That is not actually true, as we have already seen that in places like Switzerland, concerned ski resorts are covering mountainsides with reflective sheets to increase albedo and reflect sunlight (and heat), with the value that the glaciers melt much more slowly. And it works.

Others are experimenting with covering parts of glaciers with sawdust (something my grandparents used to do in Argentina to conserve big blocks of ice left by the “ice man” who was as popular, (or even more popular on hot days) than the milkman—this was before refrigerators arrived in many homes). Still others build snow walls on mountainsides to divert wind flow and generate snowfall accumulation where otherwise the snow would simply have swept over the terrain, thus creating *instant glaciers* in a single winter season. Actively protecting, even generating glaciers, is possible, although clearly at a global scale in the face of global warming the added glacial benefit might seem minuscule.

For the most part, however, we are not out there protecting glaciers. Growing scientific evidence, however, is showing us that many communities depend on glacier melt and periglacial environment areas for their water provision. Particularly in temperate high mountain climates, the perennial ice in glaciers and in permafrost areas are a critical water reserve, and the same ice in lower elevations where ice forms and melts cyclically are a fundamental source of water. In some areas, it’s the only source of water for local communities.

The science on just how much water a glacier provides to downstream ecosystems varies widely. The numbers generally increase for especially dry years. Hence, glaciers act as reserves for dry years. Some glacier experts have shown that in especially dry climates like the Mendoza or San Juan provinces in Argentina, in dry years, glaciers can provide up to eighty percent of river water. Other scientists have argued that glaciers actually provide very little water because much of the ice in uncovered glaciers sublimates (vaporizes) instead of melting.

What is undeniable is that even very small glaciers can store enormous amounts of water. A quick calculation taking a glacier as small as the size of an average football field and just a few meters thick, would provide a typical family of four with the total water

consumption it needs for subsistence (as determined by the UN) for the entire lives of all of the family members! That's a lot of water. In a province such as San Juan that is estimated to have over 12,000 glaciers of all sizes and types, the amount of water stored in these mountain ice bodies is colossal. A single larger glacier such as the El Potro Glacier on the border between San Juan and La Rioja provinces could provide the entire Argentine population with drinking water for over a year.

The warming trend of our global environment and the visibly accelerated glacier retreat suggests that glaciers are melting as the zero isotherm moves up mountainsides. In such a context, we can presume that melting glaciers are not in ecological balance and are actually acting as positive water providers. Hence, in a warming climate, glaciers that might otherwise be in equilibrium and not melting much are actually important sources of water to our ecosystem that will last for many years as significant water providers.

Whether we can agree or not on the theory that glaciers are not in equilibrium, they nonetheless act as water reservoirs and, as such, are important water resources.

Rock glaciers, protected by rock cover, are also significant water reserves. Not only do they hold massive ice content deep in their interior, but they actively contribute water provision to ecosystems through their active surface layers which move and have cyclical freezing and melting phases.

For communities further away from the perennial ice, such as those in large urban areas, the direct provision of glaciers to the water of those communities may represent a lesser percentage. However, discontinuous permafrost zones that cyclically freeze and melt logically contribute much larger percentages to downstream communities since the area they cover is substantially, even exponentially, greater. From a scientific standpoint, we do not have the studies to determine the percentage or reach informed conclusions on volume, but the direct relationship between permafrost melt and ecosystems is clearly undeniable.

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So what are the risks to glaciers posed by anthropogenic forces, (aside from climate change) that we should consider in this discussion? There are several.

Glaciers are generally in equilibrium or are seeking to find equilibrium. In this sense, their volume, their weight, their position, their water and ice content, and their rock or other debris content, all work together to create an ecological balance that is conducive to the glacier's survival. Because they are often on slopes, they creep downhill. The lower parts of the glacier then begin to enter warmer elevations above average zero degrees celsius and they begin to melt and, eventually, disappear. Newer snow enters the glacier from above, regenerating the portion that has moved downhill. This is a cyclical process that is repeated indefinitely with each season.

Further, a glacier's immediate surroundings are very important to its very existence. The glacier formed where it is because of its surroundings. For some reason, either due to local snowfall, wind patterns that brought snow to that location, a nestled location in a rounded mountain ridge, at the base of an incline, along a high mountain valley, especially low temperatures in the specific spot where the glacier is located, or limited exposure of the glacier to the sun (such as on hillsides that face towards the Earth's poles) are all reasons due to which a glacier may form in one place and not in an immediately adjacent one.

Science has not yet established a specific term to define this specific "glacier ecosystem" necessary for the glacier to form. Because it is important to the implementation of specific public policy geared towards glacier protection, we have established and defined a term to distinguish this area. We call it the "glaciosystem." In brief, the glaciosystem can be defined as:

The glacier and its surrounding ecosystem that influences its constitution and composition, with respect to its water and ice accumulation and ablation, determining its biological process, its natural evolution during its periods of charge and discharge, and which if affected, could impact or cause the alteration of the glacier and / or impact the ecosystem in which it exists.

If we impact the glaciosystem, or if we carry out activities that destroy part of the glacier, we can have significant impacts on the glacier or on its evolution, which could lead to its collapse or accelerated melt and disappearance.

Some critical glacier threatening impacts include:

- Modifications to the glaciosystem which are necessary for the glaciers natural formation and sustainability. This could include altering the mountain hillside or ridges where the glacier is

located, or altering the wind patterns which favor the accumulation of snow at the glacier site;

- Ice mass removal, such as carving out a section of a glacier. If a section is carved out near the glacier's end (the lowest elevation end), the large mass behind it may accelerate forward and the whole glacier may come crashing forward, while if we carve out a section above it we may affect the entry of new snow and disrupt its natural regeneration;
- Soiling of glacier surfaces with contamination (such as black carbon) that could darken the glacier and result in surface warming and accelerated melt;
- Excessive weight placed on glaciers that could alter structural balance and lead to collapse, as might occur from placing millions of tons of sterile rock on the ice from mining operations; and
- Surface impacts to rock glaciers from roads introduced on top of these glaciers that may alter the glacier's ecological balance.

We might also see impacts from certain activity that could alter the "water provision" function of the glacier, such as:

- Any of the above-mentioned impacts that lead to water flow alterations;
- Acid drainage from industrial operations that falls on glaciers and subsequently contaminates the ice and eventual meltwater; and
- Melting away of water reserves.

These cited potential impacts to glaciers are not theoretical. There is extensive evidence already available from certain areas, such as the central Andes in Argentina and Chile and the mountains of the Kyrgyzstan Republic, where such impacts are already occurring.

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Returning then to the "right to water" corollary and our question as to whether or not a "right to water" adequately protects glaciers, we should ask ourselves if the sort of regulatory frameworks to protect water sources that exist today are sufficient to protect glaciers and periglacial environments. The argument presented here is that they are not.

The right-to-water debate, and even laws or regulations attempting to protect water, has no focus on glaciers or periglacial zones. The right to water debate has not addressed the need to protect ice, or more specifically, glaciers. Nor do most people working on “the right to water,” either from a policy, legal, or civil-society angle, focus at all on glaciers or permafrost. None of the risks listed above come up in debates about water protection. As mentioned above, science has not even come up with a term that is functional to the public policy debate to understand the *glaciosystem*, the natural area surrounding a glacier and all of its natural characteristics, (mountain ridges, positioning, wind patterns, etc.) that are necessary for the glacier to form in the first place. *Glaciers are simply not on the radar screen of the “right to water” debate*, nor are they included in systemic measures, policy, or laws to protect natural resources.

The right-to-water world is mostly focused on urban water management, storage and transport, household access, use, quality, pricing, water contamination, water storage (in human areas), and sanitation. Nobody is talking, however, about the fact that much of this water derives from ice bodies way up in the mountains, where in many cases few people have ever been. The world’s second-highest peak, (K2, or otherwise known as Savage Mountain and covered with glaciers) was not even discovered by humans until the last century. It was simply too far out of reach to humans. It is such a treacherous environment that one out of every four mountaineers who tried to reach the summit perished. In fact, knowledge on glaciers, periglacial environments, and rock glaciers is extremely scarce and limited to a handful of academics who as a collective group are quite removed from broader policy discussions about natural resource conservation and, even more so, water management.

Even the science around glaciers fails to address the relationship between glaciers and downstream ecosystems. Glaciologists cannot even come to terms and agree on how much water glaciers provide to rivers, much less permafrost (which we can safely guess will be a much greater number).

What does this all mean for water policy? Essentially, that public policy, regulations, laws, norms, and cultural practices related to water leave out glaciers as a point of discussion. Glaciers are simply ignored when it comes to policies and laws. It is for this reason that the world needs laws and policies to protect glaciers and periglacial environments. Specifically, to protect them as vulnerable natural

resources and to protect the function they serve as water reserves and regulators of water basins.

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We mentioned earlier that the first glacier law ever passed was in 2008 in Argentina. It was vetoed just days later by the President due to strong opposition from the mining sector. It was not until 2010 that the first glacier laws were formally instated in Argentinean subnational government jurisdictions.

Argentina's national glacier law, promulgated officially in October of 2010, establishes "a minimum standards regime for the preservation of glaciers and the periglacial environment" which is also, the actual name of the law.

The objective of the law, as cited in Article 1, is to protect glaciers and periglacial environments "as strategic freshwater reserves for human consumption; for agriculture and as sources for watershed recharge; for the protection of biodiversity; as a source of scientific information and as a tourist attraction. Glaciers constitute goods of public character."

As mentioned above, glaciers are important because they store water for future use and regulate water flow. The law rightly captures these functions as the critical and underlying value of glacier ice in places like the central Andes, where dry climates are extremely challenging for the sustainability of human life. Without glaciers and frozen grounds (periglacial environments), the subsistence of human life would be much more difficult, if not impossible.

This function of glacier ice and frozen grounds in temperate high mountain climates is quite different from the function of the glacier ice in the polar icecaps, and the difference should be noted. In the former case, water from glacier melt is critical to human survival and local ecosystems are dependent upon that melt. In the case of the polar ice caps, glacier melt could alter ocean ecosystems and the ecological systems of local fauna, but is not likely to affect immediate downstream communities because no people live at the polar icecaps.

In both cases, however, glacier melt could pose life-threatening risks to certain communities. In the case of glaciers in the high Andes of Peru, glacier melt and collapse has led to mountain tsunamis that have taken out entire villages and cities, killing thousands of people. The melting of the polar icecaps may not affect people at the poles, but it will cause sea level rise and affect the livelihoods and habitat of

thousands, or even millions, of low-lying coastal homes in other parts of the world.

So, given the vulnerability and importance of glaciers, what is to be done, from a legal and administrative (policy) perspective, to protect glaciers and their function as a public good? The substantive elements identified in the above-mentioned law help us understand the necessary steps to guarantee effective protection.

The Argentine glacier law establishes the obligation of:

- Registering glaciers in an official inventory (Articles 3 and 4);
- Prohibiting certain activities (such as mining) that might impact glaciers through the deposit of contaminants or construction of works (Article 6);
- Conducting specialized glacier impact studies for activities taking place near glaciers (Article 7);
- Applying the law retroactively for activities currently taking place near glaciers (Article 15).

The first three elements cited (registering glaciers, prohibiting activities, and conducting studies) are three fundamental steps or tools to ensure glacier protection and to respond to the fact that, for the most part, the functions and value that we are trying to protect are largely unknown.

No glacier inventory existed—you cannot protect what you do not even know exists. Few people in Argentina even knew there were more than just a handful of glaciers. In fact, most Argentines prior to the debate on glaciers could probably mention only one glacier (the Perito Moreno) in Patagonia, because it is a very popular glacier and gets much media coverage every year when its front disintegrates upon touching land. Most Argentines were completely oblivious to the fact there were actually thousands of glaciers, particularly in provinces such as Salta, Jujuy, Catamarca, La Rioja, and San Juan. As mentioned earlier, in San Juan there are over 10,000 small glaciers, many of which are rock glaciers beneath the surface of the Earth, while in each of the other provinces, the official glacier inventory will reveal quantities in the several hundreds for each.

We also had very little or no information on anthropogenic activity such as mining affecting glaciers. Information about the impacts of activities such as mining and construction is beginning to rise, and this new area of information is pushing the regulatory framework.

Finally, glacier impact studies are a novelty for Environmental Impact Assessment (EIA) exercises. As information about glacier impacts becomes public, official agencies are now pushing for glacier impact studies from public and private projects that could affect glacier well-being.

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One question that is worth considering is *why did Argentina all of a sudden decide to embark on debating, negotiating, and eventually adopting a glacier protection law?*

Several reasons could be cited:

- Climate change has placed glaciers at risk, making them vulnerable resources;
- Argentina has many glaciers, upwards of 25,000, many of which are small but very significant water reservoirs, so that a law to protect glaciers makes sense; and
- Anthropogenic activities are impacting glaciers.

While we would like to imagine that society spontaneously generates acts geared to protect the public good *before* disaster strikes, in this case, the last reason was the underlying reason for the appearance of the legislation. In fact, it was not even the local community that first introduced the issue and concern, but a reaction to a situation in Chile that spawned the response across the border in Argentina.

In the early 2000s, preparatory studies for the bi-national mining project Pascua Lama, owned by Barrick Gold, got underway. Barrick Gold found gold deposits right at the border underneath three glaciers. They were small glaciers that had never drawn anyone's attention, not even that of the region's principal glacier academics. These glaciers (the Toro I, Toro II, and Esperanza glaciers) were nestled at nearly 5,000 meters above sea level in the high Andes, nearly two hundred kilometers from the nearest human settlements on the Argentine side of the border.

When the Diaguita indigenous group and local farms in the Huasco Valley in Chile learned that Barrick's gold deposits were sitting underneath glaciers that were at the top of the chain of their hydrological ecosystem, and that Barrick's idea was to dynamite and haul off the glaciers in dump trucks to get at the gold, they launched a massive campaign against Pascua Lama and against Barrick.

Barrick argued that the relatively small glaciers were not actually glaciers, but rather perennial ice patches. Losing this argument, Barrick shifted the terminology to “glacierettes” which would imply “small glaciers” and as such, their loss would be irrelevant. Later scientific studies debunked this theory and showed that these smaller glaciers actually provide more meltwater than nearby larger glaciers.

The debate over saving the ice went full force, largely led by Chilean stakeholders to Pascua Lama. Across the border in Argentina, concern was less manifest but slowly growing thanks to the attention raised across the border. A renowned local glacier expert, Juan Pablo Milana, approached Argentina’s National Environment Secretary, Romina Picolotti, founder of the Center for Human Rights and Environment and a strong advocate for the right to water, and brought to the attention of the national government thousands of existing glaciers in the Andes highlands, including the invisible “rock glaciers” underneath the Earth’s surface. Argentina awoke to glaciers that year and a process was put in place which resulted in the unanimous approval of the first National Glacier Law in 2008, vetoed shortly thereafter but reapproved in 2010.

Today, Argentina is set on inventorying its glaciers. There have been numerous reports by civil society groups revealing glacier impacts by mining projects and public road work in the high mountains. Provincial governments, which are at legal odds with the national government over who should manage glaciers, (and more specifically who should approve mining projects near glaciers) are actually beginning to ask for glacier impact studies from companies carrying out mining operations, both exploratory as well as extractive work.

Societies are learning about glaciers. Societies are learning about the function of glaciers, about where they are and why they are important to local ecosystems. Most ignored these facts. With the creation of a National Glacier Law and the elevation of glacier resources to “public good” stature, glaciers today are taking on a new life.

Glaciers are important to local ecosystems and they are at risk. Glaciers are important to local communities and their water contribution to those communities is at risk. As such, we need glacier protection. We need glacier protection laws and policy and yes . . . why not, we need a “right to glaciers.”