ENVIRONMENTAL JUSTICE AND CLIMATE CHANGE IN LATIN AMERICA

Cryoactivism

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One of the telltale signs of climate change in recent years is the rapid acceleration of the retreating of glaciers and polar ice at our planetary extremes. Most people have likely seen the image of a polar bear cornered onto a small piece of floating ice, the looming and threatening predicament of a collapsing *cryosphere*, that is, our "world of ice," captured in a single image. Few have posed one important question, however: What are we doing about withering glaciers? Can we actually do something about it?

In this article we explore the emerging arena of what glaciologist Bernard Francou recently dubbed "cryoactivism," that is, environmental advocacy steered toward protecting the complex dimensions of the planet's frozen environments, including glaciers and subsurface ice of the periglacial environment (such as permafrost), as they melt away amid the rapid acceleration of global warming.

While most people are able to recognize that our cryosphere is falling victim to climate change, surprisingly little has been done to date to address the anthropogenic destruction of some of our most important top-of-the-pyramid hydrological resources. A new breed of environmentalists, emerging cryoactivists, are beginning to take up this challenge, uncovering some of the anthropogenic activity that is directly impacting glaciers and permafrost, but also coming up with creative ways to protect and even to restitute this critical dimension of our ecosystems.

The Endangered Cryosphere

The shrinkage of glaciers all over the world has been documented since the 1970s; a clear trend of retreating ice mass is apparent. Scientists already recognize that currently melting glaciers will result in significant sea level rise in the coming decades. Ice stored in melting glaciers is important to humanity and to the ecosystem in part because it stores most of the world's freshwater. This ice is in reserve for when our ecosystems need the water most. Many of the glaciers that are directly relevant to the daily existence of millions if not billions of people; that are relevant to their water consumption, their agriculture, and their industry; are not the large glaciers at the polar extremes but rather much smaller and more numerous glaciers that are much closer to home, in mountain ranges like the Swiss Alps, the Pyrenees, the Andes, the Himalayas, the Rocky Mountains, or the Sierra Nevada of California.

Additionally, periglacial areas, which contain extensive frozen swaths of earth known as permafrost (defined in this context as perennially frozen ground), like glaciers, also play a significant, if not more important, role in capturing and administering water to the environment in smaller doses than otherwise occurs during springtime snowmelt periods.

We depend on glaciers and periglacial areas much more than we realize. In addition to providing water, glaciers reflect solar rays, thereby cooling our climate; they keep climate-impacting methane gases trapped under the ice; they cool our climates because their cool mass retro-nurtures their *glaciosystems*,[1] conserving their cold environments.

Advancing climate change places these cryospheric glaciosystems in deep peril, particularly glaciers and permafrost in high-mountain environments, which will likely die off en masse in some populated areas in a few decades or less. From that moment on, small streams (and even larger rivers) that flow year-round thanks to the slow cyclical melt of the perennial cryosphere will become barren during dry seasons. We will have very distinct wet and dry seasons, and once the winter snow has melted away, no more water will be available to the ecosystem until the next winter snow cycle begins. It could, and likely will be, devastating for millions if not billions of people.

So one would presume that societies around the world, especially those with glaciers and periglacial areas, would be doing something to protect this sensitive ecosystem. Ironically, this is not so. As Alejandro Iza and Marta Brunilda Rovere of the International Union for the Conservation of Nature (IUCN) discovered in their 2006 review of seven key Latin American legal systems (perhaps the first legal analysis of glacier protection ever written), few if any laws offer protection for glaciers. In fact, until recently, not a single country in the world had a law on the books to protect glaciers.

It is in this context that cryoactivism was born, that is, a movement of individuals, legislative representatives, scientists, academics, NGOs, and other actors, awoken to the vulnerability of our cryosphere, who are now attempting to adopt international and/or regional laws and policy to raise social awareness and to develop government and civil society programs to protect our perennially frozen world and our human right—why not?—to glaciers (Taillant 2013).

The Birth of Cryoactivism

The birth of cryoactivism can possibly be traced to a single moment in time, involving the publication of a cartoon by a multinational mining company in

the high Central Andes of Chile. It was the first time that a mining company had launched a quest to mine minerals at over 5,000 meters (over 16,000 feet) above sea level, where it's bitterly cold (usually below freezing), where the air is thin, where altitude makes human existence miserable, sometimes impossible, and also where glaciers and periglacial environments thrive.

The mining company had struck gold beneath three small glaciers on the border between Argentina and Chile in the Central Andes, the Toro 1, Toro 2 and Esperanza Glaciers.[2] Their plan was to remove the glaciers to get at the gold. Ironically, the company claimed the glaciers were "a threat to the environment." Glaciers move, they're fragile, they can collapse if you chip away at them with heavy equipment, and the sort of work that mining companies do at and near the glaciers would destabilize them, putting anyone near them at risk of serious harm. Mark Carey, who could be dubbed a cryoactivist, working at the University of Oregon, has studied glacier lake outburst floods in Peru and has researched and published an account of a prolonged period of collapsing glaciers that have killed thousands when massive glacier chunks larger than large buildings calve off of cliff-hanging glaciers perched over lakes up at 4,000 meters. The waves that ensue on impact with the lake surface come rushing down mountain gorges at breathtaking speed, taking out anything and everything in their path.

The glaciers sitting over gold on the Argentine-Chilean border were in the way, and so, with little consideration of the critical value of the cryosphere, the mining company proposed to dynamite them and haul off the ice in dump trucks. They distributed brochures, with a cartoon (Figure 1) depicting how the operation

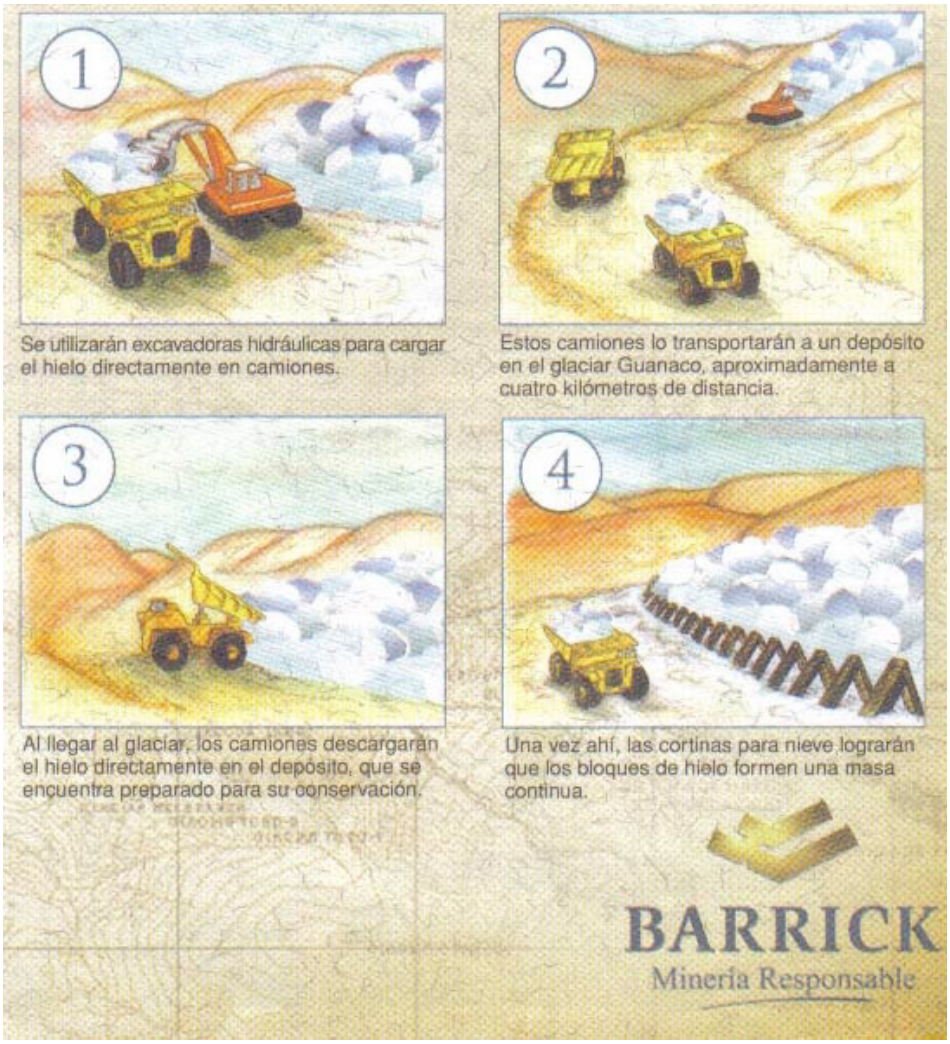

Figure 1. Cartoon depiction in brochure distributed by an international mining company to local communities showing rigs and dump trucks destroying and hauling away glacier ice spawned a global cryoactivist movement to protect glaciers. Source: Barrick Gold.

would be carried out, to downstream community stakeholders (including indigenous communities) near the operations, who were already concerned with the potential impacts to their water supply and to their delicate ecosystems due to the arrival of what would have been one of the world's largest gold mining projects ever.

While small compared to the colossal glaciers of the polar regions, these three small glaciers comprised roughly 40 city blocks of ice containing some 2 billion liters of water. To get a sense of the implications for people living downstream from the mining project, that's essentially enough water to supply the entire 300,000-strong population of the Atacama Region of Chile—near the project site—with enough drinking water (two liters per day) for nine years!

Few people knew of the existence of such glaciers in this region of the world. But as the first steps of emerging cryoactivism would uncover, tens of thousands of similar glaciers existed in this ecologically delicate and very dry region of the world (and about 400 of them in the mining company's direct area of influence). Giving free rein to mining companies willing to blow up these dynamic and very critical water towers didn't seem to be a reasonable proposition.

Figure 2. This debris-covered glacier in Nepal is an example of how colossal deposits of ice may be entirely covered by a thick layer of rock, protecting it from the warmer environment above. Note the size of the trekkers for proportion. Photo: Jorge Garcia-Dihinx.

The fight to protect these glaciers took on monumental proportions and spilled into communities up and down the Andes on both sides of the border. The very names of the glaciers took on new meaning for this cryoactivist movement.

It was just about this time, in the first several years of the century, and largely derived from local communities mobilizing to protect local water resources from expanding mining operations in the Central Andes, that the environmentalist and activist slogan "water is worth more than gold" appeared in environmental circles and became the flag for nascent cryoactivists in Chile and Argentina set on stopping this mining project as well as others that were placing glacier resources at risk. This no doubt was the birth of cryoactivism.

Across the border in Argentina, Romina Picolotti, a young human rights lawyer turned environmentalist, and recently named to head Argentina's federal Environment Secretariat, hearing of developments in Chile, was astounded to learn that a mining company was willing to blow up glaciers to get at gold. But as an environmental lawyer, she was even more surprised to discover that the world had never taken up the protection of the glaciers of our cryosphere. Climate change was placing our ice at risk, and now mining companies were aggravating the situation. Jurisdictionally, there was little she could do about it despite being Argentina's highest environmental authority.

The remoteness of our perennial cryosphere, glaciers, permafrost, high-altitude wetlands, and other cryogenic resources in high-mountain environments are simply too far removed to have come onto the radar screens of legislatures and policy makers, environmentalists, or the public consciousness. We simply don't fight to protect what we don't know exists. (See Figure 2.)

An Expanding Horizon for Cryoactivists

Since a mining company perforated a glacier in search of gold, lots of things have happened to spawn a desperate attempt to save our glaciers, to protect our right to glaciers, and to protect our planet's frozen environments from irrational industrial behavior and from a melting climate.

In Chile, with the help of leading environmental groups like Chile Sustentable, as well as forward-looking legislative representatives like Antonio Horvath, a civil engineer with a strong environmental background, an attempt to pass a glacier law was made. It would have been the world's first, if it had not been struck down by the mining lobby. The Chilean legislative failure to protect its glaciers, however, planted a seed for innovation across the border.

A wandering Argentine legislative representative named Martha Maffei had visited Chilean communities struggling with water access at the time the debates were ongoing in the legislature over the glacier law. She met with Sara Larrain of Chile Sustentable, coauthor of perhaps the first "cryoactivist" publication, *Chilean Glaciers: Strategic Fresh Water Reserves for Society, Ecosystems and the Economy*, a book that underscored the urgent need to protect Chile's glaciers. Maffei quickly recognized the importance of protecting cryospheric resources and sympathized with local Chilean communities fighting corporate dominance of water access, something that was also occurring in provinces like Mendoza and San Juan in Argentina.

And so, mirroring the stunted Chilean legal initiative, Maffei trekked back across the border and sought help from Argentina's glacier experts. She found just the person to help her at Argentina's IANIGLA (the national glacier institute). She would team up with Dario Trombotto, a geo-cryologist who helped Maffei expand on the

Chilean glacier bill adding the periglacial environment to protected territories (a significantly broader area of protection that included permafrost), and Ricardo Villalba, the IANIGLA director, who was willing to wave one of the first flags of political cryoactivism as he toured from city to city, speaking to whomever was willing to listen, calling for the creation of a national glacier protection law.

Maffei submitted the draft Glacier Protection Law to Congress in 2005, but with little priority from political circles, it was quickly filed into legislative oblivion, until Picoletti, then Argentina's environment secretary, hungry for legislation to protect glaciers, discovered it to be a perfect solution to address the mining sector's impacts to high mountain glacier systems. She began a quiet lobby in Congress to get the bill passed into law. It was supported unanimously in 2008, becoming the first glacier and periglacial environment protection act to be passed by a working Congress.[3]

The struggle was not over, however, as shortly after its adoption, Argentina's president, bowing to pressure from mining companies, vetoed the law. Picolotti resigned, and cryoactivists like Maffei, Trombotto and his colleagues at the IANIGLA, CHRE,[4] and others went back to the drawing board to figure out how to get the law back.

Mounting social pressure brought the law back in 2010[5] and it was written into the books permanently. Several local government laws followed, also establishing local protective legal frameworks to promote the sustainability of our cryosphere.

But the environmental NGO community didn't know much about glaciers, where they were or how they worked. CHRE, an NGO based in Cordoba, Argentina, a good 500 kilometers from the nearest glacier but very much engaged in the cryoactivist fight (Picolotti, the former environment secretary, was CHRE's founder and president at the time), decided to take on the technical challenge to learn the science around glaciers and map out an advocacy strategy for their protection.

With initial help from a handful of socially minded glaciologists around the world willing to cross over into the realm of social and environmental advocacy, such as Alexander Brenning (Germany), Cedo Marangunic (Chile), Juan Pablo Milana and Juan Carlos Leiva (Argentina), Benjamin Morales Arnao (Peru), Bernard Francou (France), and lots of technical help from a young geo-cryologist at the University of Córdoba, Mateo Martini, CHRE staff learned to use GPS technology to map glaciers and published a series of reports focused on glacier and periglacial vulnerability to extractive sector operations. Other NGOs in Argentina and Chile also embarked on advocacy campaigns to highlight glacier vulnerability and bring attention to the advancement of large-scale mining into sensitive high-mountain glacier environments. With a handful of glacial and periglacial laws established in Argentina, and much interest in other countries to follow suit, by 2010 and the years immediately following, a new road was being paved, setting the stones of a nascent cryoactivism geared to make glacier vulnerability visible and promote policy to protect glacier resources.

In 2016, Chile is again considering a glacier protection law to ensure the conservation of its cryospheric resources along the Andes. Peru, a country with an important pedigree of contribution to glaciology, has added political leverage to its historic and pioneering scientific work on glaciers by creating a national institute with the official task of studying and protecting the country's glacier resources.

The United Nations recognized the growing concern for the collapsing cryosphere in Ecuador, Bolivia, Peru, Chile, and Argentina, and some countries not commonly known for possessing glaciers such as Mexico, Venezuela, and Colombia. In 2010, for the first time ever, and responding to growing discussions in countries like Chile and Argentina about the deteriorating cryosphere, the UN brought together young glaciologists to discuss methodologies to study glaciers and periglacial environments. A technical training course offered to these students also exposed them to evolving public policy and laws steered to conserve the planet's cryosphere. The course was held again on two consecutive occasions. A few years later, the community fight for glacier protection in the Andes began to echo across the continents.

In 2012, James Balog, the acclaimed nature photographer, released his award-winning, must-see documentary, *Chasing Ice*, in which Balog, with relentless drive and creativity, successfully documented the daily retreat of glaciers around the world by installing automated reflex cameras at strategic viewpoints, taking thousands of pictures in mini-increments over a period of several years. He also captured some of the most incredible footage of a calving glacier ever filmed, in Greenland,[6] with pieces of millenary ice half the size of Manhattan falling into the sea. Balog was effectively bringing the withering remote glacier environments into our living rooms, calling attention to our collapsing cryosphere.

The same year, a workshop organized by CHRE at the World Summit for Sustainable

Development in Brazil (Rio+20) extended the UN's glaciologists in harnessing their efforts to the environmental advocacy world, and brought together glaciologists and environmentalists to discuss advocacy channels and policy courses to attend to the demands of cryoactivism. One of those present that day was Kalia Moldegazieva of Kyrgyzstan, who was concerned with mining impacts to glacier resources in her own country. Following this early cryoactivism event in 2012, and seeing the experiences in Chile and Argentina, Moldegazieva and some of her cryoactivist colleagues put in motion an effort to get a glacier protection law passed in Kyrgyzstan. As in Argentina and in Chile, a presidential veto fueled by mining interests and by a mining project already advancing over massive glaciers stopped the glacier law at the parliamentary level. The Kyrgyz cryoactivists, however, are not relenting, and they are now proposing the creation of a Kyrgyz National Glacier Park and listing their glacier-rich Tian Shen mountains as UNESCO-protected terrain.

In India, another cryoactivist, Chewang Norphel, also known as the "glacier man," has actually devised a way to dam winter snow on small streams and promote its survival into the summer months, effectively "fabricating" glaciers in areas where winter snows are melting faster than usual due to climate change. Eduardo Gold, a Peruvian mountain enthusiast, is also worried about climate change. He is painting mountainsides white in hopes of increasing solar reflectivity and helping spawn perennial ice fields, which essentially is an effort to create glaciosystems. In Chile, experiments are under way by the group Geoestudios to create subsurface rock glaciers, which are basically permafrost features of the periglacial environment. In California, Connie Millar is avidly studying the hydrological relevance of periglacial areas in climate-stricken regions of California's Sierra Nevada.

In sum, cryoactivism was born from the concern of many seeking environmental justice as advancing climate change and other anthropogenic activity place our cryosphere at risk. As climate change progresses, and as our mountain environments become more delicate, this critical natural resource will become increasingly fragile.

Cryoactivists are emerging to take on the challenges of a deteriorating cryosphere, shedding light on anthropogenic impacts that can be stopped or reduced, and putting forth ideas to recuperate this dwindling but important dimension of our global ecosystem.

We can understand the work of cryoactivists as yet another dimension of the climate justice movement, one that is tackling a little-understood but very visible concern of our deteriorating planetary climate. Cyroactivists are having to develop skills and learn quickly about the cryosphere and how this hitherto unknown dimension of our earth is suffering climate change, the reasons for the decline, and how anthropogenic forces are affecting the dynamics of the cryosphere.

We are learning that the cryosphere can be protected, that it can be repaired in some circumstances, and that efforts to build bridges between science and environmental policy advocacy can have beneficial outcomes. For now, the experience of cryoactivism is nascent, and cryoactivists are only beginning to explore the policies and laws that can, and in some cases do, govern our frozen Earth.

Notes

[1] See "Definition of the Glacier Ecosystem or Glaciosystem," February 1, 2012, http://wp.cedha.net/wp-content/uploads/2012/07/Definicion-de-Glaciosistema-version-1-febrero-2012-english.pdf

[2] You can see the exact location on Google Earth at: 29°19'53.50" S 70°00'56.99" W

[3] See Ley de Glaciares, http://wp.cedha.net/wp-content/uploads/2013/05/Proyecto-Maffei-Ley-de-Glaciares.pdf.

[4] Originally established in Argentina and now expanded to the United States, the Center for Human Rights and Environment (CHRE) is a nonprofit organization working to create a more harmonious relationship between the environment and people. Programs and activities including defending the human rights of communities affected by environmental degradation, and promoting more sustainable public policies on issues such as climate change, corporate accountability, extractive industries, the oil and gas sector, and protecting glacier and periglacial resources.

[5] Argentine National Glacier Act, http://wp.cedha.net/wp-content/uploads/2012/10/Argentine-National-Glacier-Act-Traducción-de-CEDHA-no-oficial.pdf.

[6] See *Chasing Ice*, "Glacier Watching Day 17," https://www.youtube.com/watch?v=hC3VTgIPoGU.

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