04

Going Circular

HOW RESTORING A RIVER ECOSYSTEM IN CHILE'S CAPITAL CITY HAS BENEFITED HUMAN HEALTH AND ECONOMICS

This anthology is a project of the Planetary Health Alliance (planetaryhealthalliance.org). The Planetary Health Alliance is a consortium of over 200 partners from around the world committed to understanding and addressing the human health impacts of global environmental change.

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Executive Summary

For further detail on themes covered in this case study, see the water section of chapter 4, chapter 6 on infectious disease, chapter 9 on mental health, chapter 13 on healthy cities, and chapter 16 on the business of planetary health of ↘ Planetary Health: Protecting Nature to Protect Ourselves.

Learning Objectives

After examining this case, in the context of Santiago, Chile, students should be able to:

① Recognize the challenges of urbanization in the context of a changing climate with regards to water use and wastewater.

② Evaluate the linkages between water, water security, water governance, and health.

③ Assess how circular economy principles can be beneficial in the face of planetary health challenges.

④ Apply co-benefit strategies to advocate for planetary health solutions.

The Mapocho River running through Santiago, Chile's capital city, was a literal sewage dump for decades. The pressures of urbanization were taking a toll on the city's water resources. Outbreaks of typhoid fever, cholera, and hepatitis A were common as Santiago residents consumed crops irrigated by river water teeming with household waste. In 1999, less than 3% of Santiago's wastewater was treated. That year, Chile privatized its water resources in order to increase the capacity and efficiency of wastewater management. The bid for Santiago's water services went to Aguas Andinas, now Chile's largest water utility company.

Twenty years later, the Mapocho is unrecognizable. Between 2000 and 2015, Aguas Andinas increased wastewater treatment to 100%, a change that has contributed to improved health outcomes for the city's residents, a revival of the river's aquatic plant and animal species, and the creation of new green spaces. In 2017, the company also adopted a circular economy approach in its operations. This approach is characterized by its cyclical reuse of resources and byproducts that may otherwise have gone to waste.

By turning its two largest wastewater treatment plants into "biofactories," Aguas Andinas has increased its energy self-sufficiency and created a valuable suite of products from treated sewage that would have previously been sent to landfill—all while demonstrating that a circular economy model is better for the company's bottom line and for climate change resilience.

This case study is based on interviews conducted in Santiago, Chile, in May and June 2019.

It feels more like a place for a leisurely picnic than the site of a sewage treatment plant. Paulina Vicentela walks towards the edge of the lagoon and gestures at the black-necked swans gliding along its still surface. One of the 170 species of birds found in this lagoon, she notes. It's autumn in the southern hemisphere, and the air smells faintly of decomposing leaves.

If this serene lagoon seems like an unusual site so close to Santiago, Chile's capital city, more unexpected still is its genesis on this spot and the owner of the land. Continue up the road around the lagoon and you reach the property's main tenant: La Farfana, one of the largest wastewater treatment plants in Latin America. Wastewater is anything that goes down the drain, from flushed toilets to kitchen dishwater to laundry liquid.[i] While wastewater treatment plants don't typically attract visitors, two big buses have just pulled up at La Farfana's main entrance. The university students starting their visit today join the more than 9,000 visitors who have come to tour the plant since 2018. Through the glass windows of the front reception they can be seen reading colorful information panels and getting a dizzying aerial view of the plant using a set of virtual reality goggles.

[i] Wastewater can also go by the term gray water.

La Farfana is one of three *biofactorias* (biofactories) in Santiago. This site and La Farfana's partner biofactories, Mapocho-Trebal and El Rutal, are owned by Aguas Andinas, Chile's largest wastewater company. Aguas Andinas oversees the household water supply for 85% of Santiago's residents.

Utilizing its three biofactories and a series of 10 other small plants, Aguas Andinas treats 100% of Santiago's wastewater. This is a relatively new accomplishment for the city and the continent. At the cusp of the new millennium, wastewater treatment levels in the capital city sat at less than 3%. Raw sewage from household and industrial waste poured directly into the Mapocho River, the waterbody that runs through the center of Santiago. That polluted water came at the detriment of environmental and human health, disrupting the river ecosystem and contributing to outbreaks of enteric disease among Santiaguinos.[ii]

[ii] Enteric diseases are those caused by intestinal infections.

Paulina Vicentela is the Chief of Resource Management of Biofactories at La Farfana. She explains that the biofactories don't only treat wastewater—they also give it new life. Biofactories use a series of biological processes to transform sewage sludge into useful resources, including biogas to power the plants themselves and surrounding homes; fertilizer for local farmer's fields; and sanitary water that can be safely used for irrigation. This modus operandi where resources are recycled and reused in order to extract maximum value and minimize waste is a business model called the circular economy. In addition to reducing Aguas Andinas' carbon footprint, the biofactories have demonstrated that the bold changes needed to protect planetary health can also be the best strategic move for a company's bottom line.

Making its operations circular is one of Aguas Andinas' key sustainability strategies for the future. With the scientific community predicting increased water insecurity internationally, Aguas Andinas' circular economy strategy and emphasis on planetary health present a progressive model for private sector industries worldwide.

Paulina Vicentela, Chief of Resource Management of Biofactories at La Farfana, stands next to the lagoon nearby the plant.

An aerial view of the lagoon that was constructed adjacent to La Farfana biofactory. Aguas Andinas was required by legislation to compensate for the land and ecosystems that would be displaced by the construction of the wastewater treatment plant. Instead of purchasing land elsewhere or opting to buy green bonds, the company decided it was important to keep animal species near their original habitat.

Santiago: Growing City, Contaminated River

Santiago sits in the bowl of a valley, and on a day free of smog you can see foothills and the Andes Mountains rising from its outlying neighborhoods. The city is the capital of both Chile and the Metropolitan Region, one of the country's 16 administrative regions. Santiago is the most populous city in the country, and has grown from 380,000 people in 1907 to 6.5 million in 2019.[1] That constitutes over a third of the country's total population. Throughout Chile, 90% of the country's population now lives in urban centers compared to 58% in 1950.[2] Politics have contributed to this shift from rural to urban, namely the centralization of services in Santiago as part of a multi-decade military regime that ended in 1990. Chile has experienced rapid economic growth since then, and today its economy is one of the fastest growing in Latin America.[3]

Chile's Political Past

Chile's political past greatly shaped the country, especially the period between 1973 and 1990. In 1973, Augusto Pinochet became the leader of a military government. One of his priorities was centralizing the country's resources. He was assisted by the natural geography of the country—Chile extends 4,270 kilometers from north to south, marginally less than the width of continental U.S. Communities in the north and south are geographically isolated, with distinctive climatic and industrial conditions. During Pinochet's military government, Santiago was the priority for government spending on infrastructure, health, and social programming. A supporter of neo-liberal policies such as lessened government control and free market economics, this period in Chile's political history saw the privatization of many essential services, including water. This privatization remains controversial today.

Environmental challenges are imminent threats to this prosperity. In 2017, the Global Climate Risk Index ranked Chile as number 16 on its list of countries most likely to be impacted by climate change. Risk has increased substantially—in the two previous decades, Chile's average ranking on the index was 94.[4] At a more local scale, Santiaguinos have identified the urgency of environmental stressors. A survey conducted as part of the city's March 2017 resilience strategy elaborates on citizen concerns such as air pollution, lack of green space, and the management of solid waste.[5] At the time of its release, the governor of the Metropolitan Region went so far as to tell *Reuters* that "Santiago is a city of disasters – we have had in the last year the worst fires ever, we had two floods in the city (and) two important water supply cuts."[6] Exacerbated by inequality and corruption, the city's resilience strategy was clear: environmental challenges pose a dire threat to Santiago and its residents.

The skyline of Santiago, Chile, featuring the central placement of the Mapocho River

Recent events and weather trends support that statement. An 8.8 magnitude earthquake in 2010 shook Santiago. The quake and the tsunami it triggered caused more than 500 fatalities.[7] In January 2017, the worst wildfires in Chile's history scorched through the country. It drove home the findings of a study from the previous year documenting that Chile's wildfire frequency had been on the rise since 1985. The authors found that "climate conditions and problems of human pressure," including poor land use management by forestry companies, were two of the main factors contributing to that increase.[8]

Then, there's the issue of water—be it too much at once or the threat of future scarcity. Trends have already demonstrated a rise in temperature in the Andes Mountains, where most of the country's water resources are stored, including for Santiago.[9] Higher temperatures in the mountainous regions translates to less snow and glaciers to serve as water reserves in dry summer months. Precipitation levels are also projected to decrease, and the World Resources Institute (WRI) ranked Chile as one of the most

[iii] How is water security defined? ↘ Review the UN Water infographic here

[iii] ↘ Learn about the WRI and their work on water here

[iv] What do you think drives increased water demand globally?

water stressed countries worldwide.[iii] Water security is already an issue in present-day Chile, and WRI suggests that stress will increase further still, reaching extremely high levels by 2040.[10] These challenges pose a threat to Chile's rapid economic growth, as an estimated quarter of the country's GDP is dependent on water intensive industries such as mining, agriculture, forestry, and manufacturing.[11] Water challenges are not faced by Chile alone. Global demand for water is expected to outpace supply by 40% over the next decade, which will create severe water stress for nearly half of the world's population.[12][iv]

Closer to Santiago, conditions are already changing. Droughts in the Maipo Valley followed by periods of heavy, sudden rainfall have triggered landslides that have flushed mud into the Maipo River, the intake source of Santiago's drinking water supply.[13] Ironically, the increasing occurrence of flash floods is paired with the forecast of long term water shortages. Studies predict a 12% drop in average monthly flow in the Maipo River between 2035 and 2065,[14] putting a serious strain on water supply for Santiago's growing population. While water supply will be a defining challenge for Santiago in the coming decades, the city has long had water concerns of another nature.

A close-up of the Mapocho River in 2019. Much of its original flow has been diverted upstream.

A Contaminated River

Patricia Arroyo Meneses has many childhood memories of the Mapocho River. She remembers the natural flow of the river, and boats sailing through the city. Then, there were the floods: torrents of water that would surge the banks of the river and sweep through the streets of Bellavista, the neighborhood where Meneses was born and raised. "The flood even reached our home two blocks from the river. I remember seeing the water. It was black and very dirty with a lot of waste from the mountainside," she says.

Now 59-years-old, Meneses has spent the better part of her life working at La Vega, Santiago's largest fruit and vegetable market on the northern bank of the Mapocho River. The Mapocho is a tributary of the Maipo River, which rises on the western slopes of the Andes. An essential source of water, the Maipo supplies up to 90% of the drinking water for Santiago[15] as well as irrigation water for surrounding agricultural fields. That has proven problematic in the city's past.

Patricia Arroyo Meneses has been working at La Vega vegetable market since she was a child in the 1970s. She has witnessed many changes in Santiago, from shifts in government to ones pertaining to the cleanliness of the river. Like many vendors here, Meneses remembers a time when they needed to rinse vegetables with chloride before they could be sold or eaten.

By the 1980s, rapid urbanization was impacting the cleanliness of the Mapocho and the health of Santiaguinos. Rivers in this part of Chile are naturally clean, originating high in the mountains and flowing for relatively short distances before emptying into the Pacific Ocean. This was historically the case with the Mapocho, says Manuel Contreras, Executive Director of El Centro de Ecología Aplicada, a Santiago-based environmental consulting group. That water purity, Contreras says, was negatively affected by the pressures of rural-urban migration. "When the population grows, particularly in a city like Santiago, the load of contaminants in the river increases. That was the situation of the Mapocho River," Contreras says. "There was a bigger demand on water, and a larger load of materials being disposed in the river. At the beginning it was wastewater and organic material, and then it was industrial contaminant. The water supply was stressed."

Increased contamination of the river was also connected with Santiago's efforts to increase household sewage collection. By 1991, 87% of Santiago homes were connected to a sewage collection system[16] operated by Empresa Metropolitana de Obras Sanitarias (EMOS), a public utility. Increased sanitation access is an indicator of improved health worldwide, but in the case of Santiago, sewage collection did not equate to sewage treatment. One chemist articulated the problem particularly well: "[sewage collection] merely removes the bulk of our excreta from our houses to choke our rivers with foul deposits and rot at our neighbors' door."[17]

That chemist was onto something. Soon, the Mapocho River that market vendor Patricia Arroyo Meneses remembers was no longer, and she was presented with another sight and smell: the city's household waste. Santiago's wastewater discharged directly into the river, and the Mapocho became an open sewage dump. Waste poured in at a rate of 13.3 cubic meters a second,[18] an Olympic swimming pool worth of sewage every three minutes. EMOS was responsible for producing and distributing clean water and collecting wastewater in Santiago, but treatment was nonexistent.

The open disposal of sewage was a problem for local irrigation as well. After flowing through Santiago, the mixture of river water and sewage was used to irrigate 1,300 square kilometers of agricultural land in the Metropolitan Region. This included 70 square kilometers of vegetable crops that would be consumed raw from La Vega and Santiago's other markets.[19] This isn't unusual—fields worldwide are still irrigated with wastewater.[20] The difference, however, is that higher income countries often treat that wastewater first.[v] Compare that with Chile in the 1980s and 90s when wastewater was being used, untreated and sometimes unplanned, to water the crops that would feed a growing population. The public health implications were substantial.

[v] A study found that as per capita income increases, a country progresses from using untreated water to treated.

Tests of irrigation water in 1983-84 found evidence of *Salmonella enterica serovar typhi* in 10% of samples.[21] *Salmonella typhi* is the bacterium causing typhoid fever, an infectious disease contracted through contact with contaminated water and food. Between 1977 and 1985 Chile faced the largest typhoid epidemic in Latin America, despite the country having the best health indicators in the region. This included a higher life expectancy and reduced rates of maternal and infant mortality.[22]

The highest incidence rates of typhoid were found in the region that includes Santiago, even though the city had a better sanitation system than the rest of the country. At its peak in 1983, typhoid incidence in Santiago was 219 cases per 100,000 people. High prevalence rates were representative of a broader trend in Latin America which, during this decade, experienced some of the highest rates of typhoid worldwide.[23]

Urbanization had led to greater water demand and more waste entering the river—it also increased the number of people in close proximity who could contract disease.[24] Dr. Sandra Cortes, a public health epidemiologist at the Pontifical Catholic University of Chile, says there were other contributors to the high prevalence of disease, including the country's political climate. "Everything related to environmental control was not a priority from 1973 to 1990," says Cortes of the past government. Unemployment conditions and a lack of health services intensified the spread of disease from contaminated irrigation waters. Not limited to one disease, the typhoid epidemic was compounded by a cholera outbreak in 1991 and cases of other enteric infections such as hepatitis A.[vi]

[vi] Beyond infectious diseases, how can contaminated rivers affect the health of populations?

As Patricia Arroyo Meneses recalls, the connection between the spread of disease and agriculture wasn't good for market business. "Customers started asking for sanitary approvals before they would buy our vegetables," she says. "We would have to wash our vegetables with chloride diluted by water."

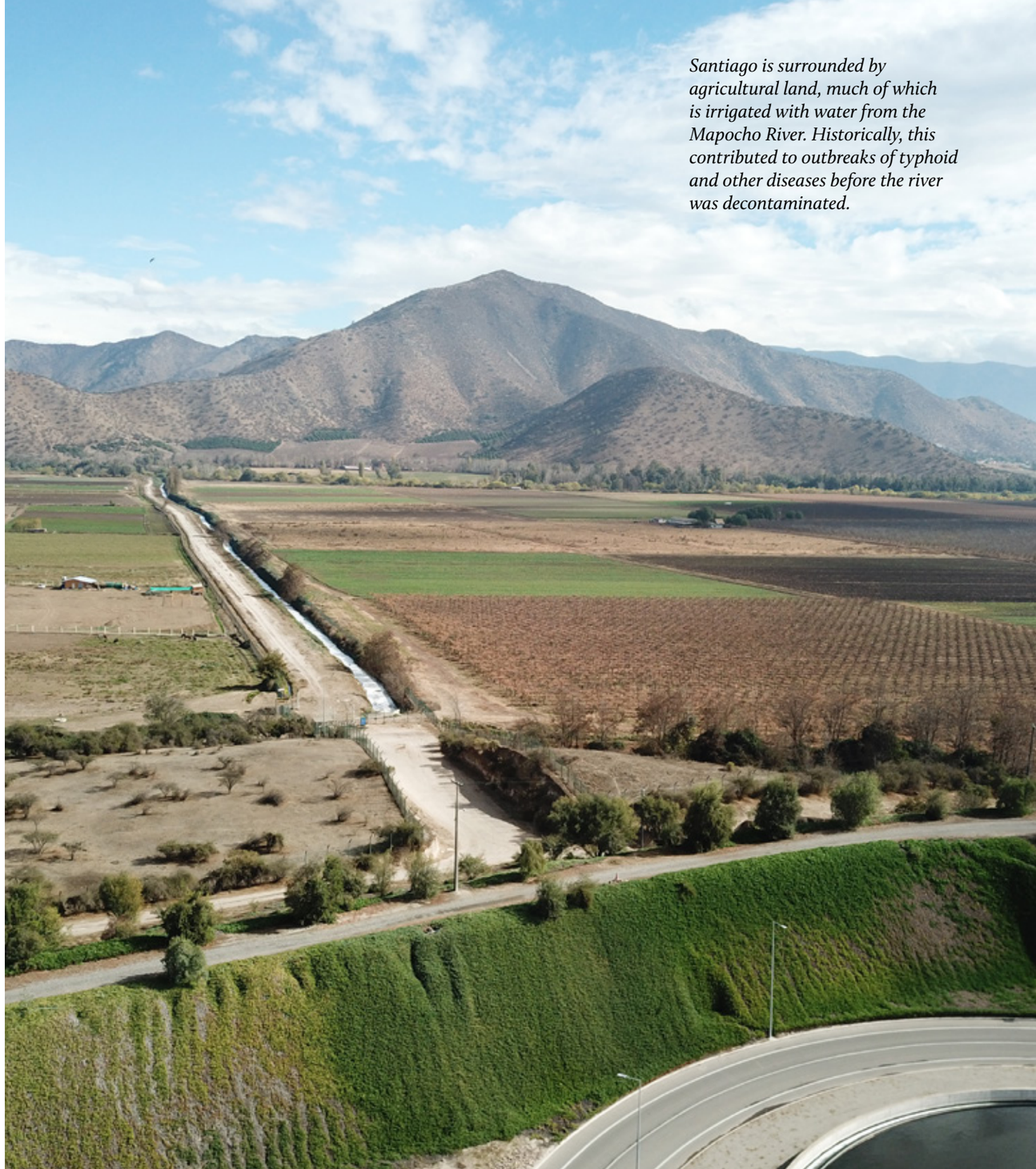
The outbreaks prompted emergency action from the Chilean government. An intervention in 1983-84 involved communication and education campaigns about hygienic crop preparation and the administration of an oral vaccine for typhoid. In 1991, emergency interventions included "increasing the number of prohibited crops; banning restaurants from serving raw vegetables, [...] and construction of new irrigation channels separated from sewage discharges"—interventions that one study notes were more effective at addressing the environmental transmission of disease rather than person-to-person transmission.[25] While these interventions had a level of success in reducing disease prevalence, the long-term improvement of public health required addressing the root cause of the problem: the contaminated Mapocho River.

Wastewater Treatment—A Public Sector Attempt

"There was an awareness of the problem [of wastewater] but it still led to the huge question of how to solve it." This is how Yves Lesty, Circular Economy Manager at Aguas Andinas, describes the situation in Santiago in the mid-1990s. Despite having identified irrigation with untreated wastewater as a cause of disease, no stakeholder had succeeded in removing the sewage from the river.

Santiago's need for wastewater treatment had first been flagged as part of a 1984 sewage master plan developed by EMOS, the city's public sanitary works company. That plan proposed constructing more than 200 kilometers of sewers as a way to prevent contamination in irrigation channels and reduce the incidence of typhoid fever.[26] The sewers would feed into a new plant that would pilot sewage treatment in the city.

Construction of the sewers was to start two years later with funding assistance from the World Bank. The goal was sidelined, however, by budgetary and bureaucratic hold-ups, in addition to flooding in 1986 that damaged existing water infrastructure. Soon, the focus of the project shifted from improving sewage coverage to improving water supply. A project completion report filed by the World Bank found that the project had not accomplished its sewerage component but had been successful in increasing water coverage.[27] The construction of infrastructure to intercept and treat household sewage would have to be managed by another project at another time. EMOS set a new goal: 100% wastewater treatment by 2024.[28]



Santiago is surrounded by agricultural land, much of which is irrigated with water from the Mapocho River. Historically, this contributed to outbreaks of typhoid and other diseases before the river was decontaminated.

Clean River, New Life: The Privatization of Chile's Water Utility

In the end, Santiaguinos didn't need to wait until 2024. By the turn of the new millennium, Santiago's water supply and sewage infrastructure was primed for another set of upgrades. After considering the idea for decades, the Chilean government decided the task of water supply and sanitation was best managed by the private sector. In 1999, the majority stake in EMOS was sold to Sociedad Inversiones Aguas Metropolitanas Ltda., owned by Agbar and Suez Group, two multinational companies. Two years later the company was renamed, and Aguas Andinas officially came into being as a privately-owned, publicly-listed operation. Angel Simon, who today serves as Executive Vice President of Suez Group in charge of Spain and Latin America, was the first General Manager of Aguas Andinas between 1999 and 2002.

Despite being privatized, water services must still comply with Chile's regulatory framework set out by a body called the *Superintendencia de Servicio Sanitario* (Superintendent of Sanitary Services). As the regulating body, the Superintendent sets the tariffs that customers pay and has final approval over any tariff increase, including ones proposed to build a new piece of infrastructure or upgrade existing systems.

The complete treatment of wastewater was one of the requirements of the new private utility. This promised to be a substantial undertaking: just 3% of Santiago's wastewater was being treated in 1999, one of the lowest rates in Chile.[29] With that requirement, Aguas Andinas launched a new program that year: Mapocho Urbano Limpio (MUL, Clean Urban Mapocho) in order to decontaminate the river. MUL involved several large infrastructure upgrades, including the construction of three new wastewater treatment plants: La Farfana, El Trebal, and Mapocho.

Prior to its decontamination efforts, Aguas Andinas commissioned an environmental baseline study of the Mapocho. "In general terms, the river was in very poor shape," says Manuel Contreras with El Centro de Ecología Aplicada, the agency that authored the report. The pressures of urbanization on the river had caused biodiversity shifts. "There should have been many fish, birds, and aquatic plants. But having the Mapocho River sick meant that the environment was sick as well," says Contreras, explaining there was not enough oxygen in the contaminated ecosystem to support life. "Our main conclusion was that the conditions were very poor and the recovery was going to be a slow process."

Manuel Contreras stands behind the office of El Centro de Ecología Aplicada. One of the only offices in Santiago with what he calls "waterfront property," Contreras says being located near this small stream would not have been possible when the Mapocho was contaminated.

In its natural state, the Mapocho River had once provided Santiaguinos with many services. "People could take a bath, they fished, they visited and walked around the area, and navigated by boat," says Contreras of the river's past. "In 2003 [before decontamination] none of that was happening." In order to improve the health of the river, Manuel Contreras and his team offered Aguas Andinas a few recommendations. One echoed the requirement of privatization: the removal of organic matter from the river through the creation of wastewater treatment plants.

Aguas Andinas got to work. Construction of the first treatment plant, El Trebal, started in 2000 and La Farfana began operations in 2003. Over the next 12 years the company eliminated 46 discharges—places where millions of cubic meters of sewage previously emptied into the river. Instead, the sewage collection pipes spilled into a new 102-kilometer-long interceptor system that channeled wastewater directly to one of three new sewage treatment plants. With the opening of the Mapocho Sewage Treatment Plant in 2013, Aguas Andinas had achieved its 100% wastewater treatment obligation in less than 15 years.

Marta Colet, Deputy CEO of Aguas Andinas, notes how this timeline compares to other parts of the world: "France and Spain started with water treatment plants in the 1950s and it was a slow progressive increase because the investment was made through public funds. It took 50 to 60 years, and in some parts of Spain, we still have areas which do not comply with European regulations," she says. "So to have 100% [wastewater] treated and returned to the environment in good condition in this time period is a record."

The Chilean Water Code

While it had the benefit of accelerating the treatment of Santiago's wastewater, the neo-liberal system of privatization has long been a controversial topic in the city and country. It started in 1981 when the military government created the Chilean Water Code, the piece of legislation that to this day governs use and management of the resource. The code made water a private commodity that could be bought, sold, or leased like any other resource.

The idea for free-market privatization came from a group of University of Chicago-educated Chilean economists nicknamed the Chicago Boys. Their new policies were supported by World Bank recommendations. Both groups suggested privatization would be a more effective way to manage water coverage and access, and said privatization would allow for a reduction in state intervention and the encouragement of foreign trade.[30]

Critics of the existing Water Code challenge its contradictory nature. It establishes water as a national public good, but also grants ownership in perpetuity to private companies, including Aguas Andinas. In some parts of Chile, this has interfered with people's access to water, one of the essential human rights set out by the United Nations General Assembly.[31] And while water privatization has improved services like wastewater treatment, advocates in favor of public ownership have demonstrated that this has come at the cost of customer tariff hikes, while private companies and utilities continue to expand their profits.[32]

The conversation of who to best manage water and other natural resources is playing out in other parts of the world, where research has found that the privatization of services could leave lower income communities more vulnerable to climate change.[33] [vii]

[vii] Where do you stand on this discussion that's happening in Chile and worldwide?

Globally, wastewater treatment isn't the norm. An estimated 80% of wastewater worldwide is discharged into the environment without ever receiving treatment.[34] Latin America does a bit better, treating nearly 40% of its wastewater, approximately double the global average.[35] A report from the International Resource Panel suggests recycling, reusing, and returning this water to the environment are three measures that could help countries more holistically manage their water resources[36] and minimize negative impacts on local ecosystems.

Privatization of Santiago's water resources impacted the price customers were paying for their household water supply. Tariffs rose by 90% in the four years following privatization[37] in order to upgrade the city's wastewater treatment services. To reduce water access inequities that would come with tariff increases, the central government has a water subsidy program that covers the first 15 cubic meters used by lower income households monthly. Depending on household size and use, this covers between 15 and 85% of water bills, and experts say this safety net has made water privatization and tariff hikes in Chile less controversial than in other Latin American countries.[38] [viii]

[viii] How is wastewater managed in the places you live and work?

Impacts on Human and Environmental Health

According to Dr. Sandra Cortes from the Pontifical Catholic University of Chile, it's difficult to quantify the exact impact privatization and the decontamination of the river had on the health of Santiago residents. As noted, incidence of typhoid fever had already dropped after 1991 with emergency government interventions that ordered an end to crop irrigation with sewage-contaminated water.[39] The only Latin American study looking at the impacts of privatization on public health found that childhood mortality rates were lower in communities with privatized utilities.[40] Overall, a literature review found the verdict is still inconclusive as to whether privatization in the region has been necessary in achieving better health outcomes.[41]

Cortes says the lowering of enteric disease also correlated with a change in government in 1990. Environmental control and public health programs had been stalled for the better part of three decades, and the new government resumed social programming. "That's why it hasn't been easy to prove that only Aguas Andinas did something about [improving the health of Santiago residents] because that improvement is also a consequence of development," says Cortes.

A decade and a half after its first study, El Centro de Ecología Aplicada performed a follow-up study on the condition of the Mapocho River. Its findings were more directly linked to the actions taken by Aguas Andinas during its Mapocho Urbano Limpio program.

"We found a high diversity of aquatic insects, and these are indicators of the quality of the water," says Manuel Contreras of the

2016 report. Compare this to 2003 when the river was home only to worms that could survive in oxygen-poor settings. “This was proof in ecological terms that the Mapocho River was improving little by little.” Those aquatic insects were joined by the recurrence of native fish species, including small catfish, Chilean silverside, and the mosquito fish. The study also found that aquatic plants had increased and that mammals and birds were beginning to reappear along the riverbank.

Cleaning of the Mapocho also led to an increase in the number of parks along the river. Numerous studies have quantified the impact of daily greenspace exposure on physical, mental, and social health. Iván Poduje, an architect and urban planner in Santiago, points out the parks on Google Earth—new strips of greenspace lining the river. Some of these spaces, he notes, were built in the 90s when the Mapocho River was still contaminated. As a result, they were rarely used. “Then we built the Parque de la Familia after the water was cleaned,” he says. A key feature of the park is a calm lagoon with water from the Mapocho River. Walk through the manicured landscape and visitors can reach a strip of path that sits next to the river. While there’s still some trash and pollution in the water, it’s a far cry from the open sewage dump of the 1980s and 90s.

Poduje adds that the Parque de la Familia is in a lower income part of Santiago. “When you clean the river and create green area you break the social segregation of the people with the river,” he says. “You create a park, land and property values go up. You eliminate security issues, and people have a beautiful park nearby. When this happens you forever change the quality of life of the people.”

With improved public health, a cleaner river, and increased green space all either directly or indirectly linked to its full treatment of wastewater, Aguas Andinas had reached an operational crossroads and had the opportunity to ask “what’s next?”

Parque de La Familia, constructed near the edge of the Mapocho River, is one of Santiago’s newest greenspaces. The park features a testament to the decontaminated river: this lagoon filled with water from the Mapocho. On the weekends families stroll through the park and take paddle boats onto the lagoon.

La Farfana is one of the largest wastewater treatment plants in Latin America. First opened in 2003, the plant was retrofit as a biofactory after Aguas Andinas' strategic change in 2016. Today, parts of the facility are open for public tours.

There's a cement block in the corner of Carlos Castro's office. Castro is the Manager of Biofactories and Sustainable Operations with Aguas Andinas, and was one of the original supporters of the company's biofactory project. This cement block is a tangible example of the valuable byproducts that can be created from what is extracted during the process of treating wastewater. This block was created from the dried ash of what was once household waste. "Our dream is that this biocement be produced from the monofill[ix] at El Rutal and then sent to plazas or buildings," says Castro, placing the block on his desk.

[ix] A monofill is a type of temporary landfill. In the case of Aguas Andinas, the monofill at El Rutal is a place where dried sludge is stored until it can be turned into something useful, like the biocement in Carlos Castro's office.

Having achieved 100% wastewater treatment by 2015, Aguas Andinas could take one of two paths. The company had met the requirements established by privatization, and the most straightforward next step would have been to maintain its status quo as a traditional water and wastewater utility. The other option was to forge a new business strategy that updated the company's mission in alignment with the shifting values of society and the changing needs of its clients.

"What we have now are empowered citizens who require a very different relationship with a utility," says Narciso Berberana, Aguas Andinas' Chief Executive Officer, and the person who led its change in strategy in Chile. He says clients today demand greater transparency around supply breaks and increased consideration of environmental responsibility, including ensuring wastewater is treated. "Nowadays it would be unthinkable to have sewage in the middle of the city," he says.

The strategy change required new infrastructure, turning Aguas Andinas' La Farfana, Mapocho-Trebal, and El Rutal facilities into one of the largest wastewater treatment systems in the world: the Gran Santiago Biofactory. The biofactories are one element of the circular economy model that was suggested by Angel Simon, and has been used by Agbar Group in Barcelona, one of the companies that owns Aguas Andinas.

At the same time, the biofactories demanded the adoption of new mindsets and business models. That wasn't easy. A long-time environmentalist, Narciso Berberana says it's key that a company change over time. "I believe in the sayings of a very famous Chilean biologist and philosopher, Humberto Maturana. He said that species arise and surge in environments that make it possible for

Carlos Castro holds a biocement brick — made exclusively from dried ash extracted from household wastewater. This could be a future market for the byproducts that come from Aguas Andinas' circular economy model.

them to do so. For me, the company is a biological being. It is alive and it depends on its surrounding environment. It needs to adapt to that environment in order to obtain a license to live," Berberana says.

He combined this personal philosophy with the new attitudes of clients, pointing to these societal demands to support his argument for a revised strategy: "how could we use the previous paradigm that was not up-to-date? We said that society is changing so we must too." At the same time, Berberana was careful not to criticize the company's past approach, mindful that his proposed changes could put the board of directors on the defensive.

The evolution of the company strategy took time. "Convincing the board was one of the most difficult things to do," says Berberana, now a board member himself. "It was a traditional board and they were used to a business environment where profit was only economically gained. The point of inflection was when I was able to open them to the vision of how the company could be five years into the future. [...] What I proposed was to change Aguas Andinas into a services company that had not only an economic focus but an environmental and social mission, too."

The updated corporate strategy was unanimously approved—almost. Water and quality of life, the final of the seven pillars proposed under the new strategy, received pushback. It included goals like increased participation in health and water studies and biodiversity preservation and recovery projects. "The board said this was outside the strategy of the company," Berberana explains.

Biodiversity and Watershed Management

Preserving the biodiversity of ecosystems is one of the objectives of Santiago Merece un 7, Aguas Andinas' long-term strategy. This includes protection of the Mapocho River and the Maipo watershed from which the river draws its source. Less than 5% of that watershed is currently protected.[42]

The company's choice to include biodiversity in its strategy elicited some confusion. "Non-health focused companies [see the inclusion of biodiversity] as exotic," says Carmen Lacoma, Manager of Sustainable Development at Aguas Andinas. "However, we find it important to link the two because the preservation of biodiversity has a direct impact on the water we capture in the basin."

The company is in the midst of preparing its first biodiversity strategy. That strategy involves more effective measuring of the company's carbon footprint, supporting the release of endangered Tricahue parrots when the Pirque Mega Tanks open, and protecting the birds of prey that have flocked to its El Rutal biosolids monofill. Lacoma notes that these projects will likely be supported by the creation of a new corporate volunteering program.

In an effort to improve watershed management, Aguas Andinas is a signatory on The Nature Conservancy's Santiago Water Fund. The fund is a public-private partnership to protect nature in the Maipo watershed. This includes investigating how nature-based solutions such as river buffer zones and healthy vegetation can improve water quality and reduce treatment costs.

Manuel Contreras with Santiago's El Centro de Ecología Aplicada says collaboration is key in making future watershed management efforts a success. Environmental activities by industry and non-governmental organizations, he says, have previously been limited to the conservation of wetlands, with each stakeholder considering only its own vested interests. "Education and agreements with these groups would be one strategy that could change how we view the water, and this is one area where Aguas Andinas could contribute more," Contreras says. He adds that he'd also like to see the company use its influence to urge the Ministry of the Environment to take greater responsibility of the country's watersheds.

To convince them of this seventh pillar, Berberana played another strategy card: he assigned responsibility of the new strategic plan to the director who most opposed it. Suddenly, this director was personally invested and responsible for persuading the rest of the board to approve and adopt the new strategic direction, quality of life and all. Broadly, similar strategies could be key in helping private companies adopt or champion more holistic planetary health business practices.

"Reaching a consensus on the new corporate strategy took about nine months. The result of this new project was Santiago Merece un 7 (Santiago Deserves a 7), the long-term strategy of Aguas Andinas," says Esteve Clos, Organization and Talent Manager. Launched in 2017, its seven pillars include resilience, circular economy, social legitimacy and water and quality of life—each a new direction for the established company.

↘ *Appendix 1: The seven pillars of Santiago Merece un 7*

Narciso Berberana is the CEO of Aguas Andinas. He was one of the key people who led the company's strategic change in 2016 following the company achieving a 100% treatment of wastewater.

When Waste Becomes Resource

Turning La Farfana and Mapocho-Trebal wastewater treatment plants into biofactories was an integral part of Aguas Andinas achieving its new vision. "Our difficulty has always been identifying how to connect with general people who don't have a technical vision," says Dulcinea Meijide, the Director of Sustainable Development with Suez Group Spain, the company that has ownership in Aguas Andinas. "When talking about the circular economy and shared value you need to identify examples. We can point to the biofactories and people say 'ah yes, I see.'"

With the opening of its biofactories, Aguas Andinas now defines itself as a "services company." It provides the traditional service of drinking water and wastewater treatment, but also produces and sells the raw materials and resources generated by its biofactories.

The creation of new products from what would otherwise be waste is part of the company's new circular economy model. It's an approach that envisions the cyclical reuse of products, resources, and waste to extract its maximum value. Compare this with standard linear economy models, defined by mentalities like "take, make, and dispose" and "use it or lose it."

↘ *Appendix 2: Linear and Circular Economy Diagram from the Ellen MacArthur Foundation*

Circular Economy Initiatives Around the World[x]

The European Union has been a global leader on transitioning to a circular economy. In 2015, the European Commission, the executive branch of the EU, started its Circular Economy Action Plan. That plan included 54 specific actions that sectors and countries could follow to extend the life of its products and materials.[43] The action plan was considered fully implemented by 2019.

On a common thread, *The Switchers*, a joint project of the European Union and the United Nations Environment Programme, profiles circular economy initiatives in the Mediterranean region. This includes stories of an innovator finding a way to extend the life of electronic waste in Palestine, an Italian sailor who creates fashionable accessories from old sails and sail cloth, and a Moroccan innovator who uses a process called pyrolysis to transform agricultural waste into a charcoal fertilizer.

[x] What are some circular economy initiatives in the places you live and work?

The biosolids monofill is located north of Santiago—the piles are household waste that has been dehydrated and sanitized. These biosolids are then given a second life, reducing the amount of waste that ends up on landfill.

Yves Lesty, a long-time engineer with Aguas Andinas, became the company's first Circular Economy Manager in September 2017. "[The circular economy concept] was little developed in Chile. There are some companies that are more specialized and recycle plastic and glass products, but these few initiatives are relatively small in size," Lesty says.

The Aguas Andinas biofactories in Chile aren't the first of their kind, but they are the largest-scale example worldwide. Suez Group, the company that owns Aguas Andinas, has also adopted biofactory models at its wastewater treatment plants in Spain. "[What we are doing in Santiago] is taking the cutting edge technology from other parts of the world and applying it in Chile," says Jordi Fontana, the General Manager of Biofactories.

There are a number of secondary products that can be created from the extracts of wastewater. Back in the reception area at La Farfana biofactory, Fontana gestures at a placard highlighting the company's aspirations in adopting a circular economy approach: zero environmental impact through producing zero waste and zero emissions, and needing no energy consumption from outside sources. "La Farfana is the biggest plant of its kind and puts all these pieces together to achieve the goals," he says.

The specifics of those goals are more technical. When wastewater enters a traditional treatment plant or biofactory, waste[xi] is extracted during the cleaning process. Traditionally, biosolids are sent to a landfill where utility companies pay for their disposal. Not only can this be expensive, but landfills are also an environmental liability, creating smells and unsafe areas. The biofactories, on the other hand, sanitize and dehydrate the biosolids, giving them to local farmers free of charge. Already high in nitrogen and phosphorous, farmers can add potassium in order to use the biosolids as fertilizer.[xii] "This allows us to reincorporate the biosolids into the food cycle and continue their lifespan," says Yves Lesty. Today, 70% of the biosolids produced by Aguas Andinas are distributed as fertilizer and what remains is sent to the monofill at El Rutal, awaiting a second life. A future goal is to further dry the biosolids in order to create a more valuable product that could be sold rather than given away.

Jordi Fontana and Paulina Vicentela are on the management team at La Farfana biofactory. The displays behind them are in the entrance of the plant, and explain to visitors the process of the biofactories and the history of water sanitation in the capital city.

[xi] The waste extracted from wastewater is called biosolids or sewer sludge. Aguas Andinas uses the term biosolids.

[xii] What is the difference between organic and inorganic fertilizers? Are there downsides to fertilizer use?

[xiii] How is a carbon footprint calculated? Why is it important to calculate it? What is your carbon footprint?
↘ Learn more here

The creation of biosolids also helps reduce the company's emissions.[xiii] Before being disposed, biosolids are dried for about 20 days. This lowers the water content of the sludge by 75%, making it more compact and lightweight for transportation. Aguas Andinas estimates it currently produces 850 tons of emissions a day in biosolid transportation. This could be reduced to 300 tons daily with proposed further drying techniques.

Finally, the biofactories are key in Aguas Andinas' aspiration of reaching carbon neutrality, and the company aspires to be 100% energy self-sufficient by 2020.[44] Water and wastewater plants demand large amounts of energy to run continuously. The distribution and treatment of water and wastewater uses about 4% of the world's total electricity supply, and this energy demand is expected to double by 2040.[45] This creates an opportunity for companies to be more efficient through the production of their own energy sources.

[xiv] Where else can biogas be obtained? How is biogas turned into energy? Is burning biogas detrimental to the environment?

Biogas is one option.[xiv] Biogas is a mixture of gases created using a process called anaerobic digestion. Visualize a giant stomach: bacteria is used to break down the sludge cleaned from wastewater, and 'digest' it in an oxygen-devoid setting. The resulting biogas is then combusted to create heat or electricity. To date, 85% of the Mapocho-Trebal biofactory is run on this biogas. An agreement between the city and La Farfana plant means it's more cost effective for Aguas Andinas to use electricity supplied by the city than to capture its own. Instead, biogas from La Farfana is sold to Santiago's natural gas distributor and provides electricity to 30,000 households. This could change in the future when Aguas Andinas is able to modernize La Farfana to operate on the biogas that's produced. The company says this project must be evaluated on its own merit, and that this process is on track to happen by 2022.

"The idea is to recover the greatest portion of energy from the sludge," says Jordi Fontana of the biogas production. "This could be electricity, hot water, steam. All of these residual energies could be used later in a boiler or to dry more waste." Aguas Andinas sees these diverse energy sources as one of its key climate change mitigation efforts. It decreases reliance on fossil fuels and also creates a new source of revenue for the company.

La Farfana's wastewater cleaning mechanics from above.

Biofactories: A Benefit to Business

The ability to create new revenue streams is another benefit of the circular economy. Take, for example, the fact that Aguas Andinas has started accepting industrial waste generated during the production of soda. This highly concentrated waste would have previously been brought by truck to the wastewater treatment plants at a high cost. The soda company would then pay to have the waste treated. Now for a lower cost, companies can opt to send effluent through a discharge pipe to the Mapocho-Trebal biofactory where it is added to the anaerobic digester and transformed into energy. Money is saved by both the soda company and Aguas Andinas, and a valuable product is produced. Aguas Andinas benefits financially at both ends of the process: with payment from the soda company and in the cost-savings it receives from producing biogas.

Whether it's biogas, biocement, fertilizer, or other future byproducts, each can be sold by Aguas Andinas through its subsidiary businesses. The requirement is that the income from these sales be used to reduce and/or mitigate the possible increases in the rates paid by customers. In other words, the more income obtained from the sale of biofactory resources, the greater the likelihood that residents of Santiago could see a stabilization in their water bills. "Aguas Andinas has the vision to advance steadily in the search for shared efficiencies," declares a company's statement.

While the biofactories have allowed Aguas Andinas to expand its environmental and social vision, it's not all about altruism, but economics, too. The company must run a careful cost-benefit analysis of every infrastructure upgrade and biofactory product it considers producing. This is because of the regulatory environment in which Aguas Andinas operates. Converting wastewater treatment plants into biofactories is not an inexpensive task. With a price tag of US $61.2 million between 2018 and 2020,[46] these infrastructure upgrades are funded by the customer tariffs that can be updated by the *Superintendencia de Servicio Sanitario* every five years.

For better or worse, the Superintendent is notoriously conservative. "If they were asked about whether or not we could carry out a change they'd simply say no because they associate all that's traditional with control, even though that's an incorrect concept," says Narciso Berberana, Aguas Andinas' CEO.

As a result of this conservative regulator, no tariff change can be made without demonstrating it will bring cost-savings over the long-run. Aguas Andinas needs to prove that its circular economy approach makes more economic sense than the traditional way of doing business. For example, say it costs the company $1 to dispose of its biosolids in a landfill. If distribution of those same biosolids to farmers cost $1.50, Aguas Andinas would have no choice but to select the first option. If the circular method is shown to be more cost effective, however, the Superintendent is more likely to approve a tariff increase to raise money for that switch. In the case of biosolids disposal, Aguas Andinas says it costs 40% less to produce biosolids for fertilizer versus sending them to landfill.[xv]

[xv] What are co-benefits of climate action? Why are they important? Read more here

The view over La Farfana's facility. Educational placards mark the place where visitors and students come each year to learn about Santiago's wastewater management system.

Tariff increases aren't the only approach Aguas Andinas is using to fund its upgrades. "The great jump in strategy was when we issued green and social bonds and the stock market received them successfully," says Berberana.

He's referring to the two rounds of bonds the company issued in 2018 and 2019, raising US $68 million and US $83 million respectively.[xv] While this represented the first time green and social bonds were issued and sold in Latin America, the approach is becoming increasingly popular worldwide as a way to fund environmental and climate-related projects. The world's first green bonds were issued by the World Bank in 2008, though the water and wastewater sector represents just 10% of green and social bonds commitments in 2018.[47] New environmental funding streams are key in directing money to urgently-needed climate change resilience, adaptation, and mitigation measures. As Mami Mizutori, the UN secretary-general's special representative on disaster risk reduction told *The Guardian* "resilience needs to become a commodity that people will pay for."[48] Green and social bonds can offer that investment model.

[xv] The payback period on the 2018 bonds is seven years at an interest rate of 1.8%. The second round of green and social bonds will be paid back over the course of 25 years at an interest rate of 2%.

Bonds are long-term, typically lower risk investments that help finance certain projects—in the case of Aguas Andinas, the funds will be directed towards projects that make an environmental and social impact.[49] Berberana says it's notable that investors are starting to consider these categories of projects as being more secure over time. "You can associate sustainability visions with more stability. It would have been impossible to speak in these terms three years ago," he says. Demand exceeded the bond amount offered in both rounds of issuance, demonstrating that there was an interest in investing in the company's long-term vision. "The investors validated our strategy and were willing to invest in a company that makes radical changes," says Berberana. Unlike the shareholders of Aguas Andinas who are almost exclusively international, the green and social bonds were available only to Chileans.[xvi]

[xvi] What are other examples in which green and social bonds are being used? What international agreements have incorporated these finance mechanisms in the past? Were they successful?

A Planetary Health Approach for Future Development

Climate change resilience and adaptation measures are two priorities for the funds raised by Aguas Andinas' green and social bonds. That includes accounting for an increase in climate-intensified flooding and future water shortages. "We have to defend our plants," says Eugenio Rodríguez, Director of Service Management with Aguas Andinas. At least five events in the last seven years have forced the company to suspend water services. Typically, this happens when sudden, heavy rains trigger landslides which muddy the river and force Aguas Andinas to close its intake valve along the Maipo River.

"This has meant one million customers without service for between one and three days. It's very bad for us because our core business is providing water continuity," says Rodríguez. "It's a reputation problem because customers don't understand that the climate is producing the event. They see a company stopping service." These water cuts occurred in the summer months, with 30 degree Celsius temperatures intensifying the impacts of water shortages.

Increasing emergency water autonomy is one of Aguas Andinas' main climate adaptation measures to address these cuts. Autonomy is the number of hours in which the company can support the city with emergency drinking water while normal water intake is disrupted. This is usually done in the form of large storage tanks and additional groundwater wells. Santiago had four hours of autonomy when the first flooding event happened in 2008. "After this event we suggested to the Superintendent that we should construct a big emergency tank, but they said 'no' because it was very expensive and nobody thought there would be a bigger event," says Rodríguez.

Just as Aguas Andinas needs to demonstrate the economic argument for transitioning to a circular economy model, the same rule applies for the approval of climate change resilience and adaptation measures. Basically, the company needs to show that it would be more costly to do nothing in the face of climate change. Two major floods affected Santiago in the first months of 2013. Shortly after, the Superintendent approved the construction of the Pirque Mega Tanks, which will store 1.5 million cubic meters of emergency water. It's Aguas Andinas' largest climate change-related resilience project to date, and has increased Santiago's water autonomy from 11 to 34 hours. If the Pirque tanks had been operational in 2013 the company would have avoided that water cut event, notes Alberto Blanco, Director of Engineering and Sustainable Development. Aguas Andinas recently presented a new proposal to raise the autonomy levels further still to 48 hours.

While new emergency storage tanks help in the case of flooding or landslides, they don't address the drop in water supply that Santiago is forecast to face.[50] "We are working on this," says Eugenio Rodríguez, the Director of Service Management. "We talk about resilience and in parallel we have a drought plan that considers different alternatives like protecting glaciers, decreasing losses in our network, and convincing the community to use less water."[xvii]

Community water consumption, conservation, and efficiency are addressed in Aguas Andinas' sustainability roadmap. A goal is to educate at least 30,000 people each year on sustainable water use. A few years ago, Aguas Andinas launched a summertime campaign called *Plazas del Agua* (Water Squares), small community water parks where children can go to cool off. This is meant to decrease one of the company's most significant water consumption concerns: kids opening fire hydrants during warm weather months. The sustainability roadmap also addresses water and quality of life, emphasizing that the creation of healthy environments can improve the quality of life for Santiago's citizens.

[xvii] Take a moment to think if you are doing your share to save water. What else could you be doing? ↘ Click here to learn more on where your water footprint is coming from

Eventually, another way to address water supply issues could be treating wastewater to the extent that it could be reused as potable drinking water. This method is already being used in water-stressed cities around the world, from Perth, Australia, to Big Spring, Texas, to Singapore, to Windhoek, Namibia. “This is an eventual goal because of our strong limitation of water in the region,” explains Yves Lesty, Circular Economy Manager.

However, the greatest opportunity for curbing water use in Santiago and Chile lies not within the purview of Aguas Andinas and household water consumption, but instead in the adoption of more efficient technologies within industries such as agriculture, mining, manufacturing, and forestry. Industrial water demand accounts for more than 90% of all water use in Chile, and demand is forecast to rise in coming years.[51] While community education and individual household water conservation is important, it’s a drop in the bucket when it comes to the larger issue of water scarcity in Chile.

Be it the opportunity to improve the health of Santiago’s citizens by improving the health of the Mapocho River system, or through the ability to reduce waste and pollution by embracing circular economy principles, Aguas Andinas presents an example of a large private sector company that has adopted a planetary health framing in its business approach. Further, the company has proved that a planetary health model doesn’t come in conflict with economic development, but can in fact aid in its behalf.

Epilogue

In 2018, Aguas Andinas was named one of four winners of a planetary health Momentum for Change award from the United Nations Framework for the Convention on Climate Change (UNFCCC).[xviii] Former CEO Narciso Berberana says the award represented another milestone for the company’s new direction, and validated its circular economy model with politicians and other corporations in Chile. It also highlighted to the international community how the private sector can engage in planetary health efforts.

“Planetary health is not about the technical performance of our water networks,” says Berberana. “We would talk to the environment, treasury board, or financial ministers, and they’d say ‘wow, your award is not about water issues, it’s about planetary health and a low carbon economy.’ The change is huge for the company. It’s not about only water, it’s about people’s health.”

More effectively communicating its environmental and social mission is one of the most important next steps for Aguas Andinas. While its corporate strategy has changed greatly in the last five years, company management says this hasn’t yet been recognized by the general public. That’s why visits will continue at La Farfana biofactory—so people, especially students, can better understand the complexities of the water system and how what goes down the drain is connected with their health and the health of their city. “Students visit and they see this huge area and it’s beautiful surroundings. They’re impressed that all the wastewater from Greater Santiago comes here,” says Paulina Vicentela, looking out at La Farfana’s lagoon. “We tell them that what happens in Santiago isn’t what happens everywhere in the world, so they leave this place with a positive point of view and a sense of pride that commits them to reducing waste and taking care of water as a resource.”

At a larger scale, Narciso Berberana hopes Aguas Andinas can be a model for other private sector companies or utilities that understand the need to step up their environmental efforts but are concerned about their bottom line or optics among their investors. “I believe a private company that thinks its only purpose is to generate profit is wrong,” he says. We have to generate an environment that’s better, and companies receive money to achieve that planetary improvement.”

[xviii] Two other winners in the planetary health category, the Sri Lanka Mangrove Conservation Project and the Plant-Powered Pupils/Climate Efficient Schools Kitchens projects, are featured in case studies within this anthology.

Keeping Track of Who's Who

Narciso Berberana

Former Chief Executive Officer of Aguas Andinas, now a member of the board of directors

Alberto Blanco

Director of Engineering and Sustainable Development, Aguas Andinas

Manuel Contreras

Executive Director of El Centro de Ecología Aplicada, a Santiago-based environmental consulting group

Dr. Sandra Cortes

A public health epidemiologist at the Pontifical Catholic University of Chile

Dulcinea Meijide

Director of Sustainable Development, Suez Group Spain

Patricia Arroyo Meneses

A long-time vegetable vendor at Santiago's La Vega market Alliance

Carlos Castro

Manager of Biofactories and Sustainable Operations, Aguas Andinas

Esteve Clos

Organization and Talent Manager, Aguas Andinas

Marta Colet

Deputy CEO of Aguas Andinas

Jordi Fontana

General Manager of Biofactories, Aguas Andinas

Carmen Lacoma

Manager of Sustainable Development, Aguas Andinas

Yves Lesty

Circular Economy Manager, Aguas Andinas

Iván Poduje

An architect and urban planner in Santiago

Eugenio Rodríguez

Director of Service Management, Aguas Andinas

Paulina Vicentela

Chief of Resource Management of Biofactories at La Farfana, Aguas Andinas

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Aguas Andinas' La Farfana wastewater treatment plant as seen from above. The corridor in the top left is where the treated water from the plant gets rechanneled back into the Mapocho River.

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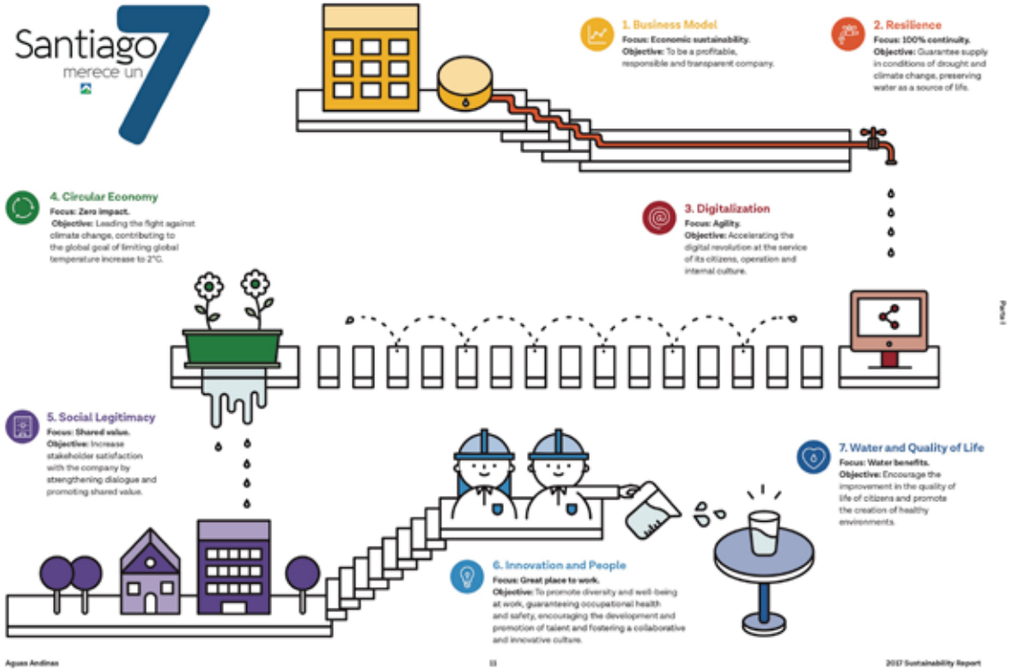
Santiago
merece un 7
1. Business Model
Focus: Economic sustainability.
Objective: To be a profitable, responsible and transparent company.
2. Resilience
Focus: 100% continuity.
Objective: Guarantee supply in conditions of drought and climate change, preserving water as a source of life.
3. Digitalization
Focus: Agility.
Objective: Accelerating the digital revolution at the service of its citizens, operation and internal culture.
4. Circular Economy
Focus: Zero impact.
Objective: Leading the fight against climate change, contributing to the global goal of limiting global temperature increase to 2°C.
5. Social Legitimacy
Focus: Shared value.
Objective: Increase stakeholder satisfaction with the company by strengthening dialogue and promoting shared value.
6. Innovation and People
Focus: Great place to work.
Objective: To promote diversity and well-being at work, guaranteeing occupational health and safety, encouraging the development and promotion of talent and fostering a collaborative and innovative culture.
7. Water and Quality of Life
Focus: Water benefits.
Objective: Encourage the improvement in the quality of life of citizens and promote the creation of healthy environments.
Aguas Andinas
11
2017 Sustainability Report


LINEAR ECONOMY
NATURAL RESOURCES
TAKE
MAKE
DISPOSE
WASTE
WASTE
WASTE
TECHNICAL & BIOLOGICAL MATERIALS MIXED UP
ENERGY FROM FINITE SOURCES
ELLEN MACARTHUR FOUNDATION
Rethink the future
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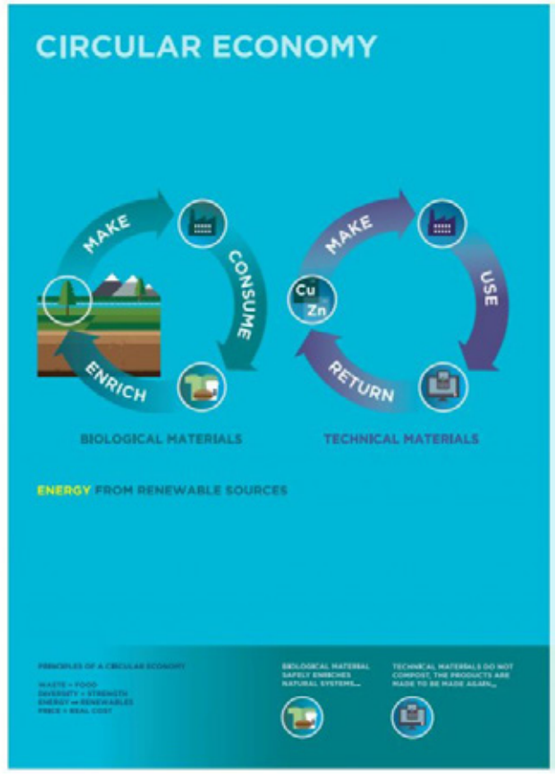
CIRCULAR ECONOMY
MAKE
CONSUME
ENRICH
MAKE
USE
RETURN
BIOLOGICAL MATERIALS
TECHNICAL MATERIALS
ENERGY FROM RENEWABLE SOURCES