

CASE STUDY

The Andina copper mine in Chile

Due diligence in downstream value chains

The Chilean Andina mine is a copper mine of the state-owned Codelco mining company in Los Andes Province in Aconcagua Valley near the capital Santiago de Chile. The mining activities are exacerbating the water shortage in the region in three ways:

- polluting the surrounding waters
- consuming vast amounts of water
- contributing to glacier retreat

Already a number of villages around the Andina mine are having to be supplied by water tanks as natural water sources have dried up or become contaminated.¹ And yet Codelco is still continuing with its plans to expand the mine. These plans are not only highly controversial, but they are also not being communicated transparently by the company.² Despite these grievances, a large number of European mining equipment manufacturers have close ties to the Andina mine.

The **environmental and water pollution** was caused, among other things, by numerous tailings and copper leaks, i.e. mining waste and copper leaked into the environment. There were seven such incidents between 2011 and 2019.³ Civil-society actors have rated Codelco's handling of these incidents as seriously flawed and non-transparent.⁴ Residents believe that the Aconcagua River is heavily polluted, and that the main reason for this lies in the repeated leaks and in the suspected illegal night-time disposal of mining waste outdoors. They report that there are no longer any fish in the river.⁵ Consequently, according to the locals, the water of the Aconcagua River is no longer safe to drink or bathe in. However, they lack the means to analyse water samples from the river.⁶

In addition to the pollution, the **high water consumption of the mining activities** is also contributing to the water shortage in the region. In 2015, for instance, the Andina mine used an estimated 2,000 litres of water per second.⁷ Precipitation is increasingly absent in the region as a result of climate change. This leads to extreme drought. The high water consumption of the Andina mine reinforces this development, which

¹ Own interview with residents of neighbouring communities on 11 July 2022.

² Arellano Ubello, Ignacio Alberto, 2021, [Análisis de la expansión minera y sus efectos entre los años 1970 - 2019 en el Valle del Aconcagua](#). Universidad de Chile. Santiago de Chile (last accessed: 19.01.2023).

³ Zúñiga, 2016, [Baja de los commodities: ¿Quién nos puede salvar de Codelco?](#) (last accessed: 08.02.2023); Laing, 2020, [Environmental regulator hits Codelco with pollution claims](#) (last accessed: 08.02.2023); Esposito und Cambero, 2017, [UPDATE 1 - Codelco Andina mine still at 65 pct after tailings duct ruptures](#) (last accessed: 08.02.2023), Observatorio Latinoamericano de Conflictos Ambientales, 2019, [Codelco Andina causa nuevo desastre ambiental por descarga de Relaves al Río Blanco](#) (last accessed: 08.02.2023).

⁴ Own interviews with residents of neighbouring communities on 11 July and 13 July 2022; Observatorio Latinoamericano de Conflictos Ambientales, 2019, [Codelco Andina causa nuevo desastre ambiental por descarga de Relaves al Río Blanco](#) (last accessed: 08.02.2023).

⁵ Own interview with residents of neighbouring communities on 11 July 2022.

⁶ Own interviews with residents of neighbouring communities on 11 July and 13 July 2022.

⁷ Observatorio Latinoamericano de Conflictos Ambientales, 2015, [Expansión de Codelco Andina 244: Una amenaza a los Glaciares, el Agua y la Vida del Valle del Aconcagua](#). Santiago de Chile (last accessed: 08.08.2022).



The Andina open-pit copper mine near the capital Santiago de Chile. Photo: Shutterstock/Jose Luis Stephens

also leads to heavy pollution of the surface water. The Aconcagua River is now completely dried up at various times of the year, and many farmers have been forced to abandon their agricultural activities.⁸

Furthermore, mining at the Andina mine is contributing significantly to the retreat of nearby glaciers in the region, which also increases the water shortage. In 2015, Greenpeace voiced the criticism that copper mining in Andina and the neighbouring Los Bronces mine has contributed to fifty percent of rock glacier retreat in the region. Between one and eight million tons of ice were removed every year between 1991 and 2000.⁹ The Fundación Chile Sustentable also concluded in a study that the Andina mine had caused an area of 1.32 km² of the Rinconada and Rio Blanco glaciers to disappear almost completely.¹⁰ Another peer-reviewed scientific study confirmed that between 2004 and 2014, 82 percent of glacier retreat in the region had been caused by the Andina and Los Bronces mines, mainly by the particles and aerosols emitted by mining.¹¹ It was not until 2018 that Codelco announced it would shift its mining activities away from the

⁸ Own interviews with residents of neighbouring communities on 11 July 2022 and on 13 July 2022; Observatorio de Conflictos Mineros de América Latina, 2013, [Carnaval por el agua y la vida de Aconcagua y rechazo al proyecto andina 244](#) (last accessed: 08.02.2023); Observatorio Latinoamericano de Conflictos Ambientales, 2015, [Expansión de Codelco Andina 244: Una amenaza a los Glaciares, el Agua y la Vida del Valle del Aconcagua, Santiago de Chile](#) (last accessed: 08.08.2022).

⁹ Chile Minería, 2015, [Greenpeace acusa a Codelco de destruir glaciares en minas Andina y Los Bronces](#) (last accessed: 08.02.2023).

¹⁰ Programa Chile Sustentable, 2020, [Glaciares de Chile: El Lobby Minero y el Tortuoso Camino para Protegerlos, Santiago de Chile](#) (last accessed: 13.10.2022).

¹¹ Cerededa-Balic, Francisco; Ruggeri, Maria F.; Vidal, Víctor; Ruiz, Lucas; Fu, Joshua S., 2022, Understanding the role of anthropogenic emissions in glaciers retreat in the central Andes of Chile. In: *Environmental research* 214 (1), p. 113756. DOI: 10.1016/j.envres.2022.113756.

glaciers.¹² Nevertheless, the contribution to glacier retreat caused by aerosols resulting from splitting and crushing remains unchanged.¹³

Expansion without regard for environmental compatibility

In 2012, Codelco applied to the Chilean Environmental Protection Agency for a major expansion of the mine that became known as Andina 244. Codelco also submitted an environmental impact assessment that downplayed the devastating effects on the environment. In response, various actors—including residents, NGOs, and public institutions—submitted over 2,000 critical statements.¹⁴ For instance, while the assessment submitted by Codelco indicated an impairment of six glaciers, municipal and civil-society actors believed that the expansion would in fact affect 26 glaciers.¹⁵ There was already a water shortage in the region at the time **of the application for the expansion, and the glaciers in question were and are central for water supplies to the residents of Santiago de Chile and for agriculture in the surrounding area.** So once the plans for expansion became widely known, various municipal actors and environmental organisations joined forces and demonstrated against the planned expansion.¹⁶

Partly in response to the protests, Codelco made a number of adjustments to the planned project, but the conflict continued. The Observatorio Latinoamericano de Conflictos Ambientales suspects that Codelco had already started working on the Andina 244 expansion despite the ongoing processes. However, as civil-society actors are not given access to the mine, regrettably this suspicion cannot be confirmed.¹⁷ Nor is the nature reserve around the mine accessible to anyone other than Codelco. In September 2015, Codelco officially withdrew the Andina 244 expansion.¹⁸ However, this did not spell the end of the environmentally destructive expansion. Rather than being stopped, the plans for expansion have de facto continued. **Instead of continuing with the expansion as a single major project under the name of Andina 244, which would have required an extensive environmental impact process, Codelco split the expansion into numerous small projects.**¹⁹ Among other things, a new expansion project was officially approved in 2017 that the company says should be less invasive. Nonetheless, even this official estimate by Codelco indicates that the new project will affect seven glaciers.²⁰ **This officially requested**

¹² Jaing, 2018, [Codelco will spend \\$250 million to adjust Andina mine to avoid glaciers](#) (last accessed: 08.02.2023).

¹³ Cereceda-Balic, Francisco; Ruggeri, Maria F.; Vidal, Víctor; Ruiz, Lucas; Fu, Joshua S., 2022, Understanding the role of anthropogenic emissions in glacier retreat in the central Andes of Chile. In: *Environmental research* 214 (1), p. 113756. DOI: 10.1016/j.envres.2022.113756.

¹⁴ International Mining, 2014, [Codelco replans the massive Andina expansion](#) (last accessed: 08.02.2023).

¹⁵ Opasso, 2013, [El memo secreto del Proyecto Andina](#) (last accessed: 08.02.2023); Tapia, 2013, [Proyecto Andina 244: La controvertida expansión de Codelco](#) (last accessed: 08.02.2023).

¹⁶ Portal Minero, 2014, [Proyecto Andina 244, el próximo Hidroaysén?](#) (last accessed: 08.02.2023); Observatorio Latinoamericano de Conflictos Ambientales, 2013, [Andina 244: El modelo minero chileno y la vida, no son compatibles](#) (last accessed: 08.02.2023); Tapia, 2013, [Proyecto Andina 244: La controvertida expansión de Codelco](#) (last accessed: 08.02.2023); Environmental Justice Atlas, 2015, [Proyecto Expansión Andina 244 CODELCO, Chile](#) (last accessed: 08.02.2023); Portal Minero, 2018, [Proyecto Desarrollo Futuro Andina, Codelco inicia proceso de precalificación para licitar estudio de factibilidad](#) (last accessed: 08.02.2023); Pm, 2020, [Estudio de Factibilidad de Desarrollo Futuro Andina registra un avance del 78%](#) (last accessed: 08.02.2023); Opasso, 2013, [El memo secreto del Proyecto Andina](#) (last accessed: 08.02.2023); Erráticas Revista, 2021, [Afectación glaciares, ríos y disponibilidad hídrica por parte de la minería de Codelco Andina](#) (last accessed: 08.02.2023).

¹⁷ Observatorio Latinoamericano de Conflictos Ambientales (OLCA) (2015).

¹⁸ Own interview with residents of neighbouring communities on 13 July 2022;

Pm, 2020, [Estudio de Factibilidad de Desarrollo Futuro Andina registra un avance del 78%](#) (last accessed: 08.02.2023)

¹⁹ Arellano Ubello, 2021, [Análisis de la expansión minera y sus efectos entre los años 1970 - 2019 en el Valle del Aconcagua](#). Universidad de Chile. Santiago de Chile (last accessed: 19.01.2023).

²⁰ International Mining, 2014, [Codelco replans the massive Andina expansion](#) (last accessed: 08.02.2023); Pm, 2020, [Estudio de Factibilidad de Desarrollo Futuro Andina registra un avance del 78%](#) (last accessed: 08.02.2023); Opasso, 2013, [El memo secreto del](#)

expansion project is not the only project that will contribute de facto to the expansion of the mine. After Andina 244 was officially stopped, a number of smaller projects were added. Many of these projects were so small that Codelco was not obliged to submit a comprehensive EIA—thereby bypassing the requirement for a cumulative environmental impact of all the sub-projects. It is likely that the numerous expansion activities will de facto merge the Andina mine with the neighbouring Los Bronces mine, in which Codelco is the second largest shareholder. The environmental impact of this potential merger was not considered collectively.²¹ The practice of splitting a project into smaller ones to avoid the requirement for an environmental impact assessment is a violation of Chilean law. None the less, the state-owned company has not yet had to fear any legal consequences.²² Aside from that, there is also a lack of transparency regarding the numerous sub-projects and the extent of the ongoing expansion. This rules out the possibility of residents and civil-society actors having any kind of serious say in the issue.²³

Close links with European companies

Numerous European manufacturers of mining machines and mining equipment have had, and others still do today, business relationships with the Andina mine. In 2013, **Caterpillar Global Mining Europe GmbH** and **SMT Scharf** signed a contract with Codelco to supply key technology for the Continuous Rockflow project at the time when the protests were flaring up around the mine.²⁴ In 2012, **Siemens** received the maintenance and repair contract for all the technical equipment in the mine, designed as a ‘long-term partnership’.²⁵ The multinational company **ABB** has also undertaken various orders from Codelco for the Andina mine, and appears to have a close business relationship with the mining company. In 2006, ABB was commissioned to implement a comprehensive automation system. In addition to engineering services and commissioning, this significant contract also included the maintenance and monitoring of the system for a period of eight years, i.e. until the end of 2014, as well as the support services for the environmental monitoring system.²⁶ ABB also installed a gearless mill drive in the Andina mine in 2010/11. So ABB clearly maintained a close business relationship with Codelco in the Andina mine during the time of the public opposition to the planning of Andina 244. In 2019, the Swedish mining equipment supplier **Epiroc** was commissioned with the maintenance of the mining equipment in the Andina mine for a period of seven years. Epiroc had already supplied various items of equipment for the mine before that, such as blast hole rotary and other drilling rigs.²⁷

According to publicly available company information, none of the companies have used their business relationships to encourage Codelco to make its plans or prevention and remedial measures more

[Proyecto Andina](#) (last accessed: 08.02.2023); Erraticas Revista, 2021, [Afectación glaciares, ríos y disponibilidad hídrica por parte de la minería de Codelco Andina](#) (last accessed: 08.02.2023).

²¹ Arellano Ubello, 2021, [Análisis de la expansión minera y sus efectos entre los años 1970 - 2019 en el Valle del Aconcagua](#). Universidad de Chile. Santiago de Chile (last accessed: 19.01.2023).

²² Own interviews with residents of neighbouring communities on 11 July and 13 July 2022; Arellano Ubello, Ignacio Alberto, 2021, [Análisis de la expansión minera y sus efectos entre los años 1970 - 2019 en el Valle del Aconcagua](#). Universidad de Chile. Santiago de Chile (last accessed: 19.01.2023).

²³ Arellano Ubello, 2021, [Análisis de la expansión minera y sus efectos entre los años 1970 - 2019 en el Valle del Aconcagua](#). Universidad de Chile. Santiago de Chile (last accessed: 19.01.2023).

²⁴ International Mining, 2014, [Caterpillar Rock Flow project progressing at Codelco Andina](#) (last accessed: 08.02.2023); SMT Scharf AG, 2014, [Geschäftsbericht 2013](#) (last accessed: 28.06.2022).

²⁵ Latinapress, 2012, [Chile: Siemens erhält Instandhaltungsauftrag für Kupfermine](#) (last accessed: 08.02.2023); El Andino, 2019, [Trabajadores del sindicato Siemens aceptaron oferta de la empresa y depusieron en forma definitiva las movilizaciones](#) (last accessed: 08.02.2023).

²⁶ Automation, 2006, [ABB integrates copper mine automations systems](#) (last accessed: 08.02.2023).

²⁷ Mining Press, 2019, [Epiroc proveerá equipos para Andina de Codelco](#) (last accessed: 08.02.2023); Ewe, 2019, [Epiroc wins \\$99m contract from world's largest copper producer](#) (last accessed: 08.02.2023); Mining Connection, 2019, [Epiroc Secures \\$68M Mining Equipment Service Contract at Andina Copper Mine](#), Chile (last accessed: 08.02.2023).

transparent. We believe that collective pressure exerted by the business partners would have a significant leverage effect (cf. our study [Downstream due diligence in the European mining equipment industry](#), pp. 18-21). This collective action could be stimulated by European legislation and so significantly increase the impact. If due diligence in downstream value chains becomes mandatory for European companies, collective action in the Andina case would be far more likely than if it were on a voluntary basis. Due diligence in downstream value chains means that companies must assess and respond appropriately to product, sector, country and customer-specific risks with which they are associated through the sale or use of their products. In order to illustrate links between machine deliveries and maladministration at the Andina mine, SMT Scharf's business relationship with Codelco is considered in more detail below. This is intended to demonstrate the potential for more responsible mining that could be developed through mandatory due diligence obligations in downstream value chains.

Focus on: Cooperation with SMT Scharf

SMT Scharf and Caterpillar Global Mining Europe GmbH²⁸ supplied a preparatory project for the expansion of the Andina mine, the Traspaso project, with central technology over the period 2012-2014. SMT Scharf speaks of a 'key role'²⁹ that its supplied technology takes for the new conveyor system³⁰. The Traspaso project was originally planned as a part of Andina 244,³¹ but was later spun off from the larger project and carried out as a standalone. The transport system was renewed as part of this project, which increased the productivity of mining and was necessary preparatory work for the expansion of the mine.³²

The fact that the conflict surrounding the expansion was at its peak in 2013 and that the catastrophic environmental effects of the mining activities in the Andina mine described above were discussed publicly a number of times³³ did not prevent SMT Scharf AG from entering into a cooperation with Codelco that same year.³⁴ The business relationship between SMT Scharf and Codelco continues to this day. In 2020, for example, Codelco awarded SMT Scharf an order for electric mining vehicles for the El Teniente mine.³⁵ Furthermore, SMT Scharf even founded its own sales company in Chile in 2017.³⁶ It is not clear whether deliveries are still being made to the Andina mine.

As due diligence obligations in downstream value chains have not yet been sufficiently discussed in the debate on human rights and environmental due diligence, we will outline the possible actions on the basis

²⁸ International Mining, 2014, [Caterpillar Rock Flow project progressing at Codelco Andina](#) (last accessed: 08.02.2023).

²⁹ SMT Scharf AG, 2014, [Geschäftsbericht 2013](#) (last accessed: 28.06.2022).

³⁰ Germanwatch has informed SMT Scharf of the research results presented in this case study. SMT Scharf then noted that they considered their share in Codelco's overall project to be very small. However, in our view this is in contradiction of the company's own presentation in the annual report, which speaks of its technology having a 'key role' in the project. Irrespective of this, the existing possibilities of influence should none the less have been used and expanded due to the probability, extent and severity of the risk, as described on the following pages.

³¹ Tapia, 2013, [Proyecto Andina 244: La controvertida expansión de Codelco](#) (last accessed: 08.02.2023).

³² Tapia, 2013, [Proyecto Andina 244: La controvertida expansión de Codelco](#) (last accessed: 08.02.2023); Moore, 2020, [Codelco Andina's new Mine-Plant Transfer System set for 2021 start-up with winter control measures](#) (last accessed: 08.02.2023); Diario El Andino, 2020, [Proyecto Traspaso Andina permitirá al yacimiento de Codelco en Río Blanco extender su vida útil en 50 años](#) (last accessed: 08.02.2023).

³³ Observatorio Latinoamericano de Conflictos Ambientales, 2013, [Andina 244: El modelo minero chileno y la vida, no son compatibles](#) (last accessed: 08.02.2023); Tapia, 2013, [Proyecto Andina 244: La controvertida expansión de Codelco](#) (last accessed: 08.02.2023).

³⁴ SMT Scharf AG, 2014, [Geschäftsbericht 2013](#) (last accessed: 28.06.2022).

³⁵ Moore, 2020, [Codelco commissions all-electric SMT Scharf E-Cruiser truck at El Teniente](#) (last accessed: 08.02.2023).

³⁶ SMT Scharf AG, 2017, [Geschäftsbericht 2016](#) (last accessed: 08.08.2022); SMT Scharf AG, 2022, [Geschäftsbericht 2021](#) (last accessed: 08.08.2022).

of this case. So how should SMT Scharf ideally have proceeded in order to meet due diligence obligations in downstream value chains?

First, the probability, extent, and severity of the risk should have been established.

- As far as **probability** is concerned, it must be rated as extremely high given the various reports showing that Andina's current mining activities have already exacerbated the water shortage and in the light of the severe impact of the Andina 244 project stated in the Environmental Impact Assessment.³⁷
- The **extent** of the risk is also considered high as the population of the capital Santiago de Chile and the entire Los Andes region would be affected by the increased water shortage.³⁸
- The **severity** of the risk is also high as the destruction of glaciers represents irreversible environmental degradation and the increased water shortage threatens the drinking water supply to Santiago de Chile and an important basis of life in the agricultural region of Los Andes.³⁹

In summary, the risk of glacier destruction and the resulting water shortage is highly likely to be extensive and serious, **so SMT Scharf and the other European manufacturers of mining machinery and mining equipment should have made limiting the damage their highest priority.** Plus further information on the alleged circumvention of admission and participation processes should have been obtained in order to assess the extent and severity. In an interview with Germanwatch on this case study, SMT Scharf claimed that their delivery had never been used in the Andina mine.⁴⁰ None the less, the risks should have been checked when the business relationship was first entered into.

As SMT Scharf not only supplied products but joint development phases for special designs were also part of the business relationships,⁴¹ it can be assumed that there would have been opportunities to influence. Had SMT Scharf used these opportunities to discuss with Codelco the lack of transparency around its projects and the environmental impact, then the position of the environmental activists, for instance, could have been strengthened. In addition, efforts should have been made to adapt the expansion activities in order to adjust the plans to the lack of water available in the region and to rule out the impact of mine expansion on the glaciers. It is our opinion that if the expansion activities were fundamentally incompatible with the preservation of the glaciers, then SMT Scharf should not have entered into the business relationship. Aside from that, the German company should have worked towards transparency regarding Codelco's expansion activities. In our view, the fact that SMT Scharf is the technology and world market leader for the supplied monorails⁴² significantly increases the opportunities to influence in this respect.

³⁷ Cereceda-Balic et al., 2022, Understanding the role of anthropogenic emissions in glaciers retreat in the central Andes of Chile. In: Environmental research 214 (1), p. 113756. DOI: 10.1016/j.envres.2022.113756

³⁸ Environmental Justice Atlas, 2015, [Proyecto Expansión Andina 244 CODELCO, Chile](#) (last accessed: 08.02.2023).

³⁹ Portal Minero, 2014, [Proyecto Andina 244, el próximo Hidroaysén?](#) (last accessed: 08.02.2023); Observatorio Latinoamericano de Conflictos Ambientales, 2013, [Andina 244: El modelo minero chileno y la vida, no son compatibles](#) (last accessed: 08.02.2023); Tapia, 2013, [Proyecto Andina 244: La controvertida expansión de Codelco](#) (last accessed: 08.02.2023); Environmental Justice Atlas, 2015, [Proyecto Expansión Andina 244 CODELCO, Chile](#) (last accessed: 08.02.2023); Portal Minero, 2018, [Proyecto Desarrollo Futuro Andina, Codelco inicia proceso de precalificación para licitar estudio de factibilidad](#) (last accessed: 08.02.2023); Pm, 2020, [Estudio de Factibilidad de Desarrollo Futuro Andina registra un avance del 78%](#) (last accessed: 08.02.2023); Opaso, 2013, [El memo secreto del Proyecto Andina](#) (last accessed: 08.02.2023); Erraticas Revista, 2021, [Afectación glaciares, ríos y disponibilidad hídrica por parte de la minería de Codelco Andina](#) (last accessed: 08.02.2023).

⁴⁰ Dialogue with representatives of SMT Scharf on 21 December 2022.

⁴¹ SMT Scharf AG, 2014, [Geschäftsbericht 2013](#) (last accessed: 28.06.2022).

⁴² SMT Scharf AG, 2014, [Geschäftsbericht 2013](#) (last accessed: 28.06.2022); [Geschäftsbericht 2013](#) (last accessed: 28.06.2022), SMT Scharf AG, 2017, [Geschäftsbericht 2016](#) (last accessed: 08.08.2022).

Even though SMT Scharf's deliveries accounted for only a small proportion of the project, as the company claimed to Germanwatch, according to the UN Guiding Principles the influence should also have been increased by cooperating with the other suppliers of mining machines in this respect. Contractual clauses allowing mining machinery manufacturers to respond to breaches of minimum social and environmental standards would have been an important prerequisite for such downstream due diligence (cf. [Downstream due diligence in the European mining equipment industry](#), pp. 20, 26). Since there is still the highest lack of transparency regarding the expansion projects, their extent and environmental impact⁴³, the European mining machinery manufacturers should continue to use their influence today, for instance to work towards increased transparency and the appropriate participation opportunities for legal practitioners in this respect⁴⁴. In this context, joint action by the European mining machinery manufacturers would be the most promising.

Conclusion

The case study shows why the legal regulation of due diligence obligations in downstream value chains is necessary within the framework of the currently discussed Corporate Sustainability Due Diligence Directive (CSDDD). European mining machinery manufacturers are currently involved in a number of highly questionable mining projects all over the world. So far, they have made little to no use voluntarily of their opportunities to influence and work towards prevention and remedial measures. Such measures are the most promising if the supplying companies work together to achieve them. The fact that companies are prepared to take such action together is much more realistic if it is on the basis of a corresponding legal obligation rather than the result of a few individual pioneering companies acting voluntarily. Aside from this, due diligence obligations in downstream value chains can effectively work towards ensuring exploration and expansion plans for mining projects are as minimally invasive as possible, which is often inadequately addressed in the case of due diligence obligations in upstream value chains.

⁴³ Arellano Ubello, Ignacio Alberto, 2021, [Análisis de la expansión minera y sus efectos entre los años 1970 - 2019 en el Valle del Aconcagua](#). Universidad de Chile. Santiago de Chile (last accessed: 19.01.2023).

⁴⁴ Arellano Ubello, Ignacio Alberto, 2021, [Análisis de la expansión minera y sus efectos entre los años 1970 - 2019 en el Valle del Aconcagua](#). Universidad de Chile. Santiago de Chile (last accessed: 19.01.2023).

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