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## Expert report concerning opportunities for scientific and technological cooperation between Switzerland and Chile

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### Summary

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#### **I. Introduction**

The expert report aims to define the major trends of Swiss scientific cooperation with Chile by establishing a repertory of existing projects, then a list of themes of common interest to both countries, of partners and cooperation instruments. It is based on a series of interviews conducted in Switzerland and Chile by request of the State Secretariat for Education and Research (SER), and on the relevant documents. Intended as a decision-making instrument, it contributes to Swiss scientific policy abroad, which insists upon the priority status of certain regions and the introduction, adaptation and strengthening of concrete measures to implement this policy.

#### **II. A few basic facts about Chile's social and economic situation**

The Republic of Chile lies in south-west South America. With a territory of 756,950 km<sup>2</sup>, it stretches almost 4300 km in length although its width never exceeds 240 km. In 2004, the country had a population of 15.82 million inhabitants, of which 95% are of European origin; 26% of the population are less than 15 years old and 66% are aged 15 to 64; life expectancy is 76.4 years. 85% of the population live in an urban environment. The political and economic capital, Santiago, now has a population of over 6 million (40% of the total population of the country) and generated 50% of the GNP.

Administratively and politically Chile is divided up into 13 regions, which in turn are subdivided into provinces. Its recent history has been marked by the return to democracy as of 1990

Economically, the country has a working population estimated at 6 million, distributed between: the service sector 55.1%, industry 38.6%, agriculture 6.4%. The unemployment rate is 8.5%. Per capita GNP is about 9,900 USD. According to the latest estimations which go back to 2000, 20.6% of the population live below the poverty threshold.

The OECD considers Chile as a particularly dynamic market economy with - since the 1980s - the strongest growth rate in all Latin America (~ 5.5% in 2004). The most dynamic sectors are: fishing, mining, industrial production and agriculture; these are key export sectors. Several free trade agreements stimulate this economic growth (with the USA, the European Union and the EFTA, i.e. with Switzerland) and there is vigorous trade with China. The World Economic Forum positions Chile in place 22 in a world ranking of 104 countries it has analyzed, far ahead of other Latin American countries.

According to the Central Bank, foreign investments went from 1.88 billion USD in 2002 to 2.98 billion USD in 2003. The main investors are: the United States, Canada, the United Kingdom, and Spain. Switzerland holds the 22nd position (but it is the 10<sup>th</sup> foreign investor over the past 30 years).

Traditionally, Switzerland's trade balance with Chile is positive; in 2003, 133 million CHF exports (mainly machines, chemical products, pharmaceuticals) and 53.7 million imports (mainly agricultural products).

The international appraisal of Chile as an economic center is based on several factors: quality of the political leadership and institutional stability, an efficient public sector, low level of corruption, expanding capital markets, good governance of companies, improved access to financial resources for SMEs. The principal remaining risks are linked to low economic diversity and potential difficulties in/with the neighboring countries (particularly Brazil and Argentina), and a very unequal distribution of wealth.

### **III. Science and research in Chile: structures and results**

Most research and scientific development in Chile takes place in the public and private universities, which are directly or indirectly subsidized by the state. In 2001, R&D investment amounted to 570 million USD, of which some 70% came from the state, 25% from the private sector and 5% from international cooperation. This represents 0.57% of GDB. For comparison, Swiss R&D investments in 2000 were 10.7 billion CHF, i.e. 2.6% of the GDP, covered to 69% by the private sector.

The number of students in Chile went from 150,000 in 1980 to 480,000 in 2001, of which 230,174 study in public universities, and 148,662 in private universities.

There are 25 traditional universities in Chile, both public and private; these are directly subsidized by the state. Moreover, there are now 39 new private universities, created in the wake of the 1980s liberalization. They receive no direct subsidies but have access to open calls for project proposals. Academic titles are: the licence, the master and the PhD. Studies last longer than in the European system.

The organization of the scientific sector is directed by the CONICYT (National commission for scientific research and technology); its mission is to advise the government on issues relative to science and technology. Its budget for 2004 was of some 88 million CHF.

CONICYT also manages several programs of scientific and technological funding and development in Chile:

- FONDECYT (National scientific and technological development fund) which annually grants around 42 million CHF per program and open call;
- *FONDEF (Scientific and technological development start-up fund)* was created in 1991 to encourage scientific and technological innovation in universities and technological institutes. Between 1991 and 1999, FONDEF invested almost 180 million USD, with equivalent funding by participating institutions and companies;
- FONDAP (Fund for advanced research programs in priority areas) has as its task the organization of groups of researchers into outstanding research centers. The first centers of excellence cover mathematics, cell regulation, materials sciences, astrophysics, ecology, oceanography and molecular cell research. CONICYT has recently taken steps to focus scientific investments in other priority areas: genomics, security, red tide, aquaculture, IC, technological cooperation with the EU.

There is also the "Millennium Science Initiative", another internationally funded network (World Bank) to create centers of excellence (currently 3 institutes in biotechnology, biology and fundamental research, and 8 "nucleos" in genetics, the neurosciences, IC, ecology, among others).

There is a risk that certain programs will run in parallel.

Political authorities take a great interest in promoting higher education and scientific research, as shown by the constant increase of public investments. In this constantly changing context, one could summarize the current results of Chilean scientific institutions as follows:

In a Latin-American comparison, the number of scientists and teachers is still relatively small (13,610), far behind Brazil, Argentina and Mexico. Investments, which amount to about 570 million USD show strong growth both in real terms and in percentage of the GDP (0.57% for Chile), but are considerably lower than in Brazil or Mexico (probably due to each country's demographic and economic scope). Chile is the 4<sup>th</sup> provider of referenced scientific publications in Latin America (peer review), after Brazil, Mexico, and Argentina. The policy of improving scientific excellence via doctoral degrees is still recent: there are 2500 doctoral students and only 83 degrees were awarded in 2004.

Nonetheless, Chile boasts very good universities with a sound scientific reputation, both nationally and internationally (internationally speaking, there are seven Latin American universities among the 500 highest ranking universities in the world; one of these is in Chile, the Universidad de Chile, in Santiago). National rankings are established each year; these show that the schools with the best international cooperation potential are traditional universities, such as: in the capital, the Universidad de Chile (public) and the Pontificia Universidad Católica (private), as well as the Universidad de Santiago (public), and at regional level the universities in Concepción (traditional private), the Universidad Técnica Federico Santa María et Católica de Valparaíso (private, Valparaíso) and the Universidad Austral (public, Valdivia).

According to official scientific documents and interviews with key players of the Chilean scientific system, there are three priority areas:

- *biotechnologies*, with a direct link to the agricultural and food industries;
- the natural and built *environment*, mainly as concerns natural resources, climate and geophysical conditions, and environmental decontamination;
- the traditional sectors of the Chilean economy with a threefold focus on the major export resources: mines, agriculture and forestry, aquaculture.

Another priority has more to do with procedure:

- to bring science and society together in the interest of applied research targeting results that can be used rapidly for economic and social applications.

#### **IV. Scientific cooperation between Chile and Switzerland;** note that the SER distinguishes between three different types of scientific cooperation

- S to S : scientific to scientific
- U to U : university to university
- G to G : government to government.

- S to S : scientific to scientific

*Climate – Berne University / Universidad católica del Norte / Universidad de Chile*

Exchange of researchers is currently funded by the SNSF; the NCCR Climate does not integrate Chilean partners. Potential areas for cooperation between Chile and Switzerland are: the environment; climatology; glaciology; astronomy; astrophysics; mineralogy, biodiversity; biotechnologies.

In the future efforts should concentrate primarily on doctoral training of young Chilean and Swiss researchers.

*Seismology – ETHZ – Geophysics Institute / Universidad de Chile*

As part of the "Seismic Hazard Assessment for Two High Risk Areas: the Bogota (Colombia) and Northern Chile Seismic Gaps" project, 11 seismographs were financed and installed by the SDC.

For earth sciences specialists Chile presents an exceptional experimental ground. Doctoral training in the country should be the focus. Chile should also play a major role as a regional platform for high level studies for students from Latin America.

*Energy and environmental protection – EPFL – LESO & LASEN / CEAM Universidad Austral / PRIEM Universidad de Chile*

There are no specific joint projects. But CEAM (Environmental studies center) of the Universidad Austral de Chile is a reference for nature and environmental questions. There are contacts with the EPFL.

*Vulcanology – Université de Genève / Universidad de Chile*

Field work in Chile, training of doctoral candidates in Geneva, funded by the SNSF. There are good contacts with the Servicio nacional de geología y minería

Future joint projects in seismology, risk cartography, legal standards to be established, environmental geology, and acquisition of scientific equipment for Chilean laboratories

*Oceanographic microbiology – Zurich University – Universidad de Concepción*

Individual instruction as part of a Latin-American postgraduate course "Ecology & Diversity of Microorganisms". Chile offers an exceptional natural environment, coupled with institutional stability and scientific excellence.

- U to U : university to university

There are currently no institutionally funded projects.

*Trade, investments and international job markets – World Trade Institute Uni. Bern / Pontificia Universidad Católica de Chile*

Cooperation on this postgraduate degree is currently suspended owing to lack of funding.

*Academic cooperation agreement – Student exchange agreement - Université de Lausanne / Universidad de Chile*

Few things have been realized in this project, no grants were awarded.

*Magellan Exchange project – Sankt Gallen University students' association / Universidad Adolfo Ibañez*

Reciprocal visit by two groups of students from the partner universities. The project will not be repeated.

*DimSud – IRL-ETHZ / PUC*

The DimSud project is part of the international "Alliance for Global Sustainability" research network, and focuses on three cities, one of which is Santiago in Chile. The final report has been published, no further activity as far as we know.

- G to G : government to government

Switzerland and Chile signed a scientific and technical cooperation agreement in October 1969; both the Swiss authorities and the Chilean diplomatic representation in Switzerland consider that it is outdated.

- A to A : administration to administration

*Atmospheric pollution – CONAMA / SDC (Swiss Development Cooperation Agency) / BUWAL (Swiss Agency for the Environment, Forests and Landscape)*

The environmental program between Chile and Switzerland (PACS) started up in 1994, and will foreseeably end in 2006. It is funded by the SDC and implemented by Terra Consult on the Swiss side and by CONAMA (Comisión nacional de medio ambiente) on

the Chilean side. It deals with atmospheric pollution in the Santiago metropolitan area. Both partners are satisfied with the project and would like to see it extended to other environmental and sanitation issues.

*Organic and integrated farming – Swiss Federal Agricultural Office / Ministerio de Agricultura Chile*

The two public institutions signed a memorandum relative to the promotion of integrated agriculture. We have no further information concerning its content or application.

- S to A: scientific to administration

L'IAUG (Architecture Institute of Geneva University) cooperates with the Ministerial health secretariat for region VI in Chile in the renovation of regional hospitals. The project is self-funded.

Besides existing projects, there is considerable potential for cooperation with outstanding Chilean scientific institutions.

- *Universidad de Chile, Santiago*

The Universidad de Chile is the largest in the country: in 2004 it had 31,307 students, 1341 full-time lecturers and 302 part-time lecturers; 811 have a doctorate. It also enjoys an international reputation, since it is one of the two Chilean universities that are mentioned in international rankings. Operating under the auspices of the Universidad de Chile and directed by Prof. M. T. Kalin Arroyo, the Centro Millennium for advanced studies in ecology and biodiversity has points of interest in common with several Swiss researchers.

- *Pontifica Universidad Católica de Chile*

The PUC is one of the most prestigious universities in the country. Founded in 1888, it now has 23,711 students and 1477 lecturers-researchers, of whom 1020 are employed full-time and 1147 have a doctoral degree. It covers all scientific disciplines, enjoys an international reputation, and is the only university in Chile to award a doctoral degree in the social sciences. The Instituto de Estudios Urbanos y Territoriales is worthy of mention – it was established 40 years ago, offers doctoral studies and research opportunities on human settlements, urban development and the territorial environment, and is in charge of the only urban peer review (ISI) in Latin America.

- *Universities of Valparaiso*

There are several universities: Universidad Tecnica Federico Santa Maria, Universidad de Valparaiso, Universidad de Playa Ancha, all traditional. The Universidad Tecnica Federico Santa Maria signed an agreement with the EPFL in 1984. Several academic units presented highly promising joint projects, notably in medical biotechnology, tissue technologies, genomics, molecular plant biology. Cooperation with Switzerland is coordinated by Prof. Tapia, Universidad de Playa Ancha, who obtained his doctorate from Lausanne University.

- *Universidad de Concepción*

The Universidad de Concepción has already been mentioned with reference to its oceanography department and its cooperation with Zurich University. In the environmental area, which is a priority for both countries, the Centro EULA-CHILE (Centro universitario Europa-Latinoamericana de investigación y formación en ciencias ambientales) has proved to be particularly interesting as a teaching and interdisciplinary research unit involved in a number of joint international projects.

Considered one of the centers of environmental research in the country alongside the CEAM at the Universidad Austral, Valdivia, it hosts Chilean students and students from other Latin American countries (60%).

## V. Strategies and mechanisms – complementary approaches and scenarios: pathways for scientific cooperation between Chile and Switzerland

Chile is a major economic and scientific hub in Latin America.

Why?

- political and institutional stability
- rigorous and transparent administrative choices
- dynamic academic and administrative institutions
- highly qualified and committed scientific staff
- competitive procedures for research and teaching funding
- state financial backing
- emerging partnership between academic institutions and the private sector
- proven experience in dealing with international scientific cooperation
- confirmed interest in scientific cooperation with European partners
- national and international recognition of the Chilean scientific system.

Scientific cooperation between Swiss and Chilean universities is still at the budding stage, almost entirely limited to cooperation at individual level. Several interesting development cooperation projects with a scientific component show that the potential is there and that results and their applications correspond to the invested resources.

There are many areas of interest. Priority status could be given to two or three scientific sectors that are vital for development and technological innovation:

- **natural and built environment**, linking most of the major technical and scientific actions conducted in this area until now
- **biotechnologies**, owing to the acknowledged competence of Swiss universities in this field and the scope it is acquiring in Chile thanks to political
- **agriculture and forestry**, though to a lesser extent, owing to the importance of these sectors in both Chile and Switzerland.

Shared will to focus on cutting edge scientific projects with an economic, social and/or environmental application-oriented focus.

The overall scenario could provide for a bottom-up cooperation approach:

- 1) reinforce individual cooperation activities and endow them with a framework and stronger institutional recognition
- 2) develop joint programs in areas with a strong scientific potential
- 3) in the medium term, extend international cooperation throughout Latin America, for the benefit of less developed countries.

This general plan could provide for several complementary scenarios.

### 1) **Reinforcing existing cooperation by:**

- increased exchange of researchers and lecturers between the two countries
- more grants for research projects by young doctoral candidates (in Chile and in Switzerland), awarded on a competitive basis
- financing scientific equipment for certain units in Chilean universities
- backing of joint application-oriented and technologically innovative studies in line with development priorities in Chile and Swiss development cooperation objectives.

### 2) **Coordinating joint programs relative to major areas of interest linked to more specific instruments:**

- the signature of a memorandum of understanding between Switzerland and China
  - financing and establishment of research programs on priority themes (single-discipline and interdisciplinary) co-funded by the two countries
  - cooperation between the FNSF for the Swiss side, and Conicyt for Chile, in order to define and implement long term scientific cooperation and its application instruments
  - nomination of a Swiss scientific advisor, to extend the relations between Swiss and Chilean scientific institutions and reinforce contacts with financial backers and international cooperation bodies
  - creation, funding and supervision by Switzerland and Chile of joint laboratories or institutes operated by several Chilean and Swiss universities.
- 3) ***Regional expansion of scientific bilateral cooperation between Chile and Switzerland to other Latin American countries will be reinforced by specific measures:***
- Swiss support for postgraduate and doctoral courses in Chile, accessible to students from other Latin American countries
  - establishment of a Swiss Science Center in Santiago (scientific and technological cooperation between Switzerland, Chile, and other Latin American countries)
  - promotion of international scientific conferences organized in Chile.

These recommendations will subsequently be developed in a strategic development plan indicating estimated framework conditions for application, requisite resources and an implementation timeframe.

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