


[Home](#)
[About this Issue](#)
[Special Report](#)
[Voices from the Field](#)
[Knowledge Resources](#)
[Bookshelf](#)
[Events](#)
[Advanced Search](#)
[Index of Articles](#)
[Archives](#)
[Text-only Version](#)
[About Us](#)
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[Receive Email Updates](#)
[Development Forum](#)
[Contact Us](#)

## SPECIAL REPORT SCIENCE & TECHNOLOGY BUILDING CAPACITY FOR DEVELOPMENT



### FIRST-RATE SCIENCE AND MODERNIZATION OF THE NATIONAL RESEARCH SYSTEM IN CHILE

[January 2007 TABLE OF CONTENTS...](#)
[Quick Search](#)


## First-Rate Science and Modernization of the National Research System in Chile

By *Claudio Wernli*

Implementation of the Millennium Science Initiative (MSI) Program, since its inception seven years ago, has been successful and exemplary. The achievements of the Millennium Science Institutes and Nuclei can be gauged from the significant number of young scientists they have trained and from their success in attaining and promoting excellence in scientific research, in fields as varied as biology, biotechnology, physics, glaciology, computer science, engineering, ecology, mathematics, geophysics, and chemistry, with links to both the private and public sectors and education, thereby making a substantial contribution to key areas of national development. Their work has also helped trigger a number of well-planned cooperative and inter-active initiatives within the national scientific community.

In Chile, as the 2002 Report on the Chile-World Bank MSI Agreement points out, the Millennium Science Initiative constitutes a successful illustration of a better and economically effective approach to scientific research, thereby helping to strengthen Chile's National System of Science, Technology, and Innovation. Over the past decade, the Government has quadrupled the resources it has allocated to that System, underscoring with concrete measures and actions the importance it attaches to scientific and technological innovation for Chile's development.

Thus, the high level of acceptance and enthusiasm sparked

by the MSI in the science and technology community has created a propitious environment for increased investment in the sector.

The fact that the MSI has been taken as a model for other countries shows that the international scientific community also acknowledges this Program's innovative features. In 2001, it was already being applied in Venezuela, Mexico, and Brazil. In 2004, Kenya adopted it, along with a small network of African countries, and over the past two years concrete steps have been taken to introduce it in Vietnam and Kazakhstan. Interest in implementing the MSI has also emerged in China and Bangladesh.

### **Original competitive funding**

Since its establishment in July 1999, based on an agreement between the Republic of Chile and the World Bank under which the Bank granted a Learning and Innovation Loan for implementation of the Initiative, the MSI has been characterized by a series of original features with respect to competitive funding for science, technology, and innovation. It operates like a competitive, public, and transparent fund, in which project proposals are evaluated and selected by a jury of eight distinguished foreign scientists representing different branches of knowledge and geographical regions, aided by specialists. Funds are disbursed directly to research teams. The MSI uses a new competitive selection process whereby applicants are asked to submit a project outline and only those who are short-listed are required to present a complete project. Those awarded a grant also have to meet certain basic conditions: for instance, that they engage in cutting edge research; train young scientists; collaborate and work via networks with other centers of excellence in the region and in other parts of the world; and share their progress with the rest of the world, especially the educational sector, industry, services, and society at large.

The MSI Program has become one of Chile's most promising sources of competitive funding and one that has endeared itself to the nation's academic and scientific institutions by being sensitive to those institutions' objectives and approaches. In so doing, it has helped strengthen them, contributing to state-of-the-art scientific and technological research: a vital lever for any country's economic, social, intellectual, and cultural progress. Thus, from its inception, the MSI has been perfectly in sync with the national developmental expectations fostered by the past two governments, in science, technology, and innovation.

Although the MSI has only a relatively small share—averaging 6.5 million dollars a year—of the approximately 560 million dollars, or 0.7 percent of GDP, that Chile allocates to research and development, that share constitutes a major investment, especially considering that the Program was initiated with a 5 million dollar World Bank grant, with an additional 10 million dollars in national counterpart funds, for a three-year period, and that in 2006 the MSI has an entirely domestic budget of close to 8.5 million dollars.

It is worth pointing out that 94 percent of the MSI's operating budget goes directly into research, with only the remaining 6 percent being used to cover management expenses. Of those 6 percentage points, only 3.5 correspond to the expenses of

the Executive Secretariat, which is responsible for implementation and operation of the MSI's scientific, administrative, and financial affairs.

The research and development contributions made by the MSI Centers undoubtedly advance the goal set by then President Lagos, and ratified by the current President of Chile, Michelle Bachelet, of doubling the share of GDP devoted to these items by 2010.

### **More and better**

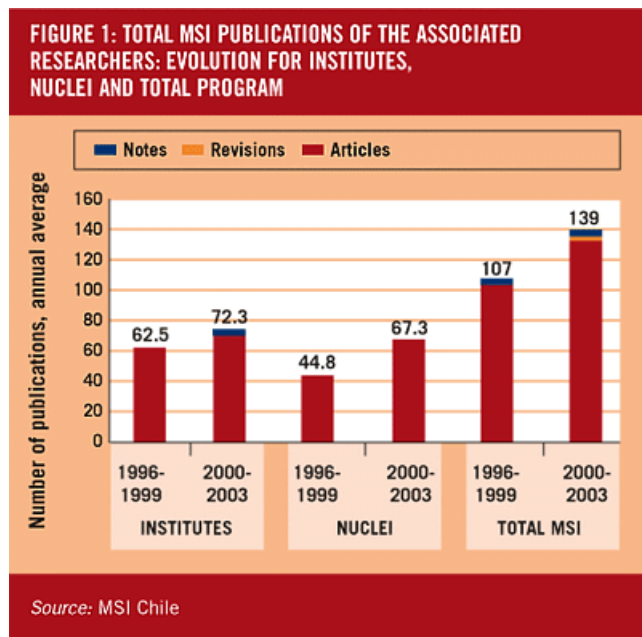
The MSI currently consists of three institutes and 14 science nuclei, all of which are formed by a high proportion of Chile's best and most internationally renowned scientists, eight of whom have won National Science Awards, while three are members of the United States Academy of Science (out of the five such members in Chile), and 12 are members of the Chilean Academy of Science; all of which testifies to the well-established qualifications of the teams and researchers that make up our Centers of Excellence.

Sustained progress has been made in developing a critical mass, especially if one considers that when the Program began few people predicted that it would grow so swiftly and with such high quality human resources. Together, the five tenders for Millennium Science Nuclei (1999, 2001, 2002, 2004, 2006) and the two tenders for Millennium Science Institutes (1999, 2005) elicited over 300 bids that met the bidding conditions: a record for a country like ours in which scientific research is better known for its quality, rather than quantity.

### **Cutting-edge research**

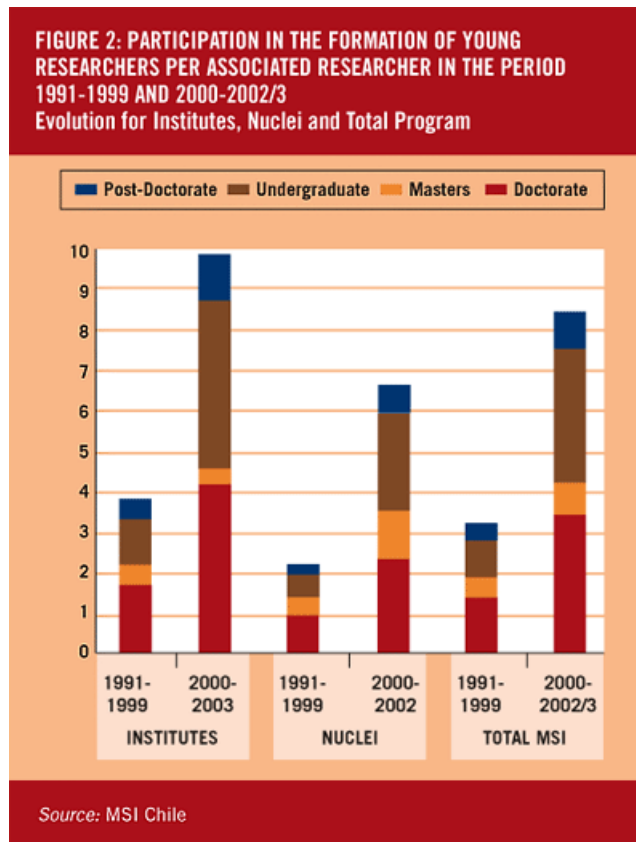
The researchers who run the MSI Centers agree that this Initiative affords a real opportunity to engage in first class science, as well as stability and basic resources for research. Dr. Mary T. Kalin, Director of the Institute of Ecology and Biodiversity-IEB, has emphasized in several interviews that "the MSI Centers must be construed as an umbrella for enriching and enhancing existing lines of research and conducting cross-cutting research, in order to assist young scientists and ensure that knowledge is passed on to the public."

Comments such as these confirm the enormous progress made by the MSI Centers in terms of the international impact they have had in various fields of cutting-edge scientific research. Some of these achievements are well known: in molecular genetics; in subjects related to the conservation of ecological biodiversity in indigenous forests and forests with imported species; in ice field research and astrophysics; in studies of the nervous system and of the workings of the brain; and in studies of the properties of materials used in state-of-the-art technologies, such as laser. Notable progress and discoveries have also been made in information mathematics, bioengineering, industrial optimization systems, information and communication technologies, and vegetal cell biology, as well as other fields of research.



### Source of training

Training young scientists is one of the core functions performed by the Millennium Institutes and Nuclei. From their inception, all of them have set about this task with great enthusiasm and success: a key achievement at a time when Chile's scientific community needs the contributions of a new generation. Between 2000 and 2005, the MSI has helped train over 400 young researchers in different fields, including several graduates. Of the total, 45 percent are doctoral students. The success of the MSI Centers in this respect has been acknowledged by the World Bank, which considers them "by far the most important source of advanced scientific training in Chile."



### Links with impact

The achievements of the Millennium Institutes and Nuclei have an enormous impact on the outside world, particularly as there are direct ties with the private, public, and education sectors.

With respect to the work of MSI Centers in connection with strategic branches of industry, the projects conducted jointly with the mining, forestry, banking, health, and environmental sectors have had a particularly strong impact. As for the MSI Centers' work with the public sector, cooperation abounds in sectors as crucial for national development as energy, planning, fisheries, public works, health, the legislature, and the preservation of Chile's ecological heritage.

As regards its education-related activities, one of the goals of the Millennium Science Initiative is to make its findings available to the educational sector. With that in mind, the MSI Centers have contributed above all to the exact and natural sciences and to training in those fields through seminars, workshops, courses, and other initiatives.

### External evaluations

Periodically, the MSI Program has been evaluated by independent panels of foreign experts, who have called it successful and exemplary. In general, these bodies emphasize the fact that the MSI has commendably carried out programs fostering excellence in scientific research and generating sound and novel forms of cooperation and collaboration in the scientific community. According to the scientists on these panels, the MSI is a focal point attracting, integrating, and promoting some of the most talented young

scientists in the country.

They also affirm that, in general terms, the MSI Centers provide an environment that fosters the development of young scientists—in line with the objective of increasing the size and integration of the Chilean scientific community and ensuring that it retains its members; enables researchers with shared interests to attain a critical mass; and yields additional benefits in terms of shared and efficiently utilized resources.

The external evaluations also agree that MSI Centers achieve a high level of productivity, particularly in new fields. Their publications are deemed not just plentiful, but of high quality, too.

Both the independent panels and the MSI's Program Committee insist that most of the teams have dealt successfully with the challenges posed by an extension work component, in the sense of establishing contacts and interacting with industry, the private sector, and society as a whole.

The MSI's successful support of training and innovation was a key factor in the World Bank's decision to support training and innovation in Chile. In 2003, an important agreement was signed by the Government of Chile and the Bank, through the National Committee of Scientific and Technological Research (CONICYT) "Science for the Knowledge Economy Project" or "Bicentennial Science and Technology Project (PBCT)". The PBCT finances scientific and technological research initiatives and, at the same time, supports the Government of Chile's strategy of establishing a comprehensive approach encompassing scientific training and technological innovation.

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<p><b>MILLENNIUM INSTITUTES AND NUCLEI</b></p> <p>The Millennium Science Institutes and Nuclei are centers combining science, technology, and engineering to make a valuable contribution to the advancement of key areas of national development.</p>
<p><b>INSTITUTES</b></p> <ul style="list-style-type: none"> <li>• Millennium Institute for Fundamental and Applied Biology— (MIFAB) <a href="http://www.mifab.cl">www.mifab.cl</a></li> <li>• Centro de Estudios Científicos (CECS)— <a href="http://www.cecs.cl">www.cecs.cl</a></li> <li>• Institute of Ecology and Biodiversity (IEB)—<a href="http://www.ieb-chile.cl">www.ieb-chile.cl</a></li> </ul>
<p><b>NUCLEI</b></p> <ul style="list-style-type: none"> <li>• Millennium Nucleus in Developmental Biology (MNDB)— <a href="http://ciencias.uchile.cl/sbcch/MNDB.html">http://ciencias.uchile.cl/sbcch/MNDB.html</a></li> </ul>

- Center for Web Research (CWR)—[www.ciw.cl](http://www.ciw.cl)
- Millennium Science Nucleus of Seismotectonics and Seismic Hazard—[www.peligrosismico.cl](http://www.peligrosismico.cl)
- Center for Integrative Neuroscience (CENI)—[www.ceni.cl](http://www.ceni.cl)
- Forest Ecosystemic Services to Aquatic System Under Climatic Fluctuations (FORECOS)—[www.forecos.net](http://www.forecos.net)
- Microbial Ecology and Environmental Microbiology and Biotechnology (EMBA)—[www.nucleomilenio-emba.cl](http://www.nucleomilenio-emba.cl)
- Millennium Nucleus on Immunology and Immunotherapy—[www.nmii.cl](http://www.nmii.cl)
- Information and Randomness: Fundamentals and Applications—[www.dim.uchile.cl/~random](http://www.dim.uchile.cl/~random)
- Millennium Nucleus in Plant Cell Biology (PCB)—[www.pcb.cl](http://www.pcb.cl)
- Millennium Science Nucleus of Quantic Applied Mechanics and Computational Chemistry—[www.nucleomileniocuantica.cl](http://www.nucleomileniocuantica.cl)
- Industrial Electronic and Mechatronics—[www.neim.utfsm.cl](http://www.neim.utfsm.cl)
- Center for Quantum Optics and Quantum Information—[www.udec.cl/milenio2002](http://www.udec.cl/milenio2002)
- Condensed Matter Physics—[www.nucleo-milenio.cl](http://www.nucleo-milenio.cl)
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