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CHILE: REVIEW OF PUBLIC TECHNOLOGICAL INSTITUTES IN THE AGRICULTURE SECTOR



Latin America and the Caribbean Region
Agriculture and Rural Development
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This report was prepared by a core team led by Matthew McMahon (Lead Consultant) and comprising Johannes Roseboom, Hugo Cetrangolo and Carlos Mena (Consultants), with guidance and supervision provided by Willem Janssen (Lead Agriculturist, LCSAR). The report is based on a mission to Chile by the core team which was carried out from August 17-September 4, 2009 as well as a review of the pertinent documentation. Based on this mission a first draft was produced. During a follow-up visit by Matthew McMahon and Willem Janssen, the draft was discussed with the Minister of Agriculture and staff on November 2, 2009. On this occasion the first draft was also discussed with various other government agencies including the ITPs and implications of possible recommendations were explored. Based on these discussions the draft was revised and then submitted to further review within the World Bank through a Quality Enhancement Review. The current report also incorporates the comments received from the review within the World Bank.

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Executive Summary

The strategic agenda for the agriculture in Chile aims at turning the country into a global Agri-Food and Forestry power, able to compete in both domestic and international markets. The Government has launched a growth strategy, which assigns a central role to innovation. Enhancing innovation will be key for driving the country's thrust towards productivity growth, improved product quality and increased competitiveness of the agricultural sector.

Progress in the agriculture and export sectors will have to be fueled by a knowledge-based approach to production, processing and marketing which will become more important over time as Chile achieves higher income levels and loses its comparative advantage in cheap labor. Generating and using new knowledge depend on an innovation system that is diverse in terms of financing and execution, competitive in the allocation of resources, international in focus, and participatory with strong private-public interaction. This report provides an analysis of one part of Chile's Agri-Food and Forestry Innovation System, the Public Technological Institutes for the Agricultural sector and their interaction with the Ministry of Agriculture (MINAGRI). It suggests a series of steps that the Ministry can undertake to enhance their contributions to innovation.

As part of the ongoing institutional initiatives, the Government has made a proposal to create a "National Public Technological Institutes System" (*Sistema Nacional de Institutos Tecnológicos Públicos*, SNITEC) which would bring fourteen public institutes spread across the various ministries under one umbrella. This system would be overseen by a Ministerial Committee for Innovation (CMI) and implemented by an institution (*Comité CORFO*) yet to be established. The three public institutes, now affiliated with the Ministry of Agriculture (MINAGRI): *Instituto Nacional de Investigación Agropecuaria*, INIA; *Instituto Nacional Forestal*, INFOR; and *Centro de Información de Recursos Naturales*, CIREN, are among the Public Technological Institutes (ITPs) that are subject to the proposed reforms.

The present situation of the agricultural sector ITPs reflects the impact of the many reforms to which they have been subject over the years. The changes that have had lasting effect are those that were initiated in the early 1980s during a period of economic opening, with a diminishing role for the state in the area of agricultural R&D as in other areas, and an increased emphasis on self-financing. Some of these institutional innovations, especially competitive funding, have had positive results both for the institutions and for the overall innovation system by diversifying the sources of funding for innovation and the supply of knowledge, as well by strengthening the capacity of the institutions to be innovative and creative in the preparation of proposals and the exploration of funding sources.

There have also been some negative impacts of these policies on the development of the Public Technological Institutes which have hindered their growth as professional organizations. The reduction of direct support from the state and the increased reliance on self-financing have resulted in long periods of budget deficits, sales of assets, uncertainty and the lack of a long-term focus in the development of the institutes and their research programs. Financial stability and a focus on long term objectives are essentials for research institutes.

The institutes have responded to these circumstances by adopting short-term approaches and survival strategies based on self-financing and competitive funding. Under these circumstances the institutes have not been able to execute their long term strategies and their priorities are effectively defined by a large array of funding agencies. Because of the predominance of project funding, characterized by defined short to medium term timelines and deliverables, the institutes do not have sufficient resources to develop long-term research and institutional development plans.

The review concludes that the sector ITPs in their present condition could be limited in their participation in the new revitalized National Innovation System. The challenge for MINAGRI and its institutions is to take advantage of the government's commitment to innovation. The expansion of financing into areas such as extension centers, the increased focus on specified clusters with new defined strategic areas of research, the increased participation of the private sector through consortia and the funding of specialized R&D will place added demands onto, as well as create opportunities for these institutions.

MINAGRI has the responsibility to lead the public sector in this endeavor, recognizing that innovation is a cross-cutting theme in the agenda for the sector in topics such as plant and animal health, support to both export and smallholder agriculture, conservation of natural resources, biodiversity and forest resources. MINAGRI has to participate actively in the National Innovation System, formulating agricultural innovation policies and ensuring that its policies and priorities are implemented. A central task is to modernize the three ITPs affiliated with MINAGRI, strengthening their governance, institutional strategies and operational performance so that they can fully participate in a revitalized National Innovation System. Up to now most of the new initiatives that characterize the Innovation System have taken place outside of MINAGRI. The Ministry and its agencies have accommodated themselves to these priorities without developing a counterproposal for a more complete Agri-food and Forestry agenda.

MINAGRI spends a limited amount of resources on innovation, about 7.5% of the Ministry budget. The rate of growth of these resources over the past five years has not kept pace with the overall growth in the innovation system as a whole. This divergence has the

potential of leaving the agriculture sector in a weak position to take advantage of the increased commitment of the Government to innovation as a driver of progress.

It is necessary that MINAGRI revamps its approach to innovation and prepares itself for more effective participation in the National Innovation System. It should start with the recognition that innovation is an integral part of all its activities and that it will become more important for the sector if Chile wishes to continue improving its competitiveness in world markets while also solving problems related to social inclusion, environment, and biodiversity among others. MINAGRI may not only consider how to assign more resources; it will also need to strengthen its capacity to formulate policy to effectively manage its investments in innovation.

To do this effectively it is recommended that:

- **Capacity is enhanced within MINAGRI to manage all issues related to agricultural innovation across the sector.** While the exact form may differ, one possible way forward would be to establish a Directorate. Its main responsibility would be to ensure the participation of the sector in the National Innovation System through: the development of a sectoral policy for innovation; the joint development of innovation strategies with the ITPs; the establishment of sector priorities with special emphasis on public goods; the development of plans to finance and implement those priorities, the creation of a focal point for the agricultural sector within the National Innovation System; the implementation of quality control systems for innovation activities in the sector; and the monitoring of developments in reference countries (OECD, Brazil). This Directorate should be strong enough to articulate the position of the agriculture sector within the CMI and the CNIC; its work would be carried out in collaboration with CNIC; this would not only strengthen the agricultural innovation system but also contribute to strengthening innovation in other sectors that may benefit from the experience gathered in the agricultural sector and by the institutes affiliated with MINAGRI.
- **A Board chaired by the Minister would be appointed to oversee and to ensure that the policy and strategy of MINAGRI are being implemented.** This Board would also oversee the three ITPs in the sector. This would help to integrate programs across the ITPs and strengthen the articulation of policy across the sector. This Board should have a strong participation from the private sector as well as the scientific and academic community and should be selected on the quality criteria developed by CNIC.
- **Performance Contracts would be developed for the ITPs to replace the actual Transfer Agreements.** The Contract should be developed as a medium term strategic framework for the financing of the ITPs. The document should consist of a multi-year plan that would cover all research programs with monitorable outcomes as well as

institutional development aspects such as staffing profiles; development of human resources, infrastructure and equipment; and identification of financing and partnerships needed to deliver the program. As part of the Performance Contract the Ministry should identify the priority public good programs across the ITPs that need to be supported and ensure full funding for these programs.

- **The ITPs, and especially INIA, should develop strategies for Technology Transfer and start their implementation within the next year.** This strategy should be developed within the context of the Performance Contract and should identify human resource needs, partnerships with public and private sectors, policy on access to information, methodologies to be used and communications technology requirements. The strategy should explore the use of Information and Communication Technology (ICT) to reach more users and allow better access to information. This is a major undertaking that would require a commitment of resources on the part of the government.
- To strengthen its relevance in the scientific community at the national level, **INIA and INFOR should focus on increasing their participation in the Centers of Excellence Program.** The expansion of the centers of excellence should be part of the Performance Contract for the ITPs.
- INFOR's future contributions will be limited by its size. In a context where resources are increasingly allocated to prioritized clusters, it runs the risk of being marginalized if it does not form partnerships with other institutions. **It is recommended that the Performance Contract for INFOR is developed on the basis of partnerships.**
- CIREN occupies a unique niche in the sector in that both the public and private sectors depend on it to maintain and update information on natural resources on a continuous and timely basis. **The public good nature of CIRENS's output lead to the recommendation that its programs should be fully funded.**

Acronyms and Abbreviations

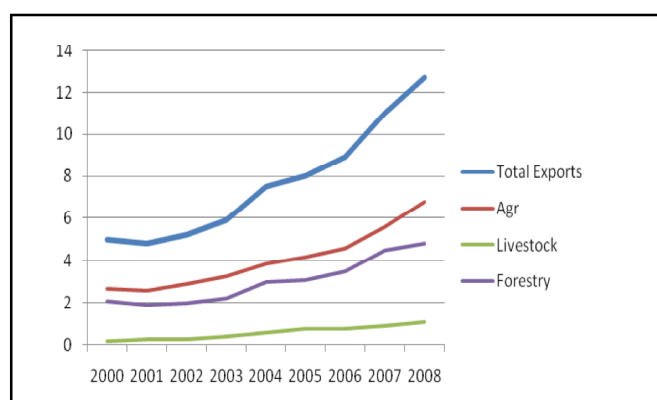
CENMA	National Center for the Environment
CGIAR	Consultative Group for International Agricultural Research
CIMM	Mining and Metallurgical Research Center
CIREN	Information Center on Natural Resources
CMI	Innovation Ministers Committee
CNIC	National Innovation Council for Competitiveness
CONICYT	National Commission for Science and Technology
CORFO	Corporation for Production Development
CORPOICA	Colombian Institute for Agricultural Research and Certification
CRC	Cooperative Research Centers
DIPRES	National Budget Directorate
EMBRAPA	Brazilian Agency for Agricultural Research
FDF	Fruit Development Foundation
FDI	Foreign Direct Investment
FEDEFruta	National Federation of Fruit Producers
FIA	Foundation for Agricultural Innovation
FIC	Innovation Fund for Competitiveness
FIP	Fisheries Research Fund
FTE	Full Time Equivalent
GDP	Gross Domestic Production
GOC	Government of Chile
GTT	Technological Transfer Groups

ICM	Millennium Scientific Initiative
ICT	Information and Communication Technologies
IFOP	Institute for Fisheries Development
INAPI	Institute for Industrial Property
INDAP	Agricultural Development Agency
INFOR	National Forestry Institute
INIA	National Institute of Agricultural Research
INIFAP	Mexican Institute for Agricultural, Forestry and Fisheries Research
INNOVA-Chile	Public Innovation Program within CORFO
INTA	Argentina's Agency for Agricultural Research
ITPs	Public Technological Institutes
MINAGRI	Ministry of Agriculture
ODEPA	Office for Agricultural Studies and Policy
OECD	Organization for Economic Cooperation and Development
PTI	Public Technological Institute
R&D	Research & Development
SAG	Plant and Livestock Health Service
SIAF	Agro-Forestry Innovation System
SNIC	National Innovation System for Competitiveness
SNITEC	National System of Public Technological Institutes

Introduction

1. Chile has as a national objective to become an important player in global agri-food markets - *una potencia agroalimentaria y forestal*. There is broad agreement among all sectors of society that this is a realistic and desired objective. Much progress has been made over the past thirty years towards this objective with notable success in the areas of fruit, wine, salmon, forestry, etc. Chile is now a well-recognized supplier of primary food products and industrial products derived from agriculture and forestry in world markets. The country has achieved an accelerated rate of growth of agricultural exports over the past decade (Figure 1). All indications are that it can continue to increase market share and value in the near, medium and long term, by promoting more efficient production, exploitation of new commodities and increased added value among others. It can also increase market share through environmentally sound production techniques and marketing of the Chilean trademark - *imagen país*.

FIGURE 1. Evolution of Chilean Agricultural Exports 2000-2009 (US\$bn)¹



2. Chile's success in developing its agricultural sector, especially its exports, has been based on carefully implemented market based policies that have been kept in place for more than 20 years. There is a consensus that further progress in the agriculture and the export sectors will depend on complementing the market policies with a knowledge-based approach to production, processing and marketing. This will become more important over time as Chile loses its comparative advantage in cheap labor as it achieves greater economic development. This development of a knowledge-based agriculture will depend on

¹ ODEPA Ministry of Agriculture website, 2009

an innovation system that is diverse in terms of financing and execution, competitive in the allocation of resources, international in focus, and participative with strong private-public interaction to give synergy to the overall system.

3. In the face of the need to generate a productive transformation in the Chilean economy, the Government has launched a growth strategy, which assigns a central role to innovation. Since 2005 with the creation of the *Fondo de Innovación para la Competitividad* (FIC), which is funded with a tax on mining, the government has dramatically increased its investment in the innovation sector at an annual rate of 24% going from US\$240m in 2005 to US\$530m in 2009. (2009 US\$). Along with increasing resources dedicated to innovation, the government has also carried out a series of institutional initiatives such as the creation of the *Consejo Nacional de Innovación para la Competitividad* (CNIC) which has broad social participation and provides an advisory role to the Executive, being also responsible for the proposal of a national innovation strategy. To ensure the implementation of this strategy, the Government has also created a committee at the ministerial level *Comité de Ministros Innovación* (CMI) ².

4. As part of the ongoing institutional initiatives the Government has made a proposal to create a National Public Technological Institutes System (*Sistema Nacional de Institutos Tecnológicos Públicos*, SNITEC) which would bring fourteen public institutes that are spread across the various ministries under one umbrella. This system would be overseen by the CMI and implemented by an institution (*Comité CORFO*) yet to be established. The three public institutes, *Instituto Nacional de Investigación Agropecuaria* (INIA), *Instituto Nacional Forestal* (INFOR), and *Centro de Información de Recursos Naturales* (CIREN), now affiliated with the Ministry of Agriculture (MINAGRI) are among the Public Technological Institutes (ITPs) that are subject to the proposed reforms.

5. To ensure the maximum benefit from the proposed reforms, MINAGRI has embarked upon a review process of its ITPs. This process covers the design and implementation of the institutional, operational, instrumental and governance changes needed for the future so that these institutions can fully participate in an efficient and effective way in the strengthened National Innovation System and to take advantage of the increased public investment in innovation, thereby contributing to the sectoral and national goal of *Chile – Potencia Agroalimentaria y Forestal*.

² Política Nacional de Innovación para la Competitividad – Orientaciones y Plan de Acción 2009, Ministerio de Economía

6. The Government of Chile (GOC) has requested the World Bank to generate a proposal on the adjustments needed in the Agri-food and Forestry Innovation Sub-System (*Sistema de Innovación Agro-Forestal*, SIAF) for it to fully participate in the revitalized National System for Innovation and Competitiveness (*Sistema Nacional de Innovación para la Competitividad*, SNIC) and to contribute to the continued development and growth of the sector. The technical assistance will have a three phased approach. **Phase 1**, which is the subject of this study, and which is covered by a Cost Share Agreement, consists of a review of the ITPs of MINAGRI; **Phase 2**, a foresight study which would build a Vision for Chile's Rural, Agricultural, and Forestry sectors towards 2030 and **Phase 3**, a study on the medium to long term adjustments of the Agri-Food and Forestry Innovation System to strengthen its participation in the overall SNIC. Phase 2 and 3 would be funded through a Fee Based Service agreement.

7. A World Bank mission carried out a review between August 17 and September 4, 2009 during which it conducted interviews with the principals involved and carried out a literature review of the overall innovation system as well the specific institutions that were under review.

8. After this review, background documents were produced on the Innovation System, the Policy context, and each one of the ITPs. A summary report was written and shared with the Ministry of Agriculture, the institutes concerned and other stakeholders during a follow-up mission in November 2009. The present report has taken into account comments received during the November mission. It provides an analysis of the ITPs and their interaction with MINAGRI and suggests a series of steps for the ministry to undertake to enhance their effectiveness.

Public Financing of Agricultural Innovation

9. **Public Financing** The rationale for public financing of agricultural innovation activities is based on the structure of the agricultural sector and the nature of many agricultural technologies.³ Agriculture is normally characterized by large numbers of relatively small firms that do not have the capacity to invest in long term research programs. Many agricultural innovations (for example open or self pollinated varieties or many crop management systems) cannot be protected with intellectual property rights and the inventor will not be able to appropriate a (reasonable) share of the benefits. The lack of capacity and the lack of incentives might lead to significant underinvestment and has led governments across the world to support agricultural research activities. In Chile, according to the 2007 agricultural census⁴, there are 240,484 agricultural operations and 20,785 forestry operations. Of the agricultural operations, 208,242 or 75% of the farms have less than 20 hectares (*agricultura familiar campesina*). There are also many smallholdings participating in the export sector. The knowledge developed from publicly funded research can show degrees of “public goodness” depending on its degree of appropriability which in turn depends on the social, technological, environmental, economic and policy context in which it is developed and applied. This context is continually changing over time and the challenge for policymakers and research administrators is to manage these variables in a way that leads to an efficient innovation system.

10. Economic efficiency is not the only variable that has to be taken into account when designing and financing innovation systems. Other variables such as environmental, social, biological and equity factors have to be taken into account and will play an important role in the development of a publicly funded research program. For example, the resolution of environmental externalities i.e. contamination of soils, water and air which will not be dealt with adequately on an individual basis, will be of interest to society as a whole. Equally, it may be of interest to the public at large that equity issues such as the support of smallholder farming and regional development be dealt with through public funding. Likewise, public interests would prevail in such areas as germplasm conservation, control of plant or animal epidemics, and food safety among others.

³ Alston, Julian M., Pardey, Philip G., *The Economics of Agricultural R&D Policy in Paying for Agricultural Productivity*, Ed. Julian M. Alston, Philip G. Pardey, Vincent H. Smith. Johns Hopkins University Press, 1999

⁴ Censo Agropecuario y Forestal 2007 (See website INE)

11. As Alston and Pardey (1999) emphasize, the participation of the public sector is not only limited to financing but also in the implementation of specific policies such as:

- Strengthening property rights for inventions;
- Creating new R&D institutions and legal arrangements for implementation, better public/private collaboration; and
- Providing incentives for private R&D. Chile has initiated a number of institutional reforms and legal arrangements over recent years as part of its innovation strategy.

(These are summarized in Table 1).

TABLE 1: Institutional Innovation in the Chilean Public Sector

Institutional Objectives	Status
Diversification of implementation	The competitive funding schemes have allowed for the participation of various actors such as universities other than the ITPs in the provision of knowledge for the sector. Requirements such as “partnering” have also strengthened public-private collaboration as well as across institutions. Competitive funding now accounts for 22% of the funding of the agricultural ITPs.
Strengthening public private collaboration	The introduction of technology consortia has allowed for a stronger participation of the private sector in identifying priority innovation areas in promising but limited subsectors. Up to 2009, 24 consortia have been established with the participation of 25 universities, and 100 firms both national and international. Fifteen of these consortia are in the agricultural sector with a total investment of \$22,385m pesos (US\$40.4m).
Strengthening the science base	The competitive funding of “research centers” around specific themes or research areas has strengthened the science base of the system. This has also allowed the ITPs that have the capacity to do so to participate in this program and forge stronger links with the national science community. INIA participates in 7 centers.
Strengthening the Human Resource Base	A US\$6bn fund has been established, the interest from which will finance scholarships abroad (US\$250m/annum) at the Master’s and Doctorate level with the goal of reaching 6,500 professionals qualified by 2015.
Increased private sector participation	Tax breaks for R&D have been introduced (Ley 20.241) – 35% of the value of the investment in R&D.

12. As evidenced from the above table Chile has already made important progress in modernizing its innovation system and has put in place many of the institutions, mechanisms and instruments that characterize a modern, competitive innovation system that is geared towards excellence across all

sectors. These reforms which have been applied in an incremental manner since the early 1990s are in line with what has been happening in most OECD countries so as to improve incentives and enhance the performance of their innovation systems. As a result the Chilean innovation system can now be described as dynamic, complex and still in construction.

13. Chile's total investment (agricultural and non-agricultural) in R&D as a percentage of GDP stood at 0.68% in 2004 which is high in comparison with other countries in the region: Argentina (0.44), Peru (0.16), and Uruguay (0.26), but lower than Brazil (0.83) and developed countries such as the United States (2.72) and Japan (3.07). Investment in R&D in Chile is dominated by the public sector (75%) and FDI (7%) leaving a very small proportion that is financed by the national private sector⁵.

14. In the case of Chile, the business community does not have a strong culture of innovation. Most of the innovation comes in the form of adaptation of imported technology and know-how or from the procurement of capital goods. As a result private sector participation in innovation in general is still low⁶ and this is true of the agriculture sector in particular. According to the latest survey⁷, investment by the private sector across all sectors was estimated at \$162,661m pesos (US\$295.5m in 2009 pesos) or 0.17% of GDP. Of this, it was estimated that 10,056 million pesos (US\$18.27m in 2009 pesos) or 0.26% of AgGDP was spent in the agricultural sector. The public sector dominates the funding for R&D in Chile and this will be the case for the medium term (10 to 15 years) since the instruments that are being put in place to encourage private sector participation such as development of consortia, tax breaks, etc. will take that amount of time to be institutionally sustainable and have an impact.

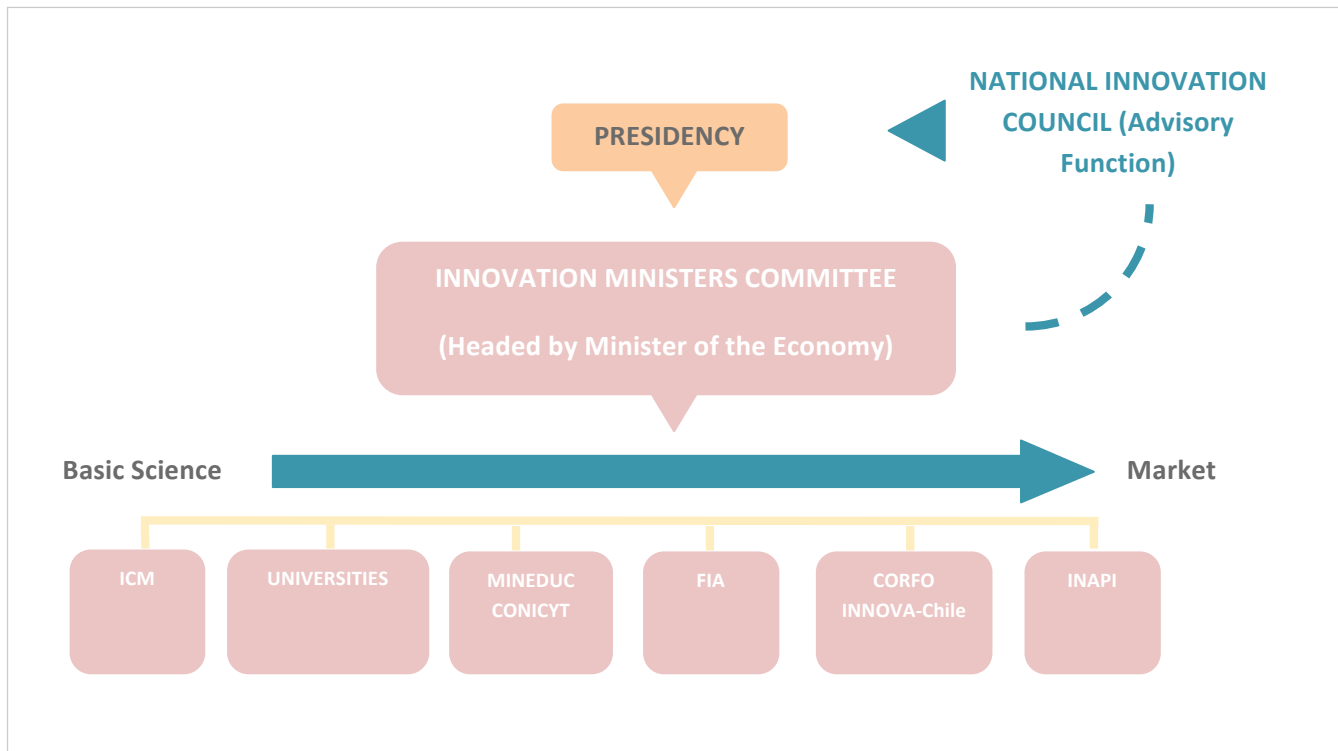
⁵ Stads, G.-J., and C. Covarrubias Zúñiga. *Chile*. ASTI Country Brief No. 42. Rome: IFPRI, December 2008

⁶ OECD Reviews of Innovation Policy, Chile, 2007

⁷ SCL Econometrics. *Análisis de la Quinta Encuesta de Innovación en Chile* Informe Final, Santiago, September 2008

Organization of Agricultural Innovation

FIGURE 2. New institutions for innovation



Source: Translated from Gobierno de Chile: Política Nacional de Innovación para la Competitividad, Orientaciones y Plan de Acción 2009-2010.

15. Institutional Organization The appropriate institutional organization for research and development varies greatly from country to country and depends on institutional history, social goals, research issues, regional demands, and relationship with other public programs such as education and technology transfer. In the case of Chile, the three ITPs of the agricultural sector (INIA, INFOR and CIREN) were established in the 1960s to address specific demands at a time when the level of investment in R&D was low, and when very few institutions including universities had the capacity to do R&D. INIA was established to address issues of agricultural productivity on mostly what would now be called traditional agriculture such as basic foodstuffs, meat and milk⁸. INFOR was founded to address forestry issues ranging from planting to harvesting and utilization of forest products. CIREN was established to provide basic information on renewable natural resources and to manage databases on soils, water

⁸ Faigenbaum Ch. Sergio, *Ciencia, Agricultura y Sociedad. Cuarenta Años del Instituto de Investigaciones Agropecuarias*. Unpublished, 2007

resources and climate, ortophotos, and the rural cadastre, thereby contributing to the sustainable development of the country.

16. The development of these institutions especially INIA and INFOR was a recognition that while technology could be imported, it needed to be adapted to local conditions and therefore the country required the technical capacity to do so. Advances were achieved through the importation and adaptation of technologies across a wide variety of crops from fruits, cereals, and pastures to livestock production in agriculture to forest germplasm, management techniques, and postharvest technology in the forestry sector. The need for adaptation is probably more pronounced in Chile than in many other countries due to its unique geography which covers a broad range of latitudes stretching from desert in the north to a high rainfall temperate climate in the south. Over the past forty years there has been increased specialization in agricultural production across the various agroecological zones. These advances have led to more specialized and concentrated areas of production with fruit and other high yielding crops being centered in the irrigated areas of northern and central Chile, the dryland (*secano*) areas being dedicated to forestry, and the more traditional food crops and livestock being produced in the rainfed southern areas. These developments call for a more decentralized approach to the implementation of R&D and as the need for a more competitive sector evolves, it will require that more capacity for innovation be centered around these distinctive agroecological zones.

17. Research and development calls for a critical mass of scientists that are specialized in different disciplines and that need to be integrated into teams that work on providing the solutions to problems. This is especially true in the case of agriculture where various disciplines need to be integrated in the development of technology. For example, the development of germplasm needs to integrate genetics, pathology, statistics, physiology, and field testing under a variety of ecological conditions and can be most effectively done by bringing scientists together in one institution. Most countries in Latin America and in other parts of the world have developed public research institutes to solve a number of issues in agriculture in this manner, examples being EMBRAPA Brazil, INTA Argentina, CORPOICA Colombia, and INIFAP Mexico.

18. A modern innovation system needs to be diverse both in sources of funding and implementation, competitive and closely linked to the private sector. The ITPs have to meet the professional and institutional requirements of such a system if they are to survive and be productive. If they meet these requirements, they bring other attributes which can contribute to the strengthening of the overall system. In the case of INIA and INFOR they have a strong decentralized

research infrastructure. They have built up a knowledge base over the past fifty years on a wide variety of areas within their respective sectors. There are few if any other institutions in the country that have such a repository of knowledge on agricultural and forestry issues and which cover the whole country. All three ITPs in the agriculture sector have shown that they have the capacity to flourish in a competitive system. In the case of INIA, it has a critical mass of scientists in certain key areas as shown by its participation in specialized R&D centers. Moreover, there is a sunk investment on the part of the government over the past fifty years, which can be built on to further the competitiveness of the sector.

Government Initiatives on Innovation

19. CNIC has the responsibility to develop an overall strategy for the National Innovation System (*Sistema Nacional de Innovación*, SNIC). It has developed a new strategy and priorities based on clusters, consortia and research centers of excellence (*Centros I+D+i*) and in which the sectoral ITPs are participating. This strategy is aimed at areas with the greatest potential for growth and will help to align priorities across the public sector be they ministries, funding agencies, or R&D organizations. In the agriculture sector there are areas and ministry priorities that would require specific attention such as small and medium farmers, traditional agriculture and sustainable use of natural resources and biodiversity.

20. **Cluster Initiative**⁹ Based on a series of studies undertaken by CNIC, the CMI has selected five clusters with high potential for future development that should be supported over the next ten to fifteen years. A cluster is defined as an agglomeration of businesses, providers and associated organizations that reside in a defined geographic area and whose productivity depends on the joint development of knowledge and innovation. The five clusters approved by the CMI are: (i) food, (ii) aquaculture, (iii) mining, (iv) tourism, and (v) global services. Forestry, an important sector in Chile has not been prioritized which has implications for INFOR. Within the food cluster, the following five sub-clusters have been prioritized, namely: (i) fruit, (ii) wine, (iii) processed food, (iv) swine & poultry, and (v) red meat. Within these subclusters the priority areas have been identified as genetics, food safety, precision agriculture, digital connectivity and

⁹ PowerPoint presentation on 'Cluster Alimentario' by the Executive Secretariat of the Food Cluster, ExpoCorfo, Puntas Arenas, July 23, 2009

human resource development. In the Action Plan approved by the CMI for 2010 at least 20% of the resources of the SNIC will be allocated to these priority clusters. 50% of the resources of FIC will be allocated to these resources and the financing of consortia and R&D centers funded by INNOVA will be in the same proportion¹⁰.

21. While targeting limited resources on those clusters and sub-clusters that are most promising makes sense from an economic point of view, the Ministry of Agriculture has to respond to a broader constituency where issues such as social inclusion and traditional agriculture (i.e. cereals, food legumes, milk production, native forests, etc.) and natural resources are included¹¹. Therefore it is important that MINAGRI has a strategy and resources that cover these objectives.

22. **Consortia.** The Technology Consortia (*Consortios Tecnológicos*) are designed to strengthen collaboration between the private sector and the research agencies since it was recognized that there was not a strong culture of innovation in the private sector. The initial idea was based on the Australian cooperative research centers (CRCs). Unlike the Australian CRCs, however, the Chilean technology consortia have been set up as private entities with private companies, sector organizations, and ITPs and universities as shareholders. The financing agencies (CONICYT, CORFO/INNOVA-Chile, and FIA) usually pay for half to two-thirds of the original investment in the company, but do not hold shares in the company. Moreover, the funding agencies have been offering funding for feasibility studies and the development of the consortia. In other words, they subsidize the start up of the model. The capital invested by the partners in the consortia is used to finance R&D and technology transfer projects over a period of usually five years. In addition to this initial investment, consortia can also formulate and mobilize resources for new, additional projects by accessing the funding agencies. The subsidy expires after five years and the members of the consortia are expected to finance the full costs from that point onwards. To date, 24 technology consortia have been created of which 15 pertain to the agricultural sector, seven of which are funded by INNOVA, five by FIA and three by CONICYT. As of 2009, altogether these consortia contributed an estimated 15-20% of total public agricultural R&D investment, per annum to the agricultural innovation system. Most of the

¹⁰ Política Nacional de Innovación para la Competitividad – Orientaciones y Plan de Acción 2009-2010. Ministerio de Economía

¹¹ Discurso Ministra de Agricultura, Marigen Hornkohl V. 170 Aniversario de la Sociedad Nacional de Agricultura, Santiago, May 19, 2008

consortia with some notable exceptions such as milk, sheep and potatoes, which have been financed by FIA, are oriented toward export agriculture leaving a wide range of subsectors yet to be covered. While it is too early to evaluate the impact of these consortia in some subsectors, they have shown a lot of promise, most notably in the wine sector, where there are now two consortia financed by INNOVA-Chile (Vinnova and Tecnovid) and which together currently manage some 24 research projects in collaboration with various universities.

23. Centers of Excellence (*Centros I+D+i*) This initiative is designed to build capacity to strengthen the competitiveness of the clusters in cross-cutting areas such as biotechnology, environment and water resources, renewable energy, and information technology and communication. The support consists of core funding for centers which is managed as a private enterprise for a defined period of time, after which the center will have to obtain its own funding. There are now 50 centers operating with the majority being university based. The model has facilitated cross-institutional collaboration and the agricultural ITPs have participation in seven of these – INIA in five and INFOR in two.

24. Competitive Funds Over the past fifteen years there has been a proliferation of funding sources for innovation in Chile which have had a profound impact on the agricultural sector by both diversifying funding sources as well as allowing a wider participation of other suppliers of innovation (i.e. universities). Agencies that led this expansion of competitive funding for applied research and innovation are CORFO (*Corporación de Fomento de la Producción*) through its INNOVA-Chile program (previously Fontec and FDI), FIA (*Fundación para la Innovación Agraria*), ICM (*Iniciativa Científica Milenio*), and FIP (*Fondo de Investigación Pesquera*). Initially most of the competitive funding schemes lacked a clear focus and had a wide array of objectives and responded mostly to the supply of projects. Over time, however, the calls for proposals have become more specific. The new cluster approach promoted by CNIC has further focused the priority setting by the competitive funds and the allocation of resources towards areas of high potential impact. The latest INNOVA-Chile call for proposals for the agricultural sector includes, for example, analyses for each of the sub-clusters targeted identifying their principal problems as well as a set of innovation priorities developed jointly with the private sector.¹² This approach if combined with larger and longer term projects would reduce the volatility in funding from year to year.

¹² INNOVA-Chile. *Programa Tecnológico para la Agroindustria Hortofrutícola, la Industria Vitivinícola y la Industria de Carnes Rojas (Bovinos y Ovinos)*. Santiago: INNOVA-Chile, August, 2009

25. These institutional innovations i.e. clusters, consortia, centers of excellence and competitive funds (with the exception of FIA) have taken place outside of MINAGRI with the result that, in practice, priorities are being set by the funding agencies rather than by the sector. The strategy adopted by the sector and its ITPs is to accommodate to these priorities without developing a counterproposal which would cover important components of the agriculture sector that may be neglected. This accommodation to the various strategies of the funding agencies has led to many ad-hoc initiatives within the sector resulting in the perception that there is a lack of overall strategy which is needed to take advantage of the increased funding and institutional innovations that are occurring at the SNIC level.

Public Agricultural R&D Strategy and Its Implementation

26. The strategy 2006-2010 of MINAGRI establishes the following policy guidelines for the sector:

- Make Chile an agri-food and forestry power;
- Promote an agricultural development that is inclusive of small and medium-sized farmers;
- Adapt and modernize public agricultural institutions;
- Promote the sustainable use of natural resources and protect biodiversity.

27. Innovation is an important tool in reaching these objectives as it is relevant to the following priority tasks which MINAGRI has identified in order to reach the above objectives: development of clusters and technology consortia; climate change, environment and water; new and better export markets; improved plant and animal genetics; the best phytosanitary and animal health standards in the world; better forests for everyone; and the construction of a modern Ministry of Agriculture, Fisheries and Food.

28. The innovation portfolio financed by MINAGRI is implemented through FIA which funds a range of initiatives such as competitive grants, consortia, networks and technology transfer and whose budget for 2008 was \$7,995m pesos (US\$14.94m), of which \$5,400m pesos (US\$10.1m) came from MINAGRI and the three ITPs which have a combined 2008 support from MINAGRI of \$13,050m pesos (US\$24m). The FIA budget has had the fastest growth rate over the past

decade, going from \$4,658m pesos in 2000 to \$7,995m pesos in 2009¹³. This increase in resources to FIA was in line with making the system more competitive, with an emphasis on engaging with the private sector.

29. The resources allocated to the ITPs are governed by Transfer Agreements (*Convenios de Transferencia*) with each of the institutions to deliver on three broad objectives that the Ministry has identified (i.e, *Chile potencia agroalimentaria*, social inclusion, and market access). The Transfer Agreement is renewed annually. However, the work plan of the ITPs is developed separately and is largely defined by the projects that these have been able to procure from the funding agencies. When the Agreement is developed there is a process of accommodation that allows for the financing of the ongoing programs of the ITPs whose priorities are set by the other funding agencies rather than on delivering on MINAGRI's strategy. Evidence for this is in the Agreement for 2009 where most of the project resources of INIA went towards *Chile potencia agroalimentaria* (64%) with a diminished amount going towards the other strategic areas such as small and medium sized agriculture (7%)¹⁴. This approach skews support to the more dynamic export sector and neglects the other important areas of the agriculture sector strategy.

30. The Ministry does not have sufficient capacity to formulate the strategy that is needed for the development and implementation of these Agreements. Therefore the discussion with ITPs in the development of these Agreements is not based on strategy but on administrative and implementation issues. Since the Agreements are annual there is no long-term joint strategy developed between MINAGRI and the ITPs which would cover the strategic objectives of MINAGRI and the institutional needs of the ITPs to deliver on the aforementioned objectives of MINAGRI and the sector. They are not strategy planning documents with a medium term horizon. As a result the sector lacks a counterproposal as to what its needs are and as to what role it can play in a revitalized SNIC.

31. The ITPs have developed their own strategies. INIA has a recently developed strategy (November 2008) which conforms in broad terms to the strategy of MINAGRI and focuses on natural resources, genetic resources, new technologies and food. However, the strategy does not set priorities and therefore it is not clear how resources are allocated and how the implementation of the strategy

¹³ FIA

¹⁴ INIA Project database

could be monitored and evaluated. Likewise, INFOR has developed a strategy, which is very strong on paper, but whose implementation is unrealistic in terms of the resources and personnel which it has available. CIREN has also developed a strategy but, under the present forms of funding, which require a high dependence on competitive funds to finance pure public goods, it is finding it difficult to get the resources necessary to implement it. In conclusion the strategic plans of the sectoral ITPs as they exist now are more aspirational than operational.

32. The connection between strategy and implementation in the sector is further weakened by the nature of the relationship between MINAGRI and the ITPs. This institutional relationship is better characterized as contractual rather than strategic where the latter would involve a constant dialogue and interaction with the goal of strengthening the sectoral innovation system. In practice, the role of the ITPs under the present institutional arrangements may best be characterized as that of a private contractor rather than an operational arm of the Ministry organized and funded so as to deliver on the innovation priorities of the sector.

33. The disconnect between strategy and implementation in the agriculture sector resides in the fact that over the past fifteen years the research agenda has been driven by the funding agencies outside the sector. During that period many of these funding agencies had separate strategies and objectives with little coherence across the system. Moreover, the competitive funds have spent most of their resources up to now on projects rather than programs leading to an atomization of activities. In the agriculture sector this situation has led to a survival strategy on the part of the ITPs by going after funds whatever their provenance and whatever the priorities that these imply.

34. Most of the resources under the Transfer Agreements go to financing personnel and administration costs of the ITPs. In the case of INIA these figures are estimated to be 68% and 20% respectively with the remaining 12% going to operations¹⁵. A similar situation exists for INFOR and CIREN. This results in MINAGRI co-financing projects that have been approved by other institutions whose priorities dictate the agenda. This further reinforces the situation that MINAGRI has little influence on the actual program of activities that are developed by the ITPs since these are mostly financed by the competitive funds.

¹⁵ Personal Communication, INIA

35. MINAGRI also runs the risk of being further marginalized in the strengthened SNIC because of the limited amount of resources that it is dedicating to innovation in the sector. The budget for the sectoral ITPs has grown at 5% per annum in the period 2005-2009 while resources dedicated to the overall innovation system (SNIC) have risen at a rate of 24% per annum over the corresponding period. This divergence has the possibility of leaving the agriculture sector in a weak position to take advantage of the increased investment in innovation that the Government has committed over the coming years.

36. Included in the Transfer Agreements are programs for which the ITPs have a defined responsibility and that are considered to be of a pure public good nature. In the case of INIA these are: conservation of biological resources, genomics and prebreeding; climate change; agrometeorology; and food safety. In the case of INFOR, it is the maintenance of the forest statistics; and for CIREN, the constant updating of information on natural resources. However, the budget transfers from MINAGRI rarely, if ever, cover complete costs of these programs, leaving the ITPs with the burden of making up the difference either from their own funds or from other sources such as competitive funds. These programs and services have a poorly articulated demand due to a lack of participation of rural dwellers (especially the poor) and consumers in policy discussions. Therefore the Ministry has a key role in identifying and supporting these areas and should take the responsibility for the full funding costs of these public good programs.

Public Agricultural Research – Staffing and Funding

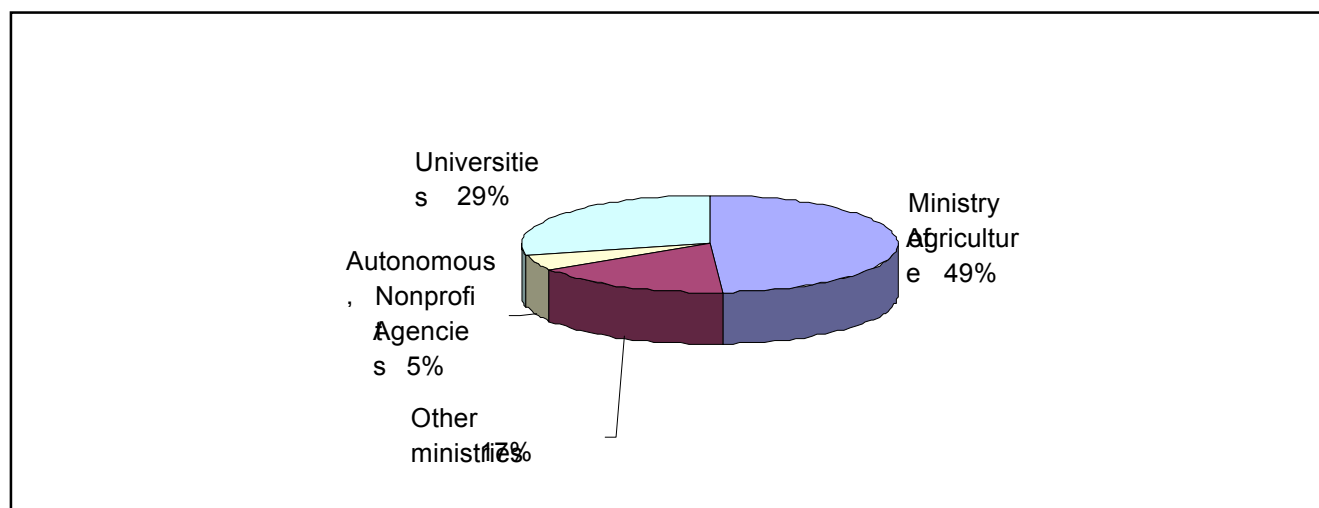
37. Total public spending as a percentage of AgGDP in Chile reached 1.22% in 2006. This was higher than the average for the Latin American and Caribbean region which was 1.14% and much lower than the 2000 figure (2.35%) for developed (OECD) countries. The overall ratio (agricultural and non agricultural) for Chile is much lower reaching only 0.68% in 2006.¹⁶

38. According to the same report, Chile had close to some 700 FTE researchers working in public (i.e., government, nonprofit and higher education) agricultural research in 2006 (see Figure 3). Of this capacity, some 49% pertains to the three institutes falling directly under MINAGRI (INIA, INFOR, and CIREN), 17.1% to institutes under other ministries (i.e., IFOP, CIMM, and CENMA – covering

¹⁶ Stads, G.-J., and C. Covarrubias Zuniga. *Chile*. ASTI Country Brief No. 42. Rome: IFPRI, December 2008

fisheries and some natural resources research), 5.2% to autonomous, nonprofit agencies (FDF and *Fundación Chile*), and 28.7% to universities (some 14 in total). *Universidad de Chile*, *Universidad Católica de Temuco*, and *Universidad de Concepción* are the three biggest universities in the country in terms of agricultural research capacity. Together they hold more than 60% of the academic research capacity in this area.

FIGURE 3. Institutional distribution of the total agricultural research capacity in Chile (697.4 FTE in 2006)



39. The corresponding expenditures in public agricultural research have been estimated at some \$36,547m pesos (or US\$58.4m, 2005 prices) in 2006. Not included in these statistics are the *intramural* research activities by private companies within the agricultural sector (like seed companies and some of the bigger agricultural, forestry and fisheries enterprises).¹⁷ Private-sector contributions to the public research agencies are included in the statistics presented above.

40. Since 2002, Chile has been conducting surveys on private sector R&D investments and innovation activities more broadly. According to the latest survey,¹⁸ the agricultural sector (including fisheries) spent some \$10,056m pesos in 2006 on both intramural and extramural R&D. In order to avoid double

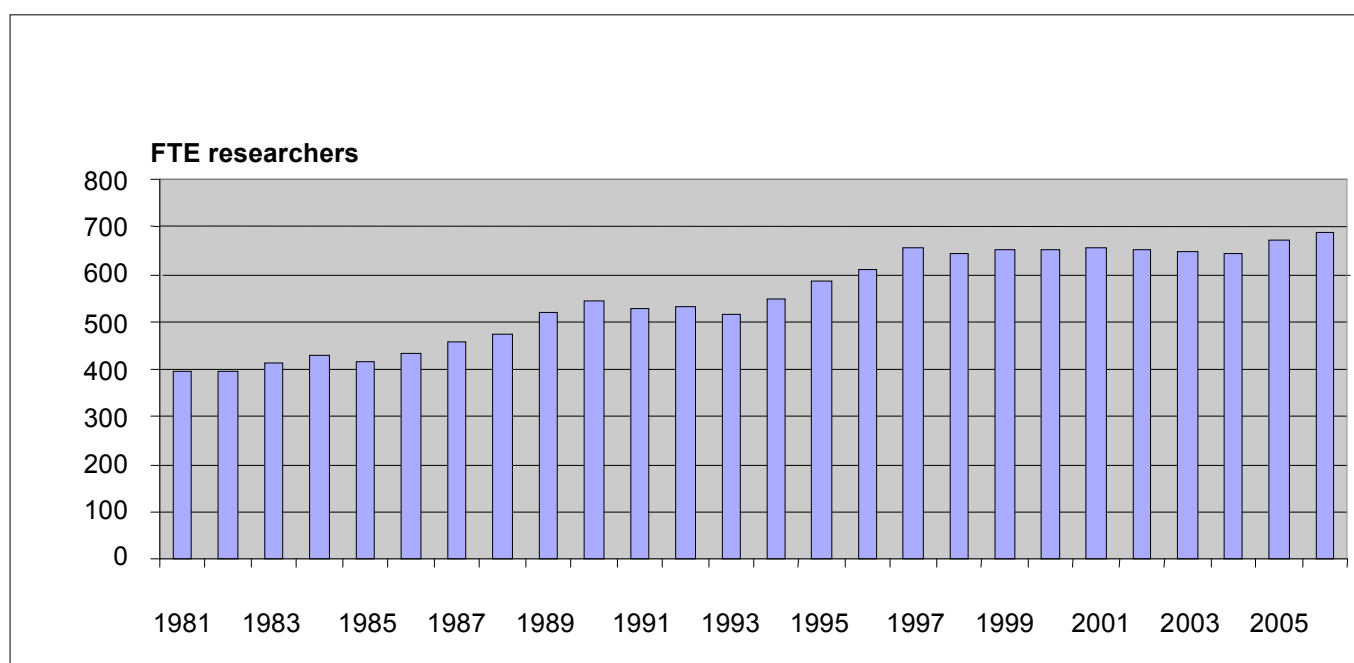
¹⁷ The “agricultural sector” definition used in this context follows the international classification of economic activities. Hence research investments by the agricultural machinery, agro-chemical industry and food processing industry are not included.

¹⁸ SCL Econometrics. *Análisis de la Quinta Encuesta de Innovación en Chile*. Informe Final. Santiago: SCL Econometrics, September 2008

counting with the data presented above, we should take out the extramural R&D spending (i.e. the research contracted out to the ITPs and the universities), but unfortunately this information is not available. It could be quite substantial – INIA reported some \$1,152m pesos in terms of private-sector R&D contracts for 2006 and also the universities are doing quite a bit of R&D contract work for private agricultural companies.

41. Historical staffing and funding trends The development of research staff, research expenditures, and expenditures per researcher for the public (i.e., government, nonprofit, and higher education) agricultural research agencies in Chile are depicted in the figures below for the period 1981-2006. The overall picture that emerges from it is that the research capacity in terms of FTE researchers grew more-or-less steadily between 1981 and 1997 and stagnated after 1997 (Figure 4). However, improvement in the educational profile of the research staff continued also after 1997.

FIGURE 4. Development of the number of FTE researchers in public and semi-public agricultural research, 1981-2006



42. Public agricultural research expenditures show considerably more fluctuation through time than the corresponding research staff figures, reflecting major donor projects putting money into the system or temporarily increases in government funding (see Figure 5). Nevertheless, since 1997 public agricultural research expenditures have been declining in real terms. As a result, budgets per researcher

have been declining as well (see Figure 6). In particular INIA and CIREN, and to a lesser extent INFOR, have suffered from declining budgets per researcher.

FIGURE 5. Development of public and semi-public agricultural research expenditures, 1981-2006

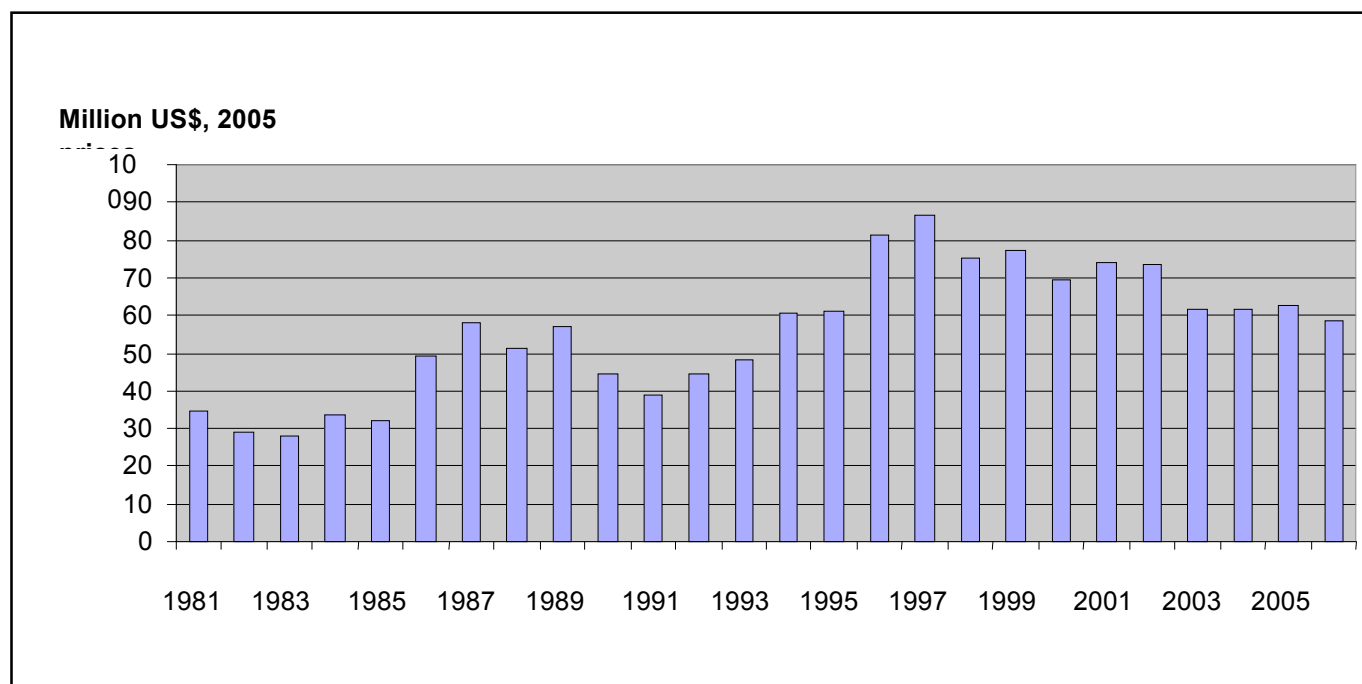
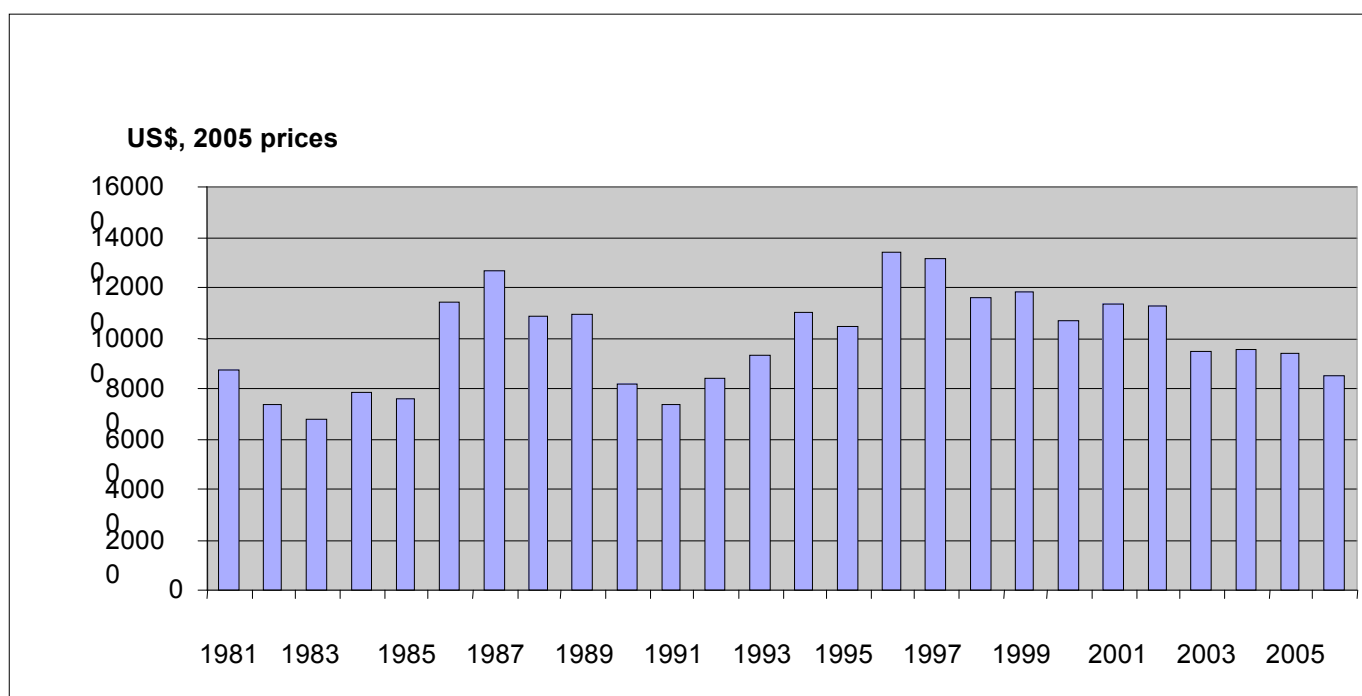


FIGURE 6. Development of expenditures per researcher, 1981- 2006



43. The average budget per agricultural researcher in Chile was about US\$84,600 in 2006. Compared to other Latin American countries, this is substantially lower than the Brazilian figure of US\$126,300 per researcher, about equivalent with the Mexican figure of US\$83,200, but higher than Colombia (US\$71,200) and Argentina (US\$49,700).¹⁹

44. **Sources of Financing** for the Chilean agricultural ITPs consist of the following four sources:

- A transfer from MINAGRI to the sectoral ITPs under a Transfer Agreement, as referred to above. In practice this transfer mostly covers personnel and administrative costs;
- Publicly funded competitive funding schemes with different objectives and priorities;²⁰
- Specific research contracts with both public and private agencies;
- Self financing generated by the sales of goods and services.

45. The relative contribution (% of total budget) from each of these sources as well as the total budget for each ITP for 2008 is presented in Table 2. This shows a wide variation in funding sources across the ITPs. By far, the biggest of the ITPs in the sector is INIA, accounting for 82% of total investment in the sector. Based on these figures it is estimated that MINAGRI transfers, which mainly go to personnel and administrative costs, comes to only 42% of the total budget of the ITPs. Compared to other countries and to other institutions this is a very low figure to adequately cover these costs. This is a legacy of the policies of the 1980s when it was considered that these institutions should seek support from the private sector and should, to a large extent, be self-financed. However, the private sector support for innovation has been very weak and the possibility of creating public-private sector alliances in the past without public subsidies has been almost non-existent. This has left these institutions with weak core support and a strong operational dependence on other sources of funding such as competitive funds and the sales of goods and services.

¹⁹ Data obtained from the ASTI website (www.asti.cgiar.org).

²⁰ Starting in 2009 there is an attempt to bring more coherence across these funds by channeling more resources to the selected clusters and consortia.

46. The advent of the competitive funding schemes in the 1990s has helped these institutions to survive and they have been active in responding to this opportunity. In 2008, INIA's capture of these funds accounted for about 31% (\$4,635m pesos) of its operational budget (excluding MINAGRI transfers). The corresponding figure of 58% (\$823m pesos) for INFOR is even higher while it stands at 50% (\$543m pesos) for CIREN. This high level of dependence of the ITPs on competitive funding especially in the case of INFOR and CIREN reinforces the observation that these institutions have little flexibility in implementing their own strategies and have to look to other sources of funding with other priorities to ensure their survival. Even though in relative terms INIA seems to be in better shape, in absolute terms its situation is still in a survival mode with a wide dispersion of effort. This is illustrated by the fact that in the past year INIA has a portfolio of 500 projects leading to an estimated average project size of \$30m pesos (US\$54,500). While competitive funding has had a positive effect on the overall innovation system there needs to be a constant monitoring and rebalancing of budgets to ensure that public goods are adequately funded and that sectoral priorities are being implemented.

47. Another aspect of the financing of the ITPs is their high dependence on the sales of goods and services. The situation of INIA in this regard stands out in absolute terms where in 2008 it accounted for \$6,236m pesos (estimated US\$11.3m) or an estimated 41% of its operational budget (excluding MINAGRI transfers). These goods and services are dominated by agricultural production and assets (i.e. seeds, fruit, meat and milk) on the farms managed by the institute.

TABLE 2. Relative Contribution (% of total budget) of Funding Sources and Total Budget of each ITP 2008²¹

Source of Funding	INIA	INFOR	CIREN
MINAGRI Transfer	39.3	52	55.7
Competitive Funds	18.6	28.1	22.3
Sales of Good and Services	25	14.1	11.7
Contracts (Public and Private)	17	n.a.	10.2
Total Budget (Million Pesos)	\$24,922	\$2,922	\$2,433

²¹ Derived from the actual budgets of the ITPs, 2008

48. In the case of INIA, which relative to the other institutes receives the largest part of its total budget from the sales of goods and services, the relative contributions of the different sources to the implementation of research program changes when the margin for production sales are calculated as shown in Table 3. These figures show that a large part of the budget (37.5%) for research comes from competitive funds and contracts, while the amount from sales of goods and services is small (7.2%) even though it is a major component of INIA's activities.

TABLE 3. Relative (%) and Total Contribution (Pesos) of Funding Sources to INIA's Research Budget 2008²²

Source of Funding	Amount (Million Pesos)	%
MINAGRI Transfer	\$9,812	55.3
Competitive Funds	\$4,620	26.1
Sales of Good and Services	\$1,273	7.2
Contracts (Public and Private)	\$2,029	11.4
Total Budget (Million Pesos)	\$17,734	100

Institutional and Operational Context of the Agricultural ITPs

49. The institutional context and operational modalities of the three ITPs affiliated with MINAGRI are quite distinct and therefore, with few exceptions, it is difficult to apply general principles in any analysis that needs to be made. Firstly, each one has a different institutional history, with INIA being created as an arm of MINAGRI and remaining within the Ministry since its inception. INFOR was created within CORFO, in 1999 it signed its first Transfer Agreement with MINAGRI and in 2002, the latter was designated as principal. Likewise with CIREN which was transferred to MINAGRI only in 2002.

50. While INIA and INFOR have a mandate to generate and disseminate technology, CIREN's mandate is the provision and constant updating of basic information (non-rival and non-excludable) on natural resources (i.e. soils, water, climate), as well as information of the fruit sector and forestry, the rural property cadastre and the maintenance of an orthophoto/orthoimage map database. INIA

²² Memoria INIA, 2008

is by far the biggest institution both in terms of resources and infrastructure. INIA's budget for 2008 was \$24,992m pesos (US\$46.58m) compared to \$2,992m pesos (US\$5.46m) and \$2,433m pesos (US\$4.55m) for INFOR and CIREN respectively. INIA accounts for 77% of MINAGRI's budget (transfers) for the ITPs while INFOR and CIREN receive 12% and 11% respectively. INIA and INFOR have a research infrastructure that is regionalized and most of their activities are de-concentrated, while CIREN has only one site. INIA has ten regional centers with 303 professionals and a total of 1065 employees spread throughout the country. INFOR has five centers with 58 professionals and a total of 100 employees.²³ CIREN has one center, its headquarters in Santiago, with 42 professionals.

51. Both INIA and INFOR have a good infrastructure for research, and in the case of INIA, it has a critical mass of scientists in the most important areas of research. Since their inception these institutions have played an important role in what is described as traditional agriculture and forestry. Their contributions have been important in many areas such as the provision of basic information for production across many areas such as agronomy, climate, disease control and eradication, germplasm conservation and development, forest use, as well as environmental externalities. CIREN has had a true public good function of developing information on natural resources for all economic sectors.

52. **History of the ITPs 1980s to the present** The present situation of the ITPs of the agricultural sector reflects the impact of the many reforms to which they have been subject over the years. The major changes that have still a lasting effect are those that were initiated in the early 1980s during a period of economic opening, with a diminishing role for the state in the area of agricultural R&D as in other areas, and an increased emphasis on self-financing. The basic premise was that these institutions should be run as businesses, even though their mission was to do research and technology. In the case of INIA this led to a distortion in its mission moving it away from research. Previously, sales of goods and services were based on the products of research but, with these changes, institutions such as INIA which has a large productive asset (*patrimonio*) of about 17,000 hectares of land, got heavily involved in commercial agriculture to cover the deficit in public funding and to augment its budget. Also in the 1980s the idea of "projectizing" the work of the institutes was introduced, where the Ministries funded what were the perceived priorities as well as distributed the projects across a range of institutions, especially universities. The innovation of using "the

²³ EMG Consultores 2007 Consultoría sobre Evaluación de Institutos CORFO – Instituto Forestal de Chile, INFOR, Informe Final

project” as the basis for financing research was further strengthened in the 90s with the widespread introduction of competitive funding emanating from various sources such as CONICYT, CORFO and the establishment of the *Fundación para la Investigación Agraria* (FIA) in the agriculture sector. The “project” modality is now the one mainly used in the institutions of the sector. Many of these funds stipulated the participation of the private sector as a condition of financing. Overall the participation of the private sector has been less than anticipated.

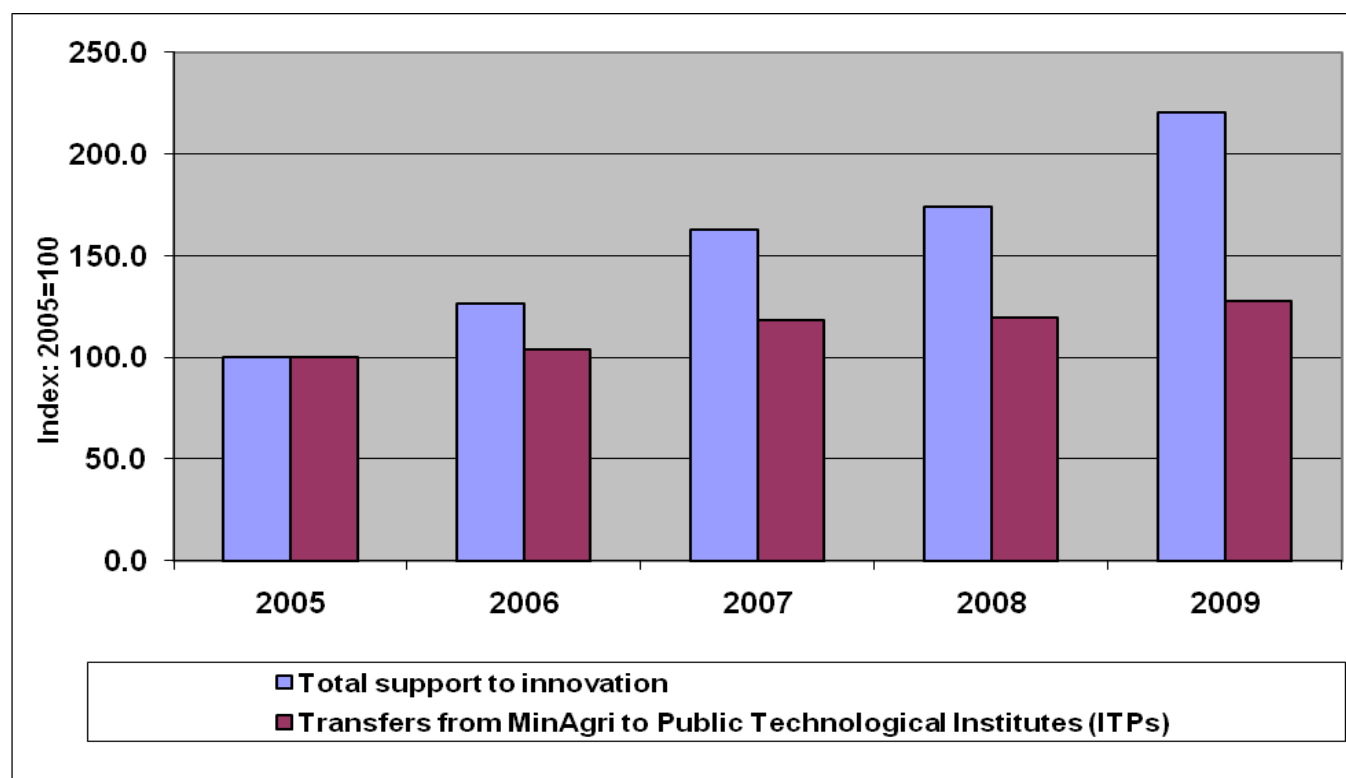
53. Some of these institutional innovations, especially competitive funding, have had positive results both for the institutions and for the overall innovation system such as diversifying the sources of funding and supply, as well strengthening the capacity of the institutions to prepare good projects and allowing the researchers to be creative in looking for funding. This is a big improvement over the previous situation where agricultural and forestry R&D were funded by direct transfers (or block grants) from the respective ministries to the institutions with the allocation and use of those funds being the responsibility of the institutions themselves and their researchers, with little or no accountability leading to a perception that the work was irrelevant in many cases.

54. There have also been some negative impacts of these policies on the development of these institutions which have hindered their growth as professional institutions. The reduction of direct support from the state and the reliance on self-financing has resulted in a long period of budget deficits, sales of assets, uncertainty and the lack of a long-term focus both in the development of the institutions and its research programs. The need for medium term certainty and focus on long term objectives are essentials for research institutions.

55. The institutions have responded to these circumstances by adopting a short-term approach and a survival strategy based on self-financing and competitive funding. Under these circumstances the institutions have not been able to execute their own strategies and the priorities are set by the funding agencies. Because of the predominance of project funding which is characterized by defined timelines and deliverables, these institutions do not have sufficient resources to develop long term plans in terms of institutional development and research programs. Therefore they lack counterproposals in the policy debate, and because of the contractual nature of their relationship with MINAGRI they have little participation in the policy debate and decision-making at the sector level. They are not seen as leaders in the sector and are perceived more as passive rather than active players surviving on funding that is provided on a short-term basis.

56. The scenario described above for the agricultural ITPs explains why these institutions in their present condition could be limited in their participation in the National Innovation System. The great challenge for MINAGRI and its institutions is to take advantage of the government's commitment to innovation and to continue contributing to the overall development of the economy. The expansion of competitive funds into areas such as extension centers²⁴, the increased focus on specified clusters with new defined strategic areas of research, the increased participation of the private sector through consortia and the funding of specialized R&D will place added demands on, as well as create opportunities for these institutions to which they will not be able to respond because of the lack of capacity. The divergence between the overall level of investment in the innovation system and the support of MINAGRI for the sectoral ITPs is shown in Figure 7. If this situation is not corrected in the short term the work of these institutions will become less relevant and MINAGRI will have one less tool by which it can implement its innovation policy.

FIGURE 7. Relative funding tendencies for the SNIC and the transfer of MINAGRI to the sectoral ITPs (2005=100)



²⁴ INNOVA-Chile/CORFO Programa Centros de Extensionismo, 2009

57. The Government of Chile has committed itself to significantly increase the funding for innovation activities. Between 2005 and 2009, it projected to more than double its innovation budget in real terms (from \$134bn pesos to \$295bn pesos). This increase in budget has been financed through a royalty levy on the mining industry. FIC (*Fondo de Innovación y de Competividad*) is in charge of allocating the resources across the innovation system. Until now, most of its resources have been channeled to the various competitive funding mechanisms (see Table 4). A substantial part of the funding that these competitive funding schemes manage goes to R&D, but they also finance scholarships and INNOVA-Chile for business incubators, startup credits, etc.

TABLE 4. Development of the budgets of the principal competitive funding schemes in Chile

Year	2004	2005	2006	2007	2008
	<i>(million pesos)</i>				
CONICYT	48518	52089	72678	90317	90277
INNOVA-Chile		10679	31201	38074	52371
FIA		4771	4223	6497	6985
ICM		4157	3975	5977	6178
FIP		Na	Na	Na	Na
FIC Regional	0	0	0	0	20227
Total		71696	112077	140865	176038
Total – 2008 prices		84141	127217	153143	176038

58. **Proposal of SNITEC** As previously mentioned, there is the proposal for the formation of the National System of Public Technological Institutes (*Sistema Nacional de Institutos Tecnológicos Públicos*, SNITEC), which would bring the fourteen ITPs across all sectors under the same umbrella. There has been a classification of these institutions with regard to their perceived roles in the system.²⁵ There is a first group to which INFOR and CIREN would pertain, whose main objective would be to provide public goods through applied research and

²⁵ Orientaciones estratégicas para los Institutos Tecnológicos Públicos, CNIC, Powerpoint presentation prepared by Jose Miguel Benavente, 2008

which should depend on their appropriate Ministry, while responding to the overall strategic direction and quality control of SNITEC. These institutions would have two sources of funding, a core funding assigned by SNITEC and complemented by competitive funding. The second group, to which INIA would belong, would focus on adaptation, scaling up of technology, establishing links with the private sector through technology transfer and the development of commercial partnerships. These institutions would also develop international partnerships and be inserted in a global innovation system. They would have core financing centered on medium to long term strategies focused on infrastructure, human resources and strengthening of management systems to maintain quality as well as competitive funding.

59. To supplement the development of SNIC, the Government has launched the Bicentenary Scholarship Fund (*Fondo Bicentenario de Capital Humano*) with US\$6 billion to finance the development of professionals at the level of Master's and Doctorate in overseas universities.²⁶ The goals for this program as can be seen from the amount of money committed are quite ambitious and will take the human resources involved in innovation to a whole new level. The goal, among others for 2010, is to have 3,300 professionals studying abroad which would be a 672% increase over 2006. This would be complemented by a program to insert newly trained professionals at these levels into the private sector and the academy.

Challenges and Opportunities for the Agricultural Sector ITP in the SNIC

60. We now have to consider how each of these ITPs are prepared for the new challenges ahead and what their roles will be in a new and revitalized national innovation system (SNIC) and what adjustments need to be made so that they can take advantage of the opportunities presented and participate in an effective way. This will require new investments in these institutions and the Government should look at this as an opportunity to use these resources to build the institutions as well as bringing about the necessary reforms that are needed for their modernization. Increased investment without reform will not give the hoped for results.

²⁶ Política Nacional de Innovación para la Competitividad – Orientaciones y Plan de Acción 2009-2010. Ministerio de Economía

61. **INIA** captures 77% of MINAGRI's contribution to the ITPs and accounts for 82% of the overall budget of the three ITPs. It is characterized by having a critical mass of scientists in many strategic areas, as well as a decentralized organization for research spread throughout the main agricultural production areas of Chile. It also has an adequate research infrastructure, farms, laboratories, etc. It has an accumulation of nearly 50 years of knowledge and experience in the execution of research programs with important contributions in several areas. It has established a knowledge base on all aspects of the agricultural systems of the country. The state has a lot of sunk costs in the institution which it can now draw on with the revitalization of the innovation system. In recent years it has shown that it has the professional initiative to participate in the new programs and institutional innovation established in the SNIC such as competitive funds, clusters and consortia, and the I+D+i centers within the limits of its resources and institutional capacity.

62. Despite these positive attributes INIA is not considered to be a leader in innovation in general and the relevance of its work is often questioned even at the sectoral level. The institution is not seen as a leader for innovation in the country (i.e. developing strategies, putting forward proposals and being active participant in the national innovation system). It is seen as passive rather than active. On analysis this seems to be a problem of perception rather than reality.

63. This perception has its roots in the institutional arrangement that INIA has with MINAGRI, and the funding strategies that allow it to function. In practical terms, its links with the Ministry, even though the Minister appoints its Board and also chairs it, is a contractual arrangement with very little joint participation in the development of strategy and priorities. This situation affords little possibility for INIA to participate in decision-making and decreases its visibility in the sector. Moreover, the annual Transfer Agreement (*Convenio de Transferencia*) that governs this relationship does not address the long-term development issues of INIA (i.e. human resources, infrastructure, and the management of its assets) that would allow it to respond adequately to new challenges and opportunities in the medium to long term. Moreover, the relationship with MINAGRI, as elaborated in the Transfer Agreement, focuses on inputs rather than on outcomes and impact, and therefore its contribution at the sectoral level is rarely valued.

64. Moreover its financing system also limits its possibilities to participate more fully in the SNIC. It is now highly dependent on self-financing and competitive funding. Competitive funding is the most dynamic component of the budget having increased 170% over the past five years, and in 2008 was 19% of the

budget, while increases from other sources have been modest²⁷. While the advent of competitive funding has been positive for the innovation system allowing it to identify areas of excellence, as well as bringing about important structural changes among others, there needs to be a constant monitoring and rebalancing of budgets to ensure that public goods are adequately funded and that sectoral priorities are being implemented. The high and increasing dependence on competitive funding will eventually be limited since INIA will not be in a position to continue this trend. Greater dependence on project financing creates several problems such as: running losses on projects because not all costs are covered in project financing, financial instability from year to year, and shortage of working capital.

65. INIA derives a major portion, roughly 25% of its resources from the sales of goods and services with the larger part coming from goods. This is mainly from agricultural production on its farms which are estimated to be 17,000 hectares in areas and are located in the various ecological regions throughout the country. These farms also comprise the research infrastructure that the institution needs to do its work. However, the greater part of the area is dedicated to agricultural production. This high dependence on self financing dates from the early eighties when INIA was required to be run as a business and to be self-sufficient in resources. Prior to that time INIA derived about 10% of its resources from the sales of goods and services and these consisted mainly of products of research i.e. seeds²⁸. The level of self financing has remained fairly stable over the recent past and it is now probably at its maximum while the margin obtained from production contributes only 7.2% of the research budget (Table 3). However, the question remains as to how these assets should be managed more efficiently so that they do not distract from the mission of the institution and how their sustainability can be guaranteed as a source of resources for the institution over time.

66. **Technology Transfer** INIA's perceived lack of presence in the farming community and the broader agricultural sector (i.e. input suppliers, processors, marketers, etc.) is due to its diminished role in technology transfer. Implicit in the definition of a Public Technological Institute (ITP) is the responsibility to transfer and scale up technology through public programs or through public-private

²⁷ Memorias INIA

²⁸ Faigenbaum Ch. Sergio, *Ciencia, Agricultura y Sociedad. Cuarenta Años del Instituto de Investigaciones Agropecuarias*. Unpublished, 2007

partnerships. In a revitalized SNIC it is envisioned that an ITP such as INIA should be involved in technology transfer, packaging and scaling up of technology.²⁹

67. The lack of focus on technology transfer is a legacy that comes from the early years of INIA when it was not in its original objectives and, instead, was viewed as the responsibility of other institutions. As a result, technology transfer was never a comfortable fit and there has always been a tension between research and technology transfer³⁰. In the early 1980s this neglect of technology transfer was identified as a major problem for the same reasons such as those cited above (i.e. relevance, etc.), and a major program was launched called *Grupos de Transferencia Tecnológica* GTT³¹. This initiative was enthusiastically received and endorsed by the farming community and was perceived to make an important contribution to the productivity gains made during that period even though the program was never formally evaluated. The government withdrew its support of the program, and as was the prevailing climate of the time, delegated the financing of the system to the private sector. As was the experience since then, the private sector was reluctant to finance the initiative and it has been reduced, forcing INIA to dismantle the capacity that it had in place although it continues to employ the GTT methodology for INDAP farmers.

68. The present state of technology transfer in INIA is limited. It is estimated that it reaches about 5% of farmers through direct contact³². This despite the fact that in terms of resources INIA reports spending about 25%³³ of its work plan on technology transfer. These resources come from a contract with INDAP which finances technology transfer programs for small farmers that cover about 8000 clients through technology transfer groups, and from some specific technology transfer competitive funding as well as technology transfer components in other competitively funded project. While an important amount of money is spent on these activities it results in an atomized approach based on a large number of

²⁹ Orientaciones estratégicas para los Institutos Tecnológicos Públicos José Miguel Benavente

³⁰ Faigenbaum Ch. Sergio, *Ciencia, Agricultura y Sociedad. Cuarenta Años del Instituto de Investigaciones Agropecuarias*. Unpublished, 2007

³¹ Soza, R., 1985 *Causas de articulación de la generación y transferencia de tecnología: los Grupos de Transferencia Tecnológica (GTT) de Chile*. En Horacio Stagno y Mario Allegri (eds). Seminario sobre Organización y Administración de la Generación y Transferencia de Tecnología Agropecuaria. Montevideo, Uruguay, October 1985 – cited by Faigenbaum

³² Memoria Anual 2007, INIA. Santiago, 2008

³³ INIA database

small projects. This ad-hoc approach to technology transfer and the overall impact is difficult to evaluate.

69. However, at the national level INNOVA-Chile has identified that technology transfer to the private sector is one of the weak links in the innovation system. It has now launched a series of initiatives in this area such as the establishment of Technology Focal Points (*nodos tecnológicos*) and, more recently, Extension Centers (*Centros de Extensionismo*) to support the diffusion of technology to small and medium sized businesses³⁴. INIA has many characteristics that would allow it to be an important participant in these programs having an adequate decentralized infrastructure that locates it in the major farming areas of the country. However, it does not have the human resource capacity nor the adequate strategy to get involved in such program and neither does it have the flexibility in funding needed to build this capacity. In such circumstances it will continue to approach this issue in an ad-hoc manner through competitive funding which will reduce the impact of whatever activities that it undertakes.

70. Since the impact of INIA's work cannot be fully appreciated by measuring the direct contacts it has with its clientele, it has now embarked on an impact study which will be finalized shortly and which should shed light on the effectiveness of its programs at the farm level. Nevertheless it is worth emphasizing that INIA's approach to technology transfer is ad-hoc and inadequately staffed.

71. Therefore, INIA will require a substantial investment on the part of the Government to support the revitalization of technology transfer. The institution has a wide range of clients, both public and private, so the investment has to be based on a broad ranging strategy. It will need to develop partnerships with both public and private actors, develop a range of methodologies depending on the message and the clientele, a policy on access to information, the use of modern communications technology in all its aspects and the recruitment of professionals across a range of specializations. This would be considered to be a major undertaking in the modernization of INIA.

72. To strengthen technology transfer the different stakeholders across the innovation chain need to be brought together to identify problems and secure funding for their solution. These groups or "platforms" could serve to bring the different interests together within the food cluster. Experiences from ongoing consortia should be reviewed to identify good practice for technology transfer.

³⁴ INNOVA-Chile/CORFO Programa Centros de Extensionismo 2009, INNOVA-Chile. Santiago, 2009

Scaling up of public private partnerships for developing and applying new technologies can support commercialization and diffusion of research results.

73. ICT applications to extend information to individual farmers and organizations (i.e. help lines, sms based information, etc.) need to put in place. The use of ICT should have a double focus: Mobile phone systems may be explored to share concise information that many people may use. Web-based systems should be developed to allow searches and on-line training programs. It would be expected that such ICT applications may be developed in public private partnerships.

74. **Linkages to the National Science System** INIA needs to strengthen its capacity to establish linkages to the main science programs in the country which are mainly located in universities. To support research in four identified cross-cutting areas (i.e. environment and water resources, biotechnology, renewable energy and information technology) for the priority clusters, CONICYT, the Millennium Science Initiative and INNOVA are supporting the establishment of scientific centers of excellence building on existing capacity and promoting collaboration among institutions.

75. All of these cross-cutting areas are of importance to the agriculture and forestry sectors. Out of the 108 centers currently established, 50 pertain to the agricultural sector and INIA participates in 7 of them. These cover such areas as biological control, nutritional genomics, stone fruits, arid regions, and food. These programs are executed in collaboration with other institutions especially universities. Even though INIA has shown some capacity to participate in these centers of excellence, it has limited capacity to develop them in the future because of the lack and uncertainty of financial resources. Participation will require the hiring of new highly qualified personnel and the provision of other monetary resources.

76. **INFOR** is a small institution with a self imposed large mandate. While it shares many of the same characteristics of INIA, such as being a decentralized institution (with five regional sites besides its administrative headquarters in Santiago), responsibility for “public good” areas, and a repository of knowledge for the forest industry, etc., its activities are limited because of its size. Its budget is inadequate for its mandate, and is in decline. In the period 2005-08³⁵ it fell 15% in real terms to \$2,922m pesos (US\$5.3m). Like the other ITPs, its budget was funded from three sources in 2008: a Transfer Agreement with MINAGRI

³⁵ INFOR Informe No.3 Analisis Institucional, Financiero y del Personal de INFOR, 2009

(52%), Competitive Funds (28%), and sales of goods and services (14%). Since 2005 resources from competitive funds have been unstable and falling, and the same is true for income from goods and services. These shortfalls have been partially made up for with resources from MINAGRI. It participates in 2 consortia and in 2 centers of excellence. It has a small staff of 97 of which 41 are classified as researchers with only 7 having doctorate degrees. This leaves the institution without the critical mass of researchers necessary to deliver on its mandate.

77. Because the forestry cluster is not prioritized, INFOR runs the risk of being excluded from increased funding from the SNIC in the short run, and become more dependent on direct support from MINAGRI. More importantly, this could lead to a further diminution in the professional capacity of the organization and make it a less attractive institution for new professionals coming into the market place. Even though the forestry cluster is not prioritized, INFOR does have the possibility of participation in partnership with other institutions in cross-cutting transversal areas such as the environment and water resources, and renewable energy.

78. INFOR has not been very successful in forming linkages and partnerships with other institutions in the sector such as CONAF, INDAP, INIA and CIREN. This lack of collaboration is a broader issue for the sector and one that needs the attention of MINAGRI. The activities of all these institutions overlap and it would be important for INFOR, with its limited resources, to develop partnerships with such institutions. INFOR has not developed strong links with the universities either, which is not surprising given the lack of a critical mass of professionals in any one area.

79. Even though the transfer of technology is clearly signaled in INFOR's mission statement, this area is neglected in practice, and INFOR's linkages with the sector in general are limited. This lack of collaboration covers the gamut from the large firms that dominate the sector, to the small and medium sized firms (PYMES), to NGOs who mostly conduct activities related to native forests and environmental issues.

80. INFOR needs to focus on a small number of areas where it has the capacity and the possibility of making an impact. An adequately financed and staffed institution could play an important role in a reduced number of areas that fall within the mandate of INFOR such as social inclusion by working with smallholder agriculture, SMEs, sustainable forestry and environmental services, and the maintenance of statistics on the forest sector which both the private and the public sectors consider to be important. The recent promulgation of the

Native Forest Law (*Ley de Recuperación del Bosque Nativo y Fomento Forestal, Ley No.20.283*), which establishes a framework of incentives for the sustainable management of Native Forests, could also open up new demands for an institution such as INFOR. However, such an institution can only exist by developing strong partnerships with other institutions and further financing of INFOR should be done on the basis of partnerships with a range of players: public, private and academic. There have been two external evaluations done of INFOR in recent years, 2005³⁶ and 2007³⁷. These reviews recommended among other things that INFOR should establish stronger linkages with the demands from the sector and should revisit its human resource management. It is suggested that before any further attempts at reforms, the recommendations of these studies should be implemented.

81. **CIREN** had its beginnings in IREN which was established in 1964 following an earthquake that affected a large part the Chilean territory and whose objective then was to provide cartographic coverage based on aerial photography that would serve as an aid to the reconstruction efforts and as a platform for the study of natural resources. In 1985 CIREN was established to provide technical support for the Economic Development Agency (*Corporación de Fomento de la Producción, CORFO*). In 2004, CIREN's technical support services were transferred to MINAGRI and its activities were directed towards the agriculture sector. Its mission is to generate, integrate and permanently update information on Natural and Productive Resources, including complementary information that will improve the competitiveness and innovation of Chile.

82. CIREN provides information on renewable natural resources and possesses the largest georeferenced database on soils, water resources, climate and fruit information in Chile. In addition, it contains the inventory surveys of rural properties and an orthophoto /orthoimage map database designed to meet the needs of the agencies of the government and, more specifically, to provide support for sustainable development in Chile. Much of the work of CIREN falls within a pure public good category in that the information it generates is non-rival and non-excludable. Its main activities such as the orthophoto map database, rural cadastre which is recognized by national tax agency (SII), soil

³⁶ Focus Estudios y Consultorías, Ministerio de Hacienda. Evaluación Comprehensiva del Gasto. Transferencias Subsecretaría de Agricultura para Innovación Agrícola a FIA, INIA, INFOR, CIREN. Fundación Chile, Resumen Ejecutivo del Informe Final, 2006

³⁷ EMG Consultores. Consultoría sobre Evaluación de Institutos CORFO: Instituto Forestal de Chile INFOR. Informe Final, 2007

classification used by SAG (*Servicio de Agricultura y Ganadería*), information on climate used by MINAGRI and other agencies to guide policies on climate change, information on irrigation used by the National Irrigation Committee, fruit survey and inventory used as a basis for policy planning by ODEPA, all fall within the category of a pure public good in that they contribute information for overall national development.

83. CIREN is comprised of 42 professionals and technicians, plus a team of administrative and technical support who form the team that is in charge of the generation, analysis and systematization of information and its dissemination, as well as the execution of an annual program of projects funded by direct grants from MINAGRI and multi-year projects awarded through competitive funding.

84. Like the other ITPs, CIREN receives funding from three different sources: Transfers from MINAGRI, Competitive Grants and sales of goods and services. In 2008 these accounted for 56%, 22%, and 19% respectively of the total budget. The overall budget has increased at an estimated 5% per annum over the past five years with most of the increase coming from transfers from the Ministry and the other two sources being relatively stable. The nature of the work that CIREN does which is basically to maintain and update information on natural resources and which fits within the definition of a pure “public good” does not fit very well within the priorities of the competitive funds provided by INNOVA and CONICYT.

85. At present CIREN’s most basic operational responsibility, which is maintaining updated information for the entire country, is only being partially accomplished due to the inadequate level of transfers from the Ministry to cover these needs. The rest of its funding comes from competitive grants that do not cover these activities. This results in the discontinuity of its work programs which makes it impossible to update and extend coverage of the information in the manner required by the agencies of the government. The dissemination of information is likewise restricted due to the obligation to self-finance part of its budget. This limits the transfer of free information to public agencies. Notwithstanding, CIREN has developed an online map service that allows the user to see the information without being able to copy it or download it. A digital library is also freely available to all users.

86. There are two scenarios possible for the future of CIREN, one is for the institution to fulfill its basic mandate of maintaining and updating the information on Natural Resources in a timely and suitable manner covering the activities that are considered to be public goods. This would require an

investment to cover the training of a professional staff as well as updating its capacity to store, process, analyze and distribute information, and also strengthening its capacity to form alliances with the public sector entities, universities and the private sector. The second scenario, is where CIREN expands its scope, extending its reach into new areas of work such as it is compelled to do under the present system of competitive funding. This would require a bigger investment in both physical and human resources.

87. Given the present situation where CIREN is not even able to comply with its basic responsibilities, it is recommended that the first scenario be developed in the short term. This would require the Government to agree with CIREN on a basic framework to carry out its continuous program of work, generating and updating information at a rate that ensures the accuracy and validity of the information. This agreement would ensure adequate core funding to fulfill this mandate and allow CIREN to develop a long-term work program to generate and maintain public goods with respect to information about natural resources.

Looking Towards the Future

88. Chile Potencia Agroalimentaria y Forestal As part of its envisaged economic transformation, Chile has the objective to become an important player in the agri-food global markets - *una potencia agroalimentaria y forestal*. Progress in the agriculture and the export sectors has to be fueled by a knowledge-based approach to production, processing and marketing which will become more important over time as Chile loses its comparative advantage in cheap labor as it achieves greater economic development. This development of a knowledge-based agriculture will depend on an innovation system that is; diverse in terms of financing and execution, competitive in the allocation of resources, integrated with the national science system, international in focus with strong links to research institutes in other countries in order to maximize knowledge and technology transfer, participative with strong private-public interaction to give synergy to the overall system.

89. Opportunities and Challenges for the Ministry of Agriculture MINAGRI has the responsibility to lead the public sector in this endeavor recognizing that innovation is a cross-cutting theme in its sectoral agenda (i.e. plant and animal health, support to smallholder agriculture, conservation of natural resources, biodiversity and forest resources, etc.) MINAGRI has to participate actively in the National Innovation System through the formulation of sectoral policies and

seeing that its agenda is incorporated and implemented. A central task is to modernize the sector's ITPs covering institutional, operational and governance issues so that they can fully participate in a revitalized National Innovation System. There is an opportunity for the Ministry of Agriculture to take advantage of the influx of fresh resources to deliver on its own innovation strategy. However, it has to make a number of changes if it is to take advantage of this opportunity. If not, agriculture will play a diminished role in the innovation system.

90. Up to now most of the new initiatives that characterize the Innovation System have taken place outside of MINAGRI and the priorities have been established by the funding agencies. The Ministry and its agencies have accommodated themselves to these priorities without developing a counterproposal for a more complete sectoral agenda. Many of the priorities being financed do not cover all of the objectives of the Ministry. The result is that an unbalanced innovation agenda with respect to the Ministry's stated policy is being implemented. With the increased emphasis on priority clusters and the refocusing of innovation resources on such clusters, there is a possibility that there will be a greater divergence away from this policy if MINAGRI does not take the lead in devising a more inclusive agenda for its innovation strategy along with the resources to implement it.

91. MINAGRI also runs the risk of being a weak partner in the revitalized Innovation System because of the limited amount of resources it spends on innovation, about 7.5% of the Ministry budget. The rate of growth of these resources over the past five years has not kept pace with the overall growth in the innovation system as a whole. This divergence has the potential of leaving the agriculture sector in a weak position to take advantage of the increased investment that the Government has committed to in the coming years.

92. More importantly, due to the earlier emphasis on the autonomy of the ITPs, MINAGRI has not invested in the human resource base required to manage its innovation policy. In line with the earlier thinking it has focused on the administrative dimensions of the Transfer Agreements with the ITPs, at the cost of its strategic content.

93. In the new context, where innovation policy is clearly prioritized at national and sectoral level, it is necessary that MINAGRI revamps its approach to innovation and to preparing for participation in the revitalized National Innovation System. It should start with the recognition that innovation is an integral part of all its activities and that it will become more important for the

sector as Chile continues to improve its competitiveness in world markets while also solving problems related to social inclusion, the environment, and biodiversity among others. MINAGRI will also need to strengthen its capacity to formulate policy to effectively manage its own investments in innovation.

94. To do this effectively MINAGRI needs to enhance its capacity to manage all issues related to agricultural innovation across the sector. While the exact form may differ, one possible way forward would be to establish a Directorate. Its main responsibility would be to ensure the participation of the sector in the National Innovation System through: the development of a sectoral policy for innovation, the joint development of an innovation strategy with the ITPs, the establishment of sectoral priorities with special emphasis on public goods, the development of cost estimates and plans to finance and implement those priorities, the creation of a focal point for agriculture within the National Innovation System, the development of Performance Contracts with the ITPs, the implementation of a quality control system for innovation in the sector, and the monitoring of developments in reference countries (OECD, Brazil). It is essential that this Directorate is strong enough to articulate that positions of the agriculture sector within the CNIC and it is envisaged that its work would be carried out in collaboration with CNIC and would not only strengthen the sectoral innovation system but the National Innovation System in general.

95. It is recommended that a Board chaired by the Minister would be appointed to oversee and to ensure that the policy and strategy of the Ministry are being implemented. This Board would also serve as a Board to cover the three ITPs in the sector. This would integrate programs across the ITPs and strengthen the articulation of policy across the sector. The Board should have a strong participation from the private sector as well as the scientific and academic community and should be selected on the quality criteria developed by CNIC.

96. As an initial step towards improving the Ministry's role it should develop a Performance Contract for the ITPs to replace the actual Transfer Agreements. The Contract should be developed as a medium term strategic framework for the financing of the ITPs. The document should consist of a multi-year plan that would cover all research programs with monitorable outcomes as well as all aspects of the development of the institution such as staffing profiles, development of human resources, infrastructure, equipment, identifying sources of financing and partnerships needed to deliver on the programs. This process would prioritize programs to be financed and would monitor the adjustments needed over time in the ITPs to deliver on these priorities. Since funding is allocated on an annual basis, the Performance Contract would be updated each

year and would allow MINAGRI and the ITPs to have a longer planning horizon than they have at present.

97. The ITPs must continue with the improvement of educational levels and job preparedness of its staff. Regarding the educational levels, it is more important to ensure that salary levels allow the ITPs to compete for quality staff than to invest in graduate training programs. Within the human resource balance, some added weight should be placed on recruiting technology transfer and ICT capacity.

98. As part of the Performance Contract the Ministry should identify the priority public good programs across the ITPs that need to be supported and ensure full funding for these programs. These programs are now being implemented with financing from an array of sources, especially competitive funding which, because of its nature, is not conducive to the maintenance of these work programs on a timely and permanent basis. Adequate funding of these programs will allow the ITPs more flexibility in responding to new initiatives on their own and a more proactive participation in the various Funds since these require a commitment of resources upfront.

99. These Performance Contracts would comply with the standards for quality and accountability that are being developed by CNIC for the overall national innovation system and would outline the roles and responsibilities of the various parties in the contracts. Research is a risky process so that monitoring of outcomes has to allow for uncertainty. There are few good examples of such contracts in the public realm and the models proposed by the CGIAR should be explored as a starting point. As a basis for developing its own performance management system, Chile should also explore the experiences of other advanced countries such as New Zealand, the Netherlands and Ireland where the relationship between the Ministry of Agriculture and the ITPs has evolved quickly.

100. Issues for ITPs In terms of the operations of the ITPs, the most important aspect that needs to be dealt with is the issue of Technology Transfer. This is very important for INIA which has a wide range of clientele and which by estimation reaches only about 5% of farmers. There are now several initiatives under way by INNOVA-Chile to improve Technology Transfer in general and which will require a response from the ITPs if they are to remain relevant. It is recommended that the ITPs, and especially INIA, should develop a strategy for Technology Transfer and start its implementation within the next year. This strategy should be developed within the context of the Performance Contract and should identify human resource needs, partnerships with public and private sectors, policy on

access to information, methodologies to be used, and communications technology requirements. This is a major undertaking and it would require a commitment of resources on the part of the government.

101. Another adjustment that needs to be made immediately is to strengthen the relationship between MINAGRI and the ITPs and to decrease the isolation of the latter. The implementation of the Performance Contract should be the instrument for this and should be a joint exercise in priority setting for the sector. The experience and expertise of the ITPs should be incorporated into the planning and strategy of MINAGRI resulting in a combined approach and thereby increasing the relevance of the ITPs to the National Innovation System.

102. To strengthen its relevance in the science community at the national level, INIA and INFOR should focus on increasing their participation in the different Centers of Excellence Programs. This will require the hiring of highly qualified scientists and access to monetary resources. The expansion of the centers of excellence should form a part of the Performance Contract for the ITPs, and MINAGRI should reserve financial resources for this purpose.

103. **INIA** has derived an increasing amount of its financing from the sales of its goods and services since the 1980s reaching 25% of its total budget and contributing only 7% to its research budget. While this approach was imposed on INIA in the 1980s when it was proposed that it should be run as a private business, over time this has distorted the central mission of the institution. INIA needs to return to its mission, *generating and transferring* technology. It is recommended that options for the management of these assets should be developed and a plan agreed on that would allow for these assets to be managed in an efficient and transparent way and would contribute to INIA's development in the long term under strict rules and guidelines that would guarantee their sustainability.

104. **INFOR's contribution will be limited** because of its size, and without forming partnerships with other institutions it will be further marginalized because of the allocation of resources to the prioritized clusters. It is recommended that the Performance Contract for INFOR should be developed on the basis of partnerships and the public good activities for which it has responsibility. However, the new Performance Contract should not be developed before the recommendations of the previous reviews have been satisfactorily dealt with.

105. **CIREN** occupies a unique niche in the sector in that both the public and private sectors depend on it to maintain and update information on natural

resources, which needs to be done on a continuous and timely basis. CIREN's work has a very high public good nature. It is recommended that CIREN's programs should be fully funded and that the institution should not have to look for financing from competitive funds which have their own priorities and would divert it from its own mission. It would be useful if CIREN could provide an estimate of the public funding required to fulfill its public goods mandate.

106. The modernization of the sectoral ITPs will require new investments, and the Government should look at this as an opportunity to use these resources to build the institutions as well as bringing about the necessary changes that are needed so that they become effective participants in the National Innovation System and to contribute to the goal of making Chile a global agri-food power.