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Towards optimal coordination of the Chilean Agricultural Innovation System:

Design for a MINAGRI Agricultural Innovation Coordination Unit

2014

FIA
Fundación para la
Innovación Agraria



Ministerio de
Agricultura

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El Gobierno del Presidente Sebastián Piñera propuso impulsar la innovación y emprendimiento como una de sus principales prioridades para el desarrollo de Chile. Justamente, en un estudio encargado al Banco Mundial publicado en 2011, se indicó al Ministerio de Agricultura la necesidad de fortalecer la articulación del sistema de innovación agrícola, para impulsar la competitividad del sector alimentario y forestal del país.

Luego de este diagnóstico se formó un grupo de trabajo dentro de la Subsecretaría, para liderar la coordinación y orientación estratégica en los temas de I+D+i, que ha estado operando desde entonces.

Considerando los grandes avances realizados durante este período por este equipo de trabajo, el Ministerio, en conjunto con la Fundación para la Innovación Agraria, decidió encargar nuevamente al Banco Mundial un estudio que elaborara una propuesta de diseño para la generación de una unidad formal de coordinación de I+D+i, convocando a los distintos actores del sector, la que se presenta a continuación.

Este documento representa la visión y opiniones del Banco Mundial, no así necesariamente la del Ministerio de Agricultura. No obstante, confiamos que esta propuesta servirá como base para mejorar la eficacia, coherencia, eficiencia y sinergia del sistema de innovación agraria.

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Acronyms

AAFC	Agriculture and Agri-Food Canada
ACHIPIA	Chilean Agency for Food Quality and Safety
AIS	Agricultural Innovation System
ASOEX	Association of Exporters of Chile
CIREN	Center of Natural Resources Information
CNIC	National Council of Innovation for Competitiveness
CNR	National Commission on Irrigation
COMSA	Committee of Agricultural Insurance
CONAF	National Forestry Corporation
CORFO	Chilean Economic Development Agency
COTRISA	Wheat Commercialization
CONICYT	National Commission for Science and Technology
FEDEFRUTA	National Federation of Fruit Producers
FIA	Foundation for Agricultural Innovation
FONDAP	Fund for Financing Priority Area Research Centers
FONDEF	Fund for Scientific and Technological Development (CONICYT)
FONDECYT	National Fund for Scientific and Technological Development
FUCOA	Foundation of Communications, Training, and Culture of Agriculture
ICT	Information and Communication Technologies
INFOR	Forestry Institute
INIA	Institute of Agricultural Research
INNOVA	Public Innovation Program of CORFO
INDAP	Institute of Agricultural Development
IPR	Intellectual property rights
M&E	Monitoring and evaluation
MINAGRI	Ministry of Agriculture of Chile
ODEPA	Office of Agricultural Studies and Policies
OECD	Organization for Economic Co-operation and Development
PTI	Public Technological Institutes
SAG	Agricultural and Livestock Service
SAGARPA	Secretariat of Agriculture, Livestock, Rural Development, Fisheries, and Food (Mexico)
SEREMI	Regional Ministerial Secretary
SNA	National Society of Agriculture
TOR	Terms of reference
VCRT	Value Chain Roundtables (Canada)

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Executive Summary

The present study follows a series of three publications that ensued from a collaboration between the Government of Chile and the World Bank to support the development of a long-term strategy for agricultural innovation. The first three studies assessed Chile's public technological institutes, formed a vision of Chile's agriculture towards 2030 using scenario planning methods, and finally developed an action plan to achieve a Vision for 2030. The present study pursues the recommendation in the action plan to enhance the coordination of the Chilean Agricultural Innovation System (AIS) by the Chilean Ministry of Agriculture (MINAGRI) with the creation of a Directorate for Agricultural Innovation. In response to this recommendation, MINAGRI established an informal coordination unit within the Subsecretary's office, which started to follow up on the recommendations of the three reports. At the request of the Subsecretary and the informal coordination unit, in the current paper the World Bank elaborates a proposal for how such a Directorate for Agricultural Innovation could be established and how it could function.

Chile's agricultural innovation, though a model in the region, faces a significant opportunity to improve efficiency and strengthen the public infrastructure of the system. As found by previous studies in the series and confirmed by the stakeholder consultation for this study, the central challenge for the AIS is coordination. The public infrastructure for the Chilean AIS struggles with a high level of fragmentation, duplication, and ambiguity about mandates and functions, so that the numerous public agencies involved in various aspects of agricultural innovation miss opportunities for collaboration, compete with one another for limited resources, on occasion conflict with one another, and fail to fully

capitalize on involvement of the private sector. In summary, the public agencies are unable to contribute to a shared vision for advancing innovation in the sector.

While several innovation coordination initiatives and instruments exist in the Chilean AIS, these have developed independently. The mix of regulatory, economic or 'soft' instruments appears to be inappropriate or incoherent to maximize impact and synergy. Some instruments are under-developed, and there appears to be a lack of specific 'systemic instruments'.

Weaknesses in the coordination of the system can be grouped into four themes: lack of shared vision, weak articulation, conflicts with funding innovation, and culture.

1. **Lack of shared vision:** Actors in the Chilean AIS are unaware of a shared agricultural policy and clear priorities for the sector. Several disarticulated priority setting and innovation agenda-setting mechanisms exist. Confusion and even conflicts about mandates of public technological institutes and other MINAGRI agencies exist, as well as between MINAGRI agencies and the universities. In general, short-term focus of support instruments jeopardizes the continuity of many programs, as political turnover generates inconsistency. The lack of systemic monitoring and evaluation precludes the possibility of understanding the impact of policies, programs, and instruments.
2. **Articulation between actors in the AIS:** The absence of formal coordination of agricultural innovation from MINAGRI has led to duplication, conflict, and ambiguity amongst agencies. The AIS does not have established mechanisms

to solicit and translate private sector priorities into government policy, representing foregone opportunities to meet the needs of the private sector, present co-financed investments, or support commercialization, a key link in the sequence of innovation. There is a lack of sufficient direct interaction and well-functioning feedback links between the public innovation support infrastructure and the private sector. Feedback on how the AIS is working from the private sector's perspective is very limited, and the public agencies' ability to represent the demands of the private sector in its strategy development is constrained.

3. **Conflicts with funding innovation:** Funding is dispersed over many different sources, and all have their own criteria. Compatibility between funding instruments is low. The lack of consistent financing for basic research and infrastructure forces agencies to compete one another for funding sources that are not intended to maintain basic operations. Inappropriate use of funding for maintaining a basic structure is common. Complex procedures and extensive 'red tape' complicate access to resources.
4. **Culture:** Stakeholders indicate a high degree of mistrust in collaborative processes, between public agencies and MINAGRI and between the public and private sectors. Individualistic behavior and lack of a culture of sharing further complicate coordination in the Chilean AIS. A disconnect also exists between federal and regional support efforts in priority setting and funding.

In order to improve on these areas, it is recommended to establish a dedicated Unit which induces processes of vision and agenda building,

priority setting, synchronization of funding flows and other innovation support activities such as research, makes sure that adequate and systematic monitoring and evaluation of the AIS takes place, and hence optimizes the existing more informal coordination efforts. Such an Agricultural Innovation Coordination Unit within MINAGRI would have the following mandate:

The mission of the MINAGRI Agricultural Innovation Coordination Unit is to enhance the coherence and synergy in agricultural innovation policy formulation and execution, by formulating broadly shared priority areas for agricultural innovation guiding policy formulation, by coordinating the efforts of the executive innovation support agencies to reach complementarity and integration among themselves and with innovators and innovation support organizations in the private sector.

The following four objectives are proposed for the MINAGRI agricultural innovation coordination unit:

1. Define long-term priority areas, shared by the sector, and translate them into coherent innovation programs with actions in the medium and short-term horizon
2. Induce and manage a process of structural adaptation of the MINAGRI agencies, redefining and synchronizing main activities and insuring that these activities are adequately resourced.
3. Monitor and evaluate the AIS to measure the impact of policies and support instruments and to improve the capacity to learn from and adjust policies and instruments in accordance with findings.

4. Organize continuous dialogue and feedback through information management, between MINAGRI and the sector, and between MINAGRI agencies, in support of the other objectives.

Five key functions of the MINAGRI Agricultural Innovation Coordination Unit are identified in support of these objectives:

1. **Strategy development and priority setting:** Design strategies to translate a long-term vision into reality through medium and short-term innovation programs with a coherent mixture of support instruments. Link relevant actors into consortia and networks that execute programs.
2. **Research and innovation policy analysis, design and implementation:** Articulate what is necessary to evaluate, contract and supervise evaluations, interpret results and inform policy with learning.
3. **Managing programs and resources, including innovation financing:** Analyze and organize the funding programs in the AIS with the objective to balance base and competitive funding for MINAGRI agencies, connect regional funds with priorities, negotiate with other agencies about funds directed to agriculture, and investigate the feasibility of levy-based innovation funds from the private sector.
4. **Innovation system management:** Define basic functions of each MINAGRI agency, divide tasks, and induce reform; organize and supervise continuous proactive coordination between agencies; analyze existing procedures to simplify and streamline where possible; and catalyze the organization of consortia and networks to delegate some program management.

5. **Information management and knowledge sharing:** Connect and integrate databases, make available information for users, create simplified formats for monitoring programs, and create an integrated system for technology transfer.

Mirroring institutional arrangements in other countries, the MINAGRI Agricultural Innovation Coordination Unit will be embedded in the Ministry of Agriculture, as a separate department or sub-directorate. Three subunits respond to the first three functions, respectively: Strategy, Program and Capacity Development; Innovation Policy Monitoring, Evaluation and Adaptation; and Funding Coordination, Administration and Control. Functions 4 and 5 are transversal and support the former three functions. The Unit can gradually delegate operational coordination tasks like program management, monitoring and evaluation, and foresight exercises to other MINAGRI agencies.

An Advisory Council and think tank both complement the Unit. The Advisory Council serves to broadly represent AIS stakeholders (different sectors, regions, researchers/industry/agencies/civil society, and so on) and innovation specialists, advising the Minister on the Unit's proposals and managing evaluation of the Unit. The think tank works to operationalize radical ideas with the potential to transform the sector. Experts on innovation from abroad can be contracted to share methodologies for sparking system innovation, but the Advisory Council, think tank, and Unit will critically rely on Chilean actors to ensure solutions are well tailored to the Chilean context and develop local capacity.

The report provides a framework for launching a process to design an Agricultural Innovation Coordination Unit. Many decisions and dialogs must be organized by MINAGRI going forward, and pressing next steps include further stakeholder

consultations and the appointment of a leader for the project with specific competencies who will become the interim director of the Unit to get it up and running in January 2014.

It is important that the existing momentum is maintained and that the Unit is quickly established and operationalized. To ensure continuity in the light of the upcoming change of administration, it is recommended that the establishment of the Unit is included in the briefing material for the next administration. If so required, the World Bank will remain available for further support in developing the Unit and implementing other recommendations of this and the previous studies.

1. Introduction

This paper follows upon a series of three papers that ensued from a collaboration of the Government of Chile and the World Bank, which dealt with 1) an assessment of the public technological institutes, 2) exploration of Chile's agriculture towards 2030 using a scenario planning methods, and 3) a study which, based on the former two studies, outlined an action plan to achieve the vision towards 2030. The current paper builds mainly on the third study, as several of the recommendations made in that study already pointed at enhancing the coordination of the Chilean agricultural innovation system by the Chilean Ministry of Agriculture (referred to henceforth as MINAGRI). One of the recommendations of these reports was to establish a Directorate for Agricultural Innovation inside MINAGRI in order to better coordinate and support the agricultural innovation system, and in the end, contribute to raising total factor productivity growth to the levels observed around the turn of the century. In response to this recommendation, MINAGRI established an informal coordination unit within the Subsecretary's office, which started to follow up on the recommendations of the three reports. At the request of the Subsecretary and the informal coordination unit, in the current paper the World Bank elaborates a proposal for how such a directorate for agricultural innovation could be established and how it could function.

1.1 Why is there a need for coordination in the Chilean agricultural innovation system?

The action plan towards 2030 made several recommendations on coordination. These are summarized below, under three headers¹:

1) leadership and facilitation, 2) getting value for money, and 3) integrating institutions.

1) Leadership and facilitation

1. MINAGRI should enhance its capacity to manage the issues related to agricultural innovation. It is recommended that a Directorate for Innovation² be established within the expected new structure of MINAGRI whose main responsibility would be to ensure the participation of the sector in the National Innovation System and facilitate the implementation of its own agenda within the sector.
2. The first responsibility of this Directorate would be to develop a strategy to articulate the position of the agriculture sector within the National Innovation System, thereby contributing to the strengthening of that same system in general.
3. MINAGRI should invite the private sector to strengthen its organization, at the sector and key subsectoral levels.

2) Getting value for money

1. To increase the efficiency of funding in the short term, MINAGRI has to work with the funding agencies and use its own budget to support multidisciplinary teams with a critical mass of scientists in its priority areas of interest.
2. A better mix of instruments should be put in place to strike a balance between core funding, competitive funding, performance

¹Derived from: World Bank, 2011. Chile's Agricultural Innovation System: An Action Plan Towards 2030. World Bank, Washington D.C.

² While the report on the Action Plan Towards 2030 uses the term 'Directorate of Innovation', given the terminology used in Chile and accounting for the legal possibilities, in this report the term MINAGRI Agricultural Innovation Coordination Unit is used. Depending on the final legal shape the Unit will have, it may also be called 'office', 'department' or 'sub-directorate'.

contracts, development of human resources, support to private sector, infrastructure, equipment, etc.

3. To benchmark with the OECD countries in the year 2020, MINAGRI needs to pursue a tripling of total public resources.
4. Regional governments should be more explicitly included as partners in the system with an emphasis on developing and financing regional agendas.
5. Instruments should be put in place to encourage private sector participation such as development of consortia, tax breaks, IPR legislation and enforcement.

3) Integrating institutions

1. A framework needs to be established to create viable and attractive linkages among the various institutions of the system. The integration should take place within the priority research areas identified for the future and through the Regional Agricultural Research and Development Centers proposed in the Action Plan 2030. Integrated teams need to have stable funding and need to pool resources where necessary. This will require programmatic funding on the basis of performance contracts; joint teaching appointments; the secondment of researchers from the Public Technology Institutes (PTIs) to bolster research teams in the universities; collaboration in doctoral and master's level programs; and the integration of research facilities, i.e. shared laboratories and equipment.

A consultation with key stakeholders in the Chilean agricultural innovation system³ (AIS) held in June 2013 confirmed the need for the coordination actions as proposed by the Action Plan 2030, as it

³ In this report forestry is also seen as part of the AIS.

found similar issues as already elaborated upon in the aforementioned Action Plan 2030⁴ such as:

- A lack of formal coordination, while more informal and ad hoc coordination does exist.
- Duplication of efforts of technology institutes and funding organizations, and ambiguity about mandates, institutional setup, objectives and task divisions.
- Insufficient articulation and prioritizing with the sector itself of sector innovation needs.
- Too short-term focus: the existence of a long-term vision is unknown or not enacted upon.
- Perception of too laborious procedures for funds procurement, and monitoring and evaluation of projects ('red tape').
- Insufficient M&E capacity to measure the impact of support programs and install learning within support programs to enhance their continuous adjustment.
- Insufficient continuity of thematic focus points (priority areas) and corresponding support programs (e.g., funding instruments).
- Creation of new support instruments without sufficiently considering the added value versus the existing ones, or without removing the support instruments that need replacement.

1.2 What does innovation system coordination comprise?

The literature indicates that a typical mandate and set of activities for an Agricultural Innovation Coordination Unit or Directorate would be the following⁵:

⁴ This is also the case within the National Chilean Innovation System; see: OECD. 2007. OECD Reviews of Innovation Policy - CHILE. OECD, Paris; World Bank. 2008. Toward a Cohesive and Well Governed National Innovation System. World Bank, Washington, D.C.

⁵ Rajalahti, 2012. National Coordination and Governance of Agricultural Innovation. Module 1, Thematic Note 1, in: Agricultural Innovation Systems: An Investment Sourcebook. World Bank, Washington, D.C.

- Coordinate the development of a strategic vision for agricultural innovation.
- Coordinate and formulate agricultural innovation policy, which will be increasingly integrated into general science-innovation policy.
- Link agricultural innovation to broader agricultural policy and science-innovation discussions.
- Continue to contribute to the development of a strategic vision of the agricultural sector.
- Coordinate and design agricultural innovation priorities and agendas.
- Coordinate the division of labor in the innovation system (e.g., of PTI, Technology Transfer Organizations) and channeling of funds to priority innovation areas.
- Monitor and evaluate innovation programs and their impact.
- Promote collaboration and exchanges among the various parts of the innovation system (e.g., funding agencies, PTI, Technology Transfer Organizations, sector organizations), including external linkages (e.g., foreign technology sources).

The outcome of coordination in the agricultural innovation systems (as proposed by the literature and confirmed in the stakeholder consultation with stakeholders from the Chilean AIS) should be reduced fragmentation and duplication of policies and support instruments and thus, enhanced synergy between the different organizations involved in the agricultural innovation system and the available support instruments, avoidance of policy inconsistencies, minimization of conflicts, an agreed ordering of priorities and balance between long-term,

middle-term, and short-term actions, greater accountability of policy actors with other actors in the agricultural sector through adequate consultation and feedback mechanisms⁶.

1.3 Methods used

For this study, a number of steps were taken:

1. A consultation was held with stakeholders, gathering their views on the current state of coordination in the Chilean AIS, and ideas on how to improve coordination. A total of 20 interviews were held with high-level staff (directors or subdirectors) of:
 - Sector organizations/private sector: Asociación de Exportadores de Chile (ASOEX); Federación Gremial Nacional de Productores de Fruta (FEDEFruta); Sociedad Nacional de Agricultura (SNA) Consorcio Lechero; Consorcio Tecnológico de la Fruta, Consorcio Biofrutales.
 - Universities: Facultad de Agronomía de la Universidad Católica; Facultad de Agronomía de la Universidad de Chile.
 - MINAGRI Agencies⁷: INIA; ODEPA; CONAF; INFOR; CIREN; FIA.
 - Agencies of the Chilean Ministry of Economic Affairs: INNOVA; Año de la Innovación; División de Innovación.
 - MINAGRI's Subsecretary staff.

⁶ Braun, 2008. Organizing the political coordination of knowledge and innovation policies. *Science and Public Policy*, 35(4): 227-239; Rajalahti, 2012. National Coordination and Governance of Agricultural Innovation. Module 1, Thematic Note 1, in: *Agricultural Innovation Systems: An Investment Sourcebook*. World Bank, Washington, D.C.; Palmberg, C. and Lemola, T., 2012. Governance of Innovation Systems. Module 6, Thematic note 2, in: *Agricultural Innovation Systems: An Investment Sourcebook*. World Bank, Washington, D.C.

⁷ See Section 3.1 for explanation of acronyms.

2. A literature review was done, including:
 - scientific literature from specialized journals in the field of science and innovation policy, on the topic of innovation system coordination;
 - policy oriented literature on innovation system coordination from organizations such as the OECD and the World Bank.
3. A comparative study was made of coordination of AIS in five countries, in order to identify different organizational models and experiences of coordination of AIS. The countries chosen were: Canada, The Netherlands, New Zealand, Mexico and South Africa. The choice was made based on available documentation, and relevance to the Chilean case (in terms of elements such as country size, sector organization, national versus decentralized governance, economic models and export orientation). Documentation (policy documents, scientific literature) was reviewed, and interviews with key informants (coordinating bodies' staff, experts on AIS in the countries) were held.
4. A draft report outlining the diagnosis of weaknesses with regard to current coordination of the AIS and the design for the Coordination Unit was shared with MINAGRI staff to receive feedback, and the main points were presented to the stakeholders to get their feedback. This feedback was used to improve the draft report. Furthermore, MINAGRI lawyers advised on the legal possibilities for setting up the Unit.

1.4 What follows?

The remainder of the report has 3 chapters. Chapter 2 will briefly review principles and practices of innovation system coordination, based on scientific evidence and policy oriented literature on the topic, and examples from the

comparative case studies, in order to provide entry points for a design of a Coordination Unit or Directorate within MINAGRI. Chapter 3 will outline the actual design in terms of mandate, functions, structure, staffing and resource requirements, informed by principles and practices as outlined in the literature on innovation system coordination and by the insights from the different stakeholders in the Chilean AIS who were consulted. In order to provide reflection on the design choices outlined in Chapter 3, there will be a continuous mirroring with experiences on agricultural innovation system coordination from Canada, New Zealand, The Netherlands, Mexico and South Africa (outlined in Annexes I to III). Chapter 4 describes next steps for the implementation of the Coordination Unit.

2. Coordination of agricultural innovation systems: Principles and practices

2.1 Governance of innovation systems

Coordination in innovation systems relies on governance. Governance concerns the mechanisms by which decisions are made. In the context of innovation systems, this specifically concerns the systems and practices for setting priorities and agendas, designing and implementing policies, and obtaining knowledge about the impacts of innovation policies and support instruments⁸. Several building blocks for effective governance of innovation have been identified⁹:

- Clarity of vision, objectives and strategy;
- Clear jurisdiction and mandates over objectives, strategy and programs, complemented with budgetary and human resource capacity;
- Coordination mechanisms (within the government and between the government and non-public participants of the national innovation system);
- Accountability mechanisms, checks and balances on decision making;
- Transparency and openness to support accountability;
- Periodic and systemic evaluation and related adjustment mechanisms.

Similar to other types of innovation systems, agricultural innovation systems typically consist of different governance layers which have different

8 Palmberg, C., and Lemola, T., 2012. Governance of Innovation Systems. Module 6, Thematic note 2, in: *Agricultural Innovation Systems: An Investment Sourcebook*. World Bank, Washington, D.C.

9 World Bank, 2008. *Toward a Cohesive and Well Governed National Innovation System*. World Bank, Washington, D.C..

functions in support of innovation. Figure 1 displays a typical governance structure of an innovation system and shows a clear division of tasks and functions such as policy making, financing and program implementation¹⁰. For innovation policies to be legitimate it is important that the stakeholders from the different governance layers in the innovation system participate in innovation policy making¹¹. Innovation governance and coordination should also include 'innovation system deconstruction' and capacity to adjust and adapt in case the innovation system becomes ineffective or inefficient¹².

Four different innovation policy instruments can be distinguished. These policy instruments are mainly executed through vertical governance (e.g., how a Ministry governs its agencies) (see Figure 1).

These four types of instruments are as follows¹³:

1. **Regulatory instruments:** These are the 'rules of the game' for knowledge and innovation processes in innovation policy. These regulatory instruments (laws, rules, directives, etc.) are obligatory in nature, meaning that actors are obliged to act within some clearly defined boundaries of what is allowed and

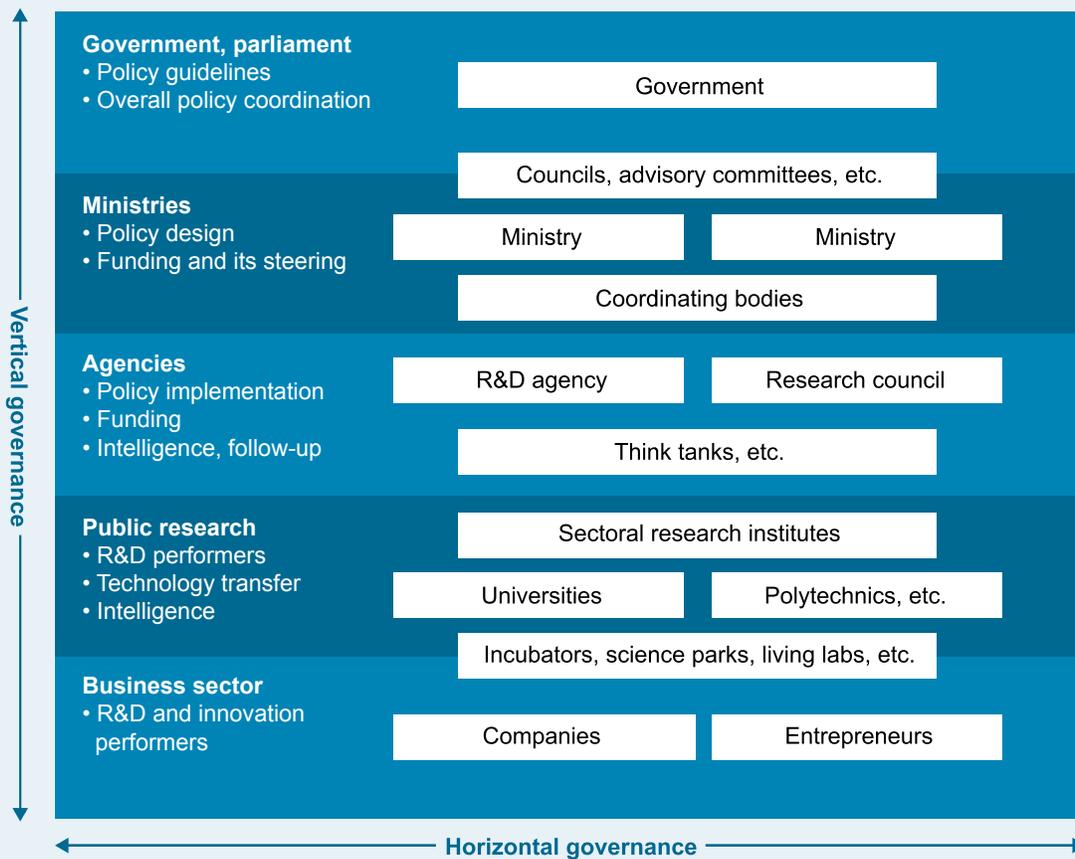
10 World Bank, 2008. *Toward a Cohesive and Well Governed National Innovation System*. World Bank, Washington, D.C..

11 Palmberg, C., and Lemola, T., 2012. Governance of Innovation Systems. Module 6, Thematic note 2, in: *Agricultural Innovation Systems: An Investment Sourcebook*. World Bank, Washington, D.C.; Rajalahti, 2012. *National Coordination and Governance of Agricultural Innovation*. Module 1, Thematic Note 1, in: *Agricultural Innovation Systems: An Investment Sourcebook*. World Bank, Washington, D.C..

12 Smits and Kuhlmann, 2004. The rise of systemic instruments in innovation policy. *International Journal of Foresight and Innovation Policy*, 1: 4–32.

13 This subsection is integrally derived from Borrás, S. and Edquist, C., 2013. The Choice of Innovation Policy Instruments. *Technological Forecasting and Social Change*, 80(8):1513–1522.

Figure 1. Typical governance structure of an innovation system¹⁴



what is not allowed. Obligatory measures are typically backed by threats of sanctions in cases of non-compliance. These sanctions can be very different in nature (fines and other economic sanctions, or temporary withdrawal of rights), depending on the content of the regulation and the definition of legal responsibility. Examples include:

- the regulation of intellectual property rights (e.g., patent regulations);
- the regulation of research and higher education organizations like universities and public research organizations (e.g., the statutory nature of the organizations);

- competition (anti-trust) policy regulations concerning R&D and innovative activities by firms in the market;
- bioethics and other ethical regulations related to innovative activities.

2. **Economic transfers:** Economic and financial instruments provide specific pecuniary incentives (or disincentives) and support specific social and economic activities (see Box 1 for examples from the comparative case studies, and Annex II, Section A for further details). They involve economic means in cash or kind, and can be based on positive incentives (encouraging, promoting, certain activities) or on disincentives (discouraging, restraining, certain activities). Examples of positive incentives include:

¹⁴ Palmberg, C., and Lemola, T., 2012. Governance of Innovation Systems. Module 6, Thematic note 2, in: Agricultural Innovation Systems: An Investment Sourcebook. World Bank, Washington, D.C.

- ‘in block’ public support to research organizations, primarily public universities and public research organizations;
 - competitive research funding (industrial or basic research), tax incentives for R&D performed at firm level, support to technology transfer, and support to venture and seed capital;
 - funding of education at all levels (basic, secondary, tertiary).
3. **‘Soft instruments’:** These instruments are largely a complement to regulatory and economic instruments. Soft instruments are characterized by being voluntary and non-coercive. With soft instruments, those who
- are ‘governed’ are not subjected to obligatory measures, sanctions or direct incentives or disincentives by the government or its public agencies. Instead, the soft instruments provide recommendations, make normative appeals or offer voluntary or contractual agreements. These instruments are very diverse, but generally based on persuasion, on the mutual exchange of information among actors, and on less hierarchical forms of cooperation between the public and the private actors. Examples of these are:
- voluntary technical standards at the national or international level;
 - codes of conduct for firms, universities or public research organizations (e.g.,

Box 1. Co-financing, public-private partnerships, and levy-based funding

The design of economic and financial instruments illustrates distinct approaches on how to stimulate research for certain objectives, timeframes, and users. To get value for money and to fund projects that truly meet demand, the government frequently collaborates with the private sector to finance innovation. Three common examples are co-financing, wherein government and industry share funding for a given project, often on a proportional basis; public-private partnerships (PPP), wherein government invests in the private sector to conduct a project; and levy-based funding, wherein a given sector coordinates itself to fund research of its choosing. Co-financing, PPPs, and levy-based funding fall along a continuum of autonomy of the private sector.

Co-financing and PPPs are often allocated on a competitive basis to encourage research that is both demand-driven and aligned with government priorities. Passing through a government-facilitated selection process, often with external or sector-representative panels making decisions on proposals, helps to ensure this balance. In Canada, the AgriInnovation Program offers over two-thirds of its budget, \$468 million, for funding industry-led Agri-Science Clusters over a five-year period under a PPP scheme. Industry submits research proposals to Agriculture and Agri-Food Canada (AAFC), which are selected and funded, contingent on support for government priorities. The winning Agri-Science Clusters, which must focus on a specific sector at the national level, then contract research from public or private research institutes and can count on technical assistance from the AAFC. The AgriInnovation program promotes commercialization, a priority for the Canadian agricultural innovation system, as the program incentivizes downstream, applicable research that the private sector itself has deemed useful in a short-time horizon.

Levy-based funding is a way for a sector to pool resources and fund research and development for solutions specific to that sector. In New Zealand, a Commodity Levy Act (1990) empowers producers in a given sector to self-impose levies on agricultural products at the farm gate through a vote, in order to finance ‘industry good activities’. Once voted, the levy becomes obligatory for all commercial producers of the products in question. For each product, farmers vote every six years to decide whether to continue to impose the levy. Levies are commonly paid by producers on each unit of a delivered commodity. See Annex II, Section A for more examples of financing approaches and examples for five case study countries.

Figure 2. Four broad areas of innovation policy instruments¹⁵

advocating transparency in recruitment procedures);

- management contracts with public research organizations (an instrument defining an agreement between policy-makers and managers of these organizations, setting up the strategic goals for that public organization);
 - public-private partnerships sharing costs, benefits and risks in the provision of specific public goods (e.g., in the field of knowledge infrastructures);
 - campaigns and public communication instruments (e.g., diffusion of scientific knowledge by using events like 'research days' or 'open houses').
4. **'Systemic instruments'**: The recognition that innovation takes place in systems and is a highly interactive process, has given rise to a fourth type of innovation policy instrument, which connects to the previous category of

'soft instruments'. These have been called 'systemic instruments'¹⁶, and their functions include:

- management of interfaces in innovation systems: making sure different elements of the existing innovation system interact;
- building and organizing systems: (de)construction of innovation systems;
- providing a platform for learning and experimenting;
- providing an infrastructure for strategic intelligence;
- stimulating demand articulation, strategy and vision development.

Typically, these systemic instruments take the form of think tanks and innovation incubator organizations which execute radical innovation programs and conduct experiments with new technologies and ways of working.

¹⁵ Adapted from Borrás, S. and Edquist, C., 2013. The Choice of Innovation Policy Instruments. *Technological Forecasting and Social Change*, 80(8): 1513-1522.

¹⁶ Smits and Kuhlmann, 2004. The rise of systemic instruments in innovation policy. *International Journal of Foresight and Innovation Policy*, 1: 4-32.

Generally, individual innovation support instruments are combined to complement and strengthen each other (known as innovation policy mixes) to ensure that the ‘innovation system functions’ of well-functioning innovation systems are realized: 1) fostering entrepreneurial activities, 2) knowledge development, 3) knowledge diffusion in networks, 4) guidance of the search, 5) market formation, 6) resource mobilization, 7) creation of legitimacy/overcoming resistance to change¹⁷.

2.2 Forms and levels of innovation system coordination

In terms of the coordination of innovation systems, two forms of coordination can be distinguished¹⁸:

- Policy coordination, which is concerned with the development of a clear, consistent and agreed set of policies, the determination of priorities and the formulation of strategies for putting these policies into practice, hence it means coordination at the level of policy formulation, often at the level of overall government and ministries.
- Administrative coordination, which concerns the problem of getting everyone to pull in the same direction given agreement on what direction to go in, so coordinating the different executive agencies of the Ministry, the public technological institutes and the private sector actors.

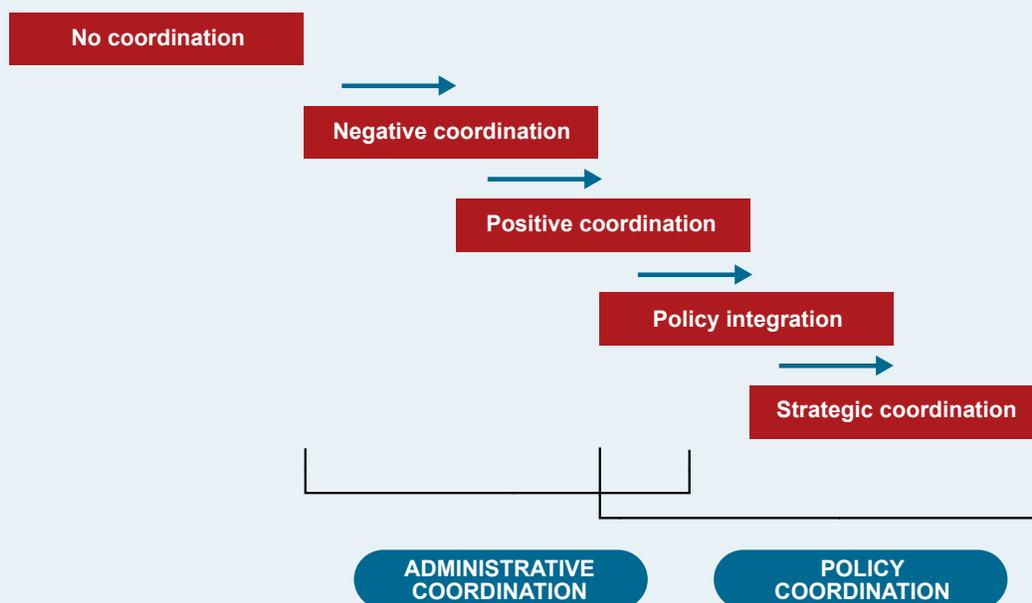
¹⁷Wieczorek, A. J. and M. P. Hekkert, 2012. Systemic instruments for systemic innovation problems: A framework for policy makers and innovation scholars. *Science and Public Policy*, 39(1): 74-87.

¹⁸This section and Figure 3 are integrally based on Braun, 2008. Organizing the political coordination of knowledge and innovation policies. *Science and Public Policy*, 35(4): 227-239.

Policy and administrative coordination are related, and to achieve optimal coordination it is important to consider the degree of intentionality of coordination, which can be put on a scale and comprises both administrative and policy coordination (see Figure 3). There are 4 different degrees of coordination, beyond ‘no coordination’:

1. **Negative’ or ‘passive’ coordination:** Actors are not completely independent in their decision-making but obliged to take into account a negative backlash against their own actions by other actors. Negative coordination often is done by formalized procedures in which other actors can react to the policy intentions of a Ministry. For example, if a certain budget change is proposed for a research institute which is to the detriment of another research institute, the affected research institute will react to minimize the damage and might propose a collaboration. Negative coordination leads to the mutual adjustment of actors, but not to concerted action nor to cohesiveness of policies.
2. **Positive’ or ‘pro-active’ coordination:** Implies more than mutual adjustment, as actors start to cooperate with each other in order to deliver certain services. Such positive coordination can take place in committees, with the help of coordination divisions of ministries, within jointly managed policy programs. It typically develops at the ministerial or agency level. In order to succeed, a ‘win-win’ game is needed in which each partner under cooperation can improve his or her position by participating in the cooperation. Positive coordination is necessary at the level of administrative coordination when overall agreed-upon strategies must be implemented.

Figure 3. Degrees of coordination



3. **'Policy integration'** strives for the coordination of goals.
4. **'Strategic coordination'** aims at the development of encompassing common visions and strategies for the future. This is, at the same time, the most far-reaching type of coordination. Policy integration and strategic coordination are adequate means for achieving an encompassing innovation policy.

Regarding the levels of coordination, in line with the governance structure in Figure 1, there can be 'vertical coordination' from government and ministries downwards to the sector, and 'horizontal coordination' e.g., between agencies that serve a certain Ministry, but also between different ministries. Following the same logic as the policy instruments, the way in which coordination takes place can be based on hierarchical control, regulatory power and coercion or through economic incentives (negative and positive), but can also be in the form of 'soft coordination' based on dialogue and concerted action.

As regards overall policy coordination, there are several modalities to organize such coordination¹⁹, which may also exist in mixed forms and with different levels of delegation:

- Internal coordination by a unit within a Ministry. Often, such units exercise steering on the basis of hierarchical relationships or through economic arrangements. International examples include The Netherlands' Agri-Knowledge Directorate in the Ministry of Economic Affairs, Agriculture, and Innovation, and Canada's Innovation Policy Division in Agriculture and Agri-Food Canada (see Annex I).
- External coordination across different ministries through, for example, ministerial committees or inter-ministerial working groups as in Mexico's Inter-Sectoral Commission on Sustainable Rural Development (see Annex I). This is often based on voluntary bargaining, and maybe

¹⁹ Braun, 2008. Organizing the political coordination of knowledge and innovation policies. *Science and Public Policy*, 35(4): 227-239.

- ineffective due to different existing routines and world views in each Ministry. Such external coordination may be internalized by a so-called 'superministry of science and innovation'²⁰ as in the case of South Africa's Department of Science and Technology.
- Coordination at the agency level. The executive agencies of ministries often act as 'intermediary organizations' between policy making, science and industry. They often have a quasi-public status and are controlled through budgetary steering, rather than hierarchical mandates. Given the proximity with the sectors they work in, there is a risk of focusing too narrowly on these sectors while losing oversight of the overall policies. Examples from the comparative cases studies include the Agri-knowledge Directorate in The Netherlands, SAGARPA in Mexico, and the Strategy, System and Science Directorate in New Zealand's Ministry of Primary Industries (see Annex I).
 - High level advisory boards, councils or think tanks. Such boards give advice based on scientific evidence and/or practice-based experience from economic sectors and civil society domains. They enhance the accountability towards the sectors, but can also enhance reflexivity. An example in Chile, not tied to a specific sector, is the Consejo Nacional de Innovación para la Competitividad (CNIC)²¹. Roles of such advisory boards, councils or think tanks may include²²:

- Providing a platform for learning and experimenting, for example The Netherlands' Innovation Network (see Annex I and Annex II, Section C).
- Providing an infrastructure for strategic intelligence to produce, identify and build links between actors, such as New Zealand's various commercialization-oriented organizations (Annex II, Section B).
- Stimulating and facilitating discourse, vision and strategy development in conjunction with users of the outcomes of the innovation process, such as farmers and processing companies, like Canada's Value Chain Roundtables (Annex II, Section B).

These advisory boards, councils or think tanks feed into the more hands-on day-to-day operational units that are responsible for coordination, such as ministerial coordination units or agencies that coordinate (sub) sectors.

2.3 Resources and skills needed by innovation system coordinators

Innovation system coordinators need a particular set of resources, capacities and skills in order to be effective. Coordinating units will need operating funds, physical infrastructure and communication infrastructure to enable transparent and open communication (through, e.g., an ICT platform)²³. They also need particular capacities and skills, which can be fully integrated within coordinating units (in-house capabilities), but may also be acquired through the delegation

²⁰ The Consejo Nacional de Innovación para la Competitividad (CNIC) has recently launched a proposal for such a superministry of science and innovation for Chile.

²¹ See: www.cnic.cl

²² Smits, R. and Kuhlmann S., 2004. The rise of systemic instruments in innovation policy. *International Journal of Foresight and Innovation Policy*, 1: 4–32.

²³ Rajalahti, 2012. National Coordination and Governance of Agricultural Innovation. Module 1, Thematic Note 1, in: *Agricultural Innovation Systems: An Investment Sourcebook*. World Bank, Washington, D.C.

of certain tasks to specialized organizations. These capacities and skills include²⁴:

- Recognize system strengths, weaknesses, problems, development potential—which requires analytical skills.
- Define the focus and the topics for political action (agenda setting)—which requires skills in communication and consensus-building.
- Encourage diverse players (through consultation and participation) to coordinate their activities in and beyond their policy field—which requires skills in facilitation, negotiation and consensus-building.
- Implement these policies—which requires policy capacity.
- Learn from previous experience (such as evaluation results)—which requires learning, intelligence and accountability.
- Make adjustments over the complete policy cycle – which requires reflexivity and flexibility.

It is important that a coordinating unit and affiliated bodies such as councils have the means to 'enforce coordination'. Otherwise coordinating units and councils may prove ineffective and mainly serve as 'window dressing'. For innovation units and affiliated councils to be more than formal constructs, they must command resources, have continuity, be seen by other actors in the AIS as honest brokers, and those actors, especially top government officials, must

24 Rajalahti, 2012. National Coordination and Governance of Agricultural Innovation. Module 1, Thematic Note 1, in: Agricultural Innovation Systems: An Investment Sourcebook. World Bank, Washington, D.C.

be willing to listen to their advice²⁵. There are a couple of key values that influence this²⁶:

- There should be transparency about the roles the coordinating unit fulfills, which requires active communication and expectations management by the coordinating unit and affiliated councils.
- There should be responsiveness to the different stakeholders needs and accountability on spending of funds, which requires adequate monitoring and evaluation of the work of the coordinating unit and affiliated councils.
- There should be good connections with top government and industry officials, strong and clear commitment of these officials, who should respect the role of the unit and affiliated councils.

There are some inherent dilemmas in this coordinating role, which require balancing between²⁷:

- taking too much credit of the achievements in the coordinated networks of actors in the AIS, and not having one's contribution recognized;
- steering processes too much in a top-down way through authority and or funding and being too laissez-faire or acting too

25 Rajalahti, 2012. National Coordination and Governance of Agricultural Innovation. Module 1, Thematic Note 1, in: Agricultural Innovation Systems: An Investment Sourcebook. World Bank, Washington, D.C.

26 Braun, 2008. Organizing the political coordination of knowledge and innovation policies. *Science and Public Policy*, 35(4): 227-239; Rajalahti, 2012. National Coordination and Governance of Agricultural Innovation. Module 1, Thematic Note 1, in: Agricultural Innovation Systems: An Investment Sourcebook. World Bank, Washington, D.C.; Palmberg, C., and Lemola, T., 2012. Governance of Innovation Systems. Module 6, Thematic note 2, in: Agricultural Innovation Systems: An Investment Sourcebook. World Bank, Washington, D.C.

27 Klerkx, L, Schut, M., Leeuwis, C., Kilelu, L., 2012. Advances in knowledge brokering in the agricultural sector: Towards innovation system facilitation. *IDS bulletin*, 43(5): 53-60.

- much bottom-up with the risk that nothing happens;
- having sufficient expert knowledge to obtain a legitimate position in a network and acting too much as an expert and overruling contributions of the network partners;
 - empowering non-powerful actors in the network and starting to act as a spokesperson for them;
 - acting in line with current policy lines and current innovation systems structures and procedures, and challenging these policy lines and reconfiguring innovation systems structures (i.e. fresh thinking).

3. Design elements for an Agricultural Innovation Coordination Unit at MINAGRI

In this section, the MINAGRI Agricultural Innovation Coordination Unit will be outlined in terms of mandate, functions, structure and positioning, and resource requirements.

3.1 The current structure of the public institutional framework in which the Chilean AIS is embedded²⁸

The current Chilean AIS is both supported by a sector specific Ministry (MINAGRI) which has its own range of agencies, and by 'generic' non-sector specific support instruments, from the Ministry of Economic Affairs and the Ministry of Education. Furthermore, support comes for specific issues from other ministries as well. Figure 4 shows an overview scheme of the overall public institutional framework in which the Chilean AIS is embedded, and Figure 5 shows an organizational chart of the Ministry and its agencies.

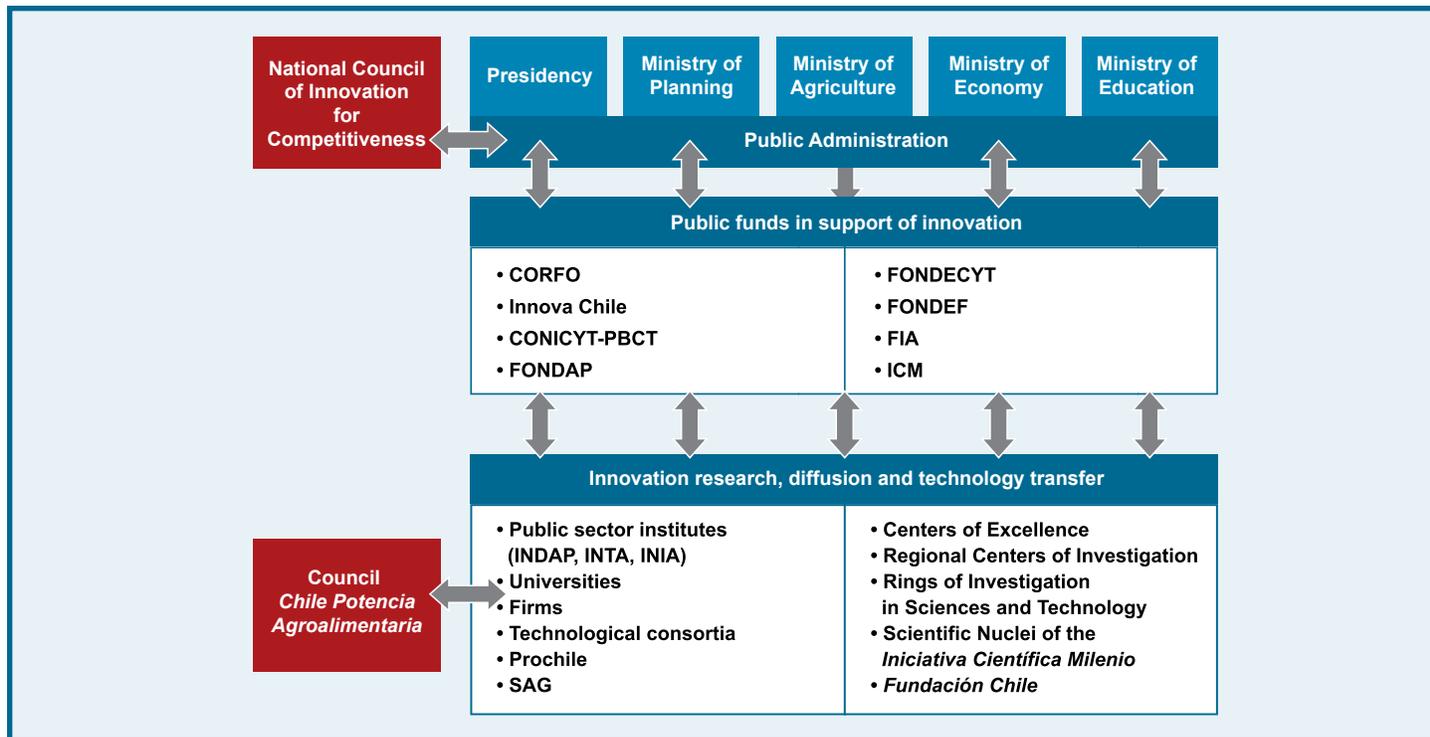
As Figure 4 shows, several organizations support agricultural innovation. Apart from sector-specific public technology institutes, generic institutes and universities also support agricultural innovation through research and extension. Apart from the agricultural sector specific innovation funding from FIA, also generic funding bodies such as CORFO and CONICYT fund projects in the agricultural and forestry sector, often through competitive grant schemes open to all sectors.

²⁸ For an overview of the evolution of Chile's AIS, see: World Bank, 2011. Chile's Agricultural Innovation System: An Action Plan Towards 2030, World Bank, Washington, D.C.

Regarding the structure of MINAGRI, and its roles in the support of agricultural innovation, Figure 5 shows the current setup. MINAGRI is headed by a Minister, and a Subsecretary, and is represented in the Chilean regions by regional representatives (SEREMI). The different agencies related to MINAGRI have diverse functions²⁹:

- ODEPA (Oficina de Estudios y Políticas Agrarias) generates and disseminates information on the agricultural and forestry sector with the goal of supporting decision making by public and private agents
- INDAP (Instituto de Desarrollo Agropecuario) provides technical and entrepreneurship support to small and medium-sized farm enterprises in order to build capacity and strengthen the integration of these enterprises in national and international value chains
- SAG (Servicio Agrícola y Ganadero) generates fitosanitary and zoonosanitary policies and norms to control, certify and protect natural resources, to avoid the entry of pests and diseases which may endanger the production capacity of Chilean agriculture and forestry
- CONAF (Corporación Nacional Forestal) contributes to the conservation, growth, management and use of forestry resources in Chile, through promotion, control and protection of forestry resources
- CNR (Comisión Nacional de Riego) coordinates, implements and evaluates

²⁹ Information derived from: <http://www.minagri.gob.cl/institucion/institucional/servicios-del-agro/>, visited on July 10, 2013.

Figure 4. Current structure of the public institutional framework in which the Chilean AIS is embedded³⁰

- the national irrigation policy, through investment programs which aim to increase the irrigated surface in Chile and the optimal use of water
- INIA (Instituto de Investigaciones Agropecuarias) generates and transfers knowledge to induce innovation, enhance sustainability and improve the competitiveness of the sector
 - FIA (Fundación para la Innovación Agraria) co-finances agricultural innovation projects (development, validation and adoption of innovations) aimed at generating or improving processes, products or management practices in the agricultural and forestry sectors. Furthermore, it facilitates the attraction of foreign knowledge and innovative solutions and enables Chilean entrepreneurs to go abroad to explore solutions to clearly defined problems or opportunities.

- FUCOA (Fundación de Comunicaciones, Capacitación y Cultura del Agro) generates communication and participation of actors in the rural areas in order to value rural traditions and culture, and provides information about rural policies and achievements of MINAGRI
- CIREN (Centro de Información de Recursos Naturales) provides information based on georeference systems (e.g., through remote sensing) about, e.g., natural resources, soils and hydrological resources to facilitate decision making by public and private agents
- INFOR (Instituto Forestal) creates and transfers scientific and technical knowledge for the sustainable use of forestry resources, development of forest products, and generate other useful economic, environmental and social information for the forestry sector

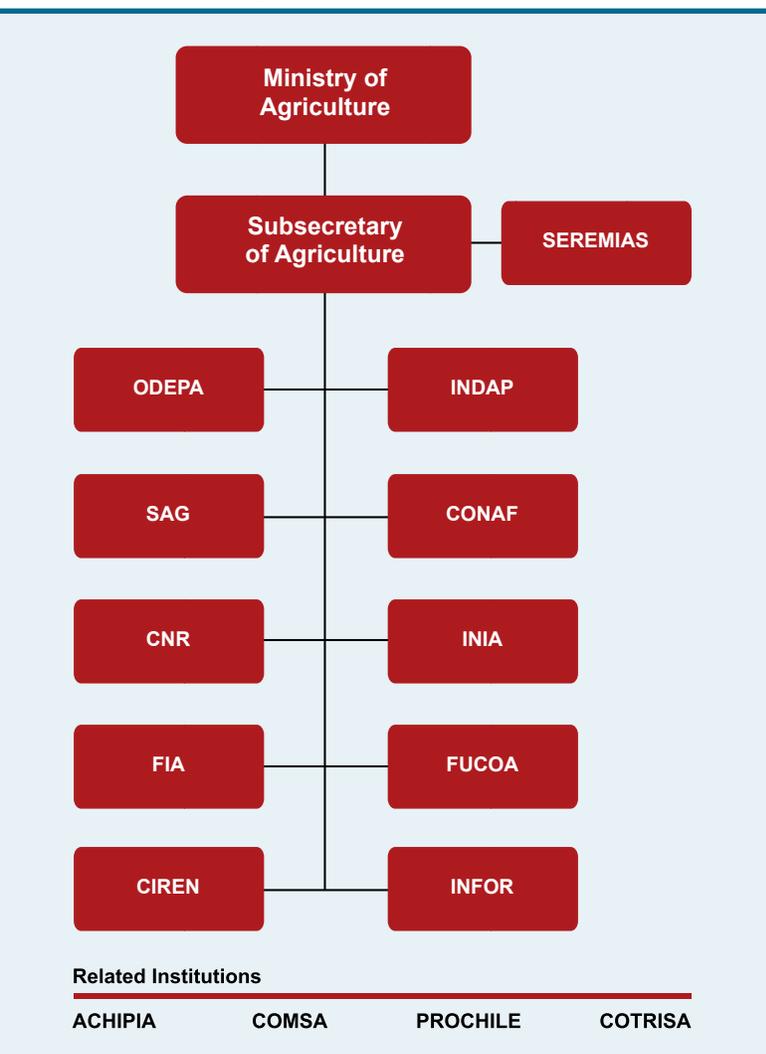
³⁰ Based on World Bank, 2011. Chile's Agricultural Innovation System: An Action Plan Towards 2030, World Bank, Washington, D.C.

These different agencies of MINAGRI all have their particular institutional set-up (i.e. legal form)

and mandate, which connects to the reason for which they were set up and their fit within the institutional context at the time of emergence.

Of the related organizations, ACHIPIA (Agencia Chilena para la Calidad e Inocuidad Alimentaria) is the agency which coordinates and oversees the national food safety regulations; COMSA (Comité de Seguro Agrícola) promotes and administrates an agricultural insurance co-financed by the state; PROCHILE aims to promote Chilean exports through market exploration and business model

Figure 5. Current organizational chart of MINAGRI and agencies³¹



31. Source: http://www.minagri.gob.cl/wp-content/uploads/2012/03/organigrama_minagri-4.jpg, visited on July 10, 2013.

innovation; and COTRISA (Comercializadora de Trigo) is a regulator of the wheat market. Given the planned reform of MINAGRI, also fishery related agencies will be included in due time.

3.2 Coordination efforts to enhance the performance of the public support infrastructure in the Chilean AIS: Mandate of the MINAGRI Agricultural Innovation Coordination Unit

As already touched upon in the introduction, there are several coordination problems (fragmentation, duplication, ambiguity about mandates and functions) within the public support infrastructure for the Chilean AIS, as indicated by previous studies and confirmed by the stakeholder consultation for this study. These link to several weaknesses for the Chilean AIS, as articulated by the consulted stakeholders.

Weaknesses concern:

- Absence or unawareness of a shared agricultural policy and clear priorities, and the existence of several disarticulated priority setting and innovation agenda setting mechanisms, as stakeholders from sector organizations, PTI and other MINAGRI agencies, and innovation support agencies from other ministries indicate.
- A lack of sufficient direct interaction and well-functioning feedback links between the public innovation support infrastructure and the private sector, as mainly the stakeholders from sector organizations and the different consortia which work with private sector partners indicate.
- Confusion and even conflicts about mandates of PTI and other MINAGRI agencies such as INDAP and CONAF amongst themselves, and between MINAGRI agencies and the universities, overlapping functions and competition for resources,

as stakeholders from PTI and universities indicate.

- Inconsistency and short-term focus of support instruments, under influence of political changes, as stakeholders from PTI, public sector organizations and consortia indicate.
- Funding is dispersed over many different sources, and all have their own criteria; compatibility between funding instruments is low, as stakeholders from PTI, universities and consortia indicate.
- No solid basic funding for a consistent basic research and technology transfer infrastructure, and hence use of inappropriate funds for maintaining a basic structure, as stakeholders from PTI and universities indicate.
- Lack of trust in collaborative processes, individualistic behavior, no culture of sharing, as most consulted stakeholders indicate.
- A disconnect between national and regional support efforts (priority setting, funding), as stakeholders from sectoral organizations and PTI indicate.

In summary, while several innovation support initiatives and instruments exist, these have developed independently with their own logic and have their own course of action. What can hence be noted is, that while different innovation policy instruments of regulatory, economic or 'soft instrument' nature exist, there appears to be an inappropriate or incoherent mix of these to maximize impact and synergy, or some instruments are under-developed (e.g., IP rights). Furthermore, there appears to be a lack of specific 'systemic instruments'.

However, several stakeholders, mainly those already involved in consortia, say that coordination has improved, in the form of 'positive coordination'. In the last 3 years, the advisors to the MINAGRI Subsecretary have

started to play several coordinating roles, and have made significant advances on this matter. Such coordination often takes place at decentralized levels of particular sectors (e.g., dairy sector) or topics (water management, geographical information systems, genetic improvement). Other coordination activities of the Subsecretariat coordination cluster include voting representation in the boards of FONDEF, CNIC, and INNOVA; providing guidance to the PTI for submitting competitive funding projects; establishment of new sector priorities such as varietal improvement; articulation of a national network of ex-situ gene banks; and the design of technology transfer instruments with CORFO.

Coordination also takes place through the different Consorcios or the Centros de Excelencia (Centers of Excellence)³². There is coordination between FIA and CORFO. CIREN has made efforts to join forces in order to improve information on land use. While such coordination may help in optimizing collaboration under the current institutional regime (in terms of how funding is organized and how PTI are organized) it often does not induce structural change and reforms to the institutional regime, to create a better attuned and synergic AIS.

A number of improvements can hence be made, to boost the performance of the public support infrastructure in the Chilean AIS performance:

- Priority areas can be better articulated and can be made more clearly visible in the different policy lines and innovation support instruments.
- A better task division between the different MINAGRI agencies and other innovation support agents can be articulated, in terms of funding, research, technology transfer, and extension.

³² See: World Bank, 2010. Chile: review of public technological institutes in the agriculture sector. World Bank, Washington D.C.

- Learning on performance and impact of innovation support policies and instruments can become more systematic.
- Linkages and feedback loops in the AIS can be improved, building on the positive experiences of instruments such as the Consorcios Tecnológicos.

In order to achieve these improvements, it would be helpful to have a dedicated Unit which induces processes of vision and agenda building, priority setting, synchronization of funding flows and other innovation support activities (such as research), makes sure that adequate and systematic monitoring and evaluation of the AIS takes place, and hence optimizes the existing more informal coordination efforts. Such an Agricultural Innovation Coordination Unit within MINAGRI would have the following mandate:

Mission

The mission of the MINAGRI Agricultural Innovation Coordination Unit is to enhance the coherence and synergy in agricultural innovation policy formulation and execution, by formulating broadly shared priority areas for agricultural innovation guiding policy formulation, by coordinating the efforts of the executive innovation support agencies to reach complementarity and integration among themselves and with innovators and innovation support organizations in the private sector.

Primary objectives

The primary objectives, which are largely in line with the proposal in the Action Plan Toward 2030 and have been confirmed and complemented by the stakeholders consulted for this study, include:

1. Defining a long-term joint vision³³ for Chilean agriculture with clearly defined priority areas, and jointly with all relevant actors relevant to those priority areas ensures that this vision is enacted through medium and short-term actions and investments. This includes ensuring that the formulation of coherent innovation programs takes place, comprising different kinds of activities contributing to innovation, such as research programming, network building, technology transfer and extension, creation of new markets; hence, combining regulatory, economic and soft innovation policy instruments. It includes synchronizing and, if possible, matching of public and private investments in agricultural innovation. Such programs are targeted towards sectors or towards cross-cutting issues affecting several sectors, and the MINAGRI Agricultural Innovation Coordination Unit should ensure that the coordination of such innovation programs is properly delegated to (sub) sectoral and/or regional levels.
2. Inducing a process of structural adaptation of the public innovation support agencies that fall under the responsibility of the Ministry, achieving synchronization of tasks with other agencies and other players in the AIS such as universities and, where needed, a redefinition of tasks. This includes defining the core business of each agency and securing adequate funding for this core business. In the cases of project funding instruments, synchronization with generic funding instruments that do not fall under the realm of MINAGRI needs to be sought, and the possibility for institutionalization of

³³ Such a vision has already been elaborated upon. See: World Bank, 2011. Towards a Vision for Agricultural Innovation in Chile in 2030. World Bank, Washington D.C. This vision should be more widely disseminated, acted upon, where needed, expanded or adapted.

sector based funding (e.g., through sector organization based levies) needs to be explored.

3. Monitoring and evaluating the Chilean AIS, both to achieve accountability on effective and efficient spending of public funds for the support of innovation (results-based and impact-based monitoring and evaluation), and to achieve enhanced reflexivity and policy learning in the AIS in order to adjust innovation priorities, policies and support instruments. Part of the monitoring function includes strategic intelligence, and monitoring developments elsewhere to feed them into Chilean agricultural innovation policy making.
4. Organizing dialogue and information management, including ensuring proper information flows between the Ministry and the sector, and information flows within the Ministry, in order to achieve the objectives of vision formulation and enactment, synchronization of tasks, and monitoring and evaluation, improve communication between stakeholders in the Chilean AIS and the public support infrastructure.

3.3 Functions of the MINAGRI Agricultural Innovation Coordination Unit

In this section, the principal functions proposed for the MINAGRI Agricultural Innovation Coordination Unit are described, outlining ways of shaping these functions. The design of these functions is informed by the stakeholder consultation and earlier work³⁴, and where appropriate the proposed design is mirrored to findings from the comparative case studies from Canada, New Zealand, The Netherlands,

³⁴ World Bank, 2011. Chile's Agricultural Innovation System: An Action Plan Towards 2030. World Bank, Washington D.C.

South Africa, and Mexico. The functions connect both to policy coordination and administrative coordination, and strive for positive coordination, policy integration and strategic coordination (as outlined in Section 2.2). Overall, the coordination by the MINAGRI Agricultural Innovation Coordination Unit is at a macro level, which means that the Unit induces and oversees that coordination at meso level (e.g., sector level) or micro level (innovation program level) occurs, but does not get involved in decision making and day-to-day management at the level of sectors, regions, programs (such as Consorcios, Centros de Excelencia) and projects as this is the domain of the sector-specific MINAGRI agencies and other public and private stakeholders.

1) Strategy development and priority setting

Linked to objectives 1 and 2, the MINAGRI Agricultural Innovation Coordination Unit is responsible for organizing the process of vision and strategy development and priority setting at macro level, and facilitating other organizations or networks (existing or new) to specify vision and priorities for specific regions, subsectors and innovation programs. The strategy development process should focus on different time horizons and scale levels and should take into account international developments and international opportunities for collaboration. It should include a long-term horizon (for which elements have already been elaborated in the Vision for 2030³⁵). Vision and strategy development comprises both topics which have to do with specific subsectors (e.g., dairy, fruit) or specific technologies (e.g., nanotechnology, biofuels), and with institutional innovation in the innovation system (e.g., forms of collaboration, IP rights, integrating PTI).

³⁵ See: World Bank, 2011. Towards a Vision for Agricultural Innovation in Chile in 2030. World Bank, Washington D.C.

While long-term strategy development efforts can help in developing the ‘macro priority areas’, in order to effectuate these there should be a good connection between long-term (10-20 years), and medium-term (5-10 years) and short-term (1-5 years) actions with corresponding meso and micro priorities - some of which have also already been elaborated³⁶. It is important that the short and medium priorities and the related action plans are agreed upon and decided upon by representatives from the different priority sectors and areas. Subsequently, coherent innovation programs are formulated which comprise a cohesive set of support instruments through concerted action by the different public support agencies (PTI and funding agencies) as well as private sector participation and investments. An example of such an approach can be found in The Netherlands, where the so-called System Innovation Programs³⁷ tried to connect the different time horizons, an approach which is continued to some extent in the current Top Sector projects (see Annex II, Section B).

Hence, to ‘bring down to earth’ the long-term vision and macro priority areas, the MINAGRI Agricultural Innovation Coordination Unit would need to: a) facilitate medium and short-term articulation and prioritization processes; b) facilitate that the priorities are developed into coherent innovation programs supported by adequate combinations of innovation policy instruments of regulatory, economic incentive or ‘soft instrument nature’ (see Sections 2.2³⁸ and 2.3); c) facilitate that the adequate networks are formed to execute innovation programs with different time horizons and ambition levels (see Figures 4 and 6); and d) safeguard the continuity of innovation programs. As indicated earlier, it

36 See: World Bank, 2010. Chile: review of public technological institutes in the agriculture sector; World Bank, 2011. Chile’s Agricultural Innovation System: An Action Plan Towards 2030. World Bank, Washington D.C.

37 Vogelenzang and Wijnands, 2011. Working methodologically on system innovations. Syscope Magazine, Summer 2011; see: http://www.wageningenur.nl/upload_mm/2/a/f/371b3837-0aca-4600-99b0-d8fe4a0aa362_Co%20innovation%202011.pdf

38 See: Wiczorek, A. J. and M. P. Hekkert, 2012. Systemic instruments for systemic innovation problems: A framework for policy makers and innovation scholars. *Science and Public Policy* 39 (1):74-87.

would not be the task of the Unit to get involved in meso and micro-level coordination processes at the level of sectors, regions, and programs, but the Unit ensures that there is exchange and alignment between these different meso and micro-level coordination, and that these coordination processes take the form of positive coordination which lead to policy coordination and strategic integration (see Figure 3).

For the short-term questions, in order to make sure that a) investments made are in line with macro priority areas, and b) that they are addressing real and pressing problems currently experimented by the sector, an articulation and priority setting mechanism delegated to sectoral organizations could be developed (or maybe build on existing mechanisms). This may include exploring the possibility and feasibility of installing a levy-based funding mechanism (see also function 3), which is currently not yet legally possible. There are many international examples of priority-setting delegated to sectors, including Bioconnect and TransForum in The Netherlands, Canada’s Value Chain Roundtables, and Mexico’s Produce Foundations (described further in Annex II, Section B), whereby some fiscal decentralization empowers sectors to finance their own priorities, aligned with national priorities. Competitive matching funds also serve to give sectors some autonomy in financing their own solutions in line with national funding criteria.

For the medium-term programs (time horizon 5-10 years), current modalities like the Consorcios Tecnológicos and Centros de Excelencia could be further developed, and, following recommendations from earlier studies³⁹, multidisciplinary research teams consisting of PTIs and university researchers can be composed, functioning through multi-disciplinary R&D programs. While the current consortia and centers of excellence mainly

39 World Bank, 2011. Chile’s Agricultural Innovation System: An Action Plan Towards 2030. World Bank, Washington D.C.

concentrate on collaborative projects between researchers and firms, a more diverse set of participants (such as civil society organizations, environmental NGOs, sector organizations, government representatives, education institutions, international partners) could be included depending on the issue at hand, to ensure that beyond improving research and technology transfer, other factors important for innovation (institutional change, human resource building, infrastructural adaptations) are addressed. Here the MINAGRI Agricultural Innovation Coordination Unit would have the function of facilitating that initial relationships are brokered and consortia formed (see also function 4) and facilitating that these consortia are properly managed and develop sufficient 'social capital' to function independently.

In addition, there needs to be room for high-risk, high-ambition projects with a 10-20 year time horizon, which may be within priority areas, but there also needs to be space for experiments and 'blue sky' research which do not neatly fall within policy lines and incumbent practices in the sector. This function is also important for Chile to move from a country which has had an approach of 'catching-up' in terms of innovation (importing technologies and business models from elsewhere) to becoming a mature innovation system with strong innovation capacities, able to define and execute its own visions for innovation⁴⁰.

⁴⁰ As done earlier with help from World Bank; see: World Bank, 2011. Towards a Vision for Agricultural Innovation in Chile in 2030. World Bank, Washington D.C.

Supporting long-term strategy development and macro priority setting: roles of the think tank and high-level Advisory Council

In order to have a continuous capacity to articulate long-term innovation agendas, and also maintain the capability to generate 'fresh ideas', the installment of a combined think tank and experiments incubator is advised. Such a think tank would be closely connected to the MINAGRI Agricultural Innovation Coordination Unit, and is responsible for foresight studies, technology assessment and strategic intelligence (see also function 2). The think tank/experiments incubator can execute some of these studies itself but should, where possible and appropriate, contract these out to organizations well-equipped for this (e.g., national or international consultancy companies, universities, Fundación Chile). A competitive tender process should be held to choose an institution to manage the think tank. If it is decided that the think tank should remain close to MINAGRI, it could be located in INIA because its current activities are most aligned with the proposed think tank.

Such 'blue sky' research projects mentioned above could be developed under the coordination of the think tank/experiments incubator. The think tank/experiments incubator has the mandate to induce these projects, source funding for it, broker the networks of public and private actors to work on the projects by making connections within and outside the agricultural sector (for fresh ideas and making innovative combinations). The think tank/experiments incubator connects issues of public concern with private sector interests. See Box 2 with an example of what such a think tank/experiments incubator does.

Box 2. Paradigm shifts into practice: The Netherlands' InnovationNetwork and Systemic Innovation

The Innovation Network for Rural Areas and Agricultural Systems (InnovationNetwork) evolved from a more traditional research intermediary, the Dutch Council for Agricultural Research (NRLO), which was intended to set priorities for mid- and long-term research, representing users of research, government representatives, and researchers. In 1999, in response to a changing agricultural economy with a greater emphasis on sustainable development and specialization, the NRLO shifted focus to system innovations (i.e. a coherent package of product and process innovations that radically transform production systems and value chains), transitioning to become the InnovationNetwork in mid-2000. With the original objective of formulating options and priorities for mid- and long-term research unchanged, InnovationNetwork's principal activities include conducting foresight exercises, building networks (for development, diffusion, and implementation) and developing instruments and methods to jointly identify, develop and implement innovative opportunities⁴¹. The network supports early-stage innovation through relationship brokering, technical advice, and some funding with the objective to ensure that these radical new concepts are put into practice by interested parties. Several organizations targeting specific sub-sectors –Horticulture Innovation Foundation (SIGN), Courage (dairy sector), Kiemkracht (arable farming sector)⁴², among others– grew out of InnovationNetwork conceptualization and incubation; other 'concepts' are perpetually being developed through radical re-imagination via building partnerships and cross-fertilizing with concepts outside of the agricultural sector. The InnovationNetwork maintains an independent board of directors, yet advises the Ministry of Economic Affairs, Agriculture, and Innovation on a yearly basis and is funded by the Ministry.

Role of the high-level Advisory Council

A high-level Advisory Council consisting of key and high-level representatives from the scientific world, civil society realm and private sector advises strategy development, manages evaluation of the Unit, and ensures legitimacy. It ensures that the MINAGRI Agricultural Innovation Coordination Unit has high level connections with the realms it operates in. As is common in international experiences, this Advisory Council serves to represent the sectors, civil society, and other stakeholders by providing opinions on the policy recommendations of the MINAGRI Unit. The council assesses the proposals and activities of the MINAGRI Unit and makes recommendations to the Minister, who retains authority on policy decisions. This council may be created as a sub-committee from

the existing council Chile Potencia Alimentaria (see Section 3.4). This option would leverage the strengths of an existing structure while creating an opportunity to adjust the mandate and representation of the council. In this case, as the Minister chairs the broader council, the Subsecretary could chair the subcommittee. The Advisory Council manages the evaluation of the MINAGRI Agricultural Innovation Coordination Unit. The Advisory Council also suggests names of organizations to contract for the evaluation and drafts TORs for the Minister's approval.

See Box 3 with examples from the international case studies of different possible configurations and functions of such a council or committee.

⁴¹ Smits, R. and Kuhlmann S., 2004. The rise of systemic instruments in innovation policy. *International Journal of Foresight and Innovation Policy*, 1: 4–32.

⁴² See: <http://www.innovatieglastuinbouw.nl/engels/>, www.courage2025.nl, <http://www.innovatienetwerk.org/en/themas/toon/33/Kiemkracht.html>

Box 3. Advisory Committees to a Ministry

Ministry entities responsible for strategy development receive advice, solicited and unsolicited, from a number of organizations representing different stakeholders in the innovation system. Formally convened advisory committees that are appointed by the Ministry and advise on a regular basis serve a special function to reflect government, research institutions, and/or sector perspectives on the actions of the Ministry and impact on the innovation ecosystem. They provide an independent, multi-disciplinary, and whole-system vision of the Ministry strategy. They also can help to build trust with stakeholders in the innovation system through representing and communicating their priorities and increase the entity's legitimacy.

In practice, many formal advisory committees are not intended to be broadly representative of government, research, and private sector and instead focus on culling a specific perspective on the agricultural innovation system. In its first year of operation, Canada's Agri-Innovators Committee is part of a government-wide trend of prioritizing industry to set agricultural priorities. The Agri-Innovators Committee advises the Minister. Participants are mostly members of the private sector and are appointed by the Minister of Agriculture, while the committee is chaired by the Deputy Minister of Agriculture and Agri-Food Canada, the principal department overseen by the Minister of Agriculture. The Netherlands' Knowledge Chambers (Kenniskamers) are embedded in the Ministry of Economic Affairs, Agriculture, and Innovation and represent policymakers, scientists, and sector stakeholders, but focus on strengthening the relationship between research institutes and the Ministry and informing policy with science.

2) Research and innovation policy analysis, design and implementation

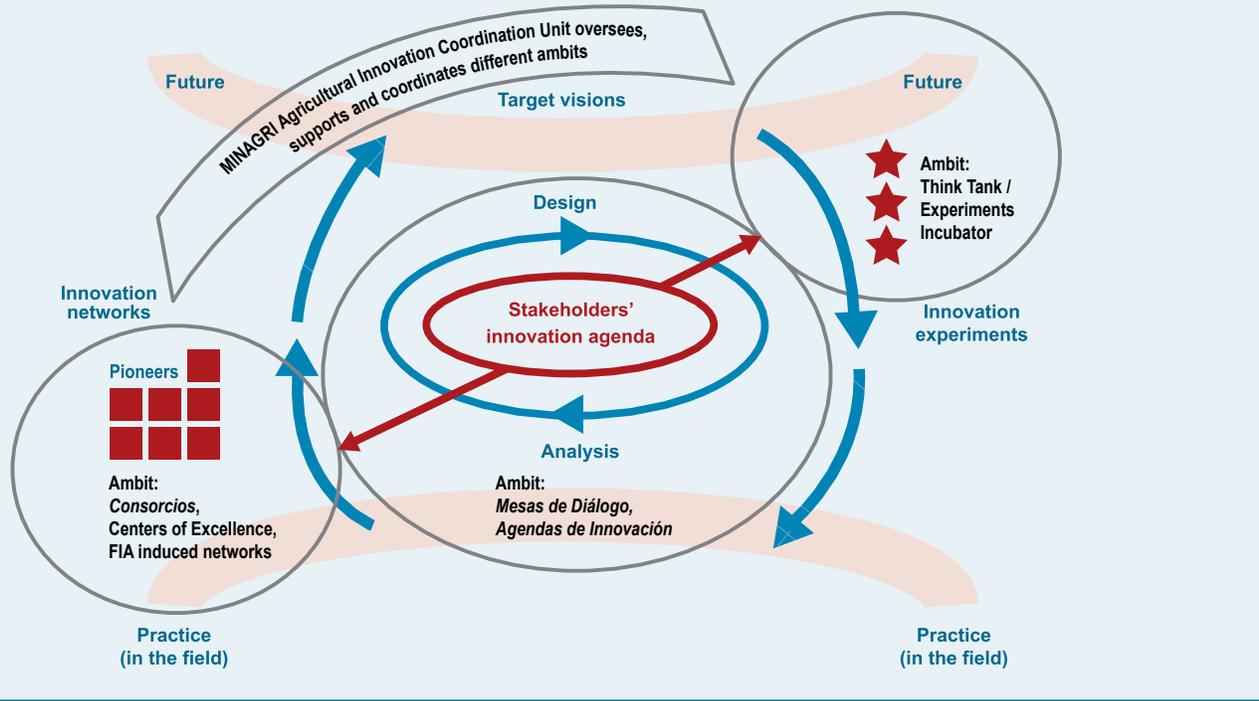
An important function of the MINAGRI Agricultural Innovation Coordination Unit, linked to objective 3 is to ensure evidence-based policy making. In order to do so, adequate information is needed about the functioning and effects of current policy and policy instruments, both those implemented in Chile by MINAGRI (i.e. monitoring and evaluating the different agencies connected to MINAGRI and the innovation programs executed through them), and experiences from elsewhere.

Evaluation needs to comprise both impact studies, but also (midterm) evaluation on innovation program functioning to learn how, for example, collaborative innovation can be better supported. The evaluation of the functioning and effects of the innovation policies and support instruments (e.g., the work of the different agencies, funding schemes) from MINAGRI could be done by a dedicated unit placed in

one of the MINAGRI's agencies (e.g., in ODEPA, or a social science unit within FIA, or could be contracted out to relevant organizations with the necessary expertise such as universities). Also, a collaboration with CORFO would be an option, since it already has innovation system evaluation schemes running which also include the agricultural sector. In international experiences, specific project evaluation is frequently contracted out while monitoring of projects is housed in a specialized unit within the Ministry. Sometimes specific financing programs are monitored and evaluated by the financing institution (see the New Zealand Primary Growth Partnership, Annex II, Section F), and specialized agencies for innovation like Chile's ODEPA (e.g., South Africa's Centre for Science, Technology, and Innovation Indicators) study the changes and impact of policies on the innovation system.

The task of the MINAGRI Agricultural Innovation Coordination Unit would be a) articulating the evaluation needs and developing the related terms of references to steer the actual

Figure 6. Connecting different ambition levels and time horizons – connections between the work of the think tank/experiments incubator⁴³ and thematic and sectoral consorcios



evaluations, and b) feeding back the results of the evaluation into policy making. In doing so, it is important that the evaluation feeds into the different types of innovation policy learning as outlined in Table 1, and induces adaptation and adjustment or reformulation of policies and related innovation policy instruments, when necessary. In The Netherlands, the Chief Scientific Officer and Knowledge Chambers serve this role of applying learning by strengthening policy with the latest science developments (see Annex I, The Netherlands).

Also here, there is a key role for the high-level Advisory Council to advise on adaptation and adjustment or reformulation of policies and related innovation policy instruments.

⁴³ Based on a figure by Vogelenzang and Wijnands, 2011. Working methodologically on system innovations. *Syscope Magazine*, Summer, 2011; see: http://www.wageningenur.nl/upload_mm/2/a/f/371b3837-0aca-4600-99b0-d8fe4a0aa362_Co%20innovation%202011.pdf

Experiences from elsewhere could be gathered by the earlier mentioned think tank/experiments incubator (see function 1) and this think tank/experiments incubator could also engage in Technology Assessment⁴⁴. The Advisory Council also manages the evaluation of the MINAGRI Agricultural Innovation Coordination Unit itself (see function 1).

3) Managing programs and resources, including innovation financing

A current weakness indicated in both earlier work⁴⁵, and also indicated by the stakeholders consulted for this study, is the fragmentation of

⁴⁴ Technology Assessment is defined as 'an applied process that considers the societal implications of technological change in order to influence policy to improve technology governance'. See: Vanclay, F.M., Russel, A.W., Kimber, J., 2013. Enhancing innovation in agriculture at the policy level: the potential contribution of technology assessment. *Land Use Policy*, 31: 406-411.

⁴⁵ World Bank, 2011. *Towards a Vision for Agricultural Innovation in Chile in 2030*. World Bank, Washington D.C.

resources and lack of a coherent programmatic approach. In relation to the priority areas developed in the long, medium and short term, coherent innovation programs should be developed as described under function 1.

In order to provide incentives to stakeholders (private sector, public innovation support agencies) to align with these priority areas and related innovation programs, a key function of the MINAGRI Agricultural Innovation Coordination Unit (linked with objective 2) is to make sure that appropriate funding lines are defined and made available. This follows up on the recommendations in an earlier study⁴⁶ on the increase of public funding levels and funding growth (matched with decentralized funds, private funds, foreign investment) and establishes differentiation of funding in order to enhance efficient use of funds.

A key task in this regard for the MINAGRI Agricultural Innovation Coordination Unit will be to a) get an overview of all the current funding lines available for the support of agricultural innovation from MINAGRI and from other public sources b) (re)organize funding in order to support priority areas and innovation programs. Such (re) organization can be done in several ways, and in most cases needs institutional and legal reform:

- Establishing what degree of core funding is needed for the different agencies (funding, PTI) in order to sustainably execute certain basic tasks and maintain critical mass (in terms of staffing, research infrastructure), and which part of the funding is distributed through competitive grants in line with priority areas and related innovation programs.

- Increasing decision-making authority on how funding is distributed to the agencies connected to MINAGRI (see Figure 4) by channeling funds coming from other sources through MINAGRI (e.g., as is currently done by the *Fondo de Innovación y Competitividad* –FIC, managed by the Ministry of Economic Affairs).
- Forging agreements with public funding sources such as CORFO and CONICYT on the earmarking of a certain share of their funds available to the agricultural and forestry sector and assign these to priority lines and specific R&D, education and innovation programs. For example, as previous World Bank studies have indicated⁴⁷, scientific capacity strengthening is a key issue, and training of MSc and PhD level students could be much more closely tied to priority lines, for example, by formulating specific PhD programs connected to *Consortios Tecnológicos* or Centers of Excellence⁴⁸, instead of having more open calls. PhD work would then go beyond training individuals, contribute to a larger goal and deliver concrete inputs to programs, or could also deal with agricultural innovation policy topics (e.g., assessing collaboration in Consortios), in support of function 2. This would imply negotiations on how generic mechanisms such as *Becas Chile* could be brought in line with these programs, or research funding could also be allocated to PhD project funding.
- Engaging organizations managing decentralized funding at the level of regions in priority setting processes, coupling national and regional funding streams to obtain more targeted funding for identified priority areas and related innovation

⁴⁶ World Bank, 2011. Chile's Agricultural Innovation System: An Action Plan Towards 2030. World Bank, Washington D.C.

⁴⁷ World Bank, 2011. Chile's Agricultural Innovation System: An Action Plan Towards 2030. World Bank, Washington D.C.

⁴⁸ For example, this modality is employed in the current International Centre of Excellence in Food led by Wageningen UR.

programs, and allowing to consider private sources of financing.

- Opening funding lines for international collaboration. This may be thought of in different ways: Specific funds may be made available for well-defined projects between a Chilean and an international partner; funding opportunities may be available to facilitate international participation across the range of instruments that the Unit will support; the Unit may facilitate international links and partnerships through its network and database.
- Assessing the legal possibility of levy-based (sub)sectoral innovation funds based on obligatory private contributions (as a percentage of production value, or based on farm size), with the possibility of public matching. Such levy-based funds are currently not legally possible. The emphasis of the Unit should be to develop measures to support sectors that want to establish such contributions.

In terms of the actual decision making on spending of funds, while the MINAGRI Agricultural Innovation Coordination Unit would draw out the boundaries and secure the overall budgets for main thematic areas and related innovation programs (supported by its Advisory Council), it would leave the management of these innovation programs to the responsible organizations. This includes the setting of the specific priorities within the broader thematic areas, selection of proposals, the decision making on funds allocation, and the monitoring of the correct spending of funds.

4) Innovation system management: *deconstructing the Chilean AIS through rationalization and constructing it through brokering of partnerships*

As stated earlier in this report, duplication, fragmentation and a high perceived degree

of bureaucracy in the Chilean AIS prevent coherence and synergy, and a key task of the MINAGRI Agricultural Innovation Coordination Unit is to reduce duplication and fragmentation. This requires a number of functions, linked to objectives 2 and 3.

A key function, also related to following up on outcomes of innovation policy evaluation as described under function 2, is organizing critical reflection on the adequacy of the diverse tasks and focus areas of the different public innovation support instruments (i.e. the agencies related to MINAGRI described in Section 3.1), as well as the task division between the different agencies. While this would be a continuous function, an initial task would be to induce an exercise to define what should be the core business of the different agencies, and how they relate to each other and other innovation support organizations (e.g., the stakeholders consulted indicated a need to assess and revise the task division and/or collaborative work between INIA and agronomy faculties of universities; between INFOR and CONAF; between ODEPA, FUCOA and CIREN; between FIA and CORFO-INNOVA; between INDAP and technology transfer units in universities, INIA, and sector organizations). This function thus aims to ensure that, from negative or passive horizontal coordination between MINAGRI agencies and organizations which perform similar functions as the MINAGRI agencies but do not fall under the control of MINAGRI, there is a gradual move towards positive horizontal coordination and eventually policy integration and strategic coordination (see Figure 3).

Another key function related to innovation system deconstruction, is assessing the current procedures for obtaining innovation support, as it has become obvious that stakeholders experience too much 'red tape'. The MINAGRI Agricultural Innovation Coordination Unit should streamline as much as possible the

different procedures and, to the extent that it is possible, engage in trust-based management. For example, formalities can be reduced in the case that there is proven management capability in projects or consortia and careful handling of funds. Connected to this issue is bringing in line the incentive and reward mechanisms with the expected core mission of an agency, so that these are not contradictory and counterproductive: for example, PTI indicated that their performance is increasingly assessed on the basis of peer reviewed publications, which takes away time for translating research results into publication for general audiences and participation in technology transfer and extension activities.

In terms of innovation system construction, regarding building relationships in order to be able to define priority areas and initiate actions in the long, medium and short term through targeted innovation programs as described under function 1, a key function of the MINAGRI Agricultural Innovation Coordination Unit is to make sure linkages are built between the different actors in the Chilean AIS, and also outward linkages with actors within the Chilean National Innovation System and abroad (combined vertical and horizontal coordination). This can be done in several (interrelated) ways:

- The MINAGRI Agricultural Innovation Coordination Unit can convene the actors for drawing up the programmatic lines (through, e.g., the organization of dialogues -mesas de diálogo-, or high-level events). It is important that a continuous facilitation of innovation programs is installed, so beyond facilitating initial network formation and funding, the Unit can enhance collaboration through improved communication, trust building, conflict resolution, etc.
- The MINAGRI Agricultural Innovation Coordination Unit can, in its operationalization of innovation programs

(see also function 1), stimulate collaborative working between public and private sector actors by means of regulatory requirements or financial incentives, e.g., prescribing a consortium approach as a requirement to obtain funding. It can also use different ways to connect to private sector initiatives, e.g., by matching funding, having a system of prizes for innovative endeavors, or organizing 'share fairs' events on innovation related themes that foster networking and matchmaking (see Annex II, Sections A and B for international experiences on financing and organizational strategies to involve the private sector).

5) Information management and knowledge sharing

This function is closely related to the previously described functions, and connects to objective 4. While coordination to a certain degree relies on personal networks and hence tacit knowledge sharing, there are a number of actions the MINAGRI Agricultural Innovation Coordination Unit can realize in order to improve information management and knowledge sharing:

- As ICT is a key tool to ensure information sharing and learning, and especially relevant in a country as Chile where distances are large, ICT to support innovation and to enhance the coordination of innovation support efforts is key. To enhance synergy, the Agricultural Innovation Coordination Unit needs to ensure that different information databases are connected or integrated, or that 'metaportals' are created, or that existing ones are better used, specifying the contribution of the different agencies to these (closely related to the function of ensuring an adequate task division as described under function 4).
- Create a simplified and, to the extent possible, unified formats for reporting

on progress and impact of projects and programs, and organize training for those responsible for reporting on using the desired format. This also implies connecting databases of different funding sources to exchange information on those that have obtained funding, as was suggested by stakeholders linked to the consulted funding agencies. New Zealand has strong online portals for research funding from various sources (see Annex I).

- In order to enhance knowledge sharing between the different coordinating entities (both the MINAGRI Agricultural Innovation Coordination Unit and the different delegated coordination entities of sectoral and thematic networks), in order to capture feedback, sharing of experiences, and learning about best practices in coordination, an ICT supported 'Community of Practice' could be formed⁴⁹.
- Following earlier recommendations⁵⁰ and also advised by stakeholders consulted from INIA, universities and the Consorcios, create a well-linked extension system, in which the MINAGRI Agricultural Innovation Coordination Unit would need to ensure a) adequate feedback links between research and extension providers (knowledge brokering to advisors, train-the-trainer functions in PTI), b) continued capacity building of the pluralistic system of advisors (extension training, quality assessment, certification) c) assessing the access of different types of farmers (large, medium, small) to extension services and ensure adequate programs (e.g., through Alianzas Productivas type programs, the proposed regional extension centers, the Grupos de

49 See: <http://www.kstoolkit.org/> for examples of different ICT based knowledge sharing tools.

50 World Bank, 2011. Chile's Agricultural Innovation System: An Action Plan Towards 2030. World Bank, Washington D.C.

Transferencia Tecnológica - GTT⁵¹). Mexico has a similar system of regional Centers for Evaluation of technology transfer (Annex I).

3.4 Positioning of the MINAGRI Agricultural Innovation Coordination Unit: Coordination with MINAGRI, the Chilean National Innovation System, and the Chilean AIS

The MINAGRI Agricultural Innovation Coordination Unit, resembling set-ups elsewhere as in The Netherlands' Agri-Knowledge Directorate or Canada's Innovation Policy Division within Agriculture and Agri-Food Canada (see Annex I), has its main operational unit embedded within the Ministry of Agriculture (see Figure 8). There are two options to set-up the Unit:

1. The Unit can be created as a department or sub-directorate of ODEPA as this agency is embedded at the central ministerial level and has coordination formally described in its existing mission statement (defined by the current law). It is then established by a formal resolution which ensures its sustainability. Though connected to ODEPA, the MINAGRI Agricultural Innovation Coordination Unit should position itself (through its branding, a separate physical location) as an independent entity to ensure a legitimate position as coordinator.
2. The Unit can be established directly within the Subsecretariat.

There are advantages and disadvantages for either option (Table 1):

While the current arrangements for public innovation policy management are ad hoc,

51 World Bank, 2011. Chile's Agricultural Innovation System: An Action Plan Towards 2030. World Bank, Washington D.C.

Table 1. Pros and cons of options to position the Agricultural Innovation Coordination Unit

Option	Pros	Cons
Within ODEPA	<ul style="list-style-type: none"> - Connects with mission statement of ODEPA - ODEPA has an institutional stability which enhances sustainability of the Unit 	<ul style="list-style-type: none"> - ODEPA cannot manage funding - The Unit will have a low position in the MINAGRI chain of command/hierarchy - The Unit will be at such a level that it cannot have a high-level Advisory Council
In the Subsecretariat	<ul style="list-style-type: none"> - Builds on three years of experience of Subsecretary advisors working on coordination - Direct authority over funding to agencies enhances steering capabilities - High position in the AIS hierarchy lends required authority to the Unit for coordination efficacy 	<ul style="list-style-type: none"> - Soft coordination may be hindered by strong hierarchical relationships and power over economic incentives - Legal construction is less solid and Unit may be more easily removed

they have functioned satisfactorily and have allowed the Ministry to progress in establishing policies. The recommendation is to maintain this informal arrangement until, possibly during the next administration, until legal steps have been completed for the establishment of a Directorate. To enhance continuity, it is recommended that the process of establishing a Directorate is initiated immediately and that the innovation directorate is explicitly considered in the transition briefing for the 2014-2018 administration.

In the medium and long term, creating the Coordination Unit as a Directorate within MINAGRI is preferable to either option for its hierarchical authority and political stability. However, the current MINAGRI law does not allow divisions such as the División de Innovación of the Chilean Ministry of Economic Affairs. While the legal process is underway to establish the legal possibility of such a Directorate, the existing coordination arrangement in the MINAGRI Subsecretariat can be developed into this unit. The law currently in preparation will redefine the form and tasks of MINAGRI, so that regardless of which option is chosen, in a few years when the new MINAGRI law is established the Unit can be made an independent division of MINAGRI. The key is to select the option that will allow for the

smoothest transition into an eventual directorate while developing political authority and continuity.

The Unit has a vertical coordination relationship with the different agencies related to MINAGRI, with the possibility to exercise steering through deliberation (soft coordination), through funding, and through backing by the Minister and the Subsecretary (hierarchical steering). With other organizations, such as private sector organizations, coordination can take place through dialogue and deliberation and, where needed, using regulatory instruments or economic incentives. It is important that the MINAGRI Agricultural Innovation Coordination Unit carefully chooses its main contact persons, i.e. the entry points to the organizations it works with. Ideally, people are chosen which have a sufficiently high level in their organizations (e.g., senior managers), but are not at the levels where there are frequent staff changes (e.g., directors' level), to ensure long-term relationships essential for effective coordination.

The MINAGRI Agricultural Innovation Coordination Unit, as discussed in Section 3.3, can gradually delegate the more operational coordination tasks ((sub)sector level, program

level, project level) to some of its agencies: set-up of topic or subsector specific priority setting, program development, program facilitation (which can be delegated to ODEPA⁵²), monitoring and evaluation of the AIS that can be delegated to an existing or new organization (e.g., FIA). Where desirable and/or complementary, the MINAGRI Agricultural Innovation Coordination Unit contracts out specific functions to third parties (such as consultancy companies, research institutes, from Chile or abroad). For its foresight, technology assessment and strategic intelligence functions it is supported by an affiliated think tank/experiments incubator.

To ensure high-level coordination and legitimacy within the Chilean National Innovation System and the Chilean AIS, the Unit is advised by a high-level Advisory Council (see function 1 in Section 3.3) presided by the Minister of Agriculture, consisting of directors of the following organizations:

- Sector organizations like ASOEX, Consorcio Lechero, FedeFruta, etc.
- Processing industry
- Civil society organizations (for issues such as, e.g., animal welfare)
- Universities
- Other ministries' innovation agencies
- Each MINAGRI agency (see Section 3.1)
- Key scientific and innovation experts from Chile (e.g., from CNIC, as these perform similar roles as the proposed Advisory Council) and from abroad

Most of the proposed stakeholders are already participating in the high level council Chile Potencia Alimentaria and to avoid setting up a parallel council, members from this same council can form a subcommittee to oversee the

⁵² Here, FIA would focus on short-term and mid-term programs (as the think tank/experiments incubator deals with the long-term programs), and has to be complementary to sector or topic specific coordination efforts already existing, such as Consorcios Tecnológicos and Consorcio Lechero, and fill gaps.

MINAGRI Agricultural Innovation Coordination Unit. The Advisory Council would include at least three members from the council Chile Potencia Alimentaria and five members from innovation-oriented organizations, public or private. Membership should also include regional representatives. It needs to be noted that the high-level Advisory Council will interact with the current separate advisory councils of the different MINAGRI agencies as some of its members will have shared positions. This will most probably also alter the functions of the advisory councils of the MINAGRI agencies.

On a more operational level, the MINAGRI Agricultural Innovation Coordination Unit can set up several working groups with relevant stakeholders from the Chilean National Innovation System and the Chilean AIS:

- A working group on the coordination of funding with representatives of other ministries and their funding agencies
- A working group with sectoral representatives on assessing the possibility and feasibility of levy-based research and innovation funding schemes
- A working group on the placement of the MINAGRI Innovation Unit in the proposed 'superministry' of science and innovation⁵³

These inter-ministerial working groups should feed into high-level committees such as the Comité Interministerial para la Innovación (CMI).

In order to effectively coordinate with the Chilean AIS as a whole, the Unit needs to ensure Chile's diverse agricultural regions are adequately represented in the national-level coordination process. In general, the Unit should aim to be regionally informed rather than decentralized.

⁵³ See: http://www.encuentrocientificointernacional.org_reportescienciaperu/201303marzomayo/Informe_Comision_Asesora_Presidencial_Institucionalidad_Ciencia_Tecnologia_e_Innovacion.pdf

The Unit should ensure the regions are able to contribute their priorities and perspectives to the national strategy development and give feedback on programs and policies. Federal-regional coordination can be achieved through ensuring at least three members of the Advisory Council represent the geographic diversity of Chile's territory beyond Santiago. These representatives may be from the public or private sector. Furthermore, the MINAGRI Agricultural

Innovation Coordination Unit should appoint one person in each subunit (three in total) tasked with managing regional linkages and communication. As part of function 3, the Unit's work in articulating streams of innovation funding should also account for regionally specific funding streams. The Unit may choose to establish additional structures for communicating with the regions. International experiences in regionalism are summarized in Box 4.

Box 4. Strategies to ensure regional representation in national AIS coordination

Chile can consider a number of strategies to ensure the regions are adequately represented in the AIS coordination. Many countries have experimented with varying degrees of devolution of control in priority-setting and of fiscal control in order to empower locally-driven and/or locally-informed agricultural innovation. In addition to regional representation in the Advisory Council and Coordination Unit, Chile may also consider additional structures to increase the communication with the regions.

Canada, like Chile, has a high degree of heterogeneity in its agricultural sector between provinces, making it complicated to set common priorities across the country. Canada has several strategies to balance regional autonomy and alignment. The agricultural sector has long been a joint responsibility between the province and federal government and a significant process of consensus building and deliberation precedes bilateral agreements between the provinces and the federal government on five-year agricultural policy plans. Financing is split on a 60-40 basis between the federal and provincial government. Canada's Value Chain Roundtables (VCRTs) were launched in 2003 as a kind of forum for regional stakeholder representation. The VCRTs convene industry leaders across one value chain with federal and provincial government policy makers; there are currently VCRTs for eleven value chains. Industry leaders set the agenda and the Ministry of Agriculture ensures roundtable priorities on policy and programs are communicated to inform its planning and decision-making. Another mechanism used in the province of Ontario is a research advisory network that provides long-term, strategic guidance for research program development and identifies short-term, emerging research priorities. A provincial advisory body identifies priorities specific for the province and an expert panel, comprised of members from across North America, provide perspective on emerging issues critical for progress (see Annex II, Section D for more information.)

Mexico's Produce Foundations are a well-known example balancing strategic and fiscal decentralization with national priorities. The Produce Foundations serve to increase farmer involvement in setting research priorities by giving such farmers a say in the allocation of funds at the state-level. Produce Foundations were established in each state to manage competitive funds for agricultural research and extension that solve their states' technological needs. Innovative, technologically advanced 'lead' farmers appointed to the research board of each Produce Foundation; state and federal government representatives serve on the board in an advisory role⁵⁴. Key to the success of such an approach is a strong monitoring system that can capture lessons from the diversity of experiments incubated through the foundations.

54 http://www.asti.cgiar.org/pdf/Mexico_CB41_En.pdf

3.5 Staffing and governance

The MINAGRI Agricultural Innovation Coordination Unit has three subunits which are interconnected (see Figure 7) and which cover both administrative and policy coordination (see Section 2.2) :

- strategy, program and capacity development (principally linked to function 1, with connections to functions 3, 4 and 5)
- innovation policy monitoring, evaluation, and adaptation (principally linked to function 2, with connections to function 1, 4 and 5)
- funding coordination, administration and control (principally linked to function 3, with connections to function 1 and 2)

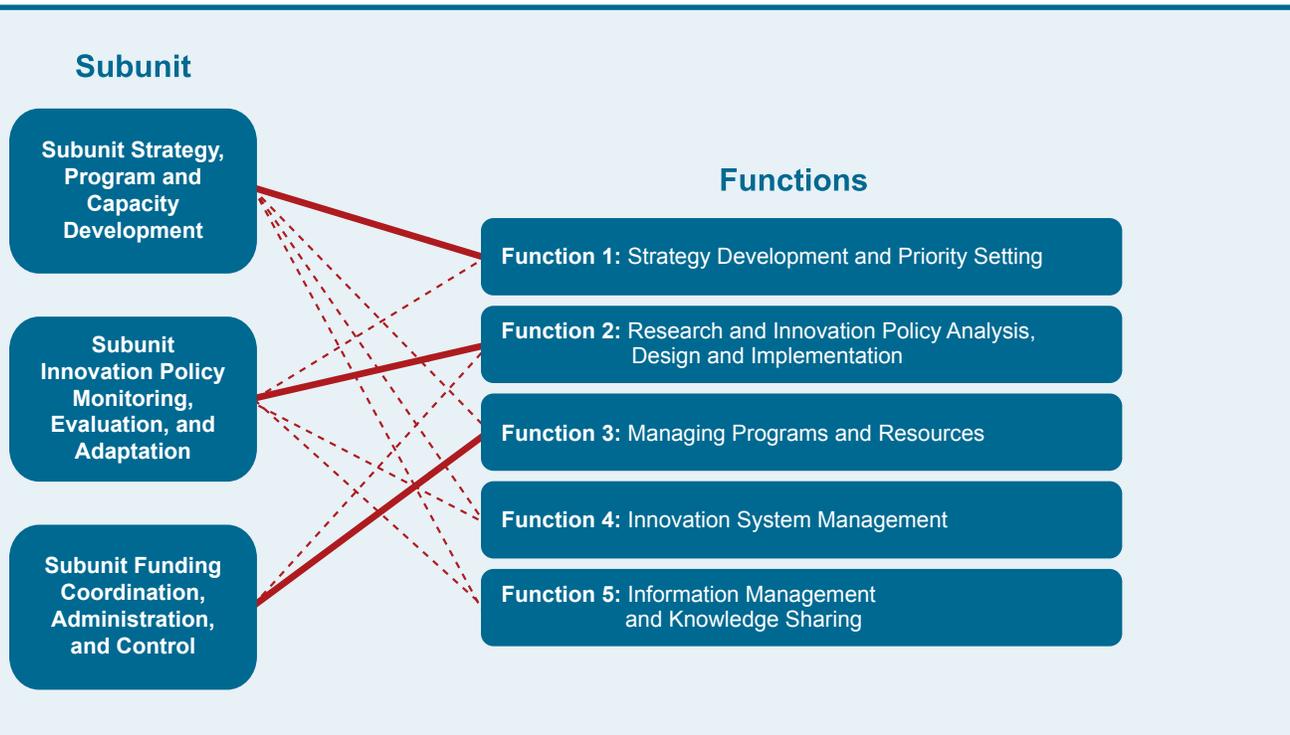
The Unit is led by a director, who can either be the same project manager who sets up the Unit (see Table 2), or it can be a senior person

selected by this project manager. Each subunit is staffed by three staff members (one senior staff member, a mid-career staff member, and a junior staff member) who possess the following characteristics and competences to gain the legitimacy to become effective as coordinators:

- sufficient specific sector knowledge and a good connection with practice, but also a holistic view
- knowledge on administrative procedures
- excellent networking skills
- pro-activeness
- diplomacy
- no explicit political orientation

The different subunits need to have a balanced staff composition in terms of having specific knowledge of the different priority sectors (e.g., horticulture, dairy, forestry), and specific knowledge related to the specific innovation coordination functions addressed by each subunit (e.g., research management, extension,

Figure 7. Functions of the subunits within the MINAGRI Agricultural Innovation Coordination Unit



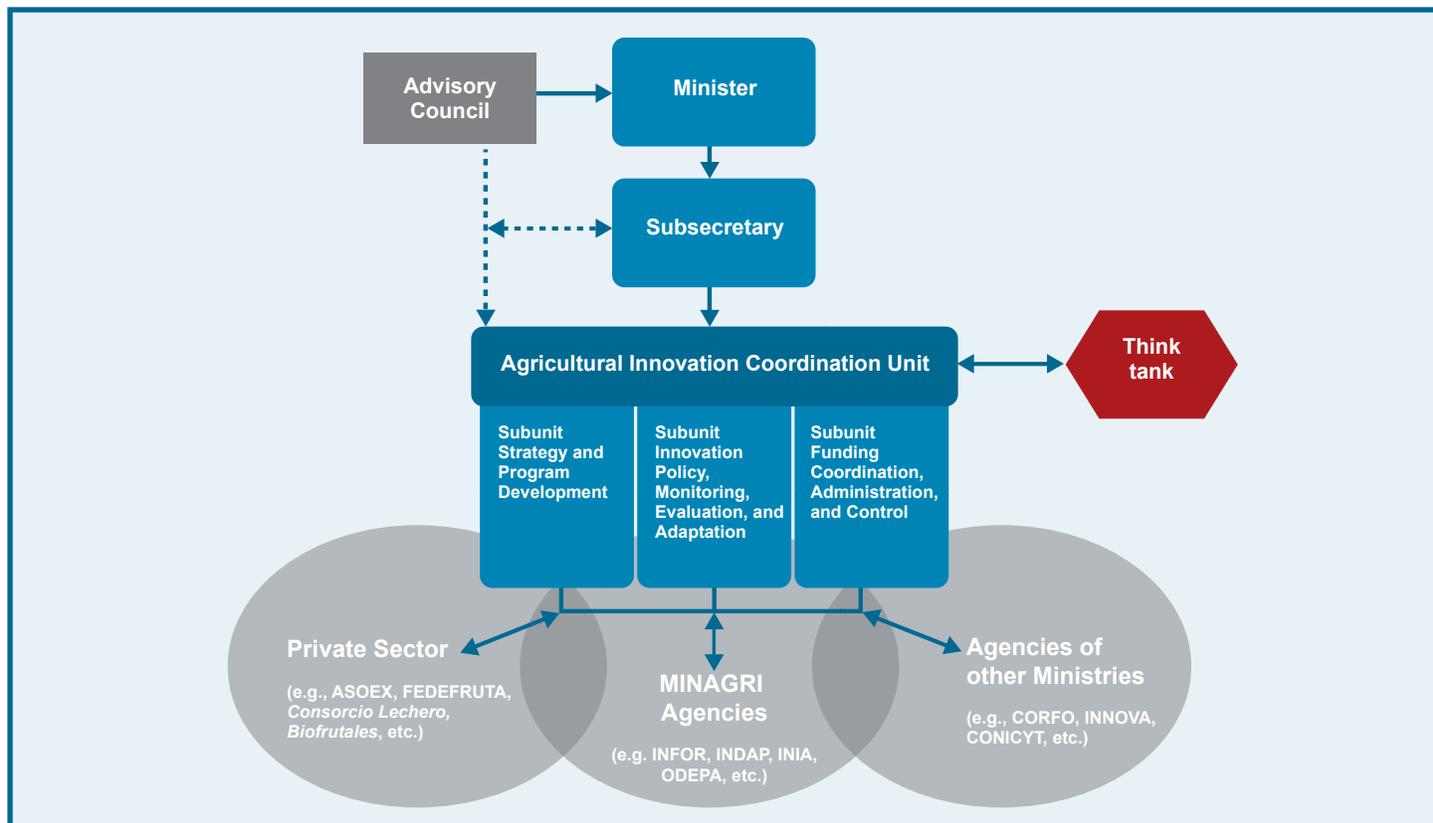
innovation funding, monitoring and evaluation). It might not be realistic to find all these characteristics and competences in a single person, but the overall composition of the think tank/experiments incubator should bring these together. If people with the required characteristics and competences already reside within MINAGRI or its agencies, the staff of the Unit can be recruited from existing staff which can then be seconded to the Unit. To ensure a rapid start of the MINAGRI Agricultural Innovation Coordination Unit, and have people with a thorough knowledge of the public innovation support structure, using existing staff would be the preferred option.

The think tank/experiments incubator is connected to the Unit but needs to have a degree of independence, and can be contracted out via a competitive call to an organization which has capacities in strategic innovation management

at the level of whole sectors or value chains (i.e. 'system innovation'). The think tank/experiments incubator gives input for strategy and program development and induces long-term innovation experiments. They act as 'honest brokers', using their independent position to broker networks to tackle innovation ambitions, and to make sure that these processes are informed by foresight, technology assessment, and scientific evidence. As their task is to influence the short and medium innovation activities in order to achieve a long-term agenda, they should make a bridge between future visions and current practices (see Figure 6).

The think tank/experiments incubator is composed by 5 permanent staff members, who engage for specific strategy development exercises and experiments with appropriate partners such as consultancy agencies, universities, and other Chilean think tanks and

Figure 8. Organizational chart of the MINAGRI Agricultural Innovation Coordination Unit



innovation facilitation organizations (e.g., CNIC, Fundación Chile⁵⁵, Consorcios Tecnológicos). Another possibility would be to connect the think tank/experiments incubator to the international Centers of Excellence, to be able to tap into expertise from elsewhere on how to shape long-term strategic innovation programs, and use both technical expertise and methodological skills (for visioning, strategic intelligence, innovation experiments)⁵⁶. International contacts are also important to identify opportunities for collaboration in specific innovation programs. It is important though to make sure that the think tank/experiments incubators get firmly rooted into the Chilean Agricultural Innovation System and that domestic capacities are developed.

The staff members should have the following characteristics and competences:

- excellent networking skills
- innovative mindset
- trend watching and scenario thinking capabilities
- risk taking and experimenting attitude
- facilitation, mediation and trust building skills
- design thinking

It might not be realistic to find all these characteristics and competences in a single person, but the overall composition of the think tank/experiments incubator should bring these together.

⁵⁵ See: Bell Jr, B. W. and C. Juma, 2007. Technology prospecting: Lessons from the early history of the Chile Foundation. *International Journal of Technology and Globalization*, 3(2-3): 296-314.

⁵⁶ For example, a connection could be made to the International Centre of Excellence in Food led by Wageningen UR, as this has specific agricultural sector experience, and has longstanding experience in system innovation approaches (see: Vogelenzang and Wijnands, 2011. Working methodologically on system innovations. *Syscope Magazine*, Summer 2011; see: http://www.wageningenur.nl/upload_mm/2/af/371b3837-0aca-4600-99b0-d8fe4a0aa362_Co%20innovation%202011.pdf), but also the other non-agricultural Centers of Excellence (led by e.g., the German Fraunhofer Institute or the Australian CSIRO) can offer value in this regard.

3.6 Estimated budget

As a new Unit is proposed, investments are needed in staff, office space, operational expenses. While this will require budget, the coordination by the Unit most likely will result in efficiency gains elsewhere, which would justify the investment. With a staffing of ten staff members for the MINAGRI Agricultural Innovation Coordination Unit and two support staff, as well as five staff members for the think tank/experiments incubator and one support staff, a total of 18 people are foreseen. Calculating an average of \$50,000 personnel costs and \$50,000 overhead, this would come to a total of \$1.8 million per year.

4. Implementation schedule: Next steps

4.1 Steps in realizing the MINAGRI Agricultural Innovation Coordination Unit

The proposed design for the MINAGRI Agricultural Innovation Coordination Unit points at different actions and initiatives at different levels of the innovation system. It requires changes internally at MINAGRI to set up and install the Unit. It requires defining a division of labor between the Unit and the different agencies related to MINAGRI (e.g., funding agencies, PTI) but also other innovation support instruments with relevance for the agricultural sector. It requires embedding in the broader innovation system by setting up the Advisory Council, so to engage in dialogue with sector organizations, universities, and innovation experts from abroad. It requires getting a good view on how existing coordination efforts can be integrated in the work of the MINAGRI Agricultural Innovation Coordination Unit, to avoid 'reinventing the wheel'.

Given that most of the consulted stakeholders work at the national level, and given the increasing delegation of tasks to regional governments, adequate follow-up consultation is needed to well incorporate the view of the regions (although also here the need for coordination is acknowledged, as was indicated by several stakeholders)⁵⁷.

Such consultation/validation will have at least three important benefits: first, the existing design for the MINAGRI Agricultural Innovation Coordination Unit can be confirmed or modified, thereby improving the chance of success and the

feeling of ownership of the Unit and acceptance of its tasks (which will affect the way of working of many organizations); secondly, the process may yield further actionable ideas that could be incorporated in the plan and, third, use can be made of the positive experiences so far. For the consultation and validation process, MINAGRI may consider a series of regional workshops and a set of further consultations with partners at the national level such as the Ministry of Economics, CORFO, CONICYT, the Ministry of Education, the National Society of Farmers (SNA), the major value chain and export associations.

In order to start setting up the MINAGRI Agricultural Innovation Coordination Unit, it is important that a project leader is appointed by MINAGRI who champions the set up of the Unit. This project leader could be recruited from or installed at the MINAGRI Subsecretariat, given its role in follow-up on the Action Plan 2030, or one of the agencies. Staff members can be seconded (comisión de servicio) from the MINAGRI agencies to build the initial team for a smoother transition. Once the Unit has been shaped, in order to give them hands-on experience, a study trip to one or several of the comparative case study countries could take place⁵⁸.

It is important that the existing momentum is maintained and that the Unit is quickly established and operationalized. To ensure continuity in the light of the upcoming change of administration it is recommended that the establishment of the Unit is included in the briefing material for the next administration. If

⁵⁷ These steps resemble and are inspired by earlier World Bank studies: World Bank, 2011. Chile's Agricultural Innovation System: An Action Plan Towards 2030.

⁵⁸ Given the proposed design, Canada and The Netherlands could be interesting options. Furthermore, hands-on support could be requested from the Unidad de Innovación of the Chilean Ministry of Economic Affairs.

so required, the World Bank will remain available for further support in developing the Unit and implementing other recommendations of this and the previous studies.

A roadmap with milestones is proposed in Table 2.

4.2 Evaluation of the usefulness of the Unit

The main purpose of the MINAGRI Agricultural Innovation Coordination Unit is to improve effectiveness, efficiency, coherence and synergy in the Chilean AIS. The process of achieving this will take several years, as it requires adaptations on part of the different stakeholders within MINAGRI and its related agencies, stakeholders of other Ministries and their agencies, as well as sectoral stakeholders.

‘The proof of the pudding is in the eating’, and hence it is important to assess the effectiveness and usefulness of the MINAGRI Agricultural Innovation Coordination Unit, taking into account that its implementation and the execution of the

different functions will also be a learning process which will take time. Also, some coordination activities (e.g., brokering relationships) are quite ‘intangible’ and difficult to measure. So sufficient time should be allowed for the MINAGRI Agricultural Innovation Coordination Unit to show its usefulness, and quantitative information should be complemented with qualitative information (e.g., narratives, showcases).

Some key indicators of the effectiveness and usefulness of the Unit include:

- Perceived reduction of overlap between PTI and other MINAGRI agencies
- Agreements on integrated funding streams with other Ministry’s agencies
- Development of 5 experimental innovation projects by the think tank/experiments incubator
- Integrated information available on AIS functioning from the M&E subunit
- Set up of 5 integrated innovation programs, comprising multi-disciplinary R&D programs

Table 2. Roadmap with milestones

Year	Milestones
2014	<ul style="list-style-type: none"> - further consultations have been finished and adaptations to design have been made - project leader has been appointed - staff of the Unit has been recruited - competitive tender process to select institution that will manage the think tank has been completed - staff of the think tank has been recruited - the Advisory Council has been composed and installed
2015	<ul style="list-style-type: none"> - study trip has taken place - assessment has been done of current funding streams, programs, task division of agencies and PTI and possibilities for integration and rationalization have been identified - operationalization of priority areas has taken place into long-term, medium-term and short-term action plans and corresponding innovation programs - reconfiguration of funding streams has taken place, for serving different purposes and innovation programs (core funding, competitive funding, levy-based funding) - agreements with other ministries have been forged on earmarking funding - implementers of delegated coordination at (sub)sector/topic/priority area have been identified and appointed
2016	<ul style="list-style-type: none"> - integration and rationalization of agencies and PTI - initiation of integrated innovation programs - external evaluation of the Unit has been contracted by the Advisory Council

- with related technology transfer activities, Consorcios Tecnológicos, Mesas de Diálogo
- Investments in the agricultural innovation system have been brought to the OECD average⁵⁹

The effectiveness and usefulness can be measured independently through a commissioned evaluation (establishing a baseline situation and measuring progress at regular intervals).

The recommendation is that after two years, the Unit be evaluated according to the following matrix, measuring to what extent has the Unit contributed to better policies, priorities, financing, public spending, knowledge sharing, and innovation agendas at the subsector level. At the time of the evaluation, more specific indicators can be defined for each of the cells in the matrix, depending on the activities undertaken by the Unit.

The evaluation process will be initiated by the Advisory Council, which will propose names and terms of reference of a small panel to the Minister, and upon his approval, will be the first point of contact for the evaluation panel.

It is also important that the MINAGRI Agricultural Innovation Coordination Unit installs a process in which it reflects on the dilemmas it encounters in its coordination tasks, to be able to find a right balance. Some dilemmas are listed in Box 5.

Public Management Parameters	More effective	More efficient	More coherent	Greater synergy
Innovation Policies				
Innovation Priorities				
Overall Innovation Financing				
Public Innovation Budgets				
Knowledge Sharing				
Sub-Sector Innovation Agendas				

⁵⁹ See also: World Bank, 2011. Chile's Agricultural Innovation System: An Action Plan Towards 2030. World Bank, Washington, D.C.

Box 5. Some probable risks and dilemmas in the coordination tasks of the MINAGRI Agricultural Innovation Unit

Risk/dilemma	Measures to mitigate risk
- Balance hierarchical steering plus economic incentives and soft-coordination: too much reliance on the former may counteract the effectiveness of soft coordination based on trust and self-organization	- Experiment on a small scale with soft coordination before expanding this practice - Move to soft coordination after proven good conduct
- Balance trust and control: a degree of trust is needed to enable positive coordination and policy integration, but in the ambit of administrative coordination control to achieve transparency and accountability is also needed	- Develop monitoring and evaluation mechanisms which reduce administrative burden
- Balance continuity and change: the priority lines require long-term attention, but they also operate within an environment which may experience political turbulence and may mean that key individuals are changed	- Ensure that the MINAGRI Agricultural Innovation Coordination Unit has an independent status, and that also the Advisory Council remains as stable as possible
- Balance established priority lines and continuous room for experimentation: to guide investments, priority lines need to be followed, but this should not be a straitjacket which does not allow for some free space	- Give the think tank/experiments incubators room to diverge from policy lines - Have an active strategic intelligence function - Have 'fresh minds' from outside Chile in the Advisory Council
- Balance creative diversity and fragmentation: not all fragmentation is bad, as it also allows for the emergence of slightly (or radically) different approaches to tackle specific problems and challenges, which enlarges the solution space	- Make use of the regional diversity working within the overall priority areas - Create parallel programs on similar issues with slightly different approaches (portfolio of promises)
- Balance incumbents with established interests and deviants with new thinking: representation enhances ownership but may also lead to compromises which do not offer real solutions and maintain a situation of 'lock-in', hence deviant ideas also need to be fostered	- Give the think tank/experiments incubators room to diverge from policy lines - Have an active strategic intelligence function - Have 'fresh minds' from outside Chile in the Advisory Council
- Balance involvement of coordination entities with self-organization of sectors, <i>Consortios</i> , etc.: avoid superfluous structures – so withdraw when coordination becomes self-organized	- Have adequate M&E - Delegate as much as possible when things move well - Be transparent about role coordinating entities and manage expectations
- Balance dialogue and stakeholder involvement with painful rationalization measures	- Be transparent and communicate about the need for change - Induce a gradual transition when possible - Make use of crisis moments

Annexes

Annexes I-III serve to capture insights relevant for MINAGRI from international experiences coordinating agricultural innovation systems (AIS). Canada, Mexico, The Netherlands, New Zealand, and South Africa were chosen for their relevance to Chile given the similarity in size and structure of their agri-food economy and their creative approaches to the AIS challenges that Chile also faces.

Annex I focuses on the governance of the 'core network' of coordinating bodies in the AIS. This Annex describes the roles and relationships that comprise the system and identifies how the five functions of the proposed MINAGRI Directorate for Innovation (provided in Chapter 3) are executed in the AIS of the case countries.

Annex II focuses on key thematic challenges in the design of an agricultural innovation coordinating unit. Noteworthy initiatives and creative approaches to several key challenges are highlighted: a) financing innovation (including co-financing, public-private partnerships, competitive funds, levy-based funding mechanisms), b) harnessing the creativity of the private sector (top sectors approach, sector-driven research planning, farmer-driven funds, and value chain roundtables), c) keeping the AIS fresh and maintaining the ability to evolve with the sector, d) balancing regional autonomy with centralized coordination, e) involving small farmers in the AIS, and f) methods for monitoring and evaluation.

Annex III provides information about the staffing and positioning of the Ministry-level coordinating units most comparable to the MINAGRI Agricultural Innovation Coordination Unit proposed in this report.

Annex I.

Governance of the core coordinating network: Roles and relationships

The governance of the core network (see Section 2.1 of the main report), understood as the mechanisms by which decisions are made, is reviewed for each of the case study countries, describing the roles and relationships of each of these actors within the system. Most of the countries' core networks include a Ministry AIS coordinating unit similar to the one proposed in this report but also involve other entities, public and private, that influence the AIS agenda. An overview of these entities for all five countries, grouped by the level of coordination at which they work, is provided in the table below.

Case Country	Ministry-level coordination	Advisory Committees to Ministry-level	Agency-level Coordination	Industry-level Coordination ⁶⁰
Canada	Agriculture and Agri-Food Canada (AAFC) Provincial Ministry of Agriculture offices (e.g., Ontario Ministry of Agriculture and Food, OMAFRA)	Agri-Innovators Committee Canadian Agricultural Innovation and Regulation Network (CAIRN) ⁶¹	Provincial departments of agriculture (e.g., OMAFRA Research Advisory Network)	Value Chain Roundtables ⁶²
Mexico ⁶³	Ministry of Agriculture (SAGARPA)	National Research and Technology Transfer System (SNITT) Inter-Sectoral Commission on Innovation Inter-Sectoral Commission on Sustainable Rural Development National Council of Science and Technology (CONACYT)	National Coordinating Agency for Produce Foundations (COFUPRO) ⁶⁴	Produce Foundations
The Netherlands	Ministry of Economics, Agriculture, and Innovation	Knowledge Chambers Advisory Council for Science and Technology ⁶⁵ The Council for Environment and Infrastructure ⁶⁶ Chief Scientific Officers InnovationNetwork	Innovation Network	Top Sectors Bioconnect (among others) Levy-based funding mechanisms

New Zealand	Ministry of Business, Innovation, and Employment (MBIE) Ministry of Primary Industries (MPI)	MBIE Science Board ⁶⁷		Primary Growth Partnership Callaghan Innovation NZBIO ⁶⁸ New Zealand Trade and Enterprise (NZTE) ⁶⁹ Food Innovation Network of New Zealand ⁷⁰
South Africa	Department of Science and Technology (DST) Department of Agriculture, Forestry, and Fisheries (DAFF)	National Advisory Council on Innovation (NACI) National Agricultural Research Forum (NARF) Centre for Science, Technology and Innovation Indicators (CeSTII) ⁷¹ Agricultural Research Council (ARC)	Technology Innovation Agency (TIA)	Technology Innovation Agency (TIA)

What can be noted in all cases is that AIS coordination is never done by a single unit: it is always a core network. All of the elements of coordination are never contained by a single entity. Instead these functions are actively delegated to government agencies, councils made up of diverse stakeholders, and some private sector organizations (e.g., Bioconnect or NZBIO).

60 Numerous private sector groups are organized in each sector to provide input to the coordination of the agricultural innovation system. For the purposes of this table, the list is not exhaustive but rather highlights a few key examples.

61 http://www.ag-innovation.usask.ca/cairn_about

62 <http://www.ats-sea.agr.gc.ca/rt-tr/index-eng.htm>

63 <http://www.asti.cgiar.org/mexico/profile> for more information on actors in agricultural research and development in Mexico. Directory of Agricultural R&D agencies, including contact information: <http://www.asti.cgiar.org/mexico/directory>

64 http://www.cofupro.org.mx/cofupro/cofupro_web.php?documentweb=2&idseccion=5

65 www.awt.nl

66 <http://en.rli.nl/>

67 <http://www.msi.govt.nz/about-us/science-board/>

68 <http://www.nzbio.org.nz>

69 <http://www.nzte.govt.nz/en/about-us/>

70 <http://www.foodinnovationnetwork.co.nz/who-we-are/networks/>

71 <http://www.nstf.org.za/ShowProperty?nodePath=/NSTF%20Repository/NSTF/files/PlenaryMeetings/2012/STISurveys.pdf>

This Annex uses the five key coordination functions identified in Chapter 3 to analyze the roles of the main organizations in each country's core network. The five functions are:

1. Strategy development and priority setting
2. Research and innovation policy analysis, design, and implementation
3. Managing programs and resources, including innovation financing
4. Innovation system management (define roles, induce reform, streamline procedures, catalyze consortia and networks of innovation)
5. Information management and knowledge sharing

Despite differing emphases in agricultural innovation (e.g., commercialization, private sector investment, or poverty alleviation) coordination of the AIS is a concern for each country. Each has developed a unique set of solutions, yielding diverse institutions, organizational structures, and programs. In many cases, there is a centralized unit, often within a Ministry, that is responsible for this delegation. The Netherlands' Agri-Knowledge Directorate and Canada's Innovation Policy Branch are most similar to the MINAGRI Agricultural Innovation Coordination Unit proposed in this report. Both are a division of the equivalent Ministry of Agriculture and work on all five of the key coordination functions, though many of the functions are also delegated. Other countries rely on councils to advise the Ministry on coordination, like South Africa's National Agricultural Research Forum (NARF) and Mexico's National System for Research and Technology Transfer (SNITT). These two bodies rely on soft coordination and do not implement projects, resulting in less hierarchical authority.

Strategy development and priority setting for agricultural innovation is centralized in a division of the Ministry, but in many cases consensus building between the regions and the national level takes place, as in the case of Canada, South Africa, and Mexico. Each country's AIS features councils and advisory bodies that provide perspectives from different stakeholder groups. In many cases a number of councils exist (especially in Canada, The Netherlands, South Africa), each advising the Ministry on strategy and policy given a certain priority theme or aspect of innovation (see Chapter 3, Box 3).

In each country, separate bodies coordinate general innovation and agricultural sector innovation. It has been challenging for many countries to define this relationship, capitalize on collaboration, and avoid duplication. In Mexico, two high-level councils that convene representatives from several ministries operate in parallel with limited communication, though both discuss agricultural innovation. South Africa has a national-level advisory council on innovation across sectors that currently only advises the Minister of Science and Technology; the advisory council is developing a platform to meet regularly with the other Ministers. In many cases, agricultural innovation is taken up by two units in two different ministries; in New Zealand and South Africa, both the equivalent Ministry of Agriculture and Ministry of Science and Technology have units that deal with agricultural innovation. In New Zealand, these two units are leveraging their distinct assets and networks, collaborating on a matching-fund program called the Primary Growth Partnership.

The private sector and civil society participate and influence priority setting; numerous industry lobbies and representative associations exist to coordinate the private sector. The task of the government is to facilitate this participation. The government can support this activity through financing innovation, catalyzing consortia and other forms of organization and representation, and designing channels to

solicit feedback from sectors (experiences in working with the private sector from the case countries are described in Annex II, Sections A and B.) In all countries, coordination units need to balance public and private interests, and each country defines these groups and determines its own priorities. Mexico and South Africa, for example, are more oriented towards public research and economic inclusion, whereas New Zealand and Canada are actively striving to increase private sector investment in agricultural innovation.

This Annex goes on to describe the key actors, roles, and relationships within each case countries' AIS, using the five key coordination functions as the operative framework.

Canada

Canada's AIS has recently been emphasizing investments and institutions to increase participation of the private sector. Active industry participation in the AIS has been encouraged with the intention of closing Canada's 'commercialization gap', cited as a greater challenge than its science and research. Several key initiatives support the private sector: the Agri-Science Clusters, competitive funding for industry-led research projects; Value Chain Roundtables to influence strategy on given value chains; and a Minister-appointed Agri-Innovators Committee, an industry advisory group to the Minister. However, problems have arisen when rapid changes including cuts to the public sector have been implemented with the mistaken expectation that the private sector would be able to assume responsibility. Coordination failures within the private sector prevented rapid absorption of some of these cut positions. Reform has occasionally outpaced the private sector's ability to self-organize.

A small domestic market, large and stable dependency on exports to the U.S. and a consensus-oriented culture that is reluctant to 'pick winners' have been cited as barriers to innovation in Canada. Partially in an effort to bring in international perspectives, Canada has established the Canadian Agricultural Innovation Network (CAIRN) composed of national and international researchers that are funded to study the Canadian AIS.

Agriculture in Canada is a joint-responsibility between provinces and the federal government, and agricultural strategy is developed, financed, and implemented jointly. Canada's heterogeneous agro-climatic zones and a high degree of provincial autonomy make it difficult to set common priorities for agricultural innovation across the country, but institutions and programs have been developed to balance a federal perspective with regional priorities. Still, some government organizations are criticized for bias towards certain regions.

Canada's Minister of Agriculture oversees several departments, the largest of which is Agriculture and Agri-Food Canada (AAFC), which develops strategy for the sector and executes programs.

Function 1: Strategy development and priority setting	Function 2: Research and innovation policy analysis, design, and implementation	Function 3: Managing programs and resources	Function 4: Innovation system management	Function 5: Information management and knowledge sharing
AAFC consensus-building process between provinces and federal government Provincial level example: OMAFRA Research Advisory Network	Innovation Policy Division (of AAFC) Canada Agricultural Innovation Research Network (CAIRN) Agri-Innovators Committee	AAFC federal and regional offices	Innovation Policy Division (of AAFC) CAIRN	Innovation Policy Division (of AAFC)

Function 1: Strategy development and priority setting

Canada balances regional and federal demands on the agricultural sector through an extensive 18-month consensus-building process that involves regional and national consultations, publications, and focus groups. Through this process the federal government and the provinces negotiate **bilateral agreements** to define the agricultural development package for the province. Programs are cost-shared 60% by the federal government and 40% by the provincial government⁷². The federal policy frameworks **Growing Forward 1 and 2** set the agenda for development plans for the agricultural sector at the national level in five-year periods.

At the provincial level, groups like the **OMAFRA Research Advisory Network (ORAN)** in Ontario set regional research priorities in a process that balances input from the regional agricultural Ministry (Ontario Ministry of Agriculture, OMAFRA), an external scientific expert panel with members from all of North America, and a mixed thematic panel made up of industry, university, and government leaders. Research professors select a theme from the priorities determined through this process and competitively propose projects for funding in accordance with the theme. Project performance is then monitored by the thematic group (see Annex II, Section D for more information).

Two principal committees represent stakeholders and advise the Minister of Agriculture. In its first year of operation, the **Agri-Innovators Committee** primarily represents the private sector. Members are selected by the Minister, while the committee is chaired by the Deputy Minister (and director of AAFC). CAIRN is a research network that advises AAFC. Its objective is to increase understanding of agricultural innovation and aid in the development of public policy and regulation to support innovation in the Canadian agriculture and food sector.

⁷² <http://www.agr.gc.ca/eng/about-us/partners-and-agencies/meetings-of-federal-provincial-and-territorial-ministers-of-agriculture/?id=1173979162358>

Function 2: Policy analysis, design, and implementation

The Innovation Policy Division in the AAFC is responsible for research and policy analysis on innovation. It advises other programs and other branches of the AAFC, employing a 'challenge function' to evaluate other programs of AAFC for their impact, intentional or not, on agricultural innovation. The Innovation Policy Division advises the Deputy Minister and senior management of AAFC. Internal monitoring and evaluation of AAFC activities is the responsibility of the **Program Branch** of AAFC. The **Research and Analysis Directorate** of AAFC, staffed by economists, monitors performance indicators for AAFC innovation activities.

An important role of **CAIRN** is to conduct analysis on the innovation system. CAIRN brings researchers together to study the processes of agricultural innovation while proactively engaging government, industry, and the public in an effort to improve the agricultural innovation system in Canada⁷³. CAIRN researchers conduct policy analysis including industry coordination and commercialization, regulatory systems analysis, and innovation impact and measurement. This is a body established in 2004 that has 37 members from across Canada, the U.S., and Europe representing academic, government, and private institutions.

Function 3: Managing programs and resources

The **Program Branch** of AAFC manages the Growing Forward programs at the federal level. Key programs include the industry-led innovation financing program based around Agri-Science Clusters, described further in Annex II. **Provincial AAFC offices** manage programs and resources assigned in the cost-sharing Growing Forward agreements.

Function 4: Innovation system management

The **Innovation Policy Team** monitors and analyses the functioning of the AIS as a whole while working to facilitate relationships between actors in the system.

Function 5: Information management and knowledge sharing

AAFC maintains a comprehensive website on science and innovation in Canada's agricultural sector, providing information on current research projects, scientific staff and expertise, technology transfer and licensing, among other relevant topics⁷⁴.

Key lessons

Canada has well-developed functions for centralized and decentralized priority setting and, through AAFC and CAIRN, has especially strong capabilities for innovation systems management and M&E. CAIRN makes possible independent research on Canada AIS policy from diverse researchers, including from abroad, though it has been criticized for a bias towards Western Canada. Influence from the private sector is strong on government strategy and investments, but funding for basic/upstream research (through AAFC, private institutes, and universities) remains relatively consistent. OMAFRA demonstrates an effective competitive system of balancing regional priorities with industry demand, informing these thematic priorities with scientific expertise, and maintaining a broader perspective with geographically diverse representatives including international participants.

⁷³ http://www.ag-innovation.usask.ca/cairn_about/index.html

⁷⁴ <http://www.agr.gc.ca/eng/science-and-innovation/?id=1360882179814>

Mexico

In contrast to Canada, Mexico's AIS features lower participation of the private sector, with government supporting research that tends to orient towards academia rather than the market. Mexico's AIS features a strong role of public research universities and institutes, with 54% of agricultural researchers employed by a university⁷⁵. As for coordination of the AIS, the core network of coordinating entities is extensive and complex, with multiple coordinating entities whose roles are often duplicated⁷⁶. The numerous coordinating actors (the two inter-sectoral commissions, SNITT, and the SAGARPA Directorate) in practice tend to coordinate passively rather than actively, with roles and hierarchy not particularly clear; an IICA diagnostic⁷⁷ concluded that Mexico's national system of agricultural innovation struggles with a high degree of fragmentation.

Function 1: Strategy development and priority setting	Function 2: Research and innovation policy analysis, design, and implementation	Function 3: Managing programs and resources	Function 4: Innovation system management	Function 5: Information management and knowledge sharing
COFUPRO Directorate of Productivity and Technological Development (SAGARPA) Inter-Sectoral Commission on Sustainable Rural Development Inter-Sectoral Commission on Innovation Council of Sustainable Rural Development	Directorate of Productivity and Technological Development (SAGARPA) State Centers of Evaluation CONACYT	COFUPRO CONACYT	COFUPRO SNITT	COFUPRO SNITT Knowledge Management System (SIAC) ⁷⁸

Function 1: Strategy development and priority setting

The main entity responsible for setting priorities for agricultural innovation policy and programs is the **Directorate of Productivity and Technological Development**, a division of the Secretariat of Agriculture, Livestock, Rural Development, Fisheries, and Food (SAGARPA). Within this directorate, there is a director of support for agricultural production, under which there is a subdirector of research

75 http://www.asti.cgiar.org/pdf/Mexico_CB41_En.pdf

76 <http://www.iica.int/Esp/regiones/norte/mexico/Publicaciones%20de%20la%20Oficina/Innovacion%20Agroalimentaria%20final.pdf>

77 http://www.redinnovagro.in/documentosinnov/IICA%20SNIA_M%C3%A9xico_ingl%C3%A9s.pdf

78 <http://www.siac.org.mx/?documentweb=5&idseccion=17>

and technology transfer. This subdirector oversees three departments: scientific and technological innovation, integration of reports, and agricultural research.

Policy priorities for rural development more generally are established in a legal framework with the Law of Sustainable Rural Development. The **Inter-Sectoral Commission on Sustainable Rural Development**, led by SAGARPA with the participation of several other secretariats, oversees the translation of these goals into policy. A **Council of Sustainable Rural Development**, comprised of members of the government, research institutes, and the private sector, also advises this commission.

The **Inter-Sectoral Commission on Innovation** (led by CONACYT, Secretariat of Public Education, and Secretariat of the Economy, with the participation of SAGARPA and other secretariats) establishes priorities in innovation across sectors, but integration with agriculture is very weak. Both inter-sectoral commissions have suffered from poor leadership and not been very effective in aligning priorities between the two. The new administration is beginning to develop a new policy framework, holding open dialogs with stakeholders in a process led by SAGARPA, but future changes are unpredictable.

Priority-setting at the regional level is done by the **Produce Foundations**. Each state has its own Produce Foundation which involves representation from leaders of each of the priority supply chains of the state. They meet, along with state and federal government representatives who have a voice but no vote, to determine the innovation agenda on an annual basis.

The **National System of Innovation and Technology Transfer (SNITT)**, a group of 10-15 government functionaries appointed by SAGARPA, was created to advise the Directorate. The Law of Sustainable Rural Development declared the creation of a mechanism for coordinating the agricultural innovation system, not an organization, but in practice SNITT is both coordinating network and small organization. SNITT receives direction from the Inter-Sectoral Commission for Sustainable Rural Development. Though SNITT personnel tend to have government backgrounds, the SNITT advisory council involves representatives from the government, research institutions, and private sector. SNITT has faced some challenges. Its resources and administration are the responsibility of COFUPRO since no budget is laid out by law. In practice, in terms of setting priorities, it operates subordinated to the SAGARPA Directorate⁷⁹.

A system of **state evaluation centers** evaluates technology transfer and technical assistance, contributing to policy design.

Function 2: Policy analysis, design, and implementation

Policy analysis and design is under the responsibility of the General Directorate of Productivity and Technological Development and implemented by COFUPRO.

Function 3: Managing programs and resources

SNITT and COFUPRO each administer a fund from SAGARPA for agricultural innovation. The Sector Fund for Agricultural Research, managed by **SNITT**, distributes competitive funds from the National Council for Technology (CONACYT) primarily for technological innovation and research⁸⁰. The second principal

⁷⁹ <http://www.iica.int/Esp/regiones/norte/mexico/Publicaciones%20de%20la%20Oficina/Innovacion%20Agroalimentaria%20final.pdf>

⁸⁰ <http://www.conacyt.gob.mx/FondosyApoyos/Sectoriales/Paginas/default.aspx>

fund, the Subprogram for Research and Technology Transfer, is managed by the **National Coordinating Agency for Produce Foundations (COFUPRO)**, whereby farmers' associations commission research on specific themes of their choosing for the Produce Foundation of their state (see Annex II for more information on Produce Foundations). The objective of this fund is to prioritize research that solves technological problems at the state level.

Function 4: Innovation system management

The mandate of SNITT is to coordinate the different sectors involved in agricultural innovation and broker relationships between actors. COFUPRO oversees the system of Produce Foundations, of which there is one for each state of Mexico based on producer demand⁸¹. COFUPRO represents the Produce Foundations and negotiates with SAGARPA for funding.

Function 5: Information management and knowledge sharing

COFUPRO plays a role in capturing and diffusing lessons learned from the individual states' Produce Foundations. COFUPRO develops methodologies and systems that help to homogenize the national process of innovation management⁸². SNITT collaborates with COFUPRO to disseminate information through the production of educational materials and holding workshops⁸³. Its **Information System for Knowledge Management (SIAC)** serves to share new technologies, knowledge, and successful case studies from the agricultural innovation system.

Key lessons

Mexico's AIS coordination, particularly in the area of priority-setting, tends to be passive in practice as multiple government bodies inhabit an unclear hierarchy and accommodate each other's actions. SNITT was created by federal law to coordinate the actors in the AIS but in practice did not achieve the hierarchical authority over many of the main actors. Originally designed as a network with no formal budget, SNITT evolved into a small organization. People interviewed stated that SNITT is actually managed by COFUPRO and seen as subordinate to the SAGARPA Directorate for Productivity and Technological Development. Staffing decisions did not help: SNITT was mostly composed of people from within the government and upon its creation had trouble establishing legitimacy as a fresh coordinating body able to forge new relationships with actors in the AIS. SNITT's principal role is seen as information dissemination.

The two commissions related to agricultural innovation (Commission for Sustainable Rural Development and Commission for Technology and Innovation) do not meet regularly and do not have mechanisms for interacting with one another. Though their mandate is to translate two federal laws into policy, they, like SNITT, are also embedded at the Ministry level without strong pathways to seek input from other actors in the system. The sectors are therefore weakly integrated into the system, without national representation in priority setting or steering research through control of funding.

However, at the regional level, Produce Foundations exemplify participatory priority-setting involving local stakeholders. The Produce Foundations enable farmer associations to direct funds for agricultural

81 Vera-Cruz, A. O., G. Dutrénit, J. Ekboir, G. Martínez, and A. Torres-Vargas, 2008. Virtues and limits of competitive funds to finance research and innovation: The case of Mexican agriculture. *Science and Public Policy*, 35(7):501-513.

82 <http://www.iica.int/Esp/regiones/norte/mexico/Publicaciones%20de%20la%20Oficina/Innovacion%20Agroalimentaria%20final.pdf>

83 Mauricio Lastra, Personal Communication, August 21, 2013.

research that meets their short-term, applicable needs specific to the given region, serving on a board composed of regional and national government representatives. The coordinating and learning mechanism, COFUPRO, of the Produce Foundations serves to diffuse lessons learned through the dispersed produce experiments but does not have a strong mechanism for feeding back into the individual foundations.

The Netherlands

In recent years, The Netherlands has shifted emphasis of its AIS from efficiency and productivity towards agricultural diversification, specialization, recognizing and enhancing the multi-functionality of agriculture and advancing the social and ecological sustainability of the system. Greater specificity of farmers' demands has led to privatization in many areas to move away from supply- towards demand-driven innovation services⁸⁴. Agricultural extension was privatized at the end of the 1990s, and the most important constellation of agricultural research is housed in the Wageningen University and Research Center (WUR), composed of the university and nine private research institutes. The Agri-Knowledge Directorate is the principal coordinator of the AIS but has multiple and diverse relationships to other organizations that help develop strategy. The Agri-Knowledge Directorate also delegates substantially policy analysis to the WUR and program management/sector engagement to the noteworthy InnovationNetwork.

Function 1: Strategy development and priority setting	Function 2: Research and innovation policy analysis, design, and implementation	Function 3: Managing programs and resources	Function 4: Innovation system management	Function 5: Information management and knowledge sharing
Agri-Knowledge Directorate	Agri-Knowledge Directorate	Agri-Knowledge Directorate	Agri-Knowledge Directorate	Agri-Knowledge Directorate
Knowledge Chambers	Contracts WUR, Rathenau, and other institutes for analysis ⁸⁵	InnovationNetwork	InnovationNetwork	Agroportal
InnovationNetwork	Council on Environment and Infrastructure	WUR	Bioconnect and other 'innovation brokers'	Knowledge on the Field (KODA)
	Council for Science and Technology Policy	Bioconnect ⁸⁶		Green Knowledge Cooperative
		Transforum		

84 Klerkx and Leeuwis, 2008. Establishment and embedding of innovation brokers at different innovation system levels: Insights from the Dutch agricultural sector, 76(6): 849-860.

85 <http://www.rathenau.nl/en.html>

86 Bioconnect is one example of many coordinating bodies for a specific sector that receive some funding from the Innovation Network or the Ministry of Economic Affairs, Agriculture, and Innovation, sometimes referred to as 'innovation brokers'. For further examples, see: Klerkx and Leeuwis, 2008. Establishment and embedding of innovation brokers at different innovation system levels: Insights from the Dutch agricultural sector, 76(6): 849-860.

Function 1: Strategy development and priority setting

The **Agri-Knowledge Directorate**, in the Ministry of Economic Affairs, Agriculture, and Innovation⁸⁷ is the executive unit for coordinating priority-setting and funding streams to agricultural innovation.

Knowledge Chambers serve to inform policy with science and strengthen the relationship between the research institutes and the Ministry. They are composed of policymakers, scientists, and private sector stakeholders. A division of the Ministry of Economic Affairs, the Knowledge Chambers identify research and innovation priorities. The affiliated entity InnovationNetwork carries out foresight studies, develops strategies for innovation, and supports early-stage innovation. The **InnovationNetwork** advises the Ministry on a yearly basis (see Annex II). The mission of the InnovationNetwork is to develop and promote the implementation of ground-breaking innovations⁸⁸. It emerged from the Dutch Council for Agricultural Research which coordinated agricultural research policy and investments since the 1950s, but gradually moved to an advisory role to the Ministry of Agriculture in the 1980s and expanded its mandate in the 1990s⁸⁹.

The **Top Sectors Approach** in The Netherlands identifies nine 'top' sectors of the economy to receive government investment and assistance, including agri-food. Top teams, comprised of a scientist, a senior official, and an innovative small or medium enterprise entrepreneur and a standard-bearer for the sector. The top team advises businesses, science, and the government on measures to address challenges in the agri-food sector, setting out its advice and priorities in an action plan. The sector and government together implement these actions. Innovation contracts set out arrangements and financial agreements between businesses, scientists, and the government⁹⁰.

Function 2: Policy analysis, design, and implementation

The **Agri-Knowledge Directorate** plays a principal role analyzing, designing, and implementing innovation policy. The **Wageningen University and Research Center (WUR)**, composed of the research university and private research institutes (the DLO)⁹¹, are often contracted by government to analyze policy. The research institutes conduct research that is oriented towards practical applications. The Ministry contracts monitoring and evaluation from external parties, including the **Agricultural Economics Institute (LEI) from DLO** and the **Rathenau Institute**. In addition, but not specifically aimed at the agricultural sector, the **Council on Environment and Infrastructure** and the **Advisory Council for Science and Technology Policy** provide solicited and unsolicited advice on innovation in general.

Function 3: Managing programs and resources

The Agri-Knowledge Directorate delegates sector-based coordination to a number of sector networks and programs, which it also funds. Examples include **Bioconnect** and **TransForum**, which are both short-term grant-making councils on different themes in sustainability. **WUR** and **InnovationNetwork** also manage programs.

87 This unit has a long history; it existed in the Ministry of Agriculture since the nineteen nineties, and has continued after the merger of the Ministry of Agriculture and the Ministry of Economic Affairs in 2010.

88 <http://www.innovatienetwerk.org/en/organisatie/toon/15/>

89 Van der Meulen, B., Dijksterhuis, F.J., 2007. *Leren van sectorraden Over noodzakelijke en onmogelijke relaties tussen beleid en kennis*. Innovatie Netwerk. Utrecht, The Netherlands.

90 <http://www.government.nl/issues/entrepreneurship-and-innovation/investing-in-top-sectors/agri-food>

91 <http://www.wageningenur.nl/en/Expertise-Services/Research-Institutes.htm>

Function 4: Innovation system management

InnovationNetwork plays a key role in linking disparate actors in the innovation system and provides seed-funding and technical advice to assist new groups. In addition, a number of so-called ‘**innovation brokers**’ thrive in the Dutch AIS, many of which coordinate and broker relationships at the local or sector level and are funded at least initially by the Ministry. Some function as innovation consultants, as brokerage organizations that foster peer networks, or as boundary organizations that act at the interface between policy, research, and users, among other roles⁹².

Function 5: Information management and knowledge sharing

The Netherlands has several internet-based portals and databases that provide relevant information for stakeholders that may be privately or publicly funded, depending on the target audience, and address a broad range of strategic innovation issues at the short-term time horizon. Two such examples are the Agroportal, and Knowledge on the Field (KODA). There are also a number of non-profit foundations that work to improve educational curricula in order to better train students for business and societal needs, such as the Green Knowledge Cooperative.

Key lessons

Dutch coordination represents a clear approach to coordination that despite numerous actors, manages to avoid fragmentation with well-defined and distinct roles. Multiple permanent organizations contribute to each of the five functions. The Agri-Knowledge Directorate is the key focal point for priority setting, definition of roles, and policy analysis but actively delegates activities like evaluation, program management, and policy analysis. InnovationNetwork is a noteworthy initiative that complements the established policies of the Agri-Knowledge Directorate by catalyzing radical ideas and, importantly, leveraging networks and offering some seed-funding to put them into practice. Several organizations have been incubated by InnovationNetwork and co-financed by the private sector, these relationships are brokered by the InnovationNetwork which is trusted and seen as impartial. Bioconnect was developed by the InnovationNetwork and has become established enough to the point that now the Ministry delegates priority-setting in the entire organic sector to this group. Funding through the top sectors strategy and InnovationNetwork allows the private sector to be well represented in influencing research priorities.

New Zealand

New Zealand’s agricultural innovation system is well coordinated, capitalizing on diverse entities that play well-defined roles and guided by clear priorities. Private investment in research and development, low by OECD standards, has become a strong government priority, and a number of creative independent public agencies (Callaghan Innovation) and funding programs (Primary Growth Partnership) have emerged in response. The government’s Business Growth Agenda has set clear priorities that govern general innovation as well as agricultural innovation and, translated to the agricultural sector, the Ministry of Primary Industries (MPI) aims to double the value of exports by 2025. Coordinating agricultural innovation is chiefly the responsibility of the Ministry of Primary Industries, but some agricultural

⁹² Klerkx, L. and C. Leeuwis, 2009. The emergence and embedding of innovation brokers at different innovation system levels: Insights from the Dutch agricultural sector. *Technological Forecasting and Social Change*, 76(6):849-860.

innovation coordination is shared with the Ministry of Business, Innovation, and Employment (MBIE). The lead program for funding agricultural innovation is a collaboration between these two ministries, though MPI has final investment decision power. The Primary Growth Partnership is a competitive matching fund initiative for innovation in the primary sector. Both MPI and MBIE have units that translate government priorities into innovation policy: in MPI, the Strategy, Systems, and Science Directorate; and in MBIE, the Division of Strategy and Governance sets priorities for the innovation system as a whole⁹³.

Function 1: Strategy development and priority setting	Function 2: Research and innovation policy analysis, design, and implementation	Function 3: Managing programs and resources	Function 4: Innovation system management	Function 5: Information management and knowledge sharing
Ministry of Business, Innovation, and Employment (MBIE): Strategic Policy Division Science, Skills and Innovation Division Ministry of Primary Industries (MPI): Policy Branch; Strategy, Systems, and Science Directorate	People, Science, and Enterprise Policy (MBIE) Research Evaluation and Analysis (MBIE) Crown Ownership Monitoring Unit	Primary Growth Partnership Resource Management and Programmes Branch (MPI); Growth and Innovation Directorate Science Board (MBIE) Science and Innovation Group (MBIE) Commercialization Partner Network	Callaghan Innovation ⁹³ Institutions and System Performance (MBIE) NZBIO New Zealand Trade and Enterprise (NZTE) Food Innovation Network of New Zealand (FINNZ)	NZBIO

Function 1: Strategy development and priority setting

The **Ministry of Primary Industries (MPI)**, which was newly formed in 2012 as a merger between the forestry, fisheries, and agriculture ministries, also sets policy on agricultural innovation strategy. The Policy Branch of MPI is responsible for strategy development and priority setting in science and innovation for the primary sector. One mechanism of collaboration with MBIE is the Primary Growth Partnership. The **Strategy, Systems, and Science Directorate** in the Policy Branch of MPI leads policy development required to ensure the government's primary sector goals are achieved. It will lead the development of science planning prioritization, frameworks and processes to support regulatory quality, improvement of MPI policy advice, and a multi-year work program for the Policy Branch.

The **Ministry of Business, Innovation, and Employment (MBIE)** is responsible for general innovation policy. Two divisions contribute to innovation strategy development in MBIE: the **Science, Skills, and Innovation Division**, and **Strategic Policy** (in the Division of Strategy and Governance). MBIE monitors the government's investment in the Crown Research Institutes (principal science research institutes) and

⁹³ <http://www.callaghaninnovation.govt.nz/about-us/nz-innovation-system>

advises the Shareholding Ministers (one from the MBIE, and another from the Ministry of Finance) which are responsible for appointing boards of directors for each of the research institutes.

Function 2: Policy analysis, design, and implementation

MPI's Policy Branch provides regulatory processes and advice for legislation administered by the new MPI and conducts forward-looking analysis, strategic science, policy development and advice on strategic issues relating to the primary sectors⁹⁴. In MBIE, the **People, Science, and Enterprise Policy team**, within the Science, Skills, and Innovation Division, is principally responsible for policy analysis and implementation for innovation in general. There is also the **Research Evaluation and Analysis team**, in the Strategy and Governance Division of MBIE. The **Institutions and System Performance branch** of MBIE is also responsible for monitoring and analyzing the innovation system, including the AIS.

The **Crown Ownership Monitoring Unit** is a unit of the Treasury that monitors the government's investment in companies and entities owned by the Crown (e.g., Crown Research Institutes, the principal research institutes), provides performance and governance advice to Ministers and assists with the appointment of directors for crown-owned entities.

Function 3: Managing programs and resources

There are several coordinating bodies of funding streams. The **Primary Growth Partnership (PGP)** invests in research and innovation programs for improving economic growth and sustainability of the primary sector, throughout the value chain. The government (Ministry of Primary Industries with the Ministry of Science and Innovation) invests about \$55 million annually with matching funding from the industry⁹⁵. Launched in September 2009, the PGP has funded 10 government and industry partnerships worth nearly \$600 million⁹⁶. Within MPI, the Policy Branch manages the PGP.

The **Resource Management and Programmes Branch** of the Ministry of Primary Industries has an Aquaculture Growth and Innovation Directorate that will be responsible for the delivery of financial and all other forms of non-regulatory support to the primary sector through grants, research, and programs. The Growth and Innovation Group is housed in this directorate, but the group is nascent since the Ministry has just merged and restructured⁹⁷.

The **Science Board of the MBIE** makes independent investment decisions on funding proposals for research, science, and technology that are selected by the MBIE Chief Executive. The **MBIE Science and Innovation Group** invests in business on behalf of the government. Last year, more than 100 investments were made with a total worth of more than \$170 million. A proportion of these investments are made through the Regional business partners.

⁹⁴ <http://www.mpi.govt.nz/about-mpi/our-organisation/our-structure>

⁹⁵ <http://www.mpi.govt.nz/agriculture/funding-programmes/primary-growth-partnership.aspx>

⁹⁶ <http://www.mpi.govt.nz/about-mpi/our-organisation/current-priorities>

⁹⁷ <http://www.mpi.govt.nz/Portals/0/Images/about/overview-resource-management-programmes-branch-design.pdf>

Callaghan Innovation is new government agency that was recently delegated responsibility for administering most of the innovation funding from MBIE. The **Commercialization Partner Network (CPN)** receives funding from the MBIE Science, Skills, and Innovation group to turn science findings into commercially viable products.

Function 4: Innovation system management

Callaghan Innovation is a government agency designed to accelerate commercialization of innovation by firms in New Zealand. It is the first organization in New Zealand to act with a 'whole-of-system' view that focuses on building teams of innovation agents that work with New Zealand firms to help solve innovation challenges and catalyzing collaboration between diverse actors. It also provides funding grants for research and development for different scales of businesses.

New Zealand Trade and Enterprise (NZTE) is New Zealand's economic development and trade promotion agency. NZTE helps firms grow in international markets by offering strategic advice, access to networks and influencers, research and market intelligence, and targeted financial support.

NZBIO is an organization focused on growing New Zealand's bio-economy, with hundreds of members from agri-biotech, human health, industrial, and environmental and food bioscience, representing a variety of firms, research institutes, and specialist service professionals. Its activities include member events, seminars and conferences, policy advocacy, national and international outreach, and promotion.

The **Food Innovation Network of New Zealand (FINNZ)** is a network of regional hubs of plant facilities intended to improve access to equipment, facilities, and technical support for smaller companies.

Function 5: Information management and knowledge sharing

New Zealand has strong online communication with stakeholders. **MPI** has migrated all funding competitions online to a common portal and releases publications on the projects funded. **MSI Portal** is the government's central hub for general science and innovation information coordinated by MBIE. Components include a fund finder that helps businesses learn what funding opportunities are available and appropriate for their needs; an overview of the Science Challenges workshops that bring together stakeholders to build consensus around solutions to key challenges identified by MBIE; science and innovation news, events, social media, and other information; and a log-in portal for funding recipients. **NZBIO** maintains a web-based portal with current bioscience innovation news including latest funding opportunities, publishes a newsletter, holds events, and conducts other activities with the intention of knowledge sharing.

Key lessons

New Zealand provides a useful case of a country actively mobilizing private investment in agricultural innovation that has decided to increase the independent government agencies while consolidating at the ministry level (Ministry of Primary Industries). Several new organizations have been founded and delegated responsibilities, like Callaghan Innovation, which manages most of the innovation funding and has a strong commercialization focus and couples fund management with advising and network-building. The Primary Growth Partnership combines the innovation expertise and commercial network of MBIE with the technical/sectoral knowledge of the Ministry of Primary Industries. The Director General of the Ministry of Primary Industries makes final funding decisions and is advised by a six-member

Investment Advisory Panel composed of members of the different sectors in primary industries with private sector experience.

South Africa

Function 1: Strategy development and priority setting	Function 2: Research and innovation policy analysis, design, and implementation	Function 3: Managing programs and resources	Function 4: Innovation system management	Function 5: Information management and knowledge sharing
Department of Science and Technology (DST)	Agricultural Research Council (ARC)	TIA ARC	National Agricultural Research Forum (NARF)	ARC
National Advisory Council on Innovation (NACI)	Technology Innovation Agency (TIA)		TIA	Research Information Management System (RIMS) ⁹⁸
Department of Agriculture, Forestry, and Fisheries (DAFF)	Centre for Science, Technology, and Innovation Indicators (CeSTII)		ARC	
Provincial departments of agriculture	Department of Science and Technology Department of Agriculture, Forestry, and Fisheries (DAFF)			

South Africa's current agricultural innovation policy began to emerge amidst the advent of democracy in the 1990s. To this day, the historical legacy of apartheid has necessitated a particular emphasis on equality of access to innovation resources, and innovation is seen as needing to be clearly connected to shared socio-economic benefits. The agricultural research and development strategy is targeted to mobilize a collective action that reduces malnutrition, hunger, and poverty⁹⁹. However, innovation coordination remains limited by a 'silo mentality' that results in isolated pockets of innovative activities or models with limited reach and impact, and the agricultural system remains bifurcated between large commercial farmers and small capital-poor farmers¹⁰⁰. The Department of Agriculture develops strategy for agricultural innovation with an emphasis on vulnerable populations, and is advised by the National Agricultural Research Forum (NARF). The Department of Science and Technology (DST) is responsible for setting overall innovation policy across sectors, and a National Advisory Council on Innovation advises the Minister of Science and Technology on the coordination of innovation across all sectors.

⁹⁸ <http://info.rims.ac.za/>

⁹⁹ http://www.daff.gov.za/docs/researchP/RD_Strategy.pdf

¹⁰⁰ Personal communication, Dr. Thiambi Netchiluvhi, Director: Policy Analysis and Advice, Department of Science and Technology.

Function 1: Strategy development and priority setting

The **Department of Science and Technology (DST)** is responsible for innovation policy across sectors, including agriculture. The **National Advisory Council on Innovation (NACI)** was created to advise the Minister of Science and Technology. Specific advice is provided on the role and contribution of science, mathematics, innovation, and technology, including indigenous technologies, in promoting and achieving national objectives¹⁰¹. NACI membership of 17 advisors is intended to broadly represent all sectors and disciplines and to balance national and provincial interests, as well as needs of different socio-economic groups. Sub-committees focus on specific topics such as infrastructure, human capital and knowledge base, STI for competitiveness, and reach and benefits of innovation¹⁰². Though the primary client of NACI is the Minister of Science and Technology, the council is developing an inclusive platform that will bring together all the Ministers, as well as leaders of key public institutions and the private sector, to regularly discuss national priorities across the whole science, technology, and innovation landscape¹⁰³.

The **Department of Agriculture** does not have a specific division dedicated to research or innovation and is generally seen as playing less of an active role in establishing priorities in innovation than the DST. However, there are efforts, documented in the Department's research and development strategy papers, to develop a Division of Research and Technology that would report to the Minister of Agriculture and provide overall strategic planning and coordination of national agricultural research priorities in line with a broader government vision¹⁰⁴.

Function 2: Policy analysis, design, and implementation

The **Department of Agriculture** is responsible for research and innovation priority setting in the agricultural sector. The Policy, Planning, Monitoring and Evaluation Branch includes divisions dedicated to different aspects on M&E (including organizational performance, economic analysis, and SOE and provincial monitoring) and strategic planning, policy research, and program development¹⁰⁵. NARF advises on coordination policy.

The **Agricultural Research Council (ARC)** is the principle agricultural research institute in South Africa, and the conducted range of research includes analysis of agricultural innovation policy. Its 11 research institutes are grouped in five divisions: field crops, horticulture, animal production and health, natural resources and engineering, and technology transfer¹⁰⁶.

The **Socio-Economic Partnerships** program of the Department of Science and Technology aims to lead and support other government departments in sector-specific research and development, technology, and directed human capital programs, including in agriculture. It has three sub-programs that focus on science and technology for economic impact (including a climate change and biodiversity unit), science and technology for social impact, and strategic guidelines for science and technology investments.

101 <http://www.naci.org.za/index.php/about-naci>

102 <http://www.naci.org.za/index.php/about-naci/structure>

103 Personal communication, Dr. Thiambi Ntshiluvhi, Director: Policy Analysis and Advice, Department of Science and Technology.

104 http://www.nda.agric.za/docs/Policy/Research_and_Development_Strategy.pdf

105 <http://www.nda.agric.za/doiDev/topMenu/aboutUs/organisationalStructure/18%20JUNE%202013%20%20organogram.pdf>

106 <http://www.arc.agric.za/home.asp?pid=283>

The Centre for Science, Technology, and Innovation Indicators (CeSTII) (see Annex II, Section F) is commissioned by the Department of Science and Technology to conduct annual R&D surveys, general innovation surveys, and biotechnology and agricultural R&D surveys.

Function 3: Managing programs and resources

The **Technology Innovation Agency (TIA)** was established in 2008 with the objective of promoting technological innovation. Its core business objective is to support the development and commercialization of competitive technology-based services and products. TIA was formed through merging seven DST entities previously tasked with supporting and promoting innovation in the country¹⁰⁷. The TIA invests in the following technology sectors: Advanced Manufacturing, Agriculture, Industrial Biotechnology, Health, Mining, Energy and ICT. One program it manages related to agriculture is the Tshwane Animal Health Innovation Cluster that aims to support technological innovation and commercialization in the animal health industry in the municipality of Tshwane. The cluster brings together TIA with ARC, the National Research Foundation, two universities, and the private sector, offering an initial \$9 million¹⁰⁸. The **ARC** is also responsible for maintaining national assets, undertaking programs and rendering services that are required from the Department of Agriculture and other stakeholders.

Function 4: Innovation system management

The **National Agricultural Research Forum (NARF)** was launched through a long series of extensive consultations, plenary sessions, and development of supportive documents and among major stakeholders of the status of the National Agricultural Research Systems (NARS) in May 2002. The mission of the NARF is to facilitate consensus and integrate coordination in the fields of research, development, and technology transfer to agriculture in order to enhance national economic growth, social welfare and environmental sustainability. NARF's activities are implemented by the NARF Secretariat, which is situated in the national Department of Agriculture. The NARF Secretariat is responsible for providing sectoral support to the NARF Plenary and Steering Committee, composed of representatives of NARF's stakeholders headed by a chairperson who, in turn, is responsible to the NARF plenary session¹⁰⁹.

Function 5: Information management and knowledge sharing

The **ARC** serves as the principal portal for information on the agricultural innovation system in South Africa. The **South Africa Research and Information Management Program (RIMS)** aims to provide a common application platform for publicly funded research institutions and establish a common platform for the DST to distill data from the publicly funded institutions that will inform strategic research decision making.

Key lessons

South Africa features a less complex constellation of agencies in the agricultural innovation system, with coordination the responsibility of one Department (DST), implementation largely the role of TIA, and agricultural research consolidated in the Agricultural Research Council. Horizontal coordination is not very

¹⁰⁷ These entities included the Innovation Fund, Tshumisano Trust, Cape Biotech Trust, PlantBio Trust, LIFElab, BioPAD Trust, and the Advanced Manufacturing Technology Strategy (AMTS).

¹⁰⁸ <http://www.tia.org.za/Our-Projects/tshwane-animal-health-cluster-initiative>

¹⁰⁹ <http://www.nda.agric.za/doaDev/sideMenu/others/RTD/NARF.html>

strong between DST and the Department of Agriculture, and DST/TIA actions do not seem to affect the ARC. Given the historical legacy of economic exclusion in South Africa, government initiatives are largely oriented towards maximizing and sharing socio-economic benefits of agricultural innovation.

Overall conclusions

From the review of how the different countries executed the different coordination functions, a number of crosscutting observations can be made.

Despite the sometimes quite large network of coordinating entities, in each country the main priority setting unit for agricultural innovation is embedded within a Ministry. These divisions, teams, branches, directorates, or units all employ some degree of hierarchical and soft coordination and often delegate coordination via economic incentives to other agencies.

In no country does coordination occur in just one unit. Different entities coordinate different parts of the innovation system. These different units have different focus points in terms of the level of aggregation at which they work (national, regional, sectoral), their time horizon (short term, medium term, long term), their specific functions (brokering, M&E). Some organizations engage more in 'macro-management', while others work more on 'micro-management', sometimes with clear delegation relationships.

This unit, however, does not determine priorities for the agricultural sector independently; each unit has a number of channels through which it receives advice from the constituents it must represent. Where the innovation system is relatively less complex, as in South Africa, there is a council that advises on agricultural research and innovation that is supposed to broadly represent all stakeholders from each sector, all regions, etc. In other cases, multiple councils provide input to the coordinating unit and other levels of the Ministry. In Canada, the Agri-Innovators' Committee, representing different members of the private sector, advises the Minister, while the Canadian Agricultural Innovation Research Network (CAIRN), like a decentralized think tank, brings together researchers from Canada and abroad to study the Canadian innovation system and share findings with Agriculture and Agri-Food Canada. The Value Chain Roundtables also advise Agricultural and Agri-Food Canada for different sectors. At the regional level, to which much coordination is delegated in the Canadian system, a network of advisory bodies, each representing scientific or sector experts, helps set priorities and make investment decisions in a competitive research process. The different advisory bodies offer input at different levels (Ministry, provincial), representing different groups (private sector, research scientists), and for different ends (setting priorities, investment decisions, etc.). Clear definition of roles and distinct contributions of these advisory bodies helps to represent the universe of stakeholders while avoiding fragmentation.

The advisory committees and think tanks organized by coordinating units in different countries often tend to be coupled with some financial and technical support from the Ministry. This support provides an incentive to collaborate and helps to bring distinct, sometimes competitive actors together. Canada's Value Chain Roundtables and The Netherlands' InnovationNetwork exemplify this. The Ministry-level coordination unit tends to emphasize continuity in its staffing while the associated advisory bodies have rotating positions.

In all the case countries, agricultural innovation system coordination exists alongside 'generic' innovation system coordination. Of the countries studied, only The Netherlands has a 'superministry' approach wherein all innovation policy, for agriculture and otherwise, is embedded within one Ministry. Even then, there are separate units in charge of coordinating agricultural innovation and general innovation. Agriculture is the only sector to have its own innovation coordination unit in all the cases. Partnerships between generic innovation and agricultural innovation teams can bring together fruitful new combinations of networks and combine expertise from different sectors, as in the case of New Zealand's Primary Growth Partnership.

Some of the stronger systems in these countries exhibit clear programs to give space to early-stage, radical ideas, like The Netherlands' InnovationNetwork and New Zealand's Callaghan Innovation.

There are always 'coordination gaps' and, while sometimes coordination entities are there, they are not effective. This may have to do with an unclear mandate, a lack of means to exercise authority, poor leadership, or otherwise the means to become a legitimate coordinator.

Annex II.

Approaches to key thematic challenges in AIS coordination

Annex II describes how these countries have managed challenges that arise with coordinating agricultural innovation systems. The challenges are: Financing of innovation, the ‘Keeping it Fresh’ function, Regionalism and Representation, Involving Smallholders in Innovation, Linking AIS to the National Innovation System, and Monitoring and Evaluation.

A. Financing

Financing innovation and research takes different forms across the case study countries. The design of financing tools illustrates distinct approaches on how to involve industry and how to stimulate research for certain objectives, timeframes, and users. Table A2.1 provides a selection of innovation financing tools that are employed by the case countries, and this section on financing profiles an example each of co-financing, public-private partnerships, farmer-driven funds, and compulsory levies.

Table A2.1 Types of economic transfers as innovation policy instruments

Case country	Examples of economic transfers
Canada	<ul style="list-style-type: none"> · \$2 billion for cost-shared programs on a 60:40 basis between federal government and provinces (Growing Forward policy framework, 2013-2018) · AgrilInnovation Program funds industry research proposals to form national-level agri-science clusters · Science and research development tax credit · Canada Agricultural Innovation Research Network (CAIRN) funds policy-relevant research on issues of interest for the sector · Provincial ministry and university partnerships for research and programs (e.g., Ontario AAFC and University of Guelph)
Mexico	<ul style="list-style-type: none"> · Competitive Sector Fund from CONACYT managed by SNITT · Competitive fund for agricultural research and technology transfer managed through Produce Foundations
The Netherlands	<ul style="list-style-type: none"> · Short-term start-up funding via InnovationNetwork: Decision Investments in Knowledge Infrastructure (e.g., Transforum, SIGN), sometimes with industry matching funds · Identify and invest in 9 top sectors
New Zealand	<ul style="list-style-type: none"> · Contestable funding¹¹⁰ · On-demand funding · Core funding for Crown Research Institutes · Matching funding from industry for primary sector research (Primary Growth Partnership)¹¹¹ · Compulsory levies commonly used to fund industry R&D · R&D funding for commercialization via Callaghan Innovation

110 <http://www.msi.govt.nz/about-us/how-we-invest/>

111 <http://www.mpi.govt.nz/agriculture/funding-programmes/primary-growth-partnership.aspx>

South Africa	<ul style="list-style-type: none"> · Intellectual Property Fund · Technology Development Fund · Youth Technology Innovation Fund · Industry Matching Fund¹¹² · R&D Tax Incentives program¹¹³ · Statutory levies important
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Co-financing

In New Zealand, the **Primary Growth Partnership (PGP)** brings together two government ministries (the Ministry of Primary Industries and the Ministry of Business, Innovation, and Employment) and industry to invest in research and innovation programs for improving economic growth and sustainability of the primary, forestry, and food sectors. The Primary Growth Partnership is a competitive matching fund initiative aimed to increase private investment in innovation in the primary sector. An amount of NZD 70 million is invested annually by the government, with industry at least matching this sum. The PGP makes investments throughout the value chain, including education and skills development, research and development, product development, commercialization, commercial development, and technology transfer¹¹⁴. The Primary Growth Partnership combines the innovation expertise and commercial network of MBIE with the technical/sectoral knowledge of the Ministry of Primary Industries. The Director General of the Ministry of Primary Industries makes final funding decisions and is advised by a six-member Investment Advisory Panel composed of members of the different sectors in primary industries with private sector experience.

Public-private partnerships

In Canada, the AgriInnovation Program, established in the national Growing Forward 2 policy framework, administers competitive funding for **Agri-Science Clusters**. Sectors submit research proposals for funding on topics that are relevant for the sector as a whole at the national level. The funded clusters contract Agriculture and Agri-Food Canada (AAFC) scientists, public research institutes, or universities to carry out the proposed research. Up to \$468 million is available for funding projects out of the \$698 million budget for the five-year initiative. The funding can be accompanied by support in the form of collaborative assistance by AAFC research scientists to promote knowledge transfer. Given the short timeframe of five years for the Agri-Science Clusters, research tends to be downstream for industry application.

Levy-based funding mechanisms

Especially common in South Africa, New Zealand, and The Netherlands, levy-based funding mechanisms are a way for sectors to pool resources and fund research and development specific for sector solutions. Levy-funded research tends to emphasize downstream solutions for the sector in the short term and are a way to galvanize demand-based innovation. Levy-based funds have different degrees of coordination with the public sector, but often there are some incentives in place to align the levy-funded research with national priorities.

112 All administered by TIA: <http://www.tia.org.za/Funding-Procedure>

113 <http://www.dst.gov.za/index.php/services/the-rad-tax-incentives-programme>

114 Falloon, 2012 and PGP website.

In South Africa, declining government funding for public research is increasingly being replaced by private sector funding. Statutory levies paid by producers on each unit of a commodity delivered are pooled for various uses, including agricultural research. While some sectors use the funds to undertake their own research, a significant portion in one sample of ten important industries in 2009 was allocated to the Agricultural Research Council (ARC) to pursue research in consultation with the client industry. In 2009, R29 million, about a third of the total levies collected by these ten industries, went to the ARC, while the ARC received a government allocation of R450 million in the 2009/2010 fiscal year.

In New Zealand, a Commodity Levy Act (1990) empowers producers in a given sector to self-impose levies on agricultural products at the farm gate through a vote in order to finance 'industry good activities'. Once voted, the levy becomes obligatory for all commercial producers of the products in question. For each product, farmers vote every six years to decide whether to continue to impose the levy.

In The Netherlands, there are 11 commodity boards organized per sector or product (arable farming; grains and seeds; animal feed; drinks; margarines, fats and oils; poultry and eggs; horticulture; cattle and meat; fish; wine; dairy). They were installed in the 1950s, as a way of promoting collective sector interests (i.e. promotion of products, quality enhancement, research on productivity and quality). They are funded on area based or product quantity-based levies, so larger farmers contribute more. Given increasingly specialization of Dutch agriculture and, connected to this, the difficulty of having real democratic representation of levy payers, there have been debates about abolishing the obligatory levy. This will happen in 2013, after which some tasks will be taken up by the Ministry of Economic Affairs, Agriculture and Innovation, and others through voluntary contributions by the sectors.

Competitive funds

Many of the case countries are moving from open matching funds, whereby the government matches funds for any industry-proposed research, to competitive funds with clearly articulated government goals. Numerous structures of competitive funds exist to finance projects from the start-up phase to commercialization. Three key considerations are fairness and transparency in the selection process, flexible demand-driven priorities for selection that evolve with the sector, and monitoring and evaluation of the outputs of the research.

New Zealand employs two layers of selection in the process of allocating competitive funds for general innovation, with the Ministry of Business, Innovation, and Employment doing the first round of selection and the Science Board, an advisory council, making the final decision on the proposals. For the Primary Growth Partnership, the MBIE and MPI together establish funding priorities, and an Investment Advisory Panel made up of six members of the private sector advises the Minister of Primary Industries, which makes the final investment decisions.

Mexico's CONACYT operates three types of competitive funds – institutional, sectoral, and mixed – representing different levels of CONACYT control. In the case of CONACYT's institutional competitive funds, CONACYT exercises full control over the goals and administration of the funds, while for the sectoral and mixed funds, CONACYT administers the funds but other government agencies and state governments, respectively, set funding priorities and provide counterpart funding¹¹⁵. The competitive

¹¹⁵ http://www.asti.cgiar.org/pdf/Mexico_CB41_En.pdf

funds have been critiqued for not adequately reflecting real demand in the selection of projects, failing to interact with stakeholders, adapt to an evolving agricultural sector, or consider a value chain approach¹¹⁶. Mexico's agricultural research is predominated by a strong public sector with relatively little participation of industry or private research institutes.

B. Harnessing the creativity of the private sector

Several case countries have designed structures that create space for farmers and industry to organize and provide input to the priority-setting process of the agricultural innovation system (see Table A2.2).

Table A2.2 Examples of initiatives that give influence to the private sector in the coordination of the AIS

Case country	Government investments in private sector innovation	Public-private cost-sharing of innovation	Sector-driven research planning and funding	Organized sector advising to government	Industry-financed research
Canada	Agri-science clusters			Value Chain Roundtables ¹¹⁷	Levy-based funding is most common for all cases
Mexico			Produce Foundations		"
The Netherlands	InnovationNetwork Top Sectors	SIGN ¹¹⁸	Bioconnect TransForum	Bioconnect Courage ¹¹⁹	"
New Zealand	MBIE Science and Innovation Group Callaghan Innovation	Primary Growth Partnership		Callaghan Innovation NZBIO Commercialization Partners Network	"
South Africa	FAIR/Prolinnova	Industry Matching Fund			"

Top sectors approach

In The Netherlands, the Ministry of Economic Affairs through a lobby process identifies nine 'top sectors' of the economy to receive government investment and assistance, including agri-food. Top teams, comprised of a scientist, a senior official, and an innovative small or medium enterprise entrepreneur and a standard-bearer for the sector. The top team advises businesses, science, and the government on measures to address challenges in the agri-food sector, setting out its advice and priorities in an action plan. The sector and government together implement these actions. Innovation contracts set out arrangements and financial agreements between businesses, scientists, and the government¹²⁰.

116 Deschamps, Leticia. Consolidación del Sistema Mexicano de Innovación Agroalimentaria. IICA, México, D.F.

117 <http://www.ats-sea.agr.gc.ca/rt-tr/index-eng.htm>

118 SIGN is funded on a 50:50 basis by the InnovationNetwork and the greenhouse industry. See: <http://www.innovatieglastuinbouw.nl/engels/>

119 Courage is the dairy sector innovation organization and works with the InnovationNetwork. See: www.courage2025.nl

120 <http://www.government.nl/issues/entrepreneurship-and-innovation/investing-in-top-sectors/agri-food>

Sector-driven research planning

The Netherlands' **Bioconnect** is a research council for organic agriculture to advise government policy. Bioconnect is made up of various stakeholders in the organic agriculture sector. The government delegated responsibility to Bioconnect for setting the research priorities in the organic sector and allocates 10 percent (€9.6 million in 2008) of its budget for policy support research and statutory research to the sector. The users of research (farmers, agri-food supply and processing companies, civil advocacy organizations representing consumers) convene with researchers, consultants, and policy makers to determine strategy for investing public research funding through sector working groups (e.g., dairy, glass house horticulture). Following themes established by the government, working groups propose topics based on demand from their constituencies. Research is then contracted based on the selected user-oriented topics, aligned with the government-provided themes, and Bioconnect discusses topics with the research coordinators to align research with the needs of the sector. Some of the key challenges for Bioconnect include the ability to maintain a neutral position as an intermediary and maintain the trust of its numerous and varied counterparts¹²¹.

Farmer-driven funds

The **Produce Foundations** of Mexico serve to increase farmer involvement in setting research priorities by giving farmers a say in the allocation of funds at the state-level. Produce Foundations were established in each state to manage competitive funds for agricultural research and extension that solve their states' technological needs. Innovative, technologically advanced 'lead' farmers appointed to the research board of each Produce Foundation; state and federal government representatives serve on the board in an advisory role¹²². In most states the Produce Foundations have become quite independent from the state government while maintaining support from the federal government as they evolve. The large number of Foundations has helped create an innovation system with diversity and with it, the potential to exchange lessons from varied contexts; however, a weak centralized monitoring system has constrained the ability to share learning from Produce Foundations' individual experiments.

Value Chain Roundtables

Canada's **Value Chain Roundtables** (VCRTs) were launched in 2003 to bring together key industry leaders from across the value-chain – input suppliers, producers, processors, food service industries, retailers, traders and associations – with federal and provincial government policy makers. The VCRTs have become pivotal in identifying sector strengths and weaknesses, sharing information and building trust across commodity sectors, identifying research, policy, regulatory, and technical requirements, creating shared visions and cooperative long-term strategies. There are 11 national VCRTs on beef, food processing, grains, horticulture, organic, pork, pulse industry, seafood, seeds, sheep, and special crops. Industry members lead the roundtables and establish the roundtable agenda. Industry and AAFC representatives co-chair each roundtable. AAFC provides logistical support, expertise, and financial support to implement roundtable action plans. AAFC also ensures roundtable priorities on policy and programs are communicated to inform planning and decision-making of AAFC. The provincial governments also designate representatives to sector roundtables that are priorities for the province¹²³.

121 Klerkx, Hall, and Leeuwis 2009; Klerkx and Leeuwis, 2008. In the Agricultural Innovation Sourcebook, World Bank.

122 http://www.asti.cgiar.org/pdf/Mexico_CB41_En.pdf

123 <http://www.ats-sea.agr.gc.ca/rt-tr/5710-eng.htm>

C. 'Keeping it fresh': constructing and deconstructing, evolving with the sector

The **InnovationNetwork** (InnovatieNetwork) in The Netherlands functions like a crossover between an incubator and think tank and works to catalyze not incremental innovation but paradigm-shifting, radical, and far-reaching change by developing breakthrough concepts and investing in early-stage projects. Its mandate is to carry out foresight studies and develop strategies for innovation with a long-term horizon. Its staff and program budget is financed by the Ministry of Economic Affairs, Agriculture, and Innovation, and it co-finances projects (e.g., SIGN, Courage) with the corresponding sector (greenhouse horticulture, dairy industry). An independent board directs InnovationNetwork, and it presents its findings on an annual basis to the Minister to advise on innovation policy.

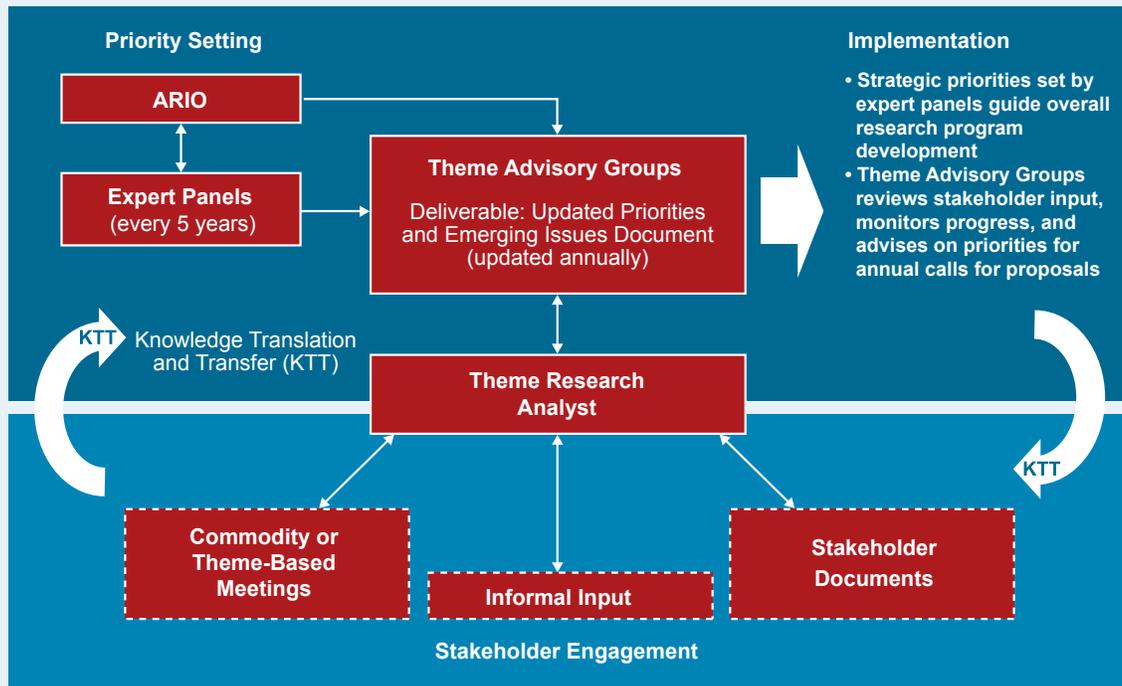
D. Regional representation and national coordination

Canada, like Chile, has a high degree of heterogeneity in its agricultural sector between provinces, making it difficult to set common priorities across the country. The agricultural sector has long been a joint responsibility between the province and federal government and a long process of consensus building and deliberation precedes bilateral agreements between the provinces and the federal government on agricultural policy. Program finance is split on a 60:40 basis between the federal and provincial government.

The province of Ontario presents a valuable case of how the provincial government tailors its research agenda while maintaining alignment with national priorities. The OMAFRA Research Advisory Network (ORAN) is a network of advisory bodies that provides long-term, strategic guidance for research program development and identifies short-term, emerging research priorities (Figure 9). While the Theme Advisory Groups identify priorities specific for the province, the expert panel is comprised of 8-10 members from across North America to provide perspective on emerging issues critical for progress. These priorities for program development are implemented through a partnership between the Ontario Minister of Agriculture, Food, and Rural Affairs (OMAFRA) with the University of Guelph. Guelph professors submit research proposals based on the list of priorities identified.

The 32 Produce Foundations, one in each state of Mexico, function to attend to state-level demand while balancing federal priorities. See Section B in this Annex.

¹²⁴ ARIO stands for the Agricultural Research Institute of Ontario (ARIO), an agency that reports directly to the Ontario Minister of Agriculture, Food, and Rural Affairs, providing advice about strategic directions in research investments. For more information see: <http://www.omafra.gov.on.ca/english/research/oran/oranindex.htm#publications>

Figure 9. Priority setting at the provincial level: The case of ORAN¹²⁴

E. Involving smallholders in the agricultural innovation system

Prolinnova (Promoting Local Innovation in ecologically-oriented agriculture and Natural Resource Management) is a global learning and advocacy platform that works to encourage farmer-driven innovation. Departing from the traditional linear model that flows through research, extension, and farmer adoption, Prolinnova uses an approach called Participatory Innovation Development (PID) with the objective of better meeting farmers' needs by empowering farmers to create an enabling environment for innovation at the local level. A pilot program, Farmers' Access to Innovation Resources (FAIR), provides grants for small farmers to experiment, strengthen local institutions, and hold cross-learning events. The grants are managed locally by farmers. In South Africa, the FAIR project is led by the Farmer Support Group in partnership with SaveAct (an NGO) and the Department of Agriculture, Environmental Affairs, and Rural Development of KwaZulu-Natal Province. In South Africa, FAIR set up innovation markets and farmers forums to exchange farmer knowledge, conducted technology testing, explored market opportunities, and linked with other stakeholders in the agri-innovation system. A Local Innovation Support Team made up of representatives from the three partners served to support the process. With a presence in 18 countries, Prolinnova forms a network of small-holder innovation groups that works to diffuse learning between members¹²⁵. The Agricultural Research Council (ARC), South Africa's principal agricultural research body, conducted an evaluation of the program.

125 http://www.prolinnova.net/sites/default/files/documents/S_Africa/2012/fair_2_in_south_africa_findings_and_lessons_learned.pdf

F. Monitoring and evaluation

Monitoring and evaluation (M&E) can take many forms and serve many functions. There is M&E for compliance, for accountability, for attribution of impact, and for unintended impacts.

In all of the case countries, program monitoring is conducted by a division of the principal ministry for agricultural innovation. Also, in many of the case countries, formal evaluation studies of the agricultural innovation system or agricultural innovation programs are contracted to external partners:

- Agriculture and Agri-Food Canada has a Program Branch that conducts regular monitoring of programs.
- In The Netherlands, the Agricultural Economics Research Institute (LEI) and Wageningen often work with the government on evaluations.
- Mexico has a network of regional Centers for Evaluation that evaluate technology transfer and extension services.
- New Zealand has developed a sophisticated monitoring and evaluation process for the programs funded by the Primary Growth Partnership (PGP) (this Annex, Part A: Financing). Evaluation has four main components: i) the Ministry of Primary Industries (MPI) and an Investment Advisory Panel monitor progress through active review of quarterly reports and annual plans; ii) Program Steering Groups, in which the Ministry has at least one representative, conduct program planning, risk management and review; iii) programs are audited for financial management (by MPI or an external group) and iv) programs are evaluated by an outcome model, which they must develop in alignment with an over-arching logic model of the PGP. The PGP contract for programs includes terms for termination or reduced funding given inadequate program performance¹²⁶.
- In South Africa, the Department of Science and Technology created the Centre for Science, Technology, and Innovation Indicators (CeSTII)¹²⁷ in 2002 to conduct annual R&D surveys, general innovation surveys, and biotechnology and agricultural R&D surveys. The Centre also conducts analytical work on the state of science, technology, and innovation in South Africa.

¹²⁶ <http://www.mpi.govt.nz/agriculture/funding-programmes/primary-growth-partnership/governance-and-monitoring>

¹²⁷ <http://www.nstf.org.za/ShowProperty?nodePath=/NSTF%20Repository/NSTF/files/PlenaryMeetings/2012/STISurveys.pdf>

Annex III.

Staffing and positioning

Annex III describes the staffing and positioning of the case countries' principal Ministry-level coordination units that are most comparable to the proposed design.

Table A3.1 Composition of lead coordinating units

Country	Lead coordinating unit	Subdivisions of unit	Embedded in:	Number of staff
Canada	Innovation Policy Division (federal level)	Innovation Policy Team, Bioproducts, Reparatory Team, Cross-Sectoral Policy Team	Strategic Policy Branch, Agriculture and Agri-Food Canada	25 in total, about 7 per team
	Varies at provincial level (e.g., OMAFRA Research Advisory Network, Ontario)	Thematic group, expert panel, etc.	Regional departments of agriculture (e.g., OMAFRA)	Varies
Mexico	National Coordinator of the Produce Foundations (COFUPRO) ¹²⁸	External advisory board with representatives of each state's Produce Foundations and informal representation from SAGARPA, INIFAP, SNITT, CONACYT, AMSDA	Independent civil society organization with funding from SAGARPA	30 staff
	National System of Innovation and Technology Transfer (SNITT)	Board of directors, technical committee, executive secretary (at the national level), and technical state commissions	Network administered by COFUPRO; Advises Inter-Sectoral Commission on Sustainable Rural Development (group representing several ministries, chaired by SAGARPA)	14 people in the SNITT office administered by COFUPRO, also a network of organizations
	Directorate for Productivity and Technological Development	Within this Directorate, there is Subdirector of Research and Technology Transfer: Departments of Scientific Innovation and Technology, Report Integration, and Agricultural Research ¹²⁹	Secretary of Agriculture, SAGARPA	4 people in the Subdirectorate of Research and Technology Transfer
The Netherlands	Agri-Knowledge Directorate	Clusters: Knowledge Management, Education and Knowledge-spreading, Research and Valorization, Knowledge Management Agriculture	Ministry of Economic Affairs, Agriculture, and Innovation	56 staff (half are full time) Management of 5

128 <http://www.cofupro.org.mx/cofupro/nosotros.php#>

129 http://portaltransparencia.gob.mx/pot/estructura/showOrganigrama.do?method=showOrganigrama&_idDependencia=00008

New Zealand	Strategy, Systems, and Science Directorate	Science Policy Group, Departmental Science Adviser, Primary Growth Partnership Fund, Irrigation Acceleration Fund, Policy Capability and Regulatory Systems Group	Ministry of Primary Industries	Not available
	Science, Skills, and Innovation	People, Science, and Enterprise Policy; Science Investments; Institutions and System Performance	Ministry of Business, Innovation, and Employment	Not available
South Africa	National Agricultural Research Forum	NARF Secretariat, Plenary, and Steering Committee ¹³⁰	Department of Agriculture, Forestry, and Fisheries	Full membership and observers of organized groups, no limit
	Socio-Economic Partnerships	Three Sub-Programmes: Science and Technology (S&T) for Economic Impact, S&T for Social Impact, S&T Investments	Department of Science and Technology	Not available

130 <http://www.nda.agric.za/doiDev/sideMenu/others/RTD/NARF.html>



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