

Agricultural Innovation - A National Approach to Grow Australia's Future

Summary report

March 2019

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Disclaimer

Ernst & Young has prepared this report for the benefit of the Department of Agriculture and Water Resources as agreed on 12 September 2018. Ernst & Young has not been engaged to act, and has not acted, as advisor to any other party on this matter. Accordingly, Ernst & Young makes no representations as to the appropriateness, accuracy or completeness of the Report for any other party's purposes. Specifically, where submissions that were collected during the course of the Project are reproduced in the Report, the submissions have not been verified for accuracy or completeness or for any other purpose.

Full report

This report is supplemented by a larger document, which provides more information on the scope, consultation process and the recommended actions for the future of agricultural innovation in Australia. This document captures high level insights and recommendations, whilst further supporting evidence and explanation can be found in the supplementary report.

1. Context

Australia's agriculture, fisheries and forestry industries are highly successful in producing a large variety of food and fibre products for our nation and our trading partners. Innovation – doing new or different things – has always been a significant contributor to the success of Australian agriculture.

Australian farmers, fishers and foresters are genuinely interested in adopting new and different practices provided they are aware of and understand the associated benefits. Participants across the agriculture value chain are constantly improving practices to drive productivity and profitability, determined to make Australia a global leader in food and fibre products.

Australia is recognised for excellent agricultural research outcomes supported by multiple streams of industry and government-backed investments. However, agricultural innovation in Australia was not designed to operate as a cohesive system – it is made up of many institutions and bodies put in place over time across different jurisdictions and commodities. This is limiting the effectiveness of our innovation investments.

Looking to the future, Australian agriculture faces unprecedented change, driven by various factors, such as changing global markets, increasing international competition, technological disruption, transforming industry structures, climate variability and change, water scarcity, and increasing threats from pests and disease.

Accelerating productivity growth is essential if we are to harness opportunities and mitigate the risks confronting Australian agriculture. The National Farmers' Federation has set an ambitious target for a \$100 billion agriculture sector by 2030 – world class innovation will be essential to drive the transformational productivity gains required to meet this target.

Co-designing a shared vision for the future

In September 2018, Ernst & Young was commissioned by the Australian Government Department of Agriculture and Water Resources (the Department) to develop a shared vision to best position the Australian agricultural innovation system for the future.

For the purpose of this report, the term 'agricultural innovation' encompasses all agricultural commodities, fisheries and forestry. This report also recognises that the agricultural innovation system fits within broader Australian and global innovation systems.

This project drew on the wealth of information and experiences from people who participate in Australian agricultural innovation today and supplemented these ideas with research on world leading innovation systems from other countries.

This project has explored the vision for agricultural innovation, including the level of ambition the industry is seeking, how it would fit into a global innovation landscape and the future the industry would like to create.

Implementation of this vision may take many courses and forms and further engagement with participants is recommended to test options to achieve the vision. 'Implementation pathways' will need to be carefully explored and examined.

To develop the vision for Australian agricultural innovation, multiple perspectives and key pieces of information were gathered and synthesised:

- Stakeholder consultation: more than 12,000 individual insights from over 550 stakeholders were gathered on the strengths and weaknesses of, and opportunities for, Australia's agricultural innovation system

- Megatrends: existing findings on megatrends impacting Australian agriculture were discussed with stakeholders to draw out implications for Australia's agricultural innovation system, including risks and opportunities
- International research: examining agricultural innovation systems of other countries helped identify insights and learnings internationally that could benefit Australia

2. The case for change

Will our approach to agricultural innovation continue to work well in the future?

Looking to the future, there is opportunity for Australian agricultural innovation to modernise and achieve greater and more diverse outcomes from investment in innovation, to adopt a more coordinated approach to respond to future opportunities, threats and trends and to better position Australia as a globally relevant agricultural innovation system.

Based on insights gathered from extensive stakeholder engagement, coupled with research into global agricultural innovation systems, there is a compelling case for change. There is an opportunity for Australia to strengthen agricultural innovation and establish a system that is cohesive, coherent, fit for the future and globally recognised.

1. **Future opportunities, threats and trends within the agriculture sector will occur in a larger, more complex and a faster manner than ever before, requiring leadership and cohesion across the ecosystem to set strategic priorities and drive a more coordinated and cross-domain approach**
 - Agricultural innovation is siloed with strategic priorities and direction set independently by system participants
 - National frameworks and priorities do not drive investment decisions
 - Participants are not yet collaborating in a strategic and sustained manner to address shared challenges and draw on experience from other sectors
 - The effectiveness and efficiency of Australian agricultural innovation today is undermined by poor cross-industry and cross-sectoral collaboration
 - Looking to 2050, traditional ways of working are unlikely to be sufficient to address new challenges
2. **Improving the mix of investment in innovation and growing the total funding pool including private sector investment would achieve better and more diverse outcomes**
 - Investment portfolios are largely focused on applied, commodity specific and incremental innovations
 - The innovation focus needs to shift towards a more balanced approach to deliver greater transformational innovation, address cross-sectoral challenges, and target economic, environmental and social outcomes
 - Private sector investment in agriculture is growing but lags international benchmarks
 - There is opportunity to grow the total funding pool through new collaborations, engagement of non-traditional participants and greater private sector participation in order to drive increased efficiency and greater impact
3. **An innovation culture that is more dynamic, encourages entrepreneurship and a more open approach to risk taking, would better position our future agricultural innovation system within the global innovation landscape**
 - The innovation culture in Australia is generally considered to present a barrier to disruptive innovation and entrepreneurship. Key elements are a risk averse culture, a territorial view of Intellectual Property and a lack of diversity

- Today, Australian agricultural innovation also lacks strong commercialisation capabilities, and the pursuit of global commercialisation opportunities is not a clear priority for the sector.
- Australia's agricultural innovation system is fragmented, and international organisations and multinationals find it difficult to identify potential collaborators in Australia, limiting our global competitiveness
- There are significant opportunities to position Australia to draw in greater private and foreign investment, develop key partnerships and collaborations with international organisations and leverage global expertise and resources
- There is scope for greater leadership across the system to prioritise investments, provide incentives and set a stronger culture that supports and encourages effective collaboration and action to address cross-sectoral and transformational innovation

4. **Strengthening the role of regions would improve innovation uptake**

- Lack of information and uncertainty about benefits of innovation is a barrier to adoption.
- Australian agricultural innovation today provides fragmented extension services, limiting the speed of innovation uptake and hindering productivity gains
- There is large opportunity to empower our regions so they can contribute to national priority setting and maximise opportunities from investment in innovation

5. **The foundations of the system need to be improved to meet the needs of the future and to provide a next generation innovation platform**

- The foundations of agricultural innovation – data, physical infrastructure and the regulatory environment – are not adapted to the needs of the future
- Agriculture is becoming increasingly digitised and existing data is highly disaggregated and inconsistent
- There is opportunity to strengthen capability to better inform decision-making and increase the speed of innovation and adoption
- Complexity and regulatory burden across different levels of government can restrict innovation and discourage collaboration and investment

Further details to support the case for change is contained in Appendices 1-4 and the full report that accompanies this summary document. Further details cover stakeholder insights, findings from international research, and a discussion on implications of megatrends for Australia's agricultural innovation system.

3. Vision for the Australian agricultural innovation system

It's 2050. Australian agriculture plays a central role in the provision of food to both the Australia population and to the 9.7 billion people, worldwide.

Technology is omnipresent, transforming the way we farm, fish and manage our forests. Intelligent robots work alongside our farmers, foresters and fishers. Capital flows into Australian agriculture with new business models arising. Multiple industries interlock with agriculture to create value for global consumers and the sector.

Our natural environment and resources are protected through leading and sustainable management practices. Energy is abundant and clean - agriculture producers generate much of their own energy. Australian agriculture maintains strong connection with our lands as custodians for future generations.

Consumers track the origin of their food and fibre purchases across the world as safety, ethics and sustainability become prominent. Transboundary pests and diseases continue to arise and consumers across the world look to Australia for its strong biosecurity systems.

Competition in global food and fibre markets is fierce and Australia is ahead of the game. Australian agriculture is a mosaic of value-added products and sets the standards for nutritious, safe, trusted and high-quality products.

Our agricultural industries generate significant economic growth for our country and deliver the best social outcomes to communities around us. They are known for using best practice production and management to sustain and nurture our natural resources over the long term.

Innovation has been and will continue to be critical to our success, as we explore and unlock new opportunities both domestically and internationally.

How will the Australian agricultural innovation system be positioned by 2050?

Who will our agricultural industries serve?

Our agricultural industries will support a diverse range of stakeholders, including producers and communities in rural areas, value adding processors and innovators and provide people with affordable food and fibre products and services. We will feed an increasing number of people, becoming a significant exporter of premium food and fibre products, IP and services.

What will be the roles of the Australian agricultural innovation system in 2050?

The Australian agricultural innovation system will build capacity and capability to innovate. It will actively support transformation of the agricultural industry and drive investment in innovation, aligned with agricultural outcomes. Our Australian agricultural innovation system will also extend beyond the domestic agriculture industry and pursue global opportunities for innovation.

The Australian agricultural innovation system will thrive with a clear unifying purpose where participants work seamlessly together and collaborate with other industry and global innovation systems to create and inspire cutting-edge science and technology breakthroughs. Agriculture innovation will be a global marketplace where Australia will be valued and recognised as a leading innovation nation with extensive collaborations. Interactions between people and information will be fluid, allowing greater speed, higher impact and greater outcomes.

Where will our agricultural innovation system focus on?

Focus will be geared across the value chain with production needs, consumer needs and technology needs, being fully considered. The agricultural innovation system will embrace a balanced horizon focus, from incremental to long-term transformational innovations.

The scope of our innovation system will expand, covering the full diversity of agricultural related industries, social and environmental domains and end-to-end considerations across multiple, specialised global food and fibre value chains.

Convergence across agricultural commodities and sectors will enhance our innovation capabilities. As a result, export of intellectual property and innovation services from Australia will create a new pillar of growth in the economy.

Where will investments be directed towards?

Our agricultural innovation system will make visionary investments in national agricultural priorities and missions, such as healthy and productive soils. It will also invest in the conversion of research into commercial outcomes, including transforming ideas into cutting-edge technology.

Finally, it will look to the world of 2100 and beyond, addressing economic, social and environmental concerns of our future generations.

Purpose of Australia's Agricultural Innovation System

Harness the power of knowledge: to make our food and fibre systems more competitive, prosperous and sustainable

"If the aspiration is to lead in terms of innovation we need to combine and conquer"

"Australia has no lack of resources (hard or soft) to deliver on a vision – we have the capital and the talent "

"We are well placed to be the AgTech hub or food bowl for Asia. We could be the leading source for AgTech, precision farming and sustainability"

"I aspire for a future where Australian Agriculture is a price-setter in the global market"

"We need a community that likes and respects agriculture - Education through human interaction will enable this. Not just tokenistic, it's a commitment"

"We have to set up a completely new research paradigm to give Australia a globally competitive research advantage"

"We need to break down tribalism across the different components of the system"

"We need to understand that we either Innovate or die"

"Our innovation system needs to be flexible, responsive and attracts "outside the industry" people and organisations to participate and provide new insights for ag and translate/adapt innovation from other sectors into agriculture"

"We need a culture that aspires to innovate, drive improvement and respond to trends"

What will the Australian agricultural innovation system look like in 2050?

Australia's agricultural innovation system will “harness the power of knowledge: to make our food and fibre systems more competitive, prosperous and sustainable”

Australia's agricultural innovation system is ranked in the top tier of innovation systems globally developing breakthrough innovations to real world problems.

Participants across the value chain work seamlessly together to shape and define the future of Australian agriculture.

1. Strengthening ecosystem leadership, cohesion and culture

The Australian agricultural innovation system thrives with a clear unifying purpose where participants work seamlessly together to drive change and success. Strong ecosystem leadership and cohesion across the system have been instrumental to the establishment of our global presence through international long-term relationships and collaborations and harnessing all of Government, and cross sectoral knowledge to generate system wide benefits.

Australia is recognised as a leading innovation nation, where interactions between people and information are fluid, allowing increased speed, higher impact and greater outcomes.

2. Funding and investment

Our agricultural innovation system makes visionary investments in national priorities and missions. It is well-funded, leveraging a diverse source of capital to develop breakthrough innovations. Researchers and innovators desire to be part of the Australian agricultural innovation system as capital flows to the best ideas and teams.

3. World-class innovation practices

The Australian agricultural innovation system builds capacity and capability to innovate and transform the agricultural industry. Young innovators are inspired throughout their education to explore, design and develop transformational solutions. Our innovation precincts are world-renowned, pursuing global opportunities for innovation.

4. Strengthening regions

Regions are the backbone of Australia's agricultural innovation system as they influence and shape directions and priorities for agricultural innovation. They are embedded internationally with their expertise and knowledge serving world problems.

5. Next generation innovation platform

The Australian agricultural innovation system is powered by a world-leading platform generating connections and collaborations to inspire cutting-edge science and technology. Data is brought to life through modern technologies, such as machine learning and artificial intelligence, creating the catalyst to innovate. Innovations are well supported by regulations and infrastructures that are evolving on pace with the speed of innovation.

Outcomes of the future agricultural innovation system

Prosperity

Accelerated and higher impact innovation drives growth and value that transcends throughout the Australian agricultural sector. It drives improved productivity and output capacity in agriculture through practical and transformational solutions that create economic value throughout the supply chain.

Social impact

Social impact considerations are at the core of the innovation process, improving health, wealth and happiness outcomes for all Australians. Innovation powers fulfilling careers, brings financial opportunities to supply chain participants and reliably provides fresh and safe products to consumers.

Sustainability

A commitment to sustainable and ethical practices is engrained in the system's DNA, ensuring that the full potential of Australia's natural environment and resources are realised long into the future. The system flourishes in an increasingly connected world as domestic and international consumers and supply chain partners establish complete trust in Australia's responsible production and commercial practices.

Global competitiveness

Australia has a distinct, globally recognised brand that possesses unique, high value qualities. Innovation safeguards Australia's reputation for providing premium products as new prevention and resilience solutions ensure that our products remain high quality and free from pests and disease. Australia's foresight exceeds that of its competitors, allowing it to capitalise on opportunities through its speed to market and the ongoing innovation of products and business models.

Innovation excellence

Australia is globally recognised as a world leader of agricultural innovation, due to its world-leading practices and capabilities for rapid idea generation and the subsequent development and commercialisation of high quality solutions. A culture of innovation excellence and continuous improvement positions Australia as a hotspot for leading global players, attracting academics and commercial entities looking to research, collaborate or invest.

Ahead of the game

The system helps the agricultural sector to anticipate megatrends and threats, and capitalise on market opportunities. Research and development focuses on societal concerns to address challenges that are broader than agriculture. It captures evolving needs to prioritise focus areas based on future issues or changes, creating resilience to future changes and shocks.

Our values to support

Passionate: *Our system is supported by people who are passionate about agriculture, innovation and meeting the needs of consumers. They nourish our agricultural industries and drive our people.*

Ambitious: *Our system embraces a culture that is bold, open to change, and prepared to fail fast and learn faster. Ambitious, risk-taking approaches are celebrated, regardless of outcome, and learnings are captured from both failure and success.*

Collaborative: *Trusted relationships built through collaboration and partnerships with shared interests driving a united approach to both opportunities and challenges.*

Entrepreneurial: *Fuel our future through entrepreneurship by fostering an accessible environment that champions a culture of innovation and disruptive thinking.*

Dynamic: *A vibrant and energetic system in which frictionless change, blue-sky thinking and striving for continuous improvement are commonplace.*

Globally differentiated: *We drive value through differentiation by innovating at a deep level of specialisation worthy of global recognition.*

4. Recommendations and proposed actions

Striving towards our shared vision for the future of Australia's agricultural innovation system will deliver many benefits as we will create and inspire cutting-edge science and technology breakthroughs.

The Australian agricultural innovation system will generate a wide range of exciting opportunities for those in the sector, including increased collaboration across participants, greater international opportunities and higher impact from innovation.

This will necessitate change and involve significant reform, including for the institutions and stakeholders operating within the system. Components of the agricultural innovation system will need to adapt, such as leadership, investment structures, governance, funding and culture, to be compatible with the rapidly changing world and increasingly technologically-enabled environment.

To achieve this vision, 5 key recommendation areas have been identified:

1. **Strengthening ecosystem leadership, cohesion and culture:** Stronger ecosystem leadership and cohesion across Australian agricultural innovation will generate greater and more diverse outcomes, driving our global competitiveness through clear strategic direction and increased collaboration
2. **Funding and investment:** Growing and improving the balance of investments will help the Australian agricultural innovation system to deliver both incremental and transformational innovation by addressing cross-commodity challenges, and targeting economic, environmental and social outcomes
3. **World-class innovation practices:** Establishing world-class innovation practices through collaboration, entrepreneurship and ambition will be critical in order to maximise opportunities from investment in agricultural innovation
4. **Strengthening regions:** In the future, regions will play a greater role in Australian agricultural innovation, to fully realise its benefits and maximise our innovation uptake
5. **Next generation innovation platform:** Improving the foundations of Australian agricultural innovation, including data, physical infrastructure and the regulatory environment, will support the transformation of our agricultural sector into the future

4.1 Recommendation 1: Strengthening ecosystem leadership, cohesion and culture

Strategic recommendations	Details
<p>1.1. Establish shared priorities across the system to guide innovation investment and activities</p>	<ul style="list-style-type: none"> ● These shared priorities should adopt a mission-oriented approach by setting a small number of ambitious national long-term priorities for agriculture that take into account areas of competitive advantage for Australia ● This should drive outcome focused activities as organisations align efforts towards priorities at the national level rather than at the project and task level
<p>1.2. Position Australian agricultural innovation as a cohesive, coherent, fit for the future and globally recognised system</p>	<ul style="list-style-type: none"> ● Co-design, with representatives from across the agricultural innovation ecosystem, a framework that builds cohesion through clear roles and accountabilities and addresses key barriers and constraints ● Empower and incentivise participants with roles and responsibilities so that the system is more coordinated, effective and dynamic ● Improve transparency to encourage continuous improvement and hold system participants accountable for performance. A system-wide performance framework would encourage continuous improvement across the system and set expectations for participants to report on their contribution to system objectives ● Enable alignment across government, including policy, procedural or possibly legislative changes as necessary
<p>1.3. Influence a culture that support entrepreneurship and risk appetite towards transformational innovation</p>	<ul style="list-style-type: none"> ● Equip leaders and participants to influence system-wide culture change through developing incentives across the agricultural innovation ecosystem and the supply chain (including end users of innovation and consumers) to achieve long-term objectives ● Support and incentivise a collaborative-first approach to innovation ● Develop diverse experiences in agricultural innovation ● Incentivise desired behaviours and recognise effective leadership, entrepreneurship and collaboration ● Encourage a positive sector image

Strategic recommendations	Details
<p>1.4. Establish ecosystem leadership</p>	<p>Stronger leadership would drive a more connected, cohesive and coordinated agricultural innovation ecosystem. A flexible approach to develop a suitable model for Australia is recommended by testing new ways of connecting participants and coordinating activities for achieve more strategic outcomes.</p> <p>An ecosystem leader (or leaders) should be encouraged to emerge, with support, to have the authority to:</p> <ul style="list-style-type: none"> ● Implement the shared vision for 2050 and set shared priorities for the agricultural innovation system that align with broader national innovation priorities ● Coordinate strategic planning across the system to drive alignment and identify mutual benefits ● Influence funding decisions and re-allocate human and physical capital to enable priorities to be achieved

Implementation guidance:

- Strengthening system-wide leadership, cohesion and culture will be a complex yet important activity to realise the vision. A considered and phased approach, which continues to involve representatives from across the agricultural innovation ecosystem to shape a solution, is recommended
- An interim leadership role could be introduced to continue the conversations on reform and provide advice on an enduring ecosystem leadership model. A key role for the interim leader will be to examine the alternatives for ecosystem leadership with the involvement of participants across the system, as well as make a decision based on an objective criterion
- In the transition to more enduring ecosystem leadership, the interim leader will need to address key barriers and constraints to the achievement of the vision (such as modifying existing governance arrangements for key participants)
- System wide leadership should be encouraged, perhaps through an agreed portfolio of initiatives that organisations and collaborations could own
- Consideration should be given to how to establish a progressive, dynamic, inspirational and globally connected system leader, and how it can garner the support of all stakeholders in the ecosystem

4.2 Recommendation 2: Funding and investment

Strategic recommendations	Details
<p>2.1 Shift the balance of public investment towards transformational and cross-sectoral outcomes</p>	<ul style="list-style-type: none"> Consolidating and redirecting portions of government funding to a common funding pool (e.g. a new Agricultural Innovation Fund) could be used to invest in projects that address transformational, cross-sectoral and public good challenges
<p>2.2. Increase flexibility and contestability of funding across the system</p>	<ul style="list-style-type: none"> This will allow for funding to flow through to the best opportunities and could include providing levy payers with greater choice in where levy funding is allocated
<p>2.3. Encourage new collaborations, non-traditional participants and greater private sector involvement</p>	<ul style="list-style-type: none"> This could be achieved through increasing contestability and co-investment that leverage public funding and a new sector specific commercially oriented organisation, with the purpose of commercialising Intellectual Property Such activities could provide a landing pad and platform for both local and international investors to access the Australian agricultural innovation system
<p>2.4. Foster an attractive environment to attract private investment</p>	<ul style="list-style-type: none"> Tax incentives or a public fund could be used to cover a portion of the downside risk associated with investment in start-ups Establishing and leveraging public-private partnerships would also be key to attracting private investment
<p>2.5. Target key partnerships and collaborations to leverage global expertise and resources</p>	<ul style="list-style-type: none"> A key enabler to this could be to encourage Australian research and government organisations engaging with these entities as a norm rather than an exception In order to attract these collaborations, establishing long term partnerships and fostering an attractive environment would be an important step
<p>2.6. Improve transparency and access to information on research activities and outcomes</p>	<ul style="list-style-type: none"> Increasing transparency of financial and Intellectual Property information would be important to facilitate investment into commercialising research outcomes

Strategic recommendations	Details
2.7. Grow the total funding pool	<ul style="list-style-type: none"> Investigating increases in Commonwealth, State and Territory Government funding to incentivise greater private investment in the system could be an initial activity

Implementation guidance:

- To encourage new collaborations and private investment, a potential solution is to establish a Government and private co-invested, dedicated Ag-Innovation or Ag-Tech fund

4.3 Recommendation 3: World-class innovation practices

Strategic recommendations	Details
<p>3.1. Scale-up a small number of innovation hubs or precincts into national flagship precincts for agricultural innovation</p>	<p>Innovation precincts:</p> <ul style="list-style-type: none"> ● act as key nodes in the innovation system, connecting and supporting innovation in regions; ● provide a physical location where researchers can innovate with potential end users of their research to co-design and test solutions; ● help break down existing silos and encourage a whole-of-supply-chain perspective; ● can develop globally relevant innovation specialisation with unique value propositions; ● can be used as a focal point to generate interest in agriculture, encourage collaboration with people outside agriculture and attract foreign investment; and ● have long-term funding commitments, with clear mandates and objectives to enable autonomy in innovation decisions to improve speed, agility and impact
<p>3.2. Introduce requirements for research funding applications to include commercial and adoption outcomes</p>	<ul style="list-style-type: none"> ● Research funding and project planning should incorporate commercialisation (if appropriate) and adoption strategies, including provision for time and resources as part of investment decisions
<p>3.3. Make more agricultural research publicly available to increase opportunities for commercialisation</p>	<ul style="list-style-type: none"> ● The development of a database of research projects, along with promoting commercialisation opportunities, will be a first step towards increasing rates of commercialisation ● This will also stimulate the development of a commercialisation market for research

Strategic recommendations	Details
3.4. Encourage diversity of capability and promote the future of the agriculture sector to improve innovation outcomes	<ul style="list-style-type: none"> ● This can be achieved through comparing current capabilities to those required, and designing interventions, such as programs to attract new capability or develop capability through interventions in the education system ● Increase the impact and speed of innovation by developing capabilities including entrepreneurship, commercialisation, design, digital, technology and modern innovation methods. Modern innovation methods include design thinking and hackathons
3.5. Establish common and standard practices for repeatable processes in the innovation system	<ul style="list-style-type: none"> ● This could include defining clear end-to-end commercialisation and adoption pathways based on end user needs, providing guidance on standardised grant application processes, establishing risk management processes and innovation impact assessment processes or implementing knowledge and information management practices

Implementation guidance:

- Establishing innovation precincts with global relevance will take long-term commitment and collaboration. Piloting one flagship innovation precinct would help demonstrate the value and the cultural change needed to fuel our future through entrepreneurship and disruptive thinking
- Innovation precincts should also draw the Government's *Statement of Principles for Australian Innovation Precincts* (2018)

4.4 Recommendation 4: Strengthening regions

Strategic recommendations	Details
4.1. Strengthen the extension and adoption of innovation by enhancing farming systems groups	<ul style="list-style-type: none"> Existing farming systems groups can offer tailored support and demonstration of innovation for their region, including mixed farming systems, which will demonstrate the benefits and increase rates of adoption. Trusted groups are shown to be the most effective at creating change on farm
4.2. Create an avenue for agricultural innovation system participants to contribute to national priority setting	<ul style="list-style-type: none"> This could be achieved through providing formal roles for farming systems groups and end users to contribute to the development of national priorities for the agricultural innovation system
4.3. Create communities of regions with similar characteristics to network both locally and internationally	<ul style="list-style-type: none"> This could be achieved through connecting agriculture leaders in Australian regions with leaders from global regions to discuss common issues that are prevalent within their regions. Through connecting agricultural leaders, common problems can be discussed in order to create innovation demand as well as share potential solutions to increase the speed of uptake Communities could be connected through a multi-channel approach, where farmers could connect digitally, face-to-face through conferences, or leverage innovation precincts
4.4. Build capability to better inform decision-making and increase the speed of innovation and adoption	<p>Multiple methods will be used to develop capability in these areas such as:</p> <ul style="list-style-type: none"> Optimising the use of existing online learning platforms; Enhancing farming systems groups as discussed in 4.1 to conduct workshops, and meet-ups that explore these topics, build capability and develop collaboration; and supporting the consistent use of a centralised online forums for regions to share experiences and knowledge with each other

Implementation guidance:

- Empowering and strengthening regions will be an iterative process. A pilot approach should be taken to increase the profile of regions in the agricultural innovation system before rolling it out more broadly. A selection process should be undertaken in order to identify a high value region willing to participate to demonstrate the impact

4.5 Recommendation 5: Next generation innovation platform

Strategic recommendations	Details
<p>5.1. Enhance data infrastructure and its use (data hub, new data standards, literacy programs, etc.)</p>	<ul style="list-style-type: none"> ● Provide the infrastructure to share and use data across the value chain and the innovation system. This will likely include the establishment of both public and private datasets. A data strategy is an early step that could best inform these developments ● Improve access to public data and deliver more detailed, accurate and timely information ● Improve the consistency of data collection, storage and sharing across organisations ● Ensure that collected data can be used multiple times for multiple purposes, with appropriate privacy protections and terms of use in place ● Assist producers and other supply chain participants to navigate data management systems, maintain protection of their data and increase the use of data for decision making
<p>5.2. Strengthen and demonstrate how data could be created and shared across the system</p>	<ul style="list-style-type: none"> ● This could be achieved through the demonstration of a targeted cross-industry pilot. It is important to note that not only monetary value needs to be demonstrated, but also peace of mind around privacy, data usage and social factors ● This could include an exercise to segment the industry based on end user needs to enable the tailoring of products and services to better meet innovation needs of end users
<p>5.3. Improve awareness of the availability of existing telecommunications technology solutions</p>	<ul style="list-style-type: none"> ● There are existing telecommunications technology solutions for rural and regional areas but more could be done to ensure producers are aware of options. For example, farming systems groups could play a role in providing producers with information on telecommunications options
<p>5.4. Support the improvement of rural and regional areas to maximise opportunities from investing</p>	<ul style="list-style-type: none"> ● Existing efforts by Commonwealth, State and Territory Governments to improve physical infrastructure are recognised, such as inland rail, the mobile black spot program and the regional rollout of the NBN. Such efforts should continue in a coordinated way across Australia

Strategic recommendations	Details
5.5. Create a more flexible regulatory environment to foster agricultural innovation	<ul style="list-style-type: none"> • Efforts are underway as the Commonwealth Government works with states and territories in response to the 2017 Innovation and Science Australia report Australia 2030: Prosperity through Innovation and the government's response to the Productivity Commission's 2017 report on its inquiry into the Regulation of Australian Agriculture
5.6. Perform ongoing scanning of global innovation systems to learn, adapt and establish international collaborations	<ul style="list-style-type: none"> • This could be a shared responsibility amongst the ecosystem leader, groups and individuals who are a part of Australian agricultural innovation • Systems globally are evolving constantly with new methods and practices for innovation arising. Performing ongoing scanning of global innovation systems will help Australia learn and adapt its future system • This could also involve establishing bilateral collaboration with international innovation systems, including data sharing and joint research

Implementation guidance:

- System participants have begun to aggregate data and share information. A potential role for the interim ecosystem leader is to better coordinate these activities, and support the acceleration of these activities

5. Roadmap for the future

“We need to reform and undertake a collaborative approach between industry and researchers”

2019: System mobilised to transform

- Appoint an interim leadership role to continue conversations on reform and approaches for enduring ecosystem leadership
- Agreement on sequence of recommendations actioned and implementation plan agreed across the sector
- System-wide governance adjustments identified to enable collaboration

2020: Foundation elements addressed (part 1)

- First mission-oriented co-designed and announced
- New sources of funding added to the funding pool, including a public fund created for private sector to participate
- Data infrastructure and standards designed
- Future-state design of the innovation system completed

2021: Foundation elements addressed (part 2)

- Key partnerships with major non-agriculture corporations established
- System-wide governance adjustments implemented
- Ecosystem leadership entity established with the release of a second innovation missions
- Capability and continuous learning model developed across the system and regions

2022: Collaboration and coordination enhanced

- First Australian flagship innovation precinct launched and plans for the remaining precincts agreed
- A set of innovation missions co-designed (across the system including regions), informed by data, announced and funded
- Collaboration and sharing insights have become the norm, and extension and adoption is no longer seen as an issue
- Data infrastructure and standards implemented

2025: Economic, social and environmental outcomes demonstrated

- Performance of the system demonstrates a balance of social, economic and environmental outcomes
- Our system is considered top tier globally
- Innovation precincts are vibrant, attracting new partners, talent and capital globally
- Regions are integrated as part of the system and represent a significant voice in shaping strategic plans

2030: Scaled-up

- Network of innovation precincts are established and their value propositions are globally relevant
- Missions are seen as critical to delivering innovation that balances social, economic and environmental outcomes
- The system consists of the best talent and innovators
- Innovations are well supported by regulations and infrastructures that are evolving on pace with the speed of innovation

2040: Globally recognised

- System leader entity and innovation precinct network are recognised as global leaders in facilitating innovation
- The mission-oriented strategic priorities are solving global issues and are the driving force of innovation efforts across Australia
- Modern technology, such as machine learning and artificial intelligence, are widely adopted and creating the catalyst to innovate

2050: World leading and continuously learning

- Australia is at the forefront of innovation in agriculture
- The best innovators desire to be part of Australian agriculture
- Users trust our system to deliver innovation that creates social, economic and environmental values

Success Factors

The magnitude and complexity of the reforms proposed in this project are significant. Stakeholders have identified six key success factors that are required to achieve the vision.

1. Commitment

“Passion and commitment for innovation are critical for driving real activity”

Transformation requires significant time and thought. Strong stakeholder involvements will be critical to ensure that commitment to the transformation is endured in the long term. Common goals and objectives need to be established amongst stakeholders, with individual accountability assigned to ensure that roles and responsibilities are well-defined in the future innovation system.

2. Momentum

“If you have the right people, you have to maintain the momentum and get it to market”

It is crucial that momentum is maintained and built from this project. In order to achieve this, an operating rhythm will be important to establish. Suggestions include agreeing on a rolling 5-year implementation plan with responsibilities and activities clearly defined. This will be supported by regular forums of participants, including leaders and functional level staff, such as researchers, finance, and middle management, to engage, check-in, and inspire each other along the journey.

3. System-wide involvement

“If the aspiration is to lead in terms of innovation we need to combine and conquer”

A co-design approach will be critical for success, as this will enable participants to influence decision making and create accountability within the future system. System-wide involvement will also help neutralise agendas and enhance commitment from system stakeholders.

4. Incentives

“We will need more incentives and support set-up for the shift [to an effective innovation system]”

To encourage participants to live the values of our future vision and embrace change, consideration will need to be given to ensure that participants are appropriately incentivised with meaningful rewards. Participants of the future system will need to become more open to taking risk and build a culture that welcomes risk-taking.

5. Global mindset

“Market forces are driven globally not nationally”
“Ag research is an international enterprise”

To be globally relevant, Australia needs to adopt a global mindset. Given our geographical location, we will need to encourage participants of our future system to connect with other parts of the world and collaborate with people of other agricultural innovation systems to share knowledge, skills and resources in order to enhance our capability and capacity.

6. Agile approach

“Trying to get everything right all the time you will move so slowly you will not be innovative”

An agile approach involves delivering packages of value over time, rather than a single ‘big-bang’ release. This approach will help demonstrate reform value faster and more frequently and generate learnings to improve the development of the system. Examples of this approach include piloting a

flagship innovation precinct in one location, rather than establishing all of them upfront; or assigning the most critical responsibilities to the ecosystem leader, before expanding their reach of influence.

Appendix A Key insights from stakeholder consultations

Challenges expressed by stakeholders across the agricultural innovation value chain have been categorised into nine key areas.

Key insight	Detail
System coordination and integration	<ul style="list-style-type: none"> • Agricultural innovation is siloed and does not deliver transformational solutions industry wide • There is misalignment between user needs and the delivery of innovation • New entrants to Australian agricultural innovation have a fragmented experience • Lack of coordinated, transparent evaluation of activities across agricultural innovation
Innovation culture	<ul style="list-style-type: none"> • A risk averse culture limits the potential for innovation • Australia provides limited incentives to innovate in agriculture • Agricultural innovation lacks scalability limiting the attractiveness of Australia for entrepreneurs
Relevance on world stage	<ul style="list-style-type: none"> • At a global level, Australian agriculture does not have a clear value proposition • Australian agricultural innovations have largely focused on the domestic market • Attracting and retaining the best global talent is a challenge for Australia
Transformational and cross-commodity investment	<ul style="list-style-type: none"> • Parts of agricultural innovation are focused on commodity-specific and incremental innovation • Investments are typically directed towards discrete, short-term projects that align with annual or 3-year funding cycles • Australia faces unique challenges in attracting foreign investment • There is limited use of private capital that is capable of transforming new ideas into commercial outcomes
Innovation capabilities	<ul style="list-style-type: none"> • Australian agricultural innovation talent needs to be upskilled in order to respond to trends affecting the industry

Key insight	Detail
	<ul style="list-style-type: none"> ● There are opportunities to better translate research into applicable, commercial outcomes that benefit end users ● Australia experiences difficulty in developing and attracting the best local talents
Innovation infrastructure	<ul style="list-style-type: none"> ● Challenges in connecting people, knowledge and rural areas with reliable physical and digital infrastructure is limiting our innovation potential ● Australia's agricultural innovation infrastructure does not have the size or the scale to be globally relevant and accelerate transformational innovation
System collaboration	<ul style="list-style-type: none"> ● Limited collaboration between researchers and commercial entities ● Silos have developed between institutions and regions creating inefficiencies and hindering innovation outcomes ● Limited involvement of end users and integration throughout the value chain limits innovation adoption
Extension and adoption	<ul style="list-style-type: none"> ● Limited involvement of end users in the innovation journey to understand their needs decreases the likelihood of adoption ● Innovation priority decisions are made with insufficient input from end users ● The role of extension has moved towards the private sector but the need is only partially met ● Existing adoption pathways fail to adequately consider extension requirements
System flexibility and adaptability	<ul style="list-style-type: none"> ● Agricultural innovation today is slow to respond to market opportunities due to incohesive structures ● Foundational capability gaps at both commercial and farming levels are inhibiting agility and resilience ● Regulatory complexity hinders the potential for ideas to be quickly developed, tested and commercialised

Appendix B Megatrends impacting agricultural innovation

Six key megatrends are impacting the Australian agricultural sector, driving unprecedented change.

Key insight	Detail
Global demand for food and fibre products	<ul style="list-style-type: none"> • 9.7 billion people to feed and clothe globally by 2050¹ • 70% increase in food production required to feed the global population by 2050² • Population aged 80 or over will more than triple³ • Real world income is expected to increase threefold⁴
Increasing consumer expectations	<ul style="list-style-type: none"> • 93% of consumers in the Asia-Pacific region would be willing to pay a premium for healthier food⁵ • Estimated decrease from ~37.5% to ~25% in dietary energy obtained from unhealthy food from 2000 to 2030⁶
Increasing competition for natural resources	<ul style="list-style-type: none"> • 12 million hectares of land lost annually to desertification and urbanisation⁷ • Water used for agriculture is estimated to be 20% higher by 2050⁸ • Currently farming accounts for almost 70% of global water withdrawals and up to 95% in certain developing countries⁹
Increased variability and volatility	<ul style="list-style-type: none"> • Increase in temperatures of 1.0-2.5 °C in Australia by 2070¹⁰

¹ Food and Agriculture Organisation, The future of food and agriculture: Trends and challenges, 2017

² Food and Agriculture Organisation, The future of food and agriculture: Trends and challenges, 2017

³ Food and Agriculture Organisation, The future of food and agriculture: Trends and challenges, 2017

⁴ Food and Agriculture Organisation, The future of food and agriculture: Trends and challenges, 2017

⁵ The Nielsen Company, We Are What We Eat: Healthy Eating Trends From Around the World, 2015

⁶ CSIRO, Australia 2030 - Navigating our uncertain future, 2016

⁷ United Nations, Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss, accessed January 2019 <https://www.un.org/sustainabledevelopment/biodiversity/>

⁸ Global agriculture, Water, Accessed January 2019, <https://www.globalagriculture.org/report-topics/water.html>

⁹ FAO, Water Scarcity - One of the greatest challenges of our time, 2017, <http://www.fao.org/zhc/detail-events/en/c/880881/>

¹⁰ CSIRO, How is climate likely to change in the future?, accessed Jan 2019, <https://www.csiro.au/en/Research/OandA/Areas/Assessing-our-climate/Climate-change-QA/Future-climate>

Key insight	Detail
	<ul style="list-style-type: none"> Altered precipitation patterns, extended heat waves, and elevated frequency and severity of extreme weather events (e.g. bushfires, flood and droughts)¹¹ ~20-40% of global production lost annually to crop and plant pests¹²
Embrace non-traditional players	<ul style="list-style-type: none"> Growing AgTech investment, with a 76% increase in the amount of funding deals in Australia¹³ New entrants into agriculture, such as technology players and start-ups Multinationals growing in significance to the Australian agricultural innovation landscape
Digital disruption	<ul style="list-style-type: none"> \$20.3 billion potential increase in gross value of production by 2050 through digital agriculture¹⁴ + 24% Compound Annual Growth Rate (CAGR) of artificial intelligence in agriculture by 2024¹⁵ Cross-sectoral automation benefits are worth ~\$7 billion¹⁶

Appendix C Key insights from international research

Eight key areas of differentiation have been identified through research and consultations with international stakeholders:

Key insight	Detail
Ecosystem leadership	<ul style="list-style-type: none"> Effective leadership and coordinated approaches to innovation drive strategic priorities and alignment of investment efforts and talents Some countries have a dedicated system leader that operates as an orchestrator: defining roles and responsibilities, incentives for participants across the

¹¹ CSIRO, How is climate likely to change in the future?, accessed Jan 2019, <https://www.csiro.au/en/Research/OandA/Areas/Assessing-our-climate/Climate-change-QA/Future-climate>

¹² Food and Agriculture Organisation, The future of food and agriculture: Trends and challenges, 2017

¹³ AgFunder, AgFunder AgriFood Tech Investing Report, 2017

¹⁴ CRDC, Accelerating Precision Agriculture to Decision Agriculture: Enabling digital agriculture in Australia (P2D) project, 2017

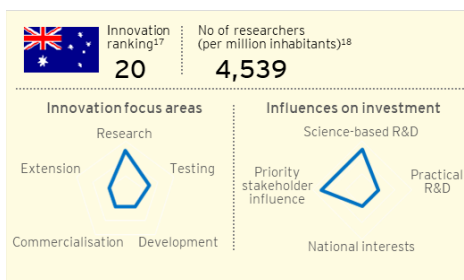
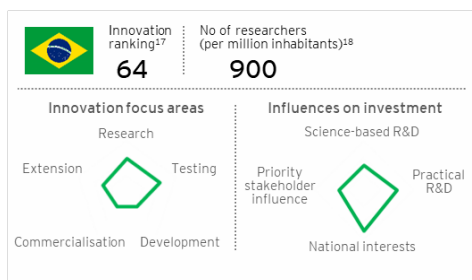
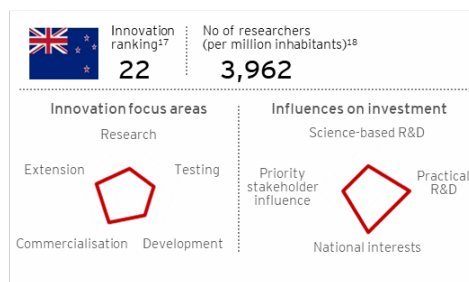
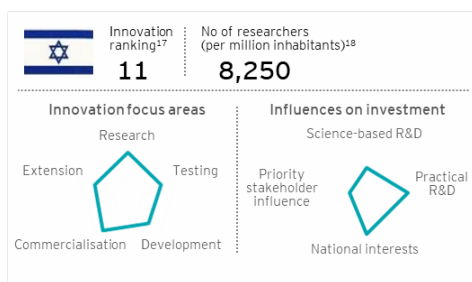
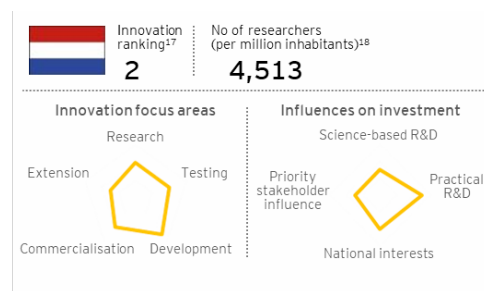
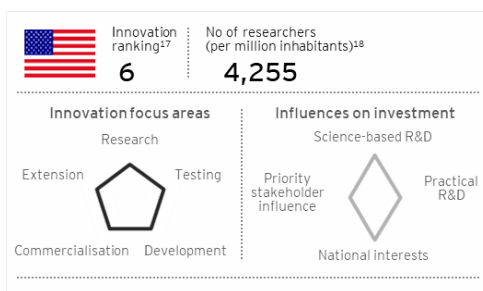
¹⁵ Energias Market Research, Global Artificial Intelligence in Agriculture Market, 2017

¹⁶ EY, The Upside of Disruption: Megatrends Shaping 2018 and Beyond, 2018

Key insight	Detail
	<p>system to achieve shared objectives, and ensuring accountability</p>
<p>Clear understanding of value proposition</p>	<ul style="list-style-type: none"> ● Having a clear understanding of strengths and positioning in the global market help shape strategic decisions ● Agreed focus areas for the agricultural sector also allow decision-makers to target resource allocation and help build our international reputation
<p>Focus on commercial viability at early stage of research</p>	<ul style="list-style-type: none"> ● Greater commercial focus help generate solutions that are industry relevant and deliver impact and value ● Both government and the private sector play a role in encouraging a focus on end user needs and commercialisation at the outset of a research project
<p>Diversity of funding environment</p>	<ul style="list-style-type: none"> ● A diverse range of funding sources allows investment to be balanced between incremental innovation and transformational outcomes ● Diversified funding sources also allows flexibility to respond to changes in the global or domestic market whilst generating innovation targeted at different time and innovation horizons
<p>International collaboration</p>	<ul style="list-style-type: none"> ● International partnerships and agreements enable sharing of knowledge and expertise to solve common issues (aridity, soils, water usage, etc.) ● An effective innovation system will naturally draw international interest in collaborating, which can be used to amplify agricultural innovation capabilities
<p>Importance of the innovation culture</p>	<ul style="list-style-type: none"> ● An innovation culture is one that centres on creating an environment for ideas to flourish, generating impact from collaboration, and recognising the value of learning from failure ● Such culture also encourages entrepreneurs to enhance their understanding of end user needs when looking to translate research into profitable products
<p>Innovation precincts, centres of excellence</p>	<ul style="list-style-type: none"> ● Precincts co-locate researchers and industry players, start-ups and accelerators to enable collaboration, idea generation and increase speed of concept development ● Best-in-class international innovation precincts are focused on a niche area that can form from specialities

Key insight	Detail
	that are specific to their region, leveraging natural advantages as a value proposition
Effective adoption pathways	<ul style="list-style-type: none"> • Clear end-to-end adoption pathways enable the innovation system to be more responsive to end user needs and foster an environment where ideas are applied to real situations • Local organisations play an important role in successful adoption of innovative technologies

An international comparison on (1) innovation focus and (2) key influences on investment, based on desktop research and interviews suggest Australia has opportunities to expand its relevance on the world-stage^{17 18}



¹⁷ Cornell University, INSEAD, World Intellectual Property Organisation; 2018 <https://www.globalinnovationindex.org/analysis-indicator>

¹⁸ UNESCO Institute for statistics; 2018, <http://uis.unesco.org/apps/visualisations/research-and-development-spending/>

Appendix D reference list

Section	Page	Reference
Megatrends	32-33	<p>1,2,3,4,12 Food and Agriculture Organisation, The future of food and agriculture: Trends and challenges, 2017</p> <p>5 The Nielsen Company, We Are What We Eat: Healthy Eating Trends From Around the World, 2015</p> <p>6 CSIRO, Australia 2030 - Navigating our uncertain future, 2016</p> <p>7 United Nations, Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss, accessed January 2019 https://www.un.org/sustainabledevelopment/biodiversity/</p> <p>8 Global agriculture, Water, Accessed January 2019, https://www.globalagriculture.org/report-topics/water.html,</p> <p>9 FAO, Water Scarcity – One of the greatest challenges of our time, 2017, http://www.fao.org/zhc/detail-events/en/c/880881/</p> <p>10,11 CSIRO, How is climate likely to change in the future?, accessed Jan 2019, https://www.csiro.au/en/Research/OandA/Areas/Assessing-our-climate/Climate-change-QA/Future-climate</p> <p>13 AgFunder, AgFunder AgriFood Tech Investing Report, 2017</p> <p>14 CRDC, Accelerating Precision Agriculture to Decision Agriculture: Enabling digital agriculture in Australia (P2D) project, 2017</p> <p>15 Energias Market Research, Global Artificial Intelligence in Agriculture Market, 2017</p> <p>16 EY, The Upside of Disruption: Megatrends Shaping 2018 and Beyond, 2018</p>
International insights	28	<p>17 Cornell University, INSEAD, World Intellectual Property Organisation; 2018 https://www.globalinnovationindex.org/analysis-indicator</p> <p>18 UNESCO Institute for statistics; 2018, http://uis.unesco.org/apps/visualisations/research-and-development-spending/</p>

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