This report provides the background rationale to the GIG Report entitled:

THE FUTURE DELIVERY OF GRAIN FARM PRODUCTION R&D
IN WESTERN AUSTRALIA

It includes Attachments 1-4. Attachment 5 is a separate document.
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Brazilian Agricultural Research Corporation

Attachment One: Definitions of Research, Development and Extension

Attachment Two: Policy rationale for public sector support of agricultural R&D

Attachment Three: The role of WA grower groups in grain farm production R&D

Attachment Four: Information on selected Check-Off Programs in the USA
INTRODUCTION

The Grains Industry Group (GIG) is a representative group of grains industry members from key grains industry bodies that have come together for the sole purpose of commissioning a review into optimum model/s for grain production Research and Development (R&D) in Western Australia.

Industry consultant David Falconer called an open meeting of all parties with an interest in WA grains industry R&D, soon after the Department of Agriculture and Food, Western Australia (DAFWA) budget forecasts were announced during June 2015 and at the same time DAFWA revealed plans to move its grain farm production research and technical staff into a not-for-profit company limited by guarantee called Grainswest. A total of 37 people attended this meeting in August 2015 and the report of that meeting is attached to this review report at Attachment 5. From that meeting, the membership of a ‘working group’ was established to act under the title of Grains Industry Group (GIG), to undertake further research into Grainswest and possible alternative models; and prepare recommendations to industry for the design of the best future model to deliver on-farm productivity research in WA.

This report provides the research undertaken on GIG’s behalf to underpin the analysis of the options and recommendations in the GIG report. The information provided in this report has been taken from public websites and documents, supplemented with interviews of personnel. The observations and opinions expressed in this report are those of the consultant and should not be attributed to the organisation or any person in that organisation.

GIG is grateful to Bluesee and its consultant team for conducting the background research and gratefully acknowledges the financial support of both the Grains Research and Development Corporation (GRDC) and DAFWA in funding this research and reports.

The reader should be aware of the confusion that may arise from the generic use of the term ‘model’ in the discussions about this subject. Wherever possible the term ‘R&D structure’ is used to refer to the overall R&D system, whilst the term model is used to describe an R&D delivery entity which is part of the R&D structure.
THE POLICY SETTINGS FOR GRAINS RESEARCH IN AUSTRALIA

The National Innovation and Science Agenda

The National Science and Innovation Strategy was launched by the Prime Minister during December 2015. It provides a framework for Australian innovation policy with initiatives worth $1.1 billion over four years. It is focused on four pillars:

- Culture and capital
- Collaboration
- Talent and skills
- Government as an exemplar

Of note for this study – the preamble to the agenda noted that while Australia was home to some of the highest quality scientific research organisations in the world, it had the lowest level of industry-research collaboration of the Organisation for Economic Co-operation and Development (OECD) member countries. The report noted that during 2015-16 the Australian Government will spend $700 million through the CSIRO and $2.8 billion on research in the higher education sector through Australian Research Council (ARC) grants and Research Block Grants (RBG’s). The current suite of six research grants that make up the RBG’s will be replaced by two programs:

- The Research Support programme will provide around $885 million in 2017 to Australian universities as a flexible funding stream to support the systemic costs of research.
- The Research Training programme will provide around $948 million in 2017 to support domestic and international higher degree by research (HDR) students, training of the next generation of researchers and innovators.

One of the main strategy actions is aimed at changing the funding incentives so that more CSIRO and, more particularly, university funding is allocated to research done in partnership with industry; and investment over the long term in critical, world-leading research infrastructure to ensure our researchers have access to the infrastructure they need. To quote:

“We will introduce new arrangements to encourage collaboration between researchers and industry by streamlining and refocussing a greater proportion of research block grant funding toward collaboration. We will also provide an additional $127 million over the forward estimates to research block grant funding.

We will introduce, for the first time, clear and transparent measures of non-academic impact and industry engagement when assessing university research performance. This will be piloted through the Australian Research Council in 2017 and fully implemented by 2018.

We will also connect more small and medium businesses with researchers by expanding and relaunching the successful Research Connections programme as Innovation Connections, opening up Australian Research Council Linkage Projects to continuous applications to fast track decisions on collaborative research grants, and opening a new application round for the Cooperative Research Centre programme in February 2016.”
During 2016 the Government will work with the higher education research sector, industry and other end-users of research to develop quantitative and qualitative measures of impact and engagement.

A pilot assessment will take place during 2017. The first national assessment and reporting will take place during 2018.

This signals a major shift in the strategies universities are likely to follow to access RBG’s; the mainstay of research funding revenue for Australian universities. In the case of agricultural production R&D this is likely to lead to universities being more proactive in seeking partnerships and agreement with the GRDC, as well as other funders of grains R&D. As one of the Agenda fact sheets puts it:

“Agricultural research in Australia is often done in close collaboration with producers – with many farming sectors funding significant research. Agricultural researchers will be well placed to take advantage of the sharpened incentives for university engagement with research end users.”

The strategy also sees ongoing funding for the National Collaborative Research Infrastructure Strategy (NCRIS) as part of a broader package of $2.3 billion over 10 years in new, sustainable funding for national scale research infrastructure, including $1.5 billion for NCRIS.

Other national government science strategies of relevance to the grains industry are:

- **Rural Research and Development Corporations (RDC)**
  Government and industry are projected to fund around $5.5 billion in collaborative research, development and extension in agriculture through the sector based Rural Research and Development Corporations over the next 10 years.

- **Rural R&D for Profit program**
  The program provides $200 million over eight years to improve farm gate returns, adoption of research outcomes and research collaboration. The Rural R&D for Profit programme aims to improve farm gate productivity and profitability. To be eligible for grant funding, RDCs must partner with one or more researchers, research agencies, RDCs, funding bodies, businesses, producer groups or not-for-profit organisations; and the partnership must provide funding (cash or cash plus an in-kind contribution) at least equal to the requested Federal Government grant funding.

- **Food and Agribusiness Growth Centre**
  The Federal Government has invested in five Industry Growth Centres, one of which is in Food and Agribusiness. The Food and Agribusiness Growth Centre is headquartered with CSIRO at their Food Innovation Centre in Werribee, Victoria. The Growth Centre also operates through other CSIRO sites across Australia. Food Innovation Australia Ltd (FIAL) is the not-for-profit company responsible for delivering the activities of the Food and Agribusiness Growth Centre. FIAL aims to leverage and build on CSIRO’s extensive national network of researchers and collaboration partners to improve engagement between researchers and businesses and drive innovation throughout the value chain.

  The Growth Centre will boost the competitiveness and productivity of Australia’s Food and Agribusiness sector by identifying opportunities to reduce regulatory burden; increasing collaboration and commercialisation; improving capabilities to engage with international markets and; global supply chains, and enhancing management and workforce skills.

  To date FIAL has been engaged in collecting ideas from stakeholders on its role and priority activities and developing a 10-year strategic plan.
• Cooperative Research Centres (CRC) program

The CRC program, first introduced during 1990, has been used extensively to successfully drive collaboration in R&D in the agricultural sector. The key funding strategy is based on the Federal Government matching funds for those raised by the CRC and its partners. CRCs also include an educational output through the training of postgraduate students and this ensures universities are also involved. The CRCs have greatly enhanced the collaboration between research institutions across Australia and delivered many real beneficial outcomes for the agricultural sector.

There have been 212 funded CRCs and currently there are 33 active CRCs, six in the agriculture sector but only one, the Plant Biosecurity CRC, which has direct relevance to the grains sector. The Plant Biosecurity CRC is due to finish during 2018-19. In the past there have been eight CRC’s of direct relevance to the grains industry. These have been in innovative grain food products; value added wheat; weed management; molecular plant breeding; quality wheat products and processes; legumes in Mediterranean agriculture; plant science; and plant based management of dryland salinity.

During December 2015 the Federal Government announced new guidelines aimed at strengthening ties between industry and research organisations to solve ‘real world industry problems’. The revised program provides two streams – traditional CRCs supporting medium to long-term industry-led research, and CRC Projects (CRC-Ps) for shorter term activity with a focus on involving small and medium sized entities (SMEs). The first call for applications under the revised program will be during 2016. Funding will be prioritised to those CRCs and CRC-Ps that are aligned with the five Industry Growth Centres and the nine Science and Research Priorities.

The National Grains Research, Development and Extension Strategy

The Grains Industry National RD&E Strategy, established during 2011, is aimed at building a more coordinated and collaborative approach to Australia’s RD&E activities across public and private sector organisations focused on areas of industry priority. It has no legal status, but is established under a Letter of Intent signed by the contributing parties including the Australian Council of the Deans of Agriculture (the universities), the Federal Department of Agriculture and Water, the State departments responsible for agriculture, the CSIRO and the Rural Research and Development Corporations with the intent of the parties “to enhance the collaboration, coordination, efficiency and effectiveness of RD&E efforts nationally”.

The parties to this Letter of Intent agreed and acknowledged “ongoing investment by governments and industry in RD&E is required to deliver a core capability for primary industries”.

It is monitored through the Agriculture Senior Officials Committee (AGSOC) and aims to keep in place a forward-looking national plan to secure the intellectual and human capital and physical resources required to underpin future RD&E and industry innovation through:

• National Research Programs to create critical mass and avoid unnecessary duplication that will address national priorities and deliver national and regional outcomes.

• National Centres of Research Capability to maintain critical infrastructure and critical science disciplines, and to establish links to access international research collaboration.
• Regional Centres of Applied RD&E that support farming systems, improved practices, and adoption of national research outcomes.
• Long-term bilateral arrangements between host organisations and the GRDC to stabilise funding and enhance the career pathways for science staff.
• A skills pipeline to develop a suitable workforce for the future grains industry.

WA plays a major role in the Strategy, providing national leadership and support across key research and development priorities, ensuring the State is well positioned to build on collaborative processes to deliver benefits to the grains industry. The National Grains RD&E Implementation Committee meet twice a year in person and have additional meetings by teleconference to share information on investments and adjust priorities. The Implementation Committee is jointly chaired by John Harvey, Managing Director of GRDC, and Dr Mark Sweetingham, Executive Director with DAFWA responsible for grains R&D.

During 2013-14 total expenditure on grains RD&E in Australia was an estimated $476 million. Based on an average annual gross value of production (GVP) of $11 billion, this represented 4.3% of GVP. Investment by State departments was reportedly declining compared to 2007-08 estimates, with a corresponding increase in investment by the GRDC and university sector. More universities provided investment estimates for the 2013-14 than 2007-08 period, and this may explain some of the increase reported here. The comparative breakdown is shown in the table below which has been sourced from the revised Grains Industry National Research, Development and Extension Strategy, 2014. Funds provided by State governments and the Federal Government are inclusive of on-costs and corporate overheads.

Table 1: Comparison of grains RD&E investment 2007-08 to 2013-14

<table>
<thead>
<tr>
<th>Organisation</th>
<th>2013/14 $ million</th>
<th>2013/14 %</th>
<th>2007/08 $ million</th>
<th>2007/08 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>State departments</td>
<td>95</td>
<td>20</td>
<td>123</td>
<td>32</td>
</tr>
<tr>
<td>CSIRO</td>
<td>51</td>
<td>11</td>
<td>45</td>
<td>12</td>
</tr>
<tr>
<td>Universities</td>
<td>69</td>
<td>15</td>
<td>39</td>
<td>10</td>
</tr>
<tr>
<td>GRDC</td>
<td>164(^27)</td>
<td>34</td>
<td>88</td>
<td>23</td>
</tr>
<tr>
<td>Private investment (estimate)</td>
<td>97</td>
<td>20</td>
<td>90(^28)</td>
<td>23</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>476</strong></td>
<td><strong>100</strong></td>
<td><strong>385</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: Grains Industry National Research, Development and Extension Strategy, Capacity audit 2012
27: GRDC investments outside state agencies, CSIRO and universities (other RDCs, grower groups/farming systems groups, CRCs; international collaboration and private industry totalled about $54m in 2013/14 and $30m during 2007/08.
28: Estimated $45m from private agrichemical, fertiliser and seed RD&E and $45m from private consultant extension service provision.

The information in the table above shows that investment in grains RD&E by State departments has declined from 32% to 20% of the total estimated expenditure on grains RD&E.
Human Resource Capacity

During 2011-12 the National Grains RD&E Implementation Committee oversaw a national audit of resources involved in grains RD&E at the universities, CSIRO and government agencies. This audit data was obtained by voluntary ‘self-assessment’. While believed valid, the data is subject to a degree of uncertainty associated with organisations’ allocation of people to discipline areas.

Nationally, 2389 people (1778 when presented as full-time equivalents (FTEs) including 228 students) were reported to be involved with grains industry RD&E during 2011-12. Just over half (53%) of capacity was professional, 34% technical and 13% postgraduate students. Extension specialists contributed 3.3% (59 FTE) of the national capacity. Capacity, by GRDC region, was split 55% southern, 25% western and 20% northern.

Table 2: Human resource capacity (FTE) contributing to public sector grains industry RD&E in GRDC regions in 2011-12

<table>
<thead>
<tr>
<th>Classification</th>
<th>Northern</th>
<th>Southern</th>
<th>Western</th>
<th>Total</th>
<th>(%)</th>
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<tbody>
<tr>
<td>Professional</td>
<td>222</td>
<td>465</td>
<td>264</td>
<td>950</td>
<td>53</td>
</tr>
<tr>
<td>Technical</td>
<td>104</td>
<td>388</td>
<td>109</td>
<td>600</td>
<td>34</td>
</tr>
<tr>
<td>Postgraduate student</td>
<td>27</td>
<td>124</td>
<td>77</td>
<td>228</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>352</td>
<td>977</td>
<td>449</td>
<td>1788</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Grains Industry National Research, Development and Extension Strategy, Capacity audit 2012

The CSIRO (277 FTE), University of Adelaide (246) and DAFWA (222) reported the greatest capacity in grains industry RD&E; making up 41% of the total. Other State departments contributed significant capacity: DAFF (175), NSW DPI (137) and Queensland DEPI (134).

Public sector human resource capacity contributing to public sector grains industry RD&E during 2011-12 was divided up into:

- variety development 35%
- farming systems 31%
- plant protection, plant physiology and agronomy 8%
- other 12%.

There were 393 positions considered important for succession planning, with key areas being plant pathology (40 positions), soil science (38), agronomy (35), plant physiology/biology (30) and grains processing/food technology/nutrition (21).
The WA Government Policy Position on Grains R&D

In the August 2013 State Budget, the WA State government announced $10 million over five years to match $15 million in GRDC funding for grains research projects and the ‘Seizing the Opportunities Initiative’ in agriculture with an allocation of $297.5 million of Royalties for Regions funds over four years to the agriculture sector.

To date, announcements for the use of these funds for R&D in the grains industry have included:

- **August 2014** – $20 million over four years for boosting grains R&D including the Grainswest initiative and to support R&D activities aimed at increasing productivity and to take advantage of trade opportunities in the region.
- **September 2014** - $10 million for the eConnected Grainbelt project.
- **October 2015** - $17 million available to grower groups to support applied research and development activities across all agricultural industries.

During 2014 the Minister for Agriculture and Food, the Honourable Ken Baston, MLC, and DAFWA introduced ‘Agrifood 2025+’ – an initiative which sought to double the real-term value of sales from WA’s agrifood sector by 2025. Closely linked to the State Government’s ‘Seizing the Opportunity’ initiative, ‘Agrifood 2025+’ supports the State Government’s goal to broaden the base of the State’s economy. Industry and government agree that the agrifood sector has the potential to contribute more to the State’s economy; with its farming business potential yet to be fully realised due to limited demand. An increasingly prosperous Asia, coupled with rapid worldwide population growth, is now starting to provide the buying power needed to make that development viable.

During February 2015, Minister Baston launched the *WA Grains Industry Strategy 2025+* which set out the industry’s response to the Minister’s challenge and identified the strategy actions it believed could lead to a doubling of the value of the WA grains industry by 2025. One of the eight principal strategy actions in this industry strategy is for focused farm productivity R&D to underpin the growth of the industry.

During April 2015, the Premier of WA and Minister for Science, the Hon. Colin Barnett, MLA, released a Science Statement for WA entitled ‘Growing Western Australia’ which identified five areas in which the advancement and application of science can help broaden the economy and create a new generation of jobs. These areas are:

- Mining and energy.
- Medicine and health.
- Agriculture and food.
- Biodiversity and marine science.
- Radio astronomy.

Cutting across each of the five science priorities are areas of opportunity that can help WA achieve greater outcomes. Areas of opportunity were identified as:

- Fostering a culture of science in WA through education and engagement initiatives.
- Developing WA’s emerging capability in data intensive science.
- Building on the State’s water science expertise.
- Strengthening partnerships for effective collaboration.
Funding Grain Farm Production R&D in WA

The relevant investment sources for grain farm production R&D for the WA grains industry are:

**The Grains Research and Development Corporation (GRDC)**
Funded by grain growers who pay a 1% levy, of which half is matched by government funds up to 0.5% of the gross value of grain production at the farm-gate. During 2014-15 GRDC funded $18.5 million grain farm production R&D through the Department of Agriculture and Food (DAFWA).

**The Australian Government**
Through direct funding to CSIRO, the Cooperative Research Centres program and through the universities via the Research Block Grant system (RBGs) and the Australian Research Council. Details of funding for grain farm production R&D in WA through these mechanisms are not readily available.

**The WA Ministry and Department of Agriculture and Food (DAFWA)**
The WA State government makes an annual budget allocation to DAFWA. During 2014-15 this was almost $136 million for the delivery of all services. An estimate of the allocation of consolidated revenue funds to grain farm production R&D (salaries and operating expenses) is $12 million. This does not include overheads which are calculated as an additional $18.7 million.

**Royalties for Regions Fund**
During 2013 the State government announced a $300 million ‘Seizing the Opportunities’ initiative to be allocated over four years to Agriculture. During August 2014 the Government announced $20 million over four years for boosting grains R&D including the Grainswest initiative and to support R&D activities aimed at increasing productivity and to take advantage of trade opportunities in the region.

**The Council of Grain Grower Organisations (COGGO)**
COGGO is a public company limited by guarantee which was incorporated in 2000 to invest in R&D for the benefit of WA grain growers. Grower members (around 400) voluntarily contribute 0.5% of their net farm-gate value of production for investment in R&D projects. Annual allocations of around $500-$600,000 fund around 10 new projects per year. The origins of COGGO began during 1997 when 10 WA grain-grower organisations joined together to give local growers a voice and a stake in plant breeding.

**Private sector agricultural research**
A large volume of basic and applied research is carried out in Australia by private companies developing crop protection and plant nutrition products aimed at improving agricultural production. Many of these companies are multi-national and produce products for both the Australian and international markets.

**In-kind contributions from grower groups, consultants and farmers**
Trials are often conducted on leased or land provided at no costs with treatments, sampling and data collection often undertaken with the voluntary contribution of time of farmers, consultants and grower groups. While not often quantified, it is a real contribution to the cost of grain farm production R&D in WA.
Delivery of Grain Farm Production R&D in WA

The delivery organisations for agricultural production R&D in WA are:

- DAFWA
- Universities
- CSIRO
- Grower groups
- Commercial companies – contract trial and analytical laboratory services, and input supply companies (crop protection, fertilisers, plant breeders).

Grain industry group members expressed concern about the declining productivity gains for Australian agriculture which seem to have fallen since 2001 from previous high rates and are now below growth rates of competitors.

Current total factor productivity growth rate for WA grain farms is thought to have averaged around 1.5% since 1980, which has been just enough to keep farmers ahead of the cost price squeeze and offset the long-term decline in grower’s terms of trade. Of the contribution of R&D to productivity growth, about one third has been attributed to genetics (varieties) and two thirds to farm management and agronomy systems (practices).

There is a view that since the mid 1990’s this rate of productivity gain may have dropped even further, and one of the main reasons for this decline is often claimed to be the reduced level of government spending on R&D.

While there is a continuum between RD&E, it is generally acknowledged that CSIRO, the universities and the large multinational life science companies largely do the research (the big ‘R’ projects); and extension (the big ‘E’) is done by grower groups, consultants and the GRDC itself through conventional publications, fact sheets, multi-media and adoption tools. Development, in between Research and Extension, (the ‘D’ space) has in the past been mainly the province of DAFWA. While it is possible for other parties to undertake Development activities, DAFWA has been seen by growers as the independent evaluator of crop and farming systems and agronomic advice; in effect taking the results of research and proving its value in the field across different soil types and seasonal climate conditions and thus speeding up adoption.

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1 The ratio of all market outputs produced to market inputs used, reflecting farmers’ business decisions — for example, and substituting chemical for mechanical cultivation. At an industry or regional level, improvements in TFP also capture increased adoption of best practice, economies of scale and the exit of less efficient farms. (taken from “Grains Industry National Research, Development and Extension Strategy, 2014” page x)
The Department of Agriculture and Food, Western Australia

The Department of Agriculture and Food, Western Australia (DAFWA) operated with a Grains Industry Directorate up until September 2015 when it was split with approximately 90 staff involved in grains policy and industry development activities, including regional services functions in the Central Agricultural Region, transferred into the Grains and Livestock Industries directorate. At the same time the Grains R&D Transformation directorate was set up with around 195 researchers, technical staff, management and administration personnel.

DAFWA advised that obtaining State Government Consolidated expenditure data for 2014-15 and 2015-16 for the then Grains Directorate would not provide a true picture for the Grains R&D Transformational Directorate forward budgets as the Directorate was split in September 2015 when 90 staff were transferred out of the then Grains Directorate and deployed into either the Grains and Livestock Directorate or the Grains R&D Transformational Directorate.

The State Government (Consolidated) Funds for the Grains R&D Transformational Directorate for 2016-17, which assumes the first year operation of the proposed Grainswest with the ‘carve out’ of 195 staff, is shown in the table below together with the budget estimate for 2017-18.

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<th>2016-17 ($m)</th>
<th>2017-18 ($m)</th>
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<tbody>
<tr>
<td>Salaries (including on costs)</td>
<td>12.4</td>
<td>12.7</td>
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<tr>
<td>Operating</td>
<td>2.9</td>
<td>3.0</td>
</tr>
<tr>
<td>Corporate Overhead</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>Start-up costs</td>
<td>2.5</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL</td>
<td>22.6</td>
<td>20.5</td>
</tr>
</tbody>
</table>

It is important to note that salaries shown here do not include superannuation payments. These are accounted for in the Corporate Overhead. However, salaries do include some significant corporate services charges. This makes it difficult to compare the individual cost items with traditional charts of accounts for commercial organisations.

Budgets for external funding and Royalties for Regions funding are shown in the table below. By far the majority of external funds come from the GRDC.

<table>
<thead>
<tr>
<th></th>
<th>2014-15 ($m)</th>
<th>2015-16 ($m)</th>
<th>2016-17 ($m)</th>
<th>2017-18 ($m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Funds</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salaries</td>
<td>11.5</td>
<td>10.9</td>
<td>9.6</td>
<td>8.4</td>
</tr>
<tr>
<td>Operating</td>
<td>7.3</td>
<td>15.2</td>
<td>10.4</td>
<td>8.6</td>
</tr>
<tr>
<td>Total</td>
<td>18.8</td>
<td>26.1</td>
<td>20.0</td>
<td>17.0</td>
</tr>
<tr>
<td>Royalties for Regions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salaries</td>
<td>0.6</td>
<td>1.5</td>
<td>1.9</td>
<td>2.0</td>
</tr>
<tr>
<td>Operating</td>
<td>0.8</td>
<td>6.2</td>
<td>5.8</td>
<td>4.6</td>
</tr>
<tr>
<td>Total</td>
<td>1.4</td>
<td>7.7</td>
<td>7.7</td>
<td>6.6</td>
</tr>
</tbody>
</table>
During March 2015 the forward estimates for 61 GRDC funded projects for 2015-16 were broken up as follows. This gives a first pass overview of the types of GRDC funded projects that DAFWA is engaged in and the relative expenditures between the areas of specialisation.

<table>
<thead>
<tr>
<th>Program</th>
<th>Number of projects</th>
<th>Total funding $m 2015-16</th>
<th>General description of projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop genetics</td>
<td>11</td>
<td>2.23</td>
<td>Australian national frost program – coordination and phenotyping; national barley foliar pathogen variety improvement program; genetic approaches to reduce the nitrogen dilution effect and increase n use efficiency in wheat; effective disease control of Stagonospora nodorum blotch; maximising barley phenology to maximise yield potential; reduced head loss and straw breakage by genetics and management; barley grain defect; sequencing the barley chromosome 7H; improved genetic solutions for the management of yellow spot in wheat; NVT services agreement for screening foliar diseases of wheat and barley; improving wheat yields on sodic, magnesic and dispersive soils.</td>
</tr>
<tr>
<td>Crop protection</td>
<td>17</td>
<td>3.6</td>
<td>National nematode epidemiology and management program; canola disease surveillance, management, epidemiology knowledge and tools; new tools and germplasm for Aust. Pulses and oilseed breeding programs to respond to changing virus threats; cultural management options for herbicide resistant weeds; evaluation herbicide tolerance of new crop varieties; management of invertebrate pests on farms; seedbank biology of emerging weeds; improving IWM practices for emerging weeds; national crown rot epidemiology and management; molecular diagnostic knowledge and tools; management of insecticide resistance in RLEM and screening of new MoA chemistry; aphid thresholds and canola yield losses; monitoring and control methods for snails and slugs; improved insecticide and fungicide use and canopy penetration in cereals and canola; yield loss response curves for host resistance to leaf, crown and root diseases in wheat and barley; national pest information service; general plant pathology</td>
</tr>
<tr>
<td>Farm business integration</td>
<td>7</td>
<td>2.9</td>
<td>Diagnostic and responsive agronomy - mycrop, holistic crop and paddock diagnostics; determining yield under frost; national pathogen modelling; Pestfax mapping; building capacity for crop protection and agronomy; evaluate and report on the effectiveness of yield predicting tools; analysis frameworks to support profitable fertiliser use.</td>
</tr>
<tr>
<td>Agronomy</td>
<td>11</td>
<td>4.5</td>
<td>Farming systems to improve frost tolerance; tactical break crop agronomy; tactical wheat agronomy; developing new mixed farming option; dry seeding; management of barley cultivars; national oat breeding program support; quinoa s a new crop; management of spray drift; optimising nitrogen fixation of grain legumes; pasture agronomy - profitable pasture sequences</td>
</tr>
<tr>
<td>Soils productivity</td>
<td>10</td>
<td>4.6</td>
<td>Management of sodic and magnesic soils; impact of soil compaction on crop yield; regional soil testing and nutrient guidelines; more profit from crop nutrition; use of micronutrients; non-wetting soils; soil acidity and managing sub soil acidity; soil organic matter</td>
</tr>
<tr>
<td>Field services</td>
<td>5</td>
<td>0.8</td>
<td>Managed environment services; Australian pastures genebank; Australian Field pea improvement program; Australian lentil improvement program; Australian Chickpea breeding.</td>
</tr>
</tbody>
</table>
The current location of staff in the Grains R&D Transformation Directorate is as follows:

<table>
<thead>
<tr>
<th>Location</th>
<th>Full time equivalent staff allocated to Grains R&amp;D Transformational Directorate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albany office</td>
<td>10.2</td>
</tr>
<tr>
<td>Esperance Downs Research Facility</td>
<td>3.3</td>
</tr>
<tr>
<td>Esperance office</td>
<td>8.0</td>
</tr>
<tr>
<td>Geraldton office</td>
<td>19.0</td>
</tr>
<tr>
<td>Geraldton technical support</td>
<td>2.0</td>
</tr>
<tr>
<td>Katanning office</td>
<td>4.6</td>
</tr>
<tr>
<td>Merredin office</td>
<td>10.5</td>
</tr>
<tr>
<td>Merredin Research Facility</td>
<td>3.0</td>
</tr>
<tr>
<td>Moora office</td>
<td>0.3</td>
</tr>
<tr>
<td>Murdoch University</td>
<td>3.6</td>
</tr>
<tr>
<td>Narrogin office</td>
<td>1.5</td>
</tr>
<tr>
<td>Northam office</td>
<td>33.7</td>
</tr>
<tr>
<td>South Perth</td>
<td>71.0*</td>
</tr>
<tr>
<td>Wongan Hills Research facility</td>
<td>2.8</td>
</tr>
</tbody>
</table>

* includes 23 FTE positions to be assigned to Northam or Murdoch

The Grains R&D Transformation Directorate operates projects at the following research station facilities which are dedicated to grains research in addition to facilities at South Perth:

- Northam
- Esperance Downs
- Merredin
- Wongan Hills
- Geraldton/Badgingarra
- Katanning (50% shared with animal production research).

In addition, the Grains Innovation Programs from time to time use some facilities at Carnarvon, Medina, Manjimup and Kununurra. The approximate replacement value of these facilities is shown in the table following. This is not the market value of these assets.

<table>
<thead>
<tr>
<th>Facility</th>
<th>Value (.000) *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albany Regional Office</td>
<td>$46,136</td>
</tr>
<tr>
<td>Northam Regional Office &amp; Research Facility</td>
<td>$51,021</td>
</tr>
<tr>
<td>Badgingarra Research Facility</td>
<td>$6,491</td>
</tr>
<tr>
<td>Esperance Office</td>
<td>$11,107</td>
</tr>
<tr>
<td>Esperance Downs Research Facility</td>
<td>$5,587</td>
</tr>
<tr>
<td>Geraldton Regional Office</td>
<td>$11,042</td>
</tr>
<tr>
<td>Geraldton Woorree</td>
<td>$3,069</td>
</tr>
<tr>
<td>Katanning - (50%)</td>
<td>$12,509</td>
</tr>
<tr>
<td>Merredin District Office &amp; Research Facility</td>
<td>$25,035</td>
</tr>
<tr>
<td>Moora Office</td>
<td>$5,984</td>
</tr>
<tr>
<td>Newdegate Research Facility</td>
<td>$6,682</td>
</tr>
<tr>
<td>Wongan Hills Research Facility</td>
<td>$26,373</td>
</tr>
<tr>
<td>Total</td>
<td>$211,036</td>
</tr>
</tbody>
</table>

* Desktop replacement value of buildings, Strategic Asset Plan 2014-2015

Source: DAFWA
Specialised facilities within the above include the Managed Environment Facility (MEF) at Merredin and the New Genes for New Environments (NGNE) research facilities at Merredin and Katanning. Wongan Hills has traditionally been a major operational base for the crop breeding effort in WA, including the crop seed production activities. It has 900 to 1000 hectares (ha) of land under crop each year with significant areas dedicated to crop breeding, crop seed production and crop agronomy experimentation. The facility currently consists of a small office building and a variety of sheds on 2503ha of land. The operational costs associated with the Grain R&D Transformation Directorates usage of these research station facilities are included in the operational costs shown in the table above.

**Commonwealth Scientific and Industrial Research Organisation**

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is the largest supplier of rural R&D in Australia. About 60% of CSIRO’s funding for agriculture and food-related R&D comes from Commonwealth block grants, with the remainder from contestable sources (of which around a quarter is from the RDCs). Its activities in grain production R&D of direct relevance to the WA Grains Industry are arguably greater than the combined level of university activity in WA.

In terms of its future role in support of grain farm production R&D CSIRO remains committed to research orientated on the export grain sector in WA and made the following points:

- Their presence is likely to grow modestly over the next five to 10 years (e.g. from 50 to 60 FTEs based in WA plus another 15 FTEs based outside the State). Around 80% of this staff time is directly relevant to R&D the grains industry. Most of this is GRDC-funded on a co-investment basis and amounts to around $5 million per annum of CSIRO investment matched by GRDC funding of the same order.
- Their focus will remain on novel agronomy, farming systems (including the role of forages and livestock), overcoming soil constraints, crop nutrition and fertiliser management, crop adaptation.
- Work will continue outside of WA that is relevant to the State, such as crop pre-breeding (including for disease resistance), digital technologies such as robotics, automation, precision agriculture, and telecommunications.
- Any work on pest, disease, or weed problems will have a focus around novel management interventions and the role of products like biologics.
- They will be striving to diversify their funding base away from almost sole reliance on GRDC towards more funding from the multinational bioscience companies and other players in private industry.
- They will continue to draw in capability from outside WA where it makes sense.
- They will continue to view themselves as a strategic applied science organisation, keen to collaborate with players further downstream and upstream.
- They would like to be a catalyst in some way for a grains R&D innovation hub in metropolitan Perth, which draws in industry and other research providers in a co-location. There is an opportunity to consider this in the midst of CSIRO reconsidering its property footprint in Perth.
- They consider relationships with university partners important (through joint appointments and co-supervision of students).
Universities

The universities, along with CSIRO, have historically been the main providers of basic rural research, seeking to add to the knowledge base, rather than targeting specific applications. In the past 20 years, through increased partnerships with the RDCs and CRCs, universities have conducted more project-focused, applied research. Some partnership arrangements are made more attractive by top-up infrastructure funding from the federal government when partnering occurs.

There are five universities based in WA. The University of Western Australia (UWA) has traditionally been the main WA university servicing the agricultural sector and remains the highest ranked WA university in terms of agricultural research output. Second is Murdoch University with its focus on veterinary science and agricultural biotechnology and then Curtin University with a strong historical focus on agribusiness research.

It has often been observed that given the small local population compared to the number of universities operating in WA it is not surprising that they seem to be focused on attracting international students and undertaking research that has international focus at the expense of focusing on local research issues.

The Australian Research Council (ARC)’s State of Australian University Research 2015-16 report compares the quality of Australian university research benchmarked against world standards. In Agricultural and Veterinary Sciences all WA universities performed well and were judged well-above world standard in selected sub-fields. The report shows that across Agriculture and Veterinary Sciences, WA’s universities provide comprehensive coverage with all of their research rated either ‘at’ (score three), ‘above’ (score four), or ‘well-above’ (score five) world standard. Murdoch University was the most comprehensive of the State’s universities in Agricultural and Veterinary Sciences and was assessed as ‘at’ or ‘above’ world standard in five out of seven possible sub-fields. UWA submitted for assessment in four sub-fields and Curtin submitted for one. UWA provided the most comprehensive submission in the Environmental Sciences and was ranked ‘well-above’ world standard (five) in all three of the disciplinary sub-fields; while Edith Cowan University (ECU), Curtin and Murdoch were all ranked ‘above’ world standard (four) in the Environmental Science and Management sub-field.

Notre Dame does not claim to service grain farm production R&D. ECU does not specifically focus on grain farm production R&D either, although it does have some researchers and projects servicing the grains industry in WA. Notably:

- Professor Kamal Alameh – photonics and electronics engineer scientist has a GRDC project for photonic detection using lasers to detect weeds in crops using sensor bars able to operate at high speeds.
- The Pilot Malting Plant used to evaluate barley varieties for malting purposes as well as train maltsters and brewers.
- A partner in Jamie Oliver’s Ministry of Food program aimed at teaching ordinary Australians to cook and adopt healthy eating options.
University of Western Australia

UWA operates its agricultural research through its Institute of Agriculture which aims to enhance the University’s contribution to the advancement of agriculture and the management of natural resources in selected international, national and regional settings. UWA prides itself on its strong focus on the basic sciences and makes no apologies for its apparent international focus aiming to address local problems in an international context.

The Institute has five research programs:

- Integrated land and water management.
- Plant production systems.
- Animal production systems.
- Rural economy, policy and development.
- Education, outreach and technology exchange.

UWA does not see its focus on agriculture waning, but rather increasing. It aims at having strengths in basic sciences and then applying these to agricultural production, especially in the areas of soil science and plant science with expertise in soil chemistry, soil physics, geology, mineralogy, microbiology, wheat genetics and crop physiology. UWA sees one of its main strengths as being in abiotic stress-related research, such as drought, heat and salinity resistance and genomic approaches for stress tolerant crops. Biotic stress related research which aims to improve disease resistance in crop plants was also a key focus of research. There is also a strong agricultural and environmental economics and policy sustainability focus.

During the 2014 Shanghai Jiao Tong University’s internationally recognised Academic Ranking of World Universities (www.shanghairanking.com), UWA climbed to 24th in the world for Life and Agricultural Sciences, the highest ranking in Australia. It has a strong international science focus and tends to look at local problems in an international context and does not have a primary driver of putting dollars in the pockets of farmers. However, it is acknowledged that the recent National Innovation and Science Strategy is likely to cause a refocus of this position.

In the recent Excellence in Research for Australia (ERA) 2015 rankings, UWA was ranked as ‘well above’ world standard in Agriculture, Land and Farm Management and Soil Science.

The University has a ‘Future Farm’, 1600 hectares at Pingelly, which is aimed at best practice mixed farming by 2015 and incorporates no-till cropping production and is part of a Worldwide Universities network examining future farming systems to ensure sustainable and responsible production healthy food from health animals.

Murdoch University

Murdoch University is committed to translational research in four key areas:

- Primary food production.
- Climate variation and adaptation, environmental and natural resources.
- Animal and human health and welfare.
- Social sciences including public policy, governance, communication, culture and education.

Murdoch houses the State Agricultural Biotechnology Centre (SABC). The SABC is the collaborative university Centre for R&D in agricultural and veterinary biotechnology in WA. It provides platform technologies and world class equipment and facilities for R&D in agricultural biotechnology to researchers from universities, State government and industry. At any time 15-20 research groups and
companies rent space and use the SABC facilities. The SABC has extensive Physical Containment Level 2 (PC2) and Federal Department of Agriculture and Water Resources Biosecurity containment facilities, including bench space for 88 full-time researchers located in three large laboratories and DAFWA Biotechnology Services Laboratories. There are a series of dedicated rooms for specialist activities such as preparing Polymerase Chain Reaction (PCR), **Deoxyribonucleic Acid** (DNA) sequencing and genomics, mass spectroscopy and proteomics, confocal and fluorescence microscopy, robotic workstations, dark room and tissue culture rooms. In addition, there are offices, a computer room and a seminar room. Externally available support facilities, includes a 52ha vet farm on-site, and major PC2 and non-PC2 glasshouse facilities. Research areas include: wheat and barley breeding, grain quality, molecular plant pathology, transgenic plants, gene discovery and functional genomics.

Another major focus of Murdoch University of relevance to the WA grains industry is the Centre for Rhizobium Studies (CRS). Since its inception during 1997, the CRS has become an internationally-recognised hub for research and training in the science of the root nodule bacteria. These organisms are unique in their ability to convert atmospheric nitrogen to plant-available nitrogen by forming symbiotic associations with legumes. In farming systems, this biological nitrogen fixation allows for inputs of nitrogen without the need for using energy-expensive and CO₂-producing industrially synthesised fertilisers. A key focus of the research at the CRS is the application of root nodule bacteria to legumes in agriculture, and to identify and solve problems which compromise nitrogen fixation. This involves understanding and integrating root nodule bacterial ecology, physiology, molecular genetics and symbiotic capacity. In addition, researchers at the CRS are working to identify, characterise and describe new root nodule bacteria from Australia and all over the world.

The University is also a node for the Plant Biosecurity CRC. Grains investment in the CRC’s programs across Australia totalled $53.8 million (40% of total investments), of which $33.5 million was for management of pests in stored grain.

Murdoch University has particular strengths in Agricultural Biotechnology. In the recent Excellence in Research for Australia (ERA) 2015 rankings Murdoch was ranked as ‘well above’ world standard in Agricultural Biotechnology.

**Curtin University of Technology**

Curtin has considerable capability in agriculture and continues to co-invest to build on the University’s existing strengths, which are in-line with industry’s understanding of their needs.

Agriculture research and education is primarily housed within the Department of Environment and Agriculture (School of Science). However, other elements occur within the Curtin Business School (supply chain logistics, agricultural economics, marketing), School of Public Health (food science and technology) and the Faculty of Humanities (sustainable communities, social sciences, planning).

Curtin has a long track record of involvement in agricultural teaching and research. However, its activities have changed rapidly over recent years and they have been strengthened through the focussed use of internal and external investment. From 2011 Curtin’s Muresk Institute transitioned to become the Department of Environment and Agriculture (School of Science). During this transition the Bachelor of Agribusiness was maintained as a core undergraduate offering and research capacity was developed within agreed areas of strength as defined by the National R, D &E framework. The research focus has underpinned rapid growth in the area of crop and pasture science and Curtin has recently been ranked as ‘well above’ world standard (ERA 5) in this area.
During 2014 Curtin and GRDC signed the first of the bilateral research agreements with GRDC and an externally-funded research centre – Centre for Crop and Disease Management (CCDM) – was formed to house much of the research activity (see details below). This major initiative is a long term commitment to research infrastructure and capability in WA and will assist to ensure that WA maintains a strong national and international profile of excellence in agricultural research.

The Bachelor of Agribusiness degree has managed a smooth transition from Muresk to Bentley and continues to demonstrate a strong growth trajectory. The degree also includes strong elements of technical agronomy and crop science and the Department of Environment and Agriculture is currently undertaking an industry-led review of the scope and structure of the degree and may offer additional streams or an alternative structure as student numbers continue to grow.

During 2010 Curtin established the International Institute for Agri-Food Security involving more than 55 academic staff from all four faculties.

Curtin has interests in the following areas:
- Crop diseases.
- Pre-breeding - crop genetics, physiology, molecular breeding and genomics.
- Agronomy.
- Farming systems.
- Crop prediction models (for disease).
- Farm business management.
- Application of new technology (ag machinery, telecommunications, robotics, big data, telemetry).
- Climate modelling including access to ClimSim and PlantGrow models, WARRF (impacts of tropical cyclones and landslide modelling).
- Post-harvest horticulture.
- Aquaculture.
- Grain food product development (lupin, sorghum, oat and wheat).
- Statistical and large scale data linkage (precision agriculture).
- Engineering (robotics, design).
- Water use efficiency and crop stress physiology in vines and broadacre crops.
- Post graduate education.

Curtin has field sites that it can use at Margaret River and Muresk.

**Muresk Institute**

Muresk is a multi-tenanted campus run by the Muresk Institute on behalf of the Western Australian Department of Training and Workforce Development. It is located 13 kilometres (10-15 minute drive) from Northam. It used to be operated by Curtin University but these days it is used as a multi-tenanted teaching facility and research field station. The C.Y. O’Connor Institute is based there, but the facility is also used for delivering the Bachelor of Agricultural Business Management courses from the Charles Sturt University and the Diploma of Agriculture delivered by the University of Queensland Gatton Vocational Centre, as well as short courses. The Head of School for Agribusiness at C.Y. O’Connor commented that for 2016 the focus would remain on teaching. There are a total of 10 staff equivalent to four Full Time Equivalents (FTE’s), with teaching on a part time basis. In 5-10 years’ time it is envisaged that some of these teaching staff will also be able to take on research projects for grain farm production R&D.
The Muresk Institute is located on a farm and is 898 hectare (ha) in total, divided into 30 paddocks of which 20 can be cropped successfully. Around 805ha (90%) of the total area is grazable, and around 506ha (56%) is arable. The Muresk Institute Farm mission and purpose is to demonstrate sustainable agricultural management and dryland farming systems, which support training and workforce development.

The farm is steadily building as a place for research providers to place trials. Kalyx is a major client and Curtin, Murdoch and DAFWA research projects have trial sites on the Muresk Institute Farm. Currently around 40ha would be used for grain trials.
Grower groups

There are 42 grower groups within the Grower Group Alliance (GGA) network in WA, with a combined grower membership of more than 3,000 (this doesn’t take into account growers being members of more than one group). Groups in the GGA network cover an area from Binnu in the north and Southern Cross in the East, down to Esperance in the South East; covering a majority of the broadacre cropping and livestock region.

WA grower groups are usually incorporated, not-for-profit organisations which aim to increase the production and profitability of their farm businesses; through the adoption of new technologies, and delivery of locally relevant research, development and extension; while providing a social hub supporting participatory research and farmer-to-farmer learning. Grower groups achieve this by understanding local priorities of their members.

Grower groups provide research, information and support to their members on agricultural production systems, business management and natural resource management. They usually have strong working partnerships with advisors, agribusiness, research partners and other grower groups. There are various size and structure differences between the 42 groups within the network, but a commonality is their strong interest to be involved in RD&E. The level of involvement and capacity to deliver on RD&E projects also differs, but there are up to 15 larger groups within the network that have paid staff and a strong ability to deliver projects in their own right. These groups, in some instances, have also become support networks to the smaller, local groups in their region, and as such still have a large geographical spread.

Grower groups’ strengths are in development and extension, with a future move into partnering and delivering more in the research space.

In the future, grower groups think there will be more demand on their services as the public sector retreats from funding R&D, particularly around delivering more RD&E projects and activities and becoming a training ground for new graduates. Groups are keen to take on this new challenge and roles within the industry. They have the desire and capability, and will create the capacity.

Grower groups will continue to be a key extension deliverer, but believe they may have to think about alternative business models such as fee for service to remain sustainable in a changing RD&E environment (with increase in private sector involvement).

Source: Extracted comments from paper provided by courtesy of the Grower Group Alliance - see Appendix 2 for the full submission invited from and provided by the Grower Group Alliance.

A few examples of WA models of grower groups follow:

Western Australian No Tillage Farming Association

The Western Australian No Tillage Association (WANTFA) is arguably one of the oldest grower groups in WA and has a permanent field research trial site at Cunderdin

WANTFA is a state-wide grower group that was founded during 1992 with the aim of promoting the use and adoption of conservation agriculture, especially no-tillage techniques to prevent the impact of wind and water erosion in broadacre farming systems.

At its peak, WANTFA had around 1000 members but currently membership sits at around 450 farm business members and 250 non-grower members. 95% of their membership is based in WA, with
others being based in South Australia and overseas. WANTFA has a staff of seven which consists of an executive director (CEO), a research manager, a marketing manager, an extension manager, a project manager, a technical officer and an administration person.

The group’s business model is highly dependent on project funding, making up to 85% of the group’s total budget, with membership and sponsorship filling the remainder.

The group operates a permanent field trial site at Cunderdin on leased land.

With WANTFA’s biggest success being the wide adoption of no-tillage farming systems, the group has found that there is a massive expectation to deliver wide scale adoption when it comes to other farming technologies and practices. Now, projects and new research is really focusing on making aspects of the system better, making it much more difficult to really understand the wider impact and benefit of some projects.

Looking to the future, WANTFA would ideally like to be partnered with a group of researchers based at a university or CSIRO who were focused on conservation farming with WANTFA leading the on-ground delivery of the research. It would like to see long term core funding for WANTFA that would underpin future activities, and enable the group to employ industry leading researchers and provide autonomy to drive its own research agenda.

Courtesy of WANTFA and the *Business Models of Grower Groups: A Collection of Case Studies*, Grower Group Alliance (GGA), 2015

**South East Premium Wheat Growers’ Association**

The South East Premium Wheat Growers’ Association (SEPWA) is a farmer-initiated group that was started during 1993 to represent wheat growers in the Esperance Port Zone.

SEPWA currently has an active membership of 270 farming entities which represents some of the most progressive growers in the region and makes SEPWA one of the largest grower groups within WA.

SEPWA’s activities include:

- Playing a significant role in lobbying and representing grain growers in the Esperance Port Zone.
- Organising field days, grower trips, workshops and meetings that are relevant to the grower base.
- Communications – regular newsletters, e-news, media releases, trial results booklet, field day booklet, website.
- Conducting and facilitating research within the grains industry.
- Conducting wheat, canola and barley variety trials throughout the region in order to determine the best suited varieties.
- Involvement in many funded projects that focus on sustainable farming.

SEPWA is a non-profit grower group and employs six staff members including an Executive Officer, two Projects Officers, a Trials Coordinator, a Media Officer and a bookkeeper.

The group was originally formed to address the perception that wheat from the south east was of inferior quality to that of wheat from other regions and set about assisting growers in the region to produce premium quality grain to improve our market position.
SEPWA has moved on since this original aim, but still strongly retains it as part of its major objectives and in more recent times has expanded into barley and canola. Today SEPWA’s role is to improve profitability and sustainability of Esperance Port Zone grain growers.

SEPWA’s grain farm production R&D expenditure is around $240,000 with around 27% coming from GRDC (including a large precision agriculture project) and 10% from the State Government. Approximately 90% of grain farm production R&D is conducted in-house with 10% out sourced. It is also undertaking a major extension project on Precision Agriculture for the GRDC.

SEPWA has applied for Royalty for Regions (R4R) project funding, including from the eConnect project so the ratio of research expenditure received from the State Government is likely to increase in the short term at least. Also SEPWA plans to concentrate on working with local sponsors and agribusiness to ensure local trials are relevant to the needs of grower members.

SEPWA has obtained a 30ha trial site, provided by three local farmers at Grass Patch, for use over the next five-10 years which will be used for commercial company trial sites and National Variety Trial (NVT) sites.

The Liebe Group

*The Liebe Group has its own 63ha long-term research site leased off a local farmer.*

The Liebe Group is a grower driven, not for profit incorporated association. The group conducts research & development and provides information to 120 farm business members in the Dalwallinu, Coorow, Perenjori and Wongan Ballidu Shires, which encompasses a land area of approximately 1,000,000 ha. Members pay $400 per year per farm business.

The Liebe Group was established during 1997 by farmers to address the concern that the area was isolated from exiting agricultural research and development.

Today it has six staff (4.6 full time equivalents) including an executive officer; a research and extension agronomist; a research agronomist and coordinator; a partnership development officer (part time); a finance manager (part time); and an administration officer.

The Liebe Group has established a dedicated 63ha Long Term Research Site, 27 kilometres west of Buntine on the Buntine-Marchagee Road which it leases off a local farmer. The site is available to researchers and other collaborators to carry out long term farming systems research and is well serviced with data sets available on soil profiling and ongoing weather station readings. The Long Term Research Site currently has two other trial partners using the site. The main trial site hosts the annual Spring Field Day which attracts over 200 people. The site moves location each year to ensure members have an opportunity to see research within their specific conditions. The site hosts and average of 15-20 trials, conducted by Liebe Group and their 15 trial partners.
Mingenew Irwin Group

The Mingenew Irwin Group (MIG) is a large grower group but with a broad focus.

MIG’s aim is to “promote and develop economic and environmentally sustainable agriculture through research, planning, monitoring and demonstrating best practice”.

MIG covers approximately 320,000ha within the shires of Mingenew and Irwin, with close to 200 farm businesses being active members. This equates to approximately 95% of farmers in the Mingenew area.

MIG was formed during 1994 based on a need for locally driven R&D. The group has grown substantially. In recent years MIG’s trial program has included approximately 70 trials, with up to 350 people attending field days. The group now employs seven staff including an Executive Officer; a R&D manager, a R&D officer; finance officer; project officer; indigenous Landcare coordinator and a communications person.

Field trials and demonstrations are core business for the group, managing approximately 60 trials during 2015, with the majority across two trial sites. The main projects of MIG during 2015 include improving productivity on non-wetting soils, demonstration of perennial shrub systems, soil water holding properties, and the establishment of Anameka saltbush. Turnover is around $500,000 per annum and approximately one third of funding for projects comes from GRDC. Around 60% of project funding is used for delivery by contract research providers and others with MIG providing the project management and extension. In the future MIG sees this moving to around 50% with more delivery of services from within the group’s own resources.

MIG’s corporate membership is available to people and organisations based in the Mingenew and Irwin Shires and associate membership is available for people outside of the Mingenew and Irwin Shires (or beyond a 50km radius of Mingenew.)

Commercial participants

Commercial sector participants interviewed could see themselves in five-10 years’ time doing more R&D, including work in the ‘D’ space which has been traditionally done by DAFWA. This needs to be borne in mind when developing any replacement delivery entity.

There is a concern that if the private sector dominated the future delivery of R&D services, there would be the potential for a reduced focus on innovation as the driver and for staff to be focused on providing efficient services bound by project outcomes, outputs and deliverables. This would not be conducive to having the time and the freedom, compared to staff in CSIRO or universities, to spend on exploring ‘blue sky’ or novel ideas.²

Interviews with private sector participants in WA focused on two subsets — contract R&D service providers for field trials, laboratory analysis and data analysis and input supply companies such as crop breeders, chemical and fertiliser suppliers who largely conduct their own R&D (and E).

² CSIRO reportedly retain a culture where it is expected that around 10% of staff time will be spent on non-core project work to enable new ideas to be explored. This is also a feature of university systems and used to be part of the Department of Agriculture and Food’s culture.
Private contract research service providers

Private research service providers such as Kalyx, Eurofins and Living Farm run efficient and effective services for putting in and harvesting crop field trials and providing most analytical laboratory services associated with grain farm production R&D trials. Increasingly researchers in the life science companies, universities, CSIRO and grower groups are making use of these specialist contract research service providers rather than operating their own field trial units. In addition, the NVT programs are almost exclusively conducted by the contract research service providers via tenders from the GRDC. The contract providers run sophisticated businesses with high throughput and effective quality control processes.

Kalyx has 65 permanent staff across Australia swelling to 100 at peak times of the year, with half of the staff based in WA. Kalyx is headquartered in Carlisle, Perth (it used to be at York and then Northam, but the Perth location is most efficient for servicing the business and helps retain staff). Kalyx do operate out of regional centres in other Australian States, but point out that these are all much larger centres than Northam and without the same issues in attracting staff to live there. Kalyx has approximately 100 different clients.

Eurofins has 600 employees in Australia with all the growth being in the laboratory area. The Agriscience team has remained reasonably stable at 50-55 FTE’s. In WA, Eurofins has seven employees based at York and two in Albany. Most of the work is done for the large life science companies (Monsanto, Bayer, Dow etc.) and is mainly field trials on farmer-owned properties. Eurofins could do more contract-applied agronomy research in the future and would consider leasing facilities in WA if they were to be provided at Northam.

Living Farm operates with seven staff at York and three in Kununurra servicing the grains and other plant industries. All but two staff (the accountant and the operations manager) have science degrees. Living Farm operate five small plot seeders and four trial plot harvesters. Living Farm are largely self-contained. They would be open minded about working with Grainswest, but would be more likely to offer their services to Grainswest rather than use Grainswest services. Living Farm could handle more work if this was requested. However, they don’t envisage a large expansion of demand for services over the next five-10 years.

There are a range of other smaller research service providers emerging mainly in association with farm management and agronomist consultancy services.

In summary, these companies vary in terms of their interest in potentially using external facilities, especially dedicated facilities as proposed at the Northam Grains Innovation Precinct or research stations. The vast majority of their field trial work is run on annually leased land they acquire off willing farmers for the short term access that they need. This gives them flexibility at minimum cost in choosing trial sites to match climatic, desired rotation sequences and soil type specifications as well as a higher degree of control over access to the site and any intellectual property (IP) that may be involved. They point out that if they had to lease land long term or own fixed land assets they would require at least five times the area of land to allow for rotations. It definitely should not be assumed that they will automatically be interested in accessing facilities established at the proposed Northam Grains Innovation precinct.

Of general concern to these contract service providers is that Grainswest could set up a subsidised research services business that would unfairly compete with them to provide contract field and analytical research services.
As to the future, contract research providers could envisage expanding into providing research scientists and agronomists to augment their field trial and analytical laboratory services but this would be gradual and would very much depend on demand.

**Commercial companies**

The two main plant breeding companies (Australian Grain Technologies (AGT) and Intergrain) have their own facilities and different models for doing their field breeding plots and trials. AGT tend to do most of their work in-house with facilities, on their own land and facilities at Roseworthy, Narrabri (although they also lease 70% of the new Plant Breeding Institute building and utilise some land on that site as well as their own site at Narrabri), Wagga, Northam and Toowoomba. Intergrain by contrast have an outsourcing model and make much more use of contract research service providers. AGT would be prepared to make some use of facilities at Northam or research stations if the business case stacked up but they would prefer to operate from their own facilities. Intergrain would be very interested in access to controlled environment growth rooms if these were available on a lease basis at Northam or Perth and would look at other opportunities to use infrastructure at Northam or Perth and lease land on research stations on a case by case needs basis.

Other input supply companies contacted during this study included WA representatives for Monsanto, Bayer and CSBP.

Bayer have recently upgraded Australia to a ‘Tier 1’ country, meaning new crop protection products will be immediately trialled in Australia as they are ready for field testing. Bayer has a major facility at Horsham, Victoria, for breeding oilseeds, and more recently cereals and at six field station around Australia. They are looking for a facility in WA and construction of controlled environment facilities at the Northam Grain Innovation Precinct may be of interest to them as they will be looking at biologics and nematode trial work, which would be difficult to do on leased farm land. Bayer has a small staff in WA: two development specialists and two technical staff. Plant breeders and other Bayer scientists come over from Victoria as needs be. Bayer tends to do its own early stage glasshouse and field trial work in-house to protect their IP, but then use contract research providers to put in field trials.

Monsanto’s core focus will always be the United States of America (US). However, they are moving into wheat and Australia is expected to become a more important market over time. Monsanto has a need for third party independent researchers for lab and field trial work to verify their own research findings. This could well be a role for a grain farm production R&D delivery organisation established in WA. Increasingly the life science companies are looking at how to protect crops using seed treatment chemistry and looking into biologics, microbes and enzymes.

CSBP has a team of three staff in its WA technical services area, one research officer and two technical staff. It carries out 35-40 cropping trials per year and is self-sufficient in conducting trials. It carries out some project work for GRDC in conjunction with DAFWA staff. It does not make use of contract research services and indeed considers it has some spare capacity it could offer to other users.

At the invitation of the Co-operative Bulk Handling Group (CBH Group) Chairman, the GIG chairman and consultant met with senior staff from CBH Group to ascertain if the CBH Group, as the largest grain service company in WA, had plans to become involved in grain farm production R&D or could assist in any way with the establishment of a more efficient delivery mechanism for grain farm production R&D in WA. CBH Group do not currently provide any agronomy services or grain farm production advisory services and do not envisage doing so in the future. The strategic plan for CBH Group only envisages providing any services to growers that demonstrably either contribute directly
to lowering input costs or providing higher returns. The headline measure of performance is the dollar per tonne charge to growers as measured by receival charges, plus freight charges, plus port charges less rebates. Any services provided to industry would need to at least meet full costs. In addition, the financial, human resources and IT management systems, which are specifically set up for the CBH Group business and its 1200 staff, would be unlikely to provide a cheaper option for back room services to an entity involved in grain farm production research. It was concluded that CBH Group would not offer any cost advantages as a host organisation for any new entity being established to deliver grain farm production R&D. Also, even if it did there would be a perceived conflict of interest from the other grain acquisition and marketing companies if CBH Group was to provide these services on behalf of all growers in the industry.

CBH Group would only participate in specific future grain farm production R&D projects if it could be shown that they would directly reduce input costs for growers.

Agricultural consultants and agronomists

It is estimated that over 50% of grain growers in the State have at least one agricultural consultant or agronomist adviser, and the largest growers commonly have 3 or 4 specialist advisers. Agricultural consultants and agronomists have a very large part to play in extension and some are engaged as scientific advisers to grower groups and/or in the provision of R&D services. Most agricultural consultants and agronomists servicing the grains industry belong to the Australian Association of Agricultural Consultants (WA) Incorporated (AAAC WA).

Why not continue with the status quo?

In response to a decline in public sector funding DAFWA has provided some reasons for rejecting the status quo:

- Erosion of regional WA skill-base in applied grains R&D.
- Constraints on responding to new investment opportunities for regionally focused R&D due to limited regional critical mass.
- Difficult to be strategic in RD&E investments –responsive to government and funder priorities.
- Specific project funding from industry lacking continuity and longer term strategy.
- GRDC may direct investment into other entities and States.

DAFWA believes there is a case for a new paradigm and a new grains R&D entity for WA that will focus on regional grain growing R&D and the development of solutions to improve the productivity and profitability of the WA grains industry and lead to greater private sector investment in regional grains industry led R&D and colocation as part of an innovation precinct. The new model should (in DAFWA’s view):

- Be more effective and enduring than the present unsustainable model.
- Strengthen the opportunity for industry consultation and influence on research approach and partnerships.
- Provide a greater focus on identifying and solving regional issues locally.
- More efficient and flexible use of infrastructure to meet grain industry R&D needs and to increase collaboration and partnerships.
- Well-equipped regional R&D precinct is attractive for new graduates and mid-career scientists.
GRAINSWEST

The information in this section of the report describing Grainswest has been taken verbatim from documents supplied by DAFWA.

DAFWA has proposed implementing this new paradigm by establishing a new entity, Grainswest, as not for profit company limited by guarantee. The case for establishing Grainswest has already been approved and announced by the Minister for Agriculture and Food at Agribusiness Crop Updates in February 2015 and has been taken to Cabinet as part of the Royalties for Regions funded $20 million Boosting Grains R&D project.

It is currently envisaged that Grainswest would comprise an estimated 150 science-based staff at establishment, with an additional 20 support / management staff.

Vision

To make the best research and innovation on grain farming readily available to WA grain growers to enhance the profitability and sustainability of their operations and deliver economic benefit to WA.

Mission

To create a credible, independent, flexible and enduring operation that provides research and development services, through partnering with key research organisations, that are accessible and adopted by grain growers in WA to improve the agronomic and financial performance of their businesses.

Research portfolios

It is envisaged that Grainswest would have the following five program streams:

- Agronomy
- Soil Productivity
- Crop Protection
- Genetic Improvement
- Farm Business Integration

Unique Value of Grainswest

Grainswest is focussed on the research and innovation needs of the WA grain grower, behind the farm gate. Drawing from the best and most relevant international, Australian and WA research; Grainswest will create, integrate and scale this research to suit the unique conditions of the WA grain farm.

Grainswest has an existing team of leading researchers and technicians with strong applied capabilities located in regional WA with access to research and development facilities, equipment, databases and networks to create solutions to the problems facing Western Australian grain growers.

The Grainswest business model will enable flexible, responsible, cost effective delivery of research and innovation services, leading in turn to greater staff productivity and effectiveness, delivering enhanced impact for the WA grains industry.
The advantages of Grainswest were seen as:

- Credible, independent and unbiased.
- Not for profit - allows for reinvestment in further R&D capability.
- Deep understanding of the production and business challenges facing WA grain growers.
- Backed by the Western Australian Government, but not constrained by red tape.
- Collaborative approach with agribusiness.
- An effective vehicle for targeted government and industry investment.
- Legacy of DAFWA’s grains R&D inherited - knowledge, staff (about 160 FTE), capabilities, scale, infrastructure, equipment.

This vision and purpose will be achieved by offering research and development services previously undertaken by the Department of Agriculture and Food within a not for profit company known as Grainswest Ltd (Grainswest). The WA Agricultural Authority (WAAA) will be the initial member of Grainswest.

Upon incorporation (originally planned for August 2015), Grainswest will, with the approval of the GRDC, take over research projects contracted by GRDC to DAFWA. Key research and management personnel currently employed by DAFWA will transfer to Grainswest, along with access to key infrastructure, which will represent DAFWA’s financial stake in the new entity.

The WA Government, through in-kind and cash contributions from DAFWA, will support Grainswest in the start-up phase (2015-2020). For funding levels beyond 2020, arrangements are to be negotiated and agreed by June 30, 2016. Grainswest will be the dominant grains research entity in WA, funded by WA grain grower levies and science partnerships with other stakeholders in the grains supply chain to deliver ongoing value through the latest scientific research and developments in grains.

Work done to-date on Grainswest model

Legals

- A constitution has been drafted and checked with Treasury, State Solicitors Office and Price Waterhouse Coopers.

Human Resources

- Grains Industry Directorate realigned on 1 September 2015 ready for transition.
- Strategic HR Project Plan developed and ongoing work in progress for HR and OSH activities to ensure private R&D company “employment ready” upon establishment.
- Identification of risks and benefits associated with potential employment options relating to the transfer of employees from the public sector to the private sector.
- Consultation with Department of Commerce, Public Sector Commission, State Solicitors Office and private legal advice (where required) on terms and conditions of employment, agreements, employment options, transition process, and application of relevant legislation.
- Staff engagement maintained through regular bulletins, “ED Chat”, staff engagement web site, planning meetings, Staff Reference Group and regular updates at Joint Consultative Committee meetings with the Union.
Finance

- 60 GRDC funded projects with a value of approximately $20 million per annum slated to be rolled in at start-up.
- Current DAFWA budget contains sufficient consolidated funds until 2017-2018, after which ongoing State Government investment will be required.
- Longer term WA government funding yet to be confirmed.

Assets

- Process is underway to identify required capital and non-capital assets including land, equipment and intellectual property.
- Discussion underway with the Department of Lands about options for land.
- Lease (gives legal interest in the land and level of control).
- Licence to Occupy (limited rights, limited security).
- Freehold (due to status as Crown Land, this would require sale at market rates and will take several years).
- Interim access agreement.

Information Technology

Identification

- Process is underway to identify which information systems are required to be accessed from DAFWA for Grainswest operation

Separation

- Phones, Computers, Email, Domain Controller

Ongoing support

- Anticipated that Grainswest will establish its own corporate systems and computer equipment.
- Current DAFWA data and technical systems remain hosted by DAFWA and accessed via the internet subject to authorization
- DAFWA already supports remote access to systems and data for various clients. Grainswest would just be another client (albeit important).

Financial budget for start-up of Grainswest

Based on the assumption of some 60 projects rolling into Grainswest with 190 staff (175 research and technical and 15 admin and management it has been estimated that Grainswest’s budget in Year One would need to be in the order of:

<table>
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<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries</td>
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<tr>
<td>Overheads</td>
<td>4.8</td>
</tr>
<tr>
<td>Total</td>
<td>20.1</td>
</tr>
</tbody>
</table>

In addition there would be an estimated $2.5 million in start-up costs.
Some closing comments on *Grainswest*

The following closing comments have been provided by DAFWA to clarify the reasons behind the proposed establishment of *Grainswest*.

There appears to be an assumption that the *Grainswest* initiative is driven out of a DAFWA financial crisis, which is false. DAFWA has been considering alternative delivery models for more than 10 years, and the development of the *Grainswest* model began during late 2013. There are non-budgetary limitations to operating within government that impact the ability to ensure ongoing successful delivery of R&D (E.g. the impact of government policies such as recruitment freezes, strict process requirements, HR procedures, lack of flexibility). These limitations need to be clearly understood in order to assess alternative models. Moving out of the government environment will allow provision of more timely, cost-effective R&D that can be better ‘future-proofed’.

The desire within DAFWA and the WA Government is to ensure timely delivery of the best achievable commercially valuable grains R&D from State and industry investment, not exit grains R&D; the former is the driver for *Grainswest* not the latter.

**The Grains Innovation Precinct at Northam**

In parallel with the development of the *Grainswest* proposal DAFWA had commenced planning for a possible Grains Innovation Centre at Northam to house the headquarters of *Grainswest*, but also to provide facilities to encourage collocation of companies and organisations involved in the funding and delivery of grain farm production R&D.

The attraction of Northam as the site for the proposed WA Grains Innovation Precinct (WAGIP) was that it was central to the grainbelt and close to related facilities in Perth, with easy access by train, bus and car and proximity to the international airport.

A draft business plan has been developed but it has not progressed and has not been taken to the Minister or Treasury at this stage. The draft business plan envisaged the precinct becoming a collaboration hub with the largest concentration of temperate dryland cropping RD&E staff in the Southern Hemisphere with over 200 people on campus, including staff from plant breeding companies, grower groups, universities, CSIRO, Australian Export Grains Innovation Centre (AEGIC), research services companies, life science companies as well as DAFWA and *Grainswest* staff. The business plan is predicated on funding of $38 million³ from the Royalties for Regions to establish the precinct which would have the following major infrastructure assets:

- Additional offices, conference and meeting facilities.
- Tunnel house.
- Glass houses.
- Growth rooms.
- Laboratories.
- Grow out plots and netting.

³ The $38 million estimate included $8.5 million for upgrades to related Grainswest facilities (at Northam, Geraldton and Esperance) and a new AEGIC office in Perth.
OTHER DELIVERY MODELS OPERATING IN WA

Australian Herbicide Resistance Initiative

The Australian Herbicide Resistance Initiative (AHRI) is regarded as the research leader in herbicide resistance and its management in cropping systems in Australia and has a strong international reputation and linkages. Research activities include the biology and population ecology of major crop weed species through to cultural and herbicide management strategies. AHRI also conduct fundamental research on biochemical and molecular resistance mechanisms responsible for endowing herbicide resistance.

Established during 1998 by a substantial investment by the GRDC and housed at UWA, AHRI has no legal structure other than as a project in the School of Plant Biology. There are 20 FTE, 17 (including three PhD students) based at UWA and agronomist/communicators based at Geraldton, Toowoomba and Wagga Wagga. Only the Director’s salary is paid by the University, all other staff and project operating costs are grant funded. Significantly there are five FTE’s involved in extension and communication. AHRI started in Research mode and then moved into Development and then Extension modes with investments from GRDC. AHRI makes extensive use of new communication technologies (AHRI Insight electronic updates has a circulation of 3,000!).

During 2015 the approximate revenue for AHRI was $3.65 million with the GRDC contributing the lion’s share at $1.8 million; the University contributing $1 million in facilities and infrastructure, ARC Nufarm linkage $245,000; ARC Bayer Linkage $220,000; WeedSmart (50% GRDC and 50% chemical companies) $300,000 and ACIAR $90,000.

Under the mantra of “More crop, less weeds – sustainably” AHRI conducts research and extension to encourage sustainable cropping and weed control across Australia. Projects are funded by the GRDC and the Australian Research Council under five project areas:

- Resistance evolution.
- Resistance mechanisms.
- Resistance management.
- Ryegrass integrated management.
- Resistance surveys.

The strength of the AHRI model is its 100% focus in the crop and weed science area. It has been operating for 17 years and is subject to five year reviews by the GRDC which the Director believes is an essential part of keeping the group focused. Its longevity is because herbicide resistance ranks as one of the highest priorities in all GRDC priority setting processes in WA. This is also paradoxically its weakness in that it is fragile because it is 100% dependent on grant funding.

Could this model be replicated in other areas of grain farm production R&D? The critical factor is the quality of the people. The right leader needs to be found and then given the freedom to operate (outcome focused).
Centre for Crop and Disease Management

The Centre for Crop and Disease Management (CCDM) is a research centre within the Faculty of Science and Engineering at Curtin University. The centre is managed through the School of Science and the Department of Environment and Agriculture. There is close connectivity between the CCDM and Curtin’s teaching in Agriculture at the undergraduate and postgraduate levels.

The CCDM is a highly flexible construct which provides the delivery mechanism for the GRDC/Curtin bilateral agreement but also a number of other, related, research agreements. To date the focus of the CCDM has been on the areas which were identified as a strength within the National R, D & E Framework (Cereal Diseases – not including rust, Agribusiness, Agronomy and Pulse Pathology and Genetics). The information below refers specifically to the GRDC/Curtin bilateral agreement.

The CCDM sits as a business unit within Curtin’s Department of Environment and Agriculture and is managed by a director and a chief scientist. There is no independent legal structure per se and the GRDC/Curtin Bilateral is governed by a research contract between GRDC and Curtin University. The GRDC and Curtin University have an agreed equity position of 50:50 for all commercial outcomes. It includes nine research programs and one extension program, housing 70 staff. The scientific staff of the CCDM is expected to increase when the new laboratory is completed during 2016. The CCDM is a flexible business unit which allows for expansion through either partnership, the inclusion of new contracts or variations.

The Centre has a Director and an administration officer with contract support provided by a spoke and hub model via Curtin’s Office of Research and Development and the Faculty of Science and Engineering.

The total value of the Curtin/GRDC bilateral agreement is approximately $100 million over five years. This includes $30 million of GRDC funds and the balance is made up of Curtin funds including, capital (laboratory) and cash plus in-kind salaries and overheads.

All outcomes are managed via project specifications with the GRDC.

The ten current CCDM programs with their approximate current project budget share are:

- Improved farming systems 18%
- Extension and engagement 7%
- Septoria nodorum Blotch of wheat 13%
- Yellow Spot of wheat 10%
- Net Form of Net Blotch of barley 9%
- Sclerotinia stem rot of canola and lupin 5%
- Ascochyta Blight of pulses 14%
- Barley Powdery Mildew 6%
- Fungicide resistance management 15%
- Bioinformatics 3%

The CCDM is a ‘lean’ enterprise with a very low level of dedicated administration. The CCDM does not ‘own’ any infrastructure – however, it does have a level of priority over required assets (lab space, glasshouse and controlled environment facilities, field trial area etc). All such facilities are owned and to a varying extent operated and maintained by other business units within Curtin. The CCDM is a flexible business unit which allows for expansion through either partnership, the inclusion of new contracts or variations.
Curtin University’s $46 million agricultural research facility, which will house the CCDM, plans to open its doors in the second half of 2016. The three story building will allow CCDM researchers to safely carry out pathogen research with high containment, and ultimately help reduce the economic impact of important grain diseases. The new building will provide better facilities to study current crop diseases as well as those that pose as a biosecurity threat to Australian farming, within uniquely-designed physical containment (PC) laboratories. Each level of the new building will include premium laboratory space to support up to one hundred researchers, with the main quarantine-approved laboratories for specific pathogen research located on the top floor.
OTHER DELIVERY MODELS OPERATING IN AUSTRALIA

GRDC investment

GRDC investment is the main fund source for all the grain RD&E delivery activities in Australia. It has adopted a framework for investment based on:

- High national impact research (40% of investment portfolio) – aimed at accessing the best science available internationally (public or private) and in Australia principally from universities and CSIRO – with an eight years plus investment plan and a national impact (‘big R’);
- Regional R&D (40% of investment portfolio) – aimed at finding regional solutions to specific crop, crop protection, climate and soil variations (‘little r and big D’); and,
- Local adaptation and adoption of R&D (20% of investment portfolio) through demonstration trials and extension activities (‘little d and big E’).

GRDC have investments in all types of grains industry R&D delivery models explored in Australia. They also have substantial investments with international partners. For example, in the International Wheat Yield Partnership with the aim of boosting annual wheat yield gains from one to 1.7% and with Bayer in the Herbicide Innovation Partnership for which the GRDC will contribute $45 million over five years and receive royalties and milestone payments on products derived from this research.

GRDC has also entered into a series of Bilateral Agreements with key research organisations in Australia to facilitate more highly targeted research through a suite of strategically managed research investments. The Bilateral Agreements allow the GRDC and its Research Partners to drive targeted and sustained research aimed at addressing identified RD&E priorities confronting the Australian grains industry. The strategic and responsive management structures within the Bilateral Agreements allow greater flexibility to pursue research results showing potentially beneficial outcomes as they occur. In turn, the longer term funding surety, with built-in research flexibility, will attract the best researchers from within Australia and internationally. Improved coordination and flexibility in managing the suite of research projects promotes collaboration, reduces duplication and fragmentation of effort, whilst driving down operational and corporate overhead costs for both parties.

GRDC has developed key principles that drive the development and operation of Bilateral Agreements that the GRDC establishes. Each Bilateral Agreement will:

- Provide for longer term investment through a joint commitment of at least five years.
- Have an overarching Strategic Plan for the term of the Agreement, to be delivered through Annual Operating Plans and frequent monitoring of progress and results.
- Align the GRDC Strategic Plan and the Research Partner’s research activities with the Grains Industry National RD&E Strategy to exploit research capability, build sector capacity and deliver benefits to the grains industry.
- Share equity and intellectual property, with commercialisation strategies incorporated into research planning.

4 Editor’s note - the classifications of big and little RD&E have been added by the Consultants and are not GRDC terminology.
Three examples of GRDC bilateral agreements are:

**Curtin University (Centre for Crop and Disease Management)**

Fungal Pathogen - non rusts, plant pathology supporting disease identification and management Programs:
1. Improved Farming Systems for Disease management.
2. Extension and communication.
4. Tan Spot (Yellow Spot) of Wheat.
7. Pulse pathology and genetics.

**Victorian Government (formerly DEPI)**

Genetic Resources, High Rainfall Zone cropping, regional capacity – D&E, cereal pathology & bio-protection Programs:
2. Pulses.
4. High Rainfall Cropping.
5. Cereal Protection and Biosecurity.
7. Adaptation to a Challenging Climate.

**South Australian Research and Development Institute (SARDI)**

Molecular diagnostics for pathogens, Oat breeding, pulse pre-breeding programs:
1. Crop Improvement.
2. Molecular Diagnostic Centre.
3. Regional Pathology and Entomology.
4. Low and Medium Rainfall Farming System.
5. Building Regional Capacity for delivering R&D.

It is understood that the New South Wales Department of Primary Industries is in the process of developing a proposal for a similar bilateral agreement with the GRDC.
SOUTH AUSTRALIA

South Australian Research and Development Institute

The South Australian Research and Development Institute (SARDI) is solely owned by the South Australian Government. It was established as a separate entity during 1992 and for a time was a stand-alone entity with its own board which reported to the Minister, independent of Primary Industries and Regions SA (PIRSA). SARDI is solely owned by the State government and has entered into a number of commercial structures; the highest profile one being a shareholder in AGT Pty Ltd.

SARDI has a turnover of $77.5 million of which the SA State government contributes $26.7 million (or 34%), with the remainder coming mainly from R&D Corporation funding, some licence fees in the fisheries sector and some income from royalties and provision of services. However, the State Government reported figure includes corporate function costs over the operating divisions so the actual amount available for R&D is probably more like $12-$14 million per annum.

There are a total of 407 FTEs reported in the 2015 Estimates papers. There was no breakdown, however it is estimated there would be around 20% in the management and admin staff category and 80% in research and technical support staff.

SARDI is structured into four divisions, one being support services. The other are:

- Aquatic Sciences.
- Livestock and Farming Systems. There are two units in this division that are relevant to grain farm production R&D – Food Safety and Innovation and Farming Systems
- Sustainable Systems. This is the division that contains much of the crops R&D capability. The groups in this division are Climate Applications, Crop Improvement, New Variety Agronomy, Entomology, Soil Biology and Diagnostics and Plant Health and Biosecurity.

The key focus of SARDI, in terms of the areas identified are:

- Plant breeding - particularly oats, vetch and pastures.
- Agronomy.
- Farming systems.
- Crop variety evaluation - major national program.
- Pests and diseases - strong capability.
- Crop nutrition.
- Water use efficiency and climate application.

Grain farm production R&D is funded from allocations from the State Government and GRDC. According to the 2013-14 GRDC Annual Report SARDI received the following funds from the GRDC for grain projects:

<table>
<thead>
<tr>
<th>Theme</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theme 1: Meeting market requirement)</td>
<td>$162,000</td>
</tr>
<tr>
<td>Theme 2: Improving crop yields</td>
<td>$2,206,000</td>
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<tr>
<td>Theme 3: Protecting your crop</td>
<td>$2,100,000</td>
</tr>
<tr>
<td>Theme 6: Building skills and capability</td>
<td>$75,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$4,543,000</td>
</tr>
</tbody>
</table>

During 2014-15 funding to SARDI from the GRDC increased to $6.89 million (an increase of 52%).
The other major source of funding is the SA Grains Industry Trust. SARDI receives up to $1 million annually from this source for grains R&D.

The strengths of the SARDI model are seen as:

- Structurally it has a clear focus on applied R&D.
- There is a clear separation between research management and leadership and program delivery.
- State government funds allocated to establishment of capability within priority areas. It is the responsibility of senior scientists to build teams and projects around non-government funding.
- It has the ability to partner with other organisations (University, CSIRO) at the Waite, Roseworthy and West Beach facilities.

As far as grain farm production R&D goes SARDI operates with its assets being the Waite and Roseworthy campuses of the University of Adelaide, with support from a number of research centres – Turretfield, Minnipa, Struan and Kybybolite.

**The WAITE Research Precinct, Adelaide**

The total area provided by Peter Waite for agricultural research and education was 66 hectares. This has been used for establishment of the Urrbrae Agricultural High School and an Institute (TAFE college) on the southern side of Fullarton Rd. The Waite Agricultural Research Institute/Precinct is located on the northern side of this estate.

The Waite Research Precinct in Adelaide is often regarded as Australia's leading grains research, education and commercialisation cluster. It has the largest concentration of Australian expertise in the in the areas of plant biotechnology, cereal breeding, sustainable agriculture, wine and horticulture and land management.

- 12 world-class researcher organisations and centres on one 300-acre site
- 1100 research and technical staff
- 845 research and agriculture students
- $100 million research income/expenditure per annum
- $265 million of research and teaching infrastructure
- 80% of southern Australian cereal production from Waite-developed varieties
- Significant infrastructure including the state-of-the-art Plant Accelerator

The organisations represented at the Waite include:

- The University of Adelaide – primarily plant science capability.
- CSIRO – predominantly horticulture/wine and soil and water capability.
- SARDI – predominantly sustainable systems/crop R&D capability.
- Australian Wine Research Institute.
- Department of Environment, Water and Natural Resources – though there is a progressive relocation of these people off the site.
- Australian Grain Technologies – wheat and barley breeding.
- The Australian Centre for Plant Functional Genomics.
- The Australian Plant Phenomics Facility
- Food SA – a food industry organisation
- A number of small groups collocated at the Waite in the main building.
A feature of the Waite is the integration of scientists from different organisations into specialist facilities, the main ones being:

- The Plant Research Centre.
- The Wine Industry Cluster.
- Plant Functional Genomics Centre.
- Plant Accelerator.
- Food Plus Centre.

The following University of Adelaide administered projects at the Waite Precinct were funded by GRDC as reported in the 2013/14 annual report:

<table>
<thead>
<tr>
<th>Theme</th>
<th>Description</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theme 1:</td>
<td>Meeting market requirement</td>
<td>$1,496,000</td>
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<tr>
<td>Theme 2:</td>
<td>Improving crop yields</td>
<td>$3,240,000</td>
</tr>
<tr>
<td>Theme 3:</td>
<td>Protecting your crop</td>
<td>$1,807,000</td>
</tr>
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<td>Theme 4:</td>
<td>Advancing profitable farming systems</td>
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<tr>
<td>Theme 5:</td>
<td>Improving your farm resource base</td>
<td>$311,000</td>
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<tr>
<td>Theme 6:</td>
<td>Building skills and capability</td>
<td>$338,000</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>$7,835,000</strong></td>
</tr>
</tbody>
</table>

During 2014-15 funding to the University of Adelaide from GRDC increased to $8.47 million (an increase of 8%).

In combination the investment by GRDC in SARDI and University of Adelaide administered projects is in excess of $15 million per year.

**Observations on the history of Waite and the reasons for its success a co-location model.**

For many decades there was a palpable tension between parties located on the Waite. The early establishment of the University in the early 1900s was followed not long after by the CSIRO Divisions of Soils and Horticulture and then Water during the late 1900s. Observations from visiting the Waite from the 70’s onwards was a poor working relationship between the University and the CSIRO groups. There was an equally poor relationship between the Waite University and the state agriculture department.

Two issues came together in the late 1980s – the sale of the Department's Northfield Research Centre (and need for a new home) and the appointment of Professor Harold Woolhouse. This was followed by the announcement of the CRC program and the approval of the CRC for Soil and Land Management during 1992.

At this time the leaders of the key agencies were Harold Woolhouse (Waite University), John Radcliffe (Primary Industries and Regions SA) and David Smiles (replaced a little while after by Roger Swift) at the CRC for Soil and Land Management. These people were the architects of the Waite Vision. Harold came with a reform agenda that included Roseworthy as well.

What resulted was a period of intense infrastructure development and collaboration on a range of areas including CRCs, special centres and commercial activities. Apart from collaboration in a number of CRCs (Soil and Land Management, Viticulture, Weed Science, Plant Molecular Biology) the CSIRO tended to remain at arm’s length, particularly in terms of project level collaboration.
The agreement between the parties was to share development costs on the basis of additional area required and for themes to be established and populated. Therefore, the clusters developed were the soil and water precinct, plant research centre, crop breeding area and the crop protection and related capability in the main Waite building. The University and SARDI capability, in particular was co-located in one of these areas and along with CRCs and special centres that followed, presented an integrated capability to the industry and world science community and industry.

What were some of the features of the co-location:

- Creation of critical mass. It was clear that successful research groups around the world were where large multifunctional and specialist groups were based. This attracted the best scientists who in turn further developed the scientific capability.
- Integration of capability. Along with the establishment of critical mass, the integration of capability was a strong selling point for the Waite. The basic, strategic and applied R&D and the educational capability was strongly promoted and resulted in some impressive investments from many countries. There was a strong selling point for post graduate studies where students could be jointly supervised by scientists at the University or SARDI/CSIRO. The key message was that the built in educational capability enhanced the reputation of the precinct.
- The capability to package significant resources and promote these was clear in the early days. Even when the beneficiary was one agency there was a willingness on all sides to assist with the pitch to win projects etc. SARDI was often called upon by the University to present to representatives from overseas looking to send students to the Waite.
- Focus for industry. There was broad acceptance of the benefits of collocation from all primary industries. This resulted in significant investment by R&D Corporations, the ARC and the private sector in work being undertaken at the Waite. It was/still is the major centre for crop research in the country.
- Ability to build on success. Due primarily to the effectiveness of the co-location, the capacity existed to attract large infrastructure projects. These included the Plant Molecular Biology Centre, the Wine Industry Cluster, Australian Genome Research Facility, Food SA and the Plant Accelerator. The State government was convinced to invest in these initiatives at a time when funding to this sector was significantly declining.

The effectiveness of the collocation model was based almost totally around leadership and good will between the parties. This required all parties to contribute, sometimes at their own expense.

An area where the original vision could have been maintained was for the parties to appoint a true Director of the Waite, rather than leaving it to the University to fill this via the Dean of the Faculty and Director of the Waite.
TASMANIA

Tasmanian Institute of Agriculture

The Tasmanian Institute of Agriculture (TIA) is a joint venture between the University of Tasmania and the Tasmanian Government.

This partnership has brought together the human and physical resources of the Tasmanian Government from its Department of Primary industries, Parks, Water and Environment with the scientific research and teaching capacity of the University of Tasmania (UTAS) to create a centre of excellence in agricultural research, development, extension, education and training. TIA’s activities are funded by the Tasmanian Government, UTAS, agricultural research, development and extension organisations, resource management organisations, other granting bodies and industry.

Outline

Funding: $5 million from Tasmanian Government, $4 million from University (through RBG system and PhD allowances) and $11 million from industry, largely through RDC projects. Tasmanian Government contribution is by way of a rolling five-year commitment and is governed by an MOU. This is supposed to include an allowance for bracket creep, but in last three years this hasn’t happened. On the plus side it has remained, and is expected to remain at around the $5 million mark and has been immune from general budget cuts (Editor’s note: The MOU seems to be viewed as quasi contractual obligation by Treasury and Government)

Legal structure: Unincorporated Joint Venture.

History: TIA has been on a growth trajectory since it began during 1994. The relationship between the Government and the University has had its ups and downs. Currently a very warm relationship between Minister and University.

Staffing: 120 of whom half are scientists and half technical. All staff are employed by the University. During 2007 the department’s extension staff were transferred to the University. The transition of extension staff was gradual and needed to change the culture from a master/servant relationship to a partnership culture. There are 20 extension staff, employed as professionals under University system, employed at six locations. There are approximately 100 postgrad students. The Minister has the right under the MOU to command a shift in resources (people) of State Government up to 10% in an emergency situation.

Governance: Advisory Board chaired by Secretary of Department of Primary industries, Parks, Water and Environment, with three University and three Departmental representatives and four independents from industry all answerable to the Minister. TIA is now responsible for delivering all agricultural research, development, extension and education on behalf of the Tasmanian Government and the University of Tasmania. In recognition of this they have developed a Monitoring, Evaluation and Reporting (MER) project to ensure that information reaches end-users. The MER will enable TIA to report against indicators used in strategic and operating plans.

Assets: Access to three farms (dairy, horticulture and dryland farming) and access to a Government-owned research facility for grains research. Two of the farms (Elliot
Dairy Farm and Forthside Vegetable Research Facility) are now fully owned by the university. They were gifted to the university by the Government under the JVA some years ago. A third farm near Cambridge in the Coal River Valley (the University Farm) is mainly used for teaching purposes and was a private donation to UTAS by a local benefactor about 20-30 years ago. TIA also use a Government owned farm in the Northern Midlands (Cressy) for cereal research. These assets are under review as they are not necessarily fit for purpose.

TIA are now looking at introducing Associate Degrees and extension staff are expected to play a role in this. Industry has been the driver for this change. Looking to linkages with Lincoln University in New Zealand because of common interest in Horticulture and Dairy.

Not much activity in grains. Only three or four staff working on grains, mainly looking at high yield irrigated grain production to substitute for feed grains imported into the State at a cost of around $50 per tonne. CSIRO is co-located and has a small presence on campus with some joint projects mainly in the agricultural systems and modelling space. Co-location helps, but it depends on leadership and the attitude of individuals to cooperate. Strengths of the model is seen to be based on partnership, trust and good articulation of expectations.

From the TIA website

“TIA has a state, national and international mandate. At the state level, we work closely with our partners in government and industry to improve the performance of Tasmania's agricultural sector, across all industries and value chains. At a national level we show leadership in research excellence and partner strategically with many other organisations around Australia. Internationally we are rapidly increasing our research portfolio, influence and student numbers.

Through the practical knowledge of our staff we support the development of robust, innovative agricultural policy that facilitates Tasmania's growth and that firmly establishes TIA as a world-class, science-based organisations.

TIA's role is to provide a solution-oriented approach to research, development, extension and education. TIA functions as an integrated unit within the Faculty of Science, Engineering and Technology of UTAS. TIA's Agricultural Science discipline within the School of Land and Food is helping to educate the next generation of farmers, agronomists, export managers and policy-makers to build the state's economy and to help feed the world's growing population”
QUEENSLAND

The policy settings in Queensland are different than those applying in WA. While there were massive cuts to the Queensland Department of Agriculture and Fisheries (QDAF) under the Newman Government, R&D was the least affected area of the Department. The current government also has a strong view that it was important to support innovation and R&D as evidenced by the Advance Queensland program. QDAF has 2000 staff and includes Fisheries and Forestry staff as well as Agriculture and Biosecurity staff.

QDAF has a number of contracts and MOU’s with several of the 10 universities operating in Queensland. The largest is the Queensland Alliance for Agriculture and Food Innovation (QAAFI) with the University of Queensland (UQ). There is also a large contract with the University of Southern Queensland (USQ). QDAF have been keen to develop a substantial partnership with James Cook University in the marine science and aquaculture area but to date this has not been progressed to any great extent. Both the UQ and USQ agreements have biosecurity clauses that allows the Minister to access staff on a cost only basis under specified conditions to manage biosecurity problems should the need arise.

The Queensland Alliance for Agriculture and Food Innovation

The Queensland Alliance for Agriculture and Food Innovation (QAAFI) was established to try and preserve funding for high priority areas of research in Queensland.

Many of the scientists who were moved across to QAAFI were working in a number of different arrangement with the UQ and from QDAF point of view the formation of QAAFI was seen as a way of formalising these arrangements and also getting UQ focused on Queensland agricultural production issues. UQ had tended to go down the path of focusing on international development work. QAAFI scientists conduct research at 15 sites across Queensland in facilities owned and operated by QDAF. There is a contract between QDAF and UQ that provides for salaries and a licence to occupy.

UQ were very selective and only chose the high performing academic researchers (15 were in the initial transfer) who could boost the returns to the University through the formulas for universities through the Australian Government for Research Block Grants, Australian Research Council Linkage and postgraduate student programs.

QAAFI incorporates three centres – The Centre for Plant Science, The Centre for Animal Science and the Centre for Nutrition and Food Sciences. Each centre operates as an independent entity within the University of Queensland.

The Centre for Plant Science (CPS) delivers enhanced economic and environmental outcomes for plant industries in Queensland and Australia by linking excellence in discovery and the plant science

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5 Advance Queensland includes investing $180 million over four years to create the knowledge based jobs of the future including:

- A $50 million Advance Queensland Best and Brightest Fund, which will develop, attract and retain world-class talent both scientific and entrepreneurial.
- A $46 million Advance Queensland Future Jobs Strategy that will open the door to new industry/research collaborations, tackle the big innovation challenges, focus on translation, and deliver 10 year roadmaps for industries with global growth potential.
- A $76 million Business Investment Attraction package, which will encourage a new wave of Queensland start-ups, support proof-of-concept projects and attract co-investment through the Business Development Fund.
development capabilities of QAAFI, UQ and QDAF. The CPS integrates strong disciplinary capabilities in major research focus areas to target improved crops, crop protection systems, and sustainable production systems.

Outline

Legal structure: Totally owned by the University of Queensland.

Funding: Approximately $35 million over five years equally funded by the Queensland Department of Agriculture and Food and the University of Queensland ($7 million each per year). Government funds are all project based and related to an annual Research Plan. Government funds are reportedly leveraged 9 fold by external funds [i.e. 90% of a projects funding comes from external sources]. QAAFI lists their partners and sponsors as DAF [Qld], ARC; GRDC; ARC Centre for Cell Walls; RIRDC; HAL; Pork CRC; Joel Ocheing; and Conservation Farms Inc.

History: Established 21 October 2010. Originally a five year contract it has recently been moved to a rolling five-year contract to ensure that contracts can go to their natural end without disruption.

Staffing: In total there are 68 scientists and 30 ‘professional’ staff in QAAFI. The 30 professional staff include an Institute Director and each Centre has a Director and Administration Officer. Other key positions are a Business Development and Engagement Manager and an Operations Manager.

In the Centre for Plant Sciences there are 34 Researchers, which includes 12 staff working in the Pacific Agribusiness Research Development Initiative (PARDI) funded by the Australian Centre for International Research (ACIAR). This unit undertakes supply chain and market driven research to identify constraints that impede economic development in the South Pacific.

Research staff are supplemented by research students that have grown to 160+ enrolling since 2013. The student numbers include a lot of international students. Staff are located at several locations [University of Queensland; DAF Ecosciences Precinct; DAF Health and Food Sciences Precinct, Coopers Plains; UQ Gatton; Toowoomba; Warwick; Kingaroy; Maroochy Research Station; Brian Pastures Research Facility; Rockhampton; Charters Towers; Centre of Tropical Agriculture and Fisheries Mareeba].

Strengths:

- Considered to be a successful transfer of government staff to the new Institute.
- In many cases staff stayed in their current locations.
- A strength is the ability of the Institute to engage research students (>160 enrolling since 2013).

When QAAFI was formed UQ only wished to take on scientific staff and would not accept technical and support staff. There was a transition period, with complex negotiations with staff and the Unions,
but today all QAAFI staff are paid by the University. One of the problems was that mid-career to principal scientists were better off on University employment contracts. While early career scientists and technical staff and operatives were better off under QDAF employment conditions. Over time it is expected that QDAF will employ less technical and support staff as QDAF staff retire or leave and new appointments will be made by UQ as required.

The Institute for Agriculture and the Environment, University of Southern Queensland

The Institute for Agriculture and the Environment (IAgE) at the USQ is focused on delivering applied, practical and profitable research solutions that strengthen agricultural productivity and environmental management challenges in Australia and overseas.

The research focus of IAgE is on:

- developing future agricultural production systems
- creating opportunities and efficiencies in food and fibre value chains
- improving management of risk and resilience in agriculture.

As part of the Institute the USQ has a significant partnership with QDAF called the Broadacre Agriculture Initiative. This initiative has enabled the expansion of research capacity and discipline expertise in the Crop Health Centre, within the Institute, making it the largest research centre investigating crop health in the northern grains region. There are 11 post graduate students in the Centre for Crop Health.

Under this agreement 24 staff from QDAF were transferred to USQ. The whole team shifted from DAFF to USQ (scientists and technicians) and this was done to maintain work that needed to be continued. QDAF effectively ‘transferred the business’ and has project based contracts with USQ to conduct the required work. The term ‘transfer the business’ is specific as under Queensland legislation it protects the conditions of employees when the business is transferred from one organisation to another. This arrangement also has some built in security for USQ as DAFF is required to give five years notice of termination.

From the perspective of QDAF, the keenness of the USQ the transition was actually easier to prosecute than the QAAFI arrangements. Of great assistance was USQ providing transitioning arrangements (salary and conditions supplementation) to ensure no staff member was worse of in going across to USQ employment.

History of this arrangement and lessons learnt

USQ’s background of involvement in agriculture grew out of engineering. In 2012/13 USQ made a decision to become more involved in agriculture and to build their capability. They looked around for a group with expertise in plant health and identified the QDAF group. They approached QDAF and the timing was right as QDAF was looking to reduce their exposure to R&D liabilities. It also did not make much sense to maintain two groups.

As USQ wanted to build their capabilities they wanted to take the entire team from “researcher to tractor driver”.

USQ had made the decision to build capability, invest in infrastructure and in people. This helped to facilitate the transition of staff from QDAF to USQ. In total 24 positions were transferred. One person identified did not transfer and 2 went to other jobs before the transfer occurred.
Three QDAF groups were transferred (Summer crop Pathology; Winter Crop Pathology; Nematology). These historical groups made no sense to USQ and transferred people went into different groups.

Three principal scientists were transferred to level D positions (associate Professor) which gave them a significant salary increase (around $20,000 per annum). After transfer their positions were reviewed and on a merit basis all were promoted to full professorships. All other staff were assessed against University salary scales with the principle that take home remuneration would, at minimum, remain the same. This resulted in a pay rise for all staff as superannuation is more favourable for university than QDAF staff. Non-academic staff were transferred to professional officers in the university system.

Of the staff transferred; 19 went into the Centre for Crop Health, two into Engineering and Agriculture; and three into the Institute Applied Science Centre.

The cost to DAFF is about $4.8m over five years which is the equivalent of the cost of salaries to QDAF at the time of transfer. Increased salary costs were born by USQ. The transaction was cost neutral to the State Government.

From a QDAF staff perspective the move was positive as it provided them with a longer term future; a vision; a move to university salary scale and access to better equipment.

In Queensland, the transfer was required to be approved by the Fair Work Commission and to achieve this the staff to be transferred had to agree to the terms and conditions of the transfer.

Discussions commenced during August 2013 and the transfer of staff occurred during December 2014. It took longer that the university envisioned.

What would USQ do differently if it did the same again?

- A majority of staff came from the Leslie Research Station. As new facilities had to be developed at USQ only about half the staff have physically relocated at present due to the time taken to develop new facilities at USQ. If USQ did it again, they would develop the infrastructure first, or seek to acquire the research station (which was not possible in this instance).
- Because some staff are still located on QDAF facilities, this has complicated negotiations with QDAF and incurred rental and other charges for USQ.

Lessons

- Cultural barriers developed over many years within QDAF presented challenges in breaking down barriers across previous groups and encouraging QDAF staff to think more broadly and work across groups.
- USQ is building $6m of glasshouse and other facilities at USQ with the help of GRDC.
- To make it work the university must want it for the long term. USQ strategically decided to build its capability. The university currently with the best capabilities may not necessarily be the best university to partner with. Motivation of the university is important.
NEW SOUTH WALES

The investment by NSW DPI in grains R&D is estimated at $20 million per year with matching investment by GRDC of $20 million per year.

While there are no immediate budget pressures, Government policy settings in NSW favour protecting agricultural R&D if budget cuts affect the NSW DPI. This is in line with strong focus on innovation and science. This policy has been in place since 2013 when realigned its research agenda with the aim of doubling the co-contribution to attract GRDC funds. NSW DPI has commenced discussions with GRDC about a 10-year bilateral agreement. At the very least this is helping to define the areas of strategic importance to GRDC and NSW DPI.

Graham Centre, Wagga Wagga

A collocation of a university and NSW DPI in an unincorporated joint venture that has some benefits but still tensions and competition with high management overheads and no direct line management of R&D staff.

The Graham Centre for Agricultural Innovation (The Centre) was established during 2005 as an unincorporated joint venture research alliance between Charles Sturt University (CSU) and the New South Wales Department of Primary Industries (NSW DPI). Located at Wagga Wagga, a major regional centre with 64,000 people, connected by air to Sydney and Melbourne (both 450 kilometres (km) away and 4-5 hours’ drive) and 250 km and 2.5-3 hours’ drive from Canberra.

Focused on research for mixed farming systems, the vision for the Centre is “to be the Australian centre of excellence for temperate mixed farming systems addressing the challenges of food security, biosecurity and adaptation to climate change”.

The history of the relationship between CSU and NSW DPI dates back to 1895 with the establishment of the Bathurst Experiment Farm. The CSU campus at Wagga Wagga is on this land and originally started as an agricultural college run by the NSW DPI when agricultural education was managed by the DPI. During 1975 there was a merger of the Riverina College of Advance Education and the Wagga Wagga Agricultural College into the Riverina College of Advanced Education. During 1989 CSU was incorporated with campuses at Albury-Wodonga, Bathurst and Wagga Wagga. At that stage the property was split with NSW DPI having its own research station, land and buildings separate from the CSU facilities. DPI farm 1800 hectares and CSU has 1500 hectares at the Wagga Wagga campus and 400ha at its Orange campus.

During 2005 the Graham Centre for Agricultural Innovation was established and a Centre Director appointed. The University contributes around $1.5 million per year to the centre. NSW DPI contributes $65,000 per year towards the Centre Director’s salary. All five direct staff of the Centre (Director, Centre Manager, Industry Partnerships and Communications Manager and two admin staff) are employed and funded by the CSU. CSU funds Centre specific programs such as:

- Conference support.
- Post graduate support programs.
- Summer internships for undergraduates.
- New initiative grants.
- Research fellowship grants (up to $650,000 per year) – to enable the Centre to ‘buy’ time from CSU staff to leverage applications and engagement in externally funded projects.
The key strengths of the Centre are:

- Its strategic location in the heart of the Murray-Darling Basin.
- Close proximity to industry partners and opportunity to develop strong partnerships with farmer groups.
- The increasing capacity to undertake research based on a diverse skills-base of scientists with the potential to develop cohesive multi-disciplinary teams.
- The expanding infrastructure.
- The commitment of CSU and the NSW DPI to an enduring alliance to address key industry issues.

The Centre has 120 staff mostly directly employed by either CSU (86) or NSW DPI (36). In addition, there are 74 higher degree research students linked to the Centre. Not all CSU or DPI staff on the campus are part of the Centre. It depends on the relevance of their work to the purpose of the Centre. NSW DPI and CSU jointly appoint the Centre Director, and the Centre management are in the process of setting a new strategic plan and reducing the number of Centre members to only include those involved in the core objectives of the Centre, particularly CSU staff. The aim is to improve the income and publication ratios to better reflect the impact of the Centre. Note that 42 CSU and DPI staff work in animal and veterinary sciences.

Current activities for the centre and the approximate CSU and DPI staff involved are shown below:

**Soil and Plant Sciences**

*Crop and pasture productivity; water use, nutrient cycling and carbon sequestration; plant biosecurity (weeds, seeds, insects)*

- Soils and water – six CSU, three DPI and five post grad students.
- Crops – three CSU, six DPI and four post grad students.
- Pastures – four CSU, six DPI and one post grad student.
- Weeds – eight CSU, two DPI and eight post grad students.
- Pathology – five CSU, four DPI and eight post grad students.
- Entomology – three CSU, three DPI and four post grad students.

**Systems Integration and Value Adding**

*Food supply, quality and safety; Bioeconomic modelling, climate change; Decision and risk support-links with farmers, agribusiness and industry.*

- Food quality – 12 CSU, three DPI and 11 post grad students.
- Social and cultural – six CSU and five post grad students.
- Economics and modelling – three CSU, three DPI and one post grad student.

**Animal and Veterinary Science**

*Animal productivity and welfare; Reproductive efficiency; Animal biosecurity & epidemiology (parasites and pests).*

- Nutrition – nine CSU, four DPI and 11 post grad students.
- Reproduction – four CSU, two DPI and three post grad students.
- Health – 23 CSU, 13 post grad students.
The campus is also home to the Functional Grains Industrial Transformation Training Centre (ITTC), funded by a $2.15 million grant from the Agricultural Research Council (ARC). The ITTC is aimed at transforming the Australian Grains Industry from a commodity-based industry into a highly efficient industry producing high quality food and feed products that exceed market expectations. The Centre focuses on rice, pulses and canola and has seven industry partners.

The Centre has a 15ha field site that was established during 2010. The field site is a 'living brochure' showcasing the Centre’s research outputs to assist farmers, advisers and natural resource managers to develop and maintain robust and sustainable farming systems.

The collaboration is managed via a Board of Management made up of the Vice Chancellor and Deputy Vice Chancellor, CSU and the Director General and the Deputy Director General, NSW DPI, which meets two-three times a year. The Board is removed from the day to day activities oft the Centre.

There is also an Industry Advisory Committee comprising of industry representatives (e.g. farmers, consultants and agribusiness), with an Independent Chair appointed by the Board of Management. The Research Management Committee (RMC) provides research leadership, promotes collaboration and advises on priority areas. The Centre Director, Industry Partnerships and Communications Manager, Centre Manager and leaders of priority research areas make up the RMC.

The Centre is revising these management structures and establishing a Centre Board (under the Board of Management) to provide more local control to try and drive a clearer focus on priorities and collaboration. This is expected to be made up of the Centre Director, three senior DPI program leaders, CSU’s Dean of Science and two CSU Heads of School.

However, the basic tension remains in that DPI and CSU need to separately maximise and account for the amount of external funding they receive, which can drive the two organisations into a silo mentality and competitive mode. The DPI need to maximise the amount of external funding they receive to meet corporate objectives with the State Treasury, and CSU needs to maximise its external funding to get credits for Research Block Grants through the university system. It is estimated that 70% of the projects logged under the Graham Centre do not involve DPI personnel. The culture has been traditionally about who controls the project rather than a focus on the outputs. There are no drivers forcing researchers to come together. That said, there are good collaborations between the majority of individual researchers, and the challenge will be to replicate this across the organisations through strong leadership from management structures and the Centre Director.

During September 2015 CSU announced its intention to establish an AgriSciences Research and Business Park in Wagga Wagga. Expected to open by mid-2017, the vision for the AgriSciences Research and Business Park is to foster collaboration and innovation between agriscience and agribusiness companies co-located with CSU and NSW DPI.

"The proposed Park will create an environment to facilitate meaningful collaboration between tenants, staff and students, and the wider regional and national agricultural and agriscience focused communities," Professor Andrew Vann, Vice-Chancellor said.

"Supporting knowledge transfer and innovation, drawing on the research and development capabilities and facilities offered by CSU and future tenants, the Park will help to close the gap between research discovery and the real world impact of a knowledge economy.

"It will also provide opportunities to enhance students' skills and knowledge through workplace learning experiences and facilitate continued professional development for Park tenant employees."
“In addition, the Park will drive regional economic growth and expand employment opportunities for the Wagga Wagga community.”

The AgriSciences Research and Business Park will be constructed on vacant land at CSU’s Wagga Wagga Campus, along Agriculture Avenue and adjacent to Pine Gully Road. Construction will comprise of purpose-designed buildings supported by service infrastructure suitable to accommodate long-term tenants.

The University of Sydney’s IA Watson Grains Research Centre, Narrabri, NSW

The Plant Breeding Institute’s IA Watson Grains Research Centre is located on land acquired by the Wheat Research Foundation which was originally funded by growers from the Wheat Industry Research Committee of NSW using funds from Wheat Board pools. The Foundation paid the University of Sydney to set up the Wheat Research Institute and the University has been using the site for its wheat breeding program (now sold) and its field research since 1961.

The University paid rent for the facilities but they were slowly deteriorating and the Foundation first tried to increase the annual lease paid by the University, but then sought to implement a different plan to rejuvenate the facility.

During 2012 a bilateral deal between the University of Sydney and GRDC saw the establishment of the new research and teaching facilities with the University of Sydney providing a new building for the Institute and GRDC providing project funding. With fit out the cost of the new building was of order $8 million and included: a purpose designed plant breeding and plant pre-breeding ‘factory’; chemical, genera, and grain quality laboratories; an archive seed store for long term storage of genetic material; a grain cleaning area; a large seed store and a large materials handling area. Under this arrangement the University has a 25-year lease of the building it funded, in return for a peppercorn annual lease payment (in effect the Wheat Research Trust is financing the building). The University will also maintain the building and facilities. The GRDC funded two position and financed the glass houses and protective plot structures through project funding.

The University has 13 full time and five-part time staff based at Narrabri with a continually growing research program. This year there are 15 PhD, Masters and Honours students using trials at the Centre (two are based at Narrabri and 13 travel up from Sydney as required). There are 18 full or part time staff with six University employed academic scientists, six technical staff and six farm operatives. Getting staff, other than academics to Narrabri is not hard. Many live in Tamworth (65,000 people) which is two hours away by car and commute to work at Narrabri during the week.

Approximately 20% of the site is used for University trials with a range of other organisations/companies conducting trials on the property including CSIRO, AGT, Longreach, NSW DPI and Kalyx. Most organisations do their own trials and just lease land and organise water as required. However, Institute staff can provide full trial planting, monitoring, measurement and harvesting as required. Serviced trial plot land is provided at $1700 per hectare. There is 300ha of irrigable land.

The GRDC is the major and crucial supporter of the research carried out at the Centre by the University of Sydney, with nine separate projects and four fulltime positions funded at $2.6 million per year. In addition, there is another $1 million of research per year conducted through the Centre.

AGT is a significant tenant of the new facilities and leases 70% of the building space at the new centre and hectares of trial sites. In addition, AGT has acquired its own land and storage facilities at Narrabri.
In January the University acquired an adjacent 2000-hectare property which will allow the expansion of the facilities through a $1.3 million irrigation development funded by the GRDC.

With the additional land the Centre will now be able to provide for seven year rotations rather than two year rotations which will increase the value of the Centre for contract research trials.

The University of Sydney’s Plant Breeding Institute operates from several sites in NSW with its main location at the Camden campus at Cobbity and 19 rural properties, totalling 1500 hectares known as the ‘Camden Farms’. One of the major diseases of winter cereals and a key selection target for cereal breeders are the cereal rusts. The rust group at PBI; is funded by the GRDC. The Australian Cereal Rust Control Program (ACRCP) based at Cobbitty is often cited as a model program for national cooperation. This program is also recognised internationally as one of the leading research groups working on cereal rusts. The PBI has worked on these diseases since its establishment and has produced a number of world leading scientists both in Australia and internationally who aim to assist plant breeders in the quest for rust resistant crop cultivars. The Plant Breeding Institute also conducts pot- and field-based crown rot resistance screening.

The Plant Breeding Team at PBI integrates molecular genetics lead by Professor Peter Sharp with theoretical and applied plant breeding lead by Professor Richard Trethowan. The Molecular Group collaborates with national and international groups and concentrates on marker technologies and tilling. The focus of the plant breeding group is broad and covers a wide range of crop species. Activities include wheat pre-breeding focusing on abiotic stress tolerance in disease resistant backgrounds, dual purpose triticale, mustard breeding for biodiesel and pulse breeding including faba bean and field peas. The team exploits various technologies including tissue culture, double haploids and integrated genomics. Professor Richard Trethowan is also the Director of the IA Watson Grains Research Centre, Narrabri. Narrabri is a key field site and is used to validate laboratory and greenhouse experiments and to manage the day to day plant breeding operations.
VICTORIA

Agriculture Victoria is the brand name for the Agriculture and Rural Division of the Department of Economic Development, Jobs, Transport and Resources (DEDJTR).

In Victoria, DEDJTR has the major capability for grains specific RD&E, currently consisting of around 120 research, development and extension staff. The applied RD&E capability specific to grains is mostly located at Horsham (around 70 full-time equivalent (FTE) staff) with a smaller proportion at Hamilton (around five FTEs, working on projects managed via Horsham); while DEDJTR’s strategic biosciences research capability is mainly located in Melbourne (around 45 FTEs at AgriBio).

The 2015-16 budget for Grains R&D in Victoria is $28.5 million of which the State will contribute 40%, GRDC 32%; agribusiness 26% and other 2%. Of the total of $11.6 million spent by the State, nearly $6 million will be on grain farm production R&D.

Under the National Grains RD&E Strategy Victoria has a major role in Gene technologies to accelerate the development and implementation of improved germplasm and genetic technologies to improve genetic potential and profitability in cereals (wheat), oilseeds (canola) and pulses (lentils, field peas, chick peas). The following projects for the period 2015-2019 address this objective:

- Australian Grains Genebank.
- Molecular breeding of pulses.
- Pulse molecular markers and germplasm enhancement.
- Canola germplasm enhancement.
- Genome analysis technologies for cereals (breeding and pre-breeding).
- Accelerated precision breeding of wheat and canola (sponsored R&D program).

In the area of grain farm production R&D, the Victorian Agriculture and Rural Division investment priorities for the grains sector for the period 2015-2019 for profitable grain farming systems provide for the following specific R&D projects:

- Pulse agronomy.
- Grain quality.
- High rainfall zone (HRZ) cropping systems.
- Soils and nutrient management.
- Grains pathology.
- Adaptation to a challenging climate.

The programs listed above build on joint investment by DEDJTR and GRDC in a long term bilateral agreement to retain RD&E capacity in areas aligned to DEDJTR’s leadership role in the Grains Industry National RD&E Strategy. The Bilateral Research Agreement is a significant long term commitment by the GRDC, DEDJTR and other co-contributors (in the order of $60.5 million over five years, with an option to renew for a further five years), for specific programs in areas aligned to DEDJTR’s major role in the National Grains Strategy. The intent of the Bilateral Research Agreement is to provide a predictable funding environment to allow longer term planning and to build capacity in applied RD&E; and to establish a platform enabling both Parties to work together to continuously improve national and regional applied RD&E capability and capacity and its impact. This will ensure that both Parties remain responsive to emerging grain industry issues and provide beneficial research outcomes for grain producers.
AgriBio and the Australian Grains Genebank (AGG) are both recognised under the National Grains RD&E Strategy as national centres of research capability (AgriBio as a national centre for pre-breeding and genetic technologies and the AGG at DEDJTR Horsham as a national centre for genetic resource acquisition, management, characterisation and distribution) that deliver through contributions to the national programs, enabling functions, agribusiness and links to the tertiary education sector.

**AgriBio, Centre for Agribioscience, Victoria**

AgriBio, Centre for Agribioscience is a joint initiative of the Government of Victoria, through the Department of Economic Development, Jobs, Transport and Resources (DEDJTR) and La Trobe University (LTU) which opened during 2013.

AgriBio accommodates over 400 staff and students, with around 300 from DEDJTR and 100 from LTU, including scientists, students, and business and science-support staff.

The facility consolidates DEDJTR’s Agricultural Biosciences Research staff with a focus on plant, animal and microbial biosciences, biosecurity and bioprotection.

AgriBio also houses LTU’s existing biosciences staff in plant and animal genomics, plant pathology, animal health and agricultural sustainability, predominantly within the Faculty of Science, Technology and Engineering’s School of Life Sciences. To facilitate collaboration, LTU and Agriculture Victoria have made a number of joint appointments, currently 17.

Established via an $A288 million public private partnership (PPP), AgriBio was delivered under the Victorian Government’s Partnerships Victoria policy. DEDJTR and LTU engaged Major Projects Victoria, a division of the Victorian Department of State Development, Business and Innovation (DSDBI), to manage procurement, design and construction of AgriBio on behalf of the Joint Venture parties up to commercial acceptance. Plenary Research (a consortium of the Plenary Group, Grocon and Honywell) designed, constructed and financed the project and will provide facility management services required for the operation of AgriBio over a 25-year period.

Total size of 30,777m² across five levels and external buildings. Facilities include the 16,000m² main three storey facility, PC2/QC2 and PC3/QC3 contained laboratories including four microbiology laboratories, and 13 glasshouses, two polyhouses, 12 screen houses and 78 controlled environment and controlled atmosphere rooms (CER’s). There is 2640m² commercial space available for lease on the ground floor. Conference facilities for up to 200 attendees and 20 meeting rooms.

AgriBio, Centre for AgriBioscience, is a major international facility for plant, animal and microbial biosciences and biosecurity research and diagnostics. Research at AgriBio spans the spectrum from strategic to applied science.

Joint scientific programs include:

- World-leading gene discovery and functional genomics in major plant and animal species of importance to Victoria and Australia.
- Molecular breeding for disease resistance, drought tolerance, bioenergy and health.
- Molecular diagnostics, biological control and other management strategies for weeds and plant and animal pests and diseases of importance to Victoria and Australia.
- Physiology and genetics related to plant and animal bioactives and health.
- The development of sustainable systems for animal and plant production.
Collaborations by AgriBio staff nationally and internationally include animal, plant, soil and microbial biosciences, ecology and biodiversity. Potential future collaborations may include forensic science, nanotechnology, electronic engineering/sensor technology, e-science, physics, and chemistry.

A multi-disciplinary and collaborative approach to research and development is increasingly seen as a more effective way to tackle complex problems, rather than in isolation, leading to better, more innovative science outcomes.

The Biosciences Advanced Scientific Computing (BASC) system located at AgriBio was refreshed and expanded in 2013 to meet current and future research needs at a total cost of $3 million. In addition, DEDJTR has made a significant investment in next-generation sequencing, robotics and state-of-the-art mass spectrometry capability – representing a collective investment in excess of $8 million for genome, transcriptome, proteome and metabolome analysis.

**Grains Innovation Park, Horsham**

Grains Innovation Park Horsham was established during the 1960s by the Victorian State government and the Wheat Research Foundation essentially to breed wheat varieties for Victoria. By the 1980s, the breeding programs had expanded to include wheat, barley, canola, field peas, lentils and chick peas as well as associated agronomy, plant pathology and grains chemistry.

Today, under the National Grains RD&E Strategy, Horsham has become the national centre for breeding pulses and also carries out pre-breeding research in cereals and oilseeds. It incorporates the Australian Grains Genebank (AGG) with a consolidated collection of tropical and temperate climate cereal, grain legume and oilseed collections.

The Grains Innovation Park (GIP) at Horsham houses 127 people: 100 from Agriculture Victoria the Agriculture and Rural Division of the Department of Economic Development, Jobs, Transport and Resources (DEDJTR) of which around 75 work in the grains sector. The GIP also hosts 20 people in nine companies. Companies based there include: Nuseed (Canola breeding); Marcroft Grains Pathology (Oilseed pathology and extension services); PB Seeds (Seed production, variety licensee); Plain Statistics (Biometric and database services); Dow AgroSciences (Cereal breeding); Seednet/Landmark and Pulse Australia (Pulse Industry Development). There is a large land area (approximately 40ha) serviced and ready for private sector organisations to establish offices/factories. It is not a requirement for a company to have a collaboration with DEDJTR in order to locate at the site. However, the company’s operations should be aligned with services to the grains industry. Collaborations do exist with many of the companies and some of these collaborations are large (for example Dow AgroSciences) and long term in nature.

The facilities include laboratories, 17 glasshouses including QC2/PC2 glasshouses and two plastic polyhouse-igloos, and just outside of Horsham is the 600ha Plant Breeding Centre Farm, where breeding and pathology plots are grown which includes 200ha of laser levelled land and wastewater treatment for irrigation water runoff. It also has a dedicated 10ha double fenced site for Genetically Modified crop field evaluation.

New controlled environment- and field-based plant phenomics infrastructure have been established at Horsham. These new facilities represent a total investment of over $5 million in state-of-the-art plant phenomics infrastructure at the Horsham node of Plant Phenomics Victoria, including the world’s first LemnaTec hyperspectral imaging capability for whole of lifecycle, non-destructive, image-based analysis of plant growth and development of grains accessions. The LemnaTec system is equipped with two high resolution sensors capable of capturing visible and hyperspectral information.
across up to 600 dedicated plant carriers at a time, with automated weighing and watering. A second Plant Phenomics Victoria site is currently under construction at AgriBio (PPV – Bundoora) (estimated completion 2017). Uniquely it will allow high resolution imaging of over 1500 plants at a time with a variety of pathogens providing the only facility with this capability, allowing research in biosecurity not previously possible. Both PPV facilities will take controlled environment plant phenotyping into the modern era with high resolution imaging capability that is currently not available to Australian researchers. The system function also includes purpose-designed software to capture and assess changes, as well as data storage and data processing, and will integrate into the existing DEDJTR Biosciences Advanced Scientific Computing (BASC) system.

Horsham also hosts one of Australia’s largest plant pathology regional groups and agronomy research in the areas of climate variability and remote sensing. Horsham is home to a major pulse breeding program which includes the development of agronomic packages to accompany the new varieties. Research activities include genetic improvements such as new genetic variation, improved adaptation, improved grain quality, disease resistance and abiotic stress tolerances. There is also research investigating management practices for biotic and abiotic constraints, efficient farming systems and climate change. Researchers are also working on the Free Air Carbon dioxide Enrichment (FACE) project which investigates the potential impacts of higher carbon dioxide levels on cereal and legume crops, insects and soil.

THE COTTON INDUSTRY

The Cotton Industry is often held up as a successful model for the grains industry due to the close integration of the industry across the supply chain. It is a much newer industry and has the advantage of a smaller geographic area, across just two states and with 1400 growers.

The rule of thumb for the cotton industry achieving 2% productivity gain per year is:

- 50% from new varieties.
- 25% from farmer management.
- 25% from agronomy and interaction of varieties and management.

The Australian Cotton Research Institute, Narrabri

The Australian Cotton Research Institute (ACRI) located between Narrabri and Wee Waa, in the middle of New South Wales’s main cotton production areas, is home of NSW Department of Primary Industries’ Centre of Excellence for Cotton, Pulses and Oilseed Improvements. ACRI is just a name as the facility is actually owned and operated by the NSW DPI. Originally established during 1958 by the NSW DPI, CSIRO moved staff working on cotton during 1972 from Canberra, Griffiths and Kununurra.

The facilities are shared now between the NSW DPI and the CSIRO Divisions of Plant Industry and Ecosystem Services (Cotton Research Unit). Until it closed in 2013, the Institute was also the home of the Cotton Catchment Communities Cooperative Research Centre (Cotton CRC) and its predecessors (Cotton had three consecutive CRC’s for 19 years from 1994 to 2013).

There is a 10-year agreement with CSIRO to share the site and provide services to CSIRO trials (up for renewal in 12 months’ time). CSIRO have two thirds of the staff and two thirds of the land use at the Institute. They are charged on actual costs in the chart of accounts and at the rate of one farm operative per 20 hectares of land utilised. CSIRO provide the IT services for all on the site. CSIRO have recently acquired a nearby site of 160 hectares for additional work.
While co-located there are few collaborative projects between DPI and CSIRO. In fact, they have try to ensure that they differentiate and do complementary work, rather than compete. There is some sub-contracting by each organisation from each other. Despite that there is an attempt to ensure mixing of ideas with staff and facilities ‘salt and peppered’ throughout the facility rather than being in separate offices and laboratories.

When the CRC was operating at the institute there were PhD students, but now there are none.

Getting staff to come and live at Narrabri is a challenge and makes recruitment difficult but it suits some people (there used to be an air service from Sydney to Narrabri but now there are only infrequent flights to Moree (one hour’s drive away) and more frequently to Tamworth (two hours’ drive away)

The Institute is located on 277ha of land on the Namoi River. It includes conference rooms, glasshouses, laboratories, cotton gins, controlled environment growth rooms, insectaries, workshops and conference rooms. There is 64ha of trial in at the ground with 100ha irrigable.

NSW DPI staff includes seven Research Officers, eight Technical Officers and three Extension Officers.

NSW DPI scientists at ACRI works closely with growers, collaborate with scientists in CSIRO, Cotton CRC and the universities and conduct research to determine optimum agronomic inputs for cotton. The NSW DPI research effort is focused on enhancing northern broad acre irrigated and dryland farming systems that entails ongoing development and improvement in integrated insect, weed, water, soil and disease management and the extension of this activity. Current cotton research at the Institute comprises:

- Integrated disease management research
- Integrated weed management research in broadacre crops
- Irrigation and water use efficiency research including irrigation best management practises
- Soil productivity research including: tillage systems and stubble management systems; carbon sequestration in soil and soil quality
- Agronomic legume research – faba beans and mungbeans and soybeans
- Extension services – irrigated and dryland crops.

The Institute undertakes insecticide resistance monitoring programmes for the Australian Cotton Industry. The Institute has extensive insect rearing facilities on site for its research activities.

Facilities include:

- A PC2 certified laboratory and glasshouse facilities for dealing with genetically modified germplasm (CSIRO).
- Glasshouses used to accelerate backcrossing in the cotton breeding program (three generations per year), undertake weed ecology and cotton physiology studies as well as rearing aphid, mite and beneficial populations (CSIRO).
- 5,000 square metre shade tent for faba bean breeding in a pollinator-free environment. Approximately 470 F2 lines are bred in the tent each year. This is the largest faba bean breeding facility in NSW.
- A range of cotton ginning facilities that handle upwards of 45,000 samples each year. There is an 8-saw gin and mini roller gin for 3-boll samples, a range of 10-saw gins for slightly larger samples, 2 20-saw gins for samples up to 0.5 kg, a 30-saw gin for lines undergoing seed increase and two Platt roller gins for the pima and fibre quality programs (CSIRO).
• A fibre quality laboratory that handles approximately 30,000 samples each year. It is equipped with an Uster HVI classing unit. Here is also a Shirley Fineness/ Maturity Tester that allows the components of micronaire to be assessed individually (CSIRO).

• A Climate controlled seed store allows long term storage (+25 years) of breeding germplasm. Cotton breeding material is also stored in the Australian Tropical Collection in Biloela, Qld.

• A recently installed growth cabinet will allow very detailed studies of cotton physiology to be conducted in the future. Unlike a glasshouse, the light, temperature and humidity are completely controlled in a growth cabinet. It is equipped with mercury vapour lights (which require water cooling) that produce 1000 micro moles/m2/sec of photosynthetic active radiation. (The average office fluoro produces about a tenth of this).

• Two spray mantis spray rigs on the station for the application of herbicides and insecticides in small plot experiments. The insecticide boom has the capacity to be carrying 8 different chemicals simultaneously. Each can be applied with their own water rate, pressure setting and nozzle type with the flick of a switch. This ensures treatments are applied in a timely manner and that each chemical is applied using parameters that maximise its potential efficacy.

• The lysimeter at ACRI is an Equilibrium Tension Drainage Lysimeter. The lysimeter measures deep drainage, the flow of water through the soil below the root zone, under irrigated cotton. The deep drainage is collected by an array of trays installed beneath 2m of undisturbed soil. Accurate flow measurement is achieved by constantly regulating the lysimeter vacuum to maintain equilibrium with the tension measured in surrounding soils (CSIRO/I&I NSW).

The Cotton Innovation Network

During 2012 the Cotton Innovation Network was formed to coordinate the cotton industry’s research and development activity and ensure a collaborative and cohesive approach to achieving the industry’s long term goals. The Network includes representatives from CRDC, Cotton Australia, Cotton Seed Distributors, CSIRO, DAF, QDAF, NSW DPI and universities, through the Australian Council of the Deans of Agriculture.

The Network is improving the coordination of all RD&E activity to ensure the industry receives the best value for its investment.

The Network is also driving the industry’s research program by mapping the current investment in research and determining the research requirements for the next 10 years. As a result of the collaboration of the Network members to date, all member organisations have aligned their strategic plans with the Cotton Sector RD&E Strategy and have a better understanding of what each organisation contributes to the overall RD&E effort.

The Network is also a channel for research organisations to raise challenges and promote opportunities for improved R&D coordination. The Network will help researchers better understand where their work fits into the overall priorities of the cotton industry and ultimately create better end results for growers.

The first major task of the Network was a project to map all of the industry’s current RD&E activities, and review these against the five research priority area:

1. Plant varieties
2. Farming systems
3. People and communities
4. Products and markets
5. Development and delivery
The analysis collated the investment, activities, purpose and timeline of every research project currently in progress - a total of 149 projects with a value of $49 million per annum. This information was gathered and analysed so that we could better understand:

- Where the effort is going?
- When will the research provide benefits to industry?
- Who is involved?
- Do projects link across the research priorities and does cotton have links to other industries’ RD&E efforts?
- When do projects end?

The study found that every member of the Network is involved in R&D activity – both leading and partnering on projects. The bulk of the research is being conducted in integrated farming systems including plant varieties ($28 million is invested across two priority areas). All member organisations are involved in farming systems research so it is important that all organisations collaborate in this area to ensure we understand how the various research elements fit together.

The research also found that two thirds of the investment focused on efforts that would provide benefits within five years. Almost 50% of the projects were scheduled to conclude or be reviewed at the end of the 2012-13 year and a further 20% would be reviewed or conclude at the end of 2013-14.

The Cotton Research and Development Corporation (CRDC)

The Cotton Research and Development Corporation (CRDC) is a statutory authority established in 1990 under the Primary Industries Research and Development Act 1989 (PIRD Act). CRDC was established by the Australian Government to work with industry to invest in RD&E for a more profitable, sustainable and dynamic cotton industry.

CRDC is based in Narrabri, the centre of one of Australia’s major cotton growing regions and the location of the major cotton research facility, the Australian Cotton Research Institute.

During 2015-16, Australia’s 1,250 cotton growers and the Australian Government will co-invest $20.6 million, through 200 projects, through CRDC into RD&E. Delivery of the R&D services will be provided as follows:

<table>
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<tr>
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<th>%</th>
<th>Change</th>
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<tbody>
<tr>
<td>CSIRO</td>
<td>25</td>
<td>declining</td>
</tr>
<tr>
<td>NSW DPI</td>
<td>17</td>
<td>increasing</td>
</tr>
<tr>
<td>QDAF</td>
<td>11</td>
<td>declining</td>
</tr>
<tr>
<td>Universities</td>
<td>33</td>
<td>declining</td>
</tr>
<tr>
<td>Private</td>
<td>14</td>
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</tbody>
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CSIRO’s share has declined from around 40-50% of the total as they are considered to be expensive and QDAF seem to be reducing R&D activities.
Cotton Australia

Cotton Australia is the peak body for Australia’s cotton producers, supporting more than 1200 cotton farming families in NSW and Queensland. The organisation strives to foster a world-class agricultural industry that’s sustainable, valued for its economic and social contributions and produces very high quality cotton in demand around the globe. It is funded by a voluntary levy on cotton growers.

Cotton Seed Distributors

Cotton Seed Distributors Ltd (CSD) is a not-for-profit company. The aim of CSD is to provide to every cotton grower the highest net return potential from the cotton varieties CSD produces.

To achieve this aim CSD works closely with CSIRO division of Plant Industry to have available the best possible varietal performance in conventional material and in the transgenic market, combine the attributes of the conventional varieties with the best possible biotechnology performance. Monsanto licence the technology to CSIRO and CSD and CSIRO own the seed.

During July 2014 CSD and CSIRO extended the Cotton Breeding Australia (CBA) collaboration agreement for an additional two years to 30 June 2024. Since the CBA collaboration commenced during 2007, CSD and CSIRO have jointly and equally invested a total of $58.7m in breeding and research. Through the terms of this extended agreement; by 2024 this investment will exceed $141m in total.

Further, CSD utilises the most modern technologies and infrastructure to bring forward the highest quality planting seed possible, in the quantities and time frames required, for all growers.

CSD is also involved in development and extension through trials, fact sheets and publications and running field days.

During 2014-15 CSD furthered its commitment to the CottonInfo team joint venture with Cotton Australia and the Cotton Research and Development Corporation (CRDC). Through the reporting period, the six Regional Development Officers (RDOs), which CSD provides to the joint venture have continued to focus on integrating into the wider CottonInfo team and complimenting the work of the CSD E&D team to deliver research based outcomes to all Australian cotton growers. The CottonInfo initiative has now been operating for two years and the impact is providing a real benefit to the Australian Cotton Industry. CSD has begun to work more closely with CRDC in the cotton research space. This is both through the inclusion of CRDC research leadership in the management structure of the CBA research program, as well as identifying potential future collaborative research aligned with both the CRDC and CSD strategic plans.

Bayer do have a cotton breeding program in Australia with varieties expected to come on stream in five-six years’ time.

THE SUGAR INDUSTRY

Sugar Research Australia (SRA) was established during 2013 under its own Commonwealth Act, the Sugar Research and Development Services Act 2013. It is a public company limited by guarantee and it raises funds via a 70 cents per tonne statutory levy. Like other RDC’s it obtains matching Commonwealth funding.

The SRA manages a portfolio of RD&E projects that drive productivity, profitability and sustainability for the Australian sugarcane industry. It invests in plant breeding, trait development, biosecurity and cropping systems.

SRA is somewhat unique in that it has its own in-house R&D team, a legacy of its merge with the BSES during 2012. In fact, BSES Limited (formerly known as the Bureau of Sugar Experiment Stations) was the main supplier of RD&E services to the Australian sugar industry.

SRA have 160 staff: 44 research scientists; 70 technical staff; 12 extension staff and 34 management/administration/support staff (includes IT, finance, HR, executive, admin support).

SRA Research expenditure in 2014-15 totalled $33.4 million and is shown in the table below.

<table>
<thead>
<tr>
<th>SRA Research expenditure in 2014-15</th>
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<tbody>
<tr>
<td>R&amp;D internal core</td>
<td>10.7</td>
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<tr>
<td>R&amp;D internal contestable</td>
<td>10.5</td>
</tr>
<tr>
<td>R&amp;D external contestable</td>
<td>6.0</td>
</tr>
<tr>
<td>Research adoption (EC)</td>
<td>2.2</td>
</tr>
<tr>
<td><strong>Total R&amp;D</strong></td>
<td><strong>29.4</strong></td>
</tr>
<tr>
<td>Support activities</td>
<td>4.0</td>
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<tr>
<td><strong>Total expenditure</strong></td>
<td><strong>33.4</strong></td>
</tr>
</tbody>
</table>

Source: SRA June 2015 management account and figures include allocation of overheads.

SRA have had only three project calls in its history, the first two were open calls and the last one was slightly directed. SRA plans to move further towards directed calls and/or commissioned work in the future.

RD&E is funded primarily by the statutory Sugarcane Levy and is supported by the Commonwealth Government matching funds of approximately $5.5 million and the Queensland Department of Agriculture, Fisheries investment of $4.15 million.
GROWER GROUP DELIVERY MODELS OUTSIDE WA

There are some larger grower groups operating in NSW, Queensland and Victoria with considerable capability to undertake delivery of D and E for the Grains Industry, and substantially supported by GRDC.

The GRDC operates three regions in Australia: Western; Southern and Northern.

The Southern Region operates in much the same way as the Western Region with a Regional Cropping Solutions Network helping to determine the one-three year local investments by GRDC and delivery is effected in the same way as in the Western region through a range of delivery organisations including grower groups. Grower groups in the Southern Region are more like the grower groups in the Western Region. The Birchip Cropping Group is the largest and most well-known of these.

The Northern Region operates somewhat differently.

Recently the Northern Region has been redefined to include all of Queensland and NSW, whereas southern NSW had been part of the Southern Region. There is no southern equivalent of the Northern Grains Alliance or the Orana Grain Alliance but GRDC are considering establishing one. There are a number of larger grower groups also operating in the southern half of the Northern Region which have somewhat different characteristics to the grower groups in WA.

Agricultural Marketing and Production Systems, NSW

An integrated input supply and D&E grower owned company built on input supply revenue.

Agricultural Marketing and Production Systems (AMPS) was established during 1999 as a new and unique concept in Australian agriculture by 23 farmers all within 100 kilometres of each other, who were concerned about getting relevant research done in their own “backyard”. Its formation owed a lot to the drive from a local agricultural consultant. AMPS was founded on the principles of improving farmer returns and building rural communities; by investing in independent production research it aims to improve yields and input efficiencies. For the first 4 years the focus was on getting the group established and building the merchandise business to build up sufficient capital. The growth phase for building up the merchandise business was from 2002 to 2007 and it really started to ramp up from 2010-11. AMPS Agribusiness is the parent company of the fully owned subsidiary entities. It became an unlisted Public Limited Company during June 2012 and now has over 60 farmer shareholders from Central and Northern NSW. It is headquartered in Tamworth and has an annual turnover of between $40 and $50 million and a staff of 30.

- AMPS objectives are listed as:
- Develop competitive and sustainable business platforms that support our shareholders and customers
- Develop sustainable and profitable farming systems
- Provide agricultural opportunities for future generations
- Ensure group strategies are in place that represents core values and long term vision of shareholders and customers
- Develop long term domestic and international relationships with suppliers and end users
- Pursue new value adding opportunities
AMPS Research Services provides:
- Benchmarking
- Variety trials
- Production technique and new product evaluation
- Field days & field trips
- Information dissemination
- Agricultural training

AMPS Storage and Handling provides the following services:
- Bulk grain storage
- Grain drying
- Contract grain storage for growers and end users
- Grain testing and classification
- Public weighing service

AMPS Commercial and AMPS Moree have developed into significant players in the agricultural merchandise business and operates from six locations with options for bulk seeds and liquid fertilisers:
- Caroona
- Armatree
- Moree
- Walgett
- Tamworth

Growers don’t have to be a shareholder to trade with AMPS.

AMPS has a Grower Committee for each of the regions it operates in (Liverpool Plains – Caroona, Gulargambone, Walgett, Moree and is headquartered in Tamworth) that determine the relevant local research questions which are out to an overarching committee that decides on the research projects to be funded. The annual allocation to research projects is around $700,000 per year.

AMPS has its own trial sowing and harvesting equipment and has moved from contracting out its trials to doing everything in-house. This move was largely in response to having the control over when trials went in.

In the past only 6-15% of projects had external funding. They do have a major GRDC funded project in 2015-16 which coincided with their own research priority. They also have some commercial trial work they do for AGT and Syngenta. They would probably like to keep external funding to around 25% of total program.

Northern Grain Alliance, northern NSW and Queensland

The Northern Grain Alliance was set up by the GRDC to provide a delivery vehicle for a GRDC funded applied agronomy program.

Northern Grower Alliance (NGA) is an Incorporated Association that was established during 2005 to provide a regional capacity for industry-driven, applied agronomic research into the challenges of grain production. It services over 170 growers in six separate grower groups. The NGA is 99% funded by GRDC. There is a small involvement of CSIRO in funding a trials with the NGA.

The NGA co-ordinates and conducts applied agronomic research in response to prioritised northern region grain grower needs. Projects are developed in collaboration with key researchers to ensure
sound scientific and practical evaluation of the impact and benefits of new practices. Rapid communication of project outcomes through the associated comprehensive network of consultants and agronomists ensures prompt and appropriate levels of industry uptake and adoption.

NGA worked on a project covering broadacre cropping in north-western NSW from 2005 to 2010 with the scope of the project broadened to cover north-eastern NSW during the period 2008 to 2010. During 2010, NGA commenced a five-year project to continue their activities in northern NSW and to replicate the model in southern Qld. All these projects were fully funded by GRDC.

NGA has six major ‘nodes’ or regions of focus: Darling Downs; Mungindi/ Balonne; Goondiwindi; Moree/ Narrabri; Walgett; and Liverpool Plains. Each node has a Local Research Group (LRG) made up of a range of growers and key local advisers and departmental extension officers. The LRG’s role is to identify and prioritise specific agronomic production issues but they are also a key component of communication or extension activity. Ideas for R&D are then prioritised by an overall research group made up of two representatives of each node to look for common issues for implementation. Larger research issues are taken to GRDC’s Northern Panel for consideration.

In total there are some 160-170 members who meet twice a year to determine R&D priorities. The area covered stretches 200 kilometres east-west and 600 kilometres north-south and covers approximately 1.5 million hectares. The NGA has an electronic mailing list of 600 and no one is excluded from access to information generated by the R&D done by the group.

NGA’s function is to rapidly develop and progress projects in response to the key industry issues. LRG’s meet twice each year to review results from the previous season’s work and to identify and prioritise new or continuing projects of importance.

Staff comprise of a Chief Executive Officer, research manager, project manager and a communications manager and a person three days per week for administration and bookkeeping, plus three trials agronomists who are regionally based.

The annual project budget is in the range of $1 to $1.2 million and this covers approximately 120 trials at in excess of 70 locations. Most projects are in the one-three years’ space for impact and are mainly Development projects, rather than fundamental research. The NGA does not operate seeding and harvesting equipment but does have basic spray equipment, quad bikes and trailers. It contracts out its trial plot seeding and harvesting to contract research providers, and in some cases to the government agriculture agencies in NSW and Queensland. NGA do the measurement and agronomy and around 10-15% of the budget is spent on contract research services to put trials in and harvest them. Around 80% of the research expertise is tied in to projects with input from NSW Department of Primary Industry or Queensland Department of Agriculture and Forestry or QAAFI or the University of Southern Queensland.

Grain Orana Alliance, Dubbo, mid NSW

*Grain Orana Alliance (GOA) is a not-for-profit organisation funded by the GRDC, which aims to provide effective solutions to current and emerging issues challenging the regions grain producers.*

GOA was officially formed as a not-for-profit incorporated association during early 2009. The GOA project was modelled strongly on the already very successful NGA operating further north. One of the key features of this model is the high level of industry engagement in determining the organisations activities.
GOA footprint covers the central-north region of NSW cropping belt. Extending from Peak Hill in the south to North of Coonamble in the North. The Coolah/Merriwa region is the eastern boundary of GOA’s region and extends the western extremes of the cropping belt in the west of Nyngan and neighbouring localities.

Twice a year the local industry is invited to take part in determining what the key issues challenging growers are in a series of meetings coined Focus Group Meetings (FGM). The issues raised at these meetings are how GOA plans it future activities.

During these meetings, there is an opportunity to put forward the key issues are that are currently challenging grain production in both the local and broader region. All issues raised are scored by their level of importance to produce a list of research questions that can be ranked in terms of their priority.

Through the use of this process the appropriation of grower levies are ensured to be applied to the issues which matter to the farmers of the Central West and Western Plains, not just ones prioritised by the researchers. GOA’s independence as an organisation ensures that it free to engage whatever sector, agency or personnel which is best for the job. GOA itself can also undertake many of these activities, with qualified staff & trial machinery. GOA utilises any number of approaches to seek solutions. These can include fully replicated plot trials through to large scale farm demonstrations, greenhouse and lab work through to extension activities. GOA’s funding structure has created quick and responsive organisation to problem solving. Funding is not tied to specific projects and once issues are identified GOA has the ability to establish trials or activities in days not weeks or months. GOA focuses on “D” (development) projects in the one-three years’ duration space and extension of the results.

GOA is staffed by a CEO and agronomist, a research and extension manager and a technical officer.

The annual budget is around $500,000 per year with all funding coming from the GRDC. There is no other source of funding.

The majority of trial work is now done in-house. GOA used to use commercial research providers but now does most of its work in-house. They have managed to cobble together most of the equipment required to plant and harvest trial plots (using a 4WD vehicle to tow equipment) comprising a planter, an old plot harvester and trial spray rig. This was in response to cost and getting trials in at the right time without delays.

There is no membership of GOA and information is available to all.

FarmLink Research, Southern NSW

Similar to the Northern Grains Alliance and the Grain Orana Alliance, but unique in sharing management (jointly with the Temora Shire Council of the Temora Research Station that was gifted to the Shire by the NSW Government).

FarmLink Research Limited (FarmLink) is a not-for-profit agricultural research and extension organisation in southern NSW owned by growers and formed from 26 grower groups in southern NSW. FarmLink’s main objective is to coordinate and communicate private, public and grower group funded research and development activities within in the region. FarmLink has been operating since 2003. There are three main parts to the business including research, communication and collaboration.

FarmLink has 320 members including 240 farm businesses (up to eight people pre-farm business) who pay $250 per year, with other categories for researchers/advisers, corporates and young farmers.
FarmLink has five staff and has an annual turnover of $700,000. Half of this turnover is from GRDC projects, 5% for State projects and 45% of turnover comes from memberships.

The Temora Shire Council are the trustees for the Temora Research Station (650ha) which was gifted to the Council by the NSW Government to run it for research purposes. It has been running at a net loss to the Council and the challenge ever since has been to turn this around. While it has considerable infrastructure (sheds, cool rooms, shearing sheds etc.) it was being run down and everything that could be was stripped out before it was handed across to the Shire.

FarmLink commenced management of the Temora Research Station during 2011 in a joint venture between FarmLink Research and the Temora Shire Council, with a five-year management agreement with the shire to manage the Research Station. It is a mixed farm with areas not being used for research cropped or used for agisting sheep. There are currently 16 different organisations/companies running field trials (relating to cereal, canola and pasture varieties, nutrition, disease, weeds, carbon, growth regulants, farming systems, trace elements, time of sowing and water use efficiency) on 56 hectares which FarmLink lease to them at $1,000 per hectare. In addition, there is 100 hectares being used for pasture and livestock trials. The companies/organisations say that dealing with FarmLink to put trials in at Temora RS is easier than doing trials on Government managed research stations (less red tape and more flexibility).

During September 2012, the Station celebrated its 100th Anniversary and was re-named the Temora Agricultural Innovation Centre. The vision for the facility is one of a respected Centre of Excellence for Mixed Farming Research and Development. The Centre also provides numerous activities throughout the year such as Annual Research Expo, University Crop Competition, Field Days, Crop Walks, Sire Evaluation Workshops, training days and seminars at the centre.

FarmLink conducts rural and agricultural research and extension activities in southern NSW and results are distributed across Australia. Projects address issues including water use efficiency, conservation farming, mixed farming, stubble management and precision. Information generated is provided to everyone, not just members.

Communicating research to farmers is a key priority for FarmLink. FarmLink members receive a range of publications including fortnightly e-links, quarterly newsletters, reports and updates. Communication is not just one way. FarmLink provides training, workshops, field days and crop walks to members throughout the year.

FarmLink is about – collaboration, working closely with a number of organisations such as CSIRO, NSW Department of Primary Industries, Lachlan and Murrumbidgee Catchment Management Authorities, Landcare, EH Graham Centre, agribusiness and other farming system groups across Australia.

The Birchip Cropping Group Inc., Victoria

The Birchip Cropping Group Inc. (BCG) is a not-for-profit agricultural research and extension organisation led by farmers from the Wimmera and Mallee regions of Victoria; an area expanding a 200km radius around Birchip.

BCG was established by a group of farmers during 1992. Their motivation was to conduct localised and relevant research that would answer key agronomic questions and support them to adopt new practices and improve the productivity and profitability of their farms, in turn, improving the prosperity of their local communities. The venture proved successful with BCG today boasting 430 members, 20 corporate partners and 20 full-time equivalent staff members who annually oversee more than 100 research trials sown across 20 sites as well as five major events and numerous other
communication and extension activities. The turnover of the Birchip Group is estimated at $2.5 million per year. The BCG currently earns 85% of its revenue from project work. A large part of the research program is agronomic and farming systems research and development – predominantly field-based research trials and demonstrations focused on crop varieties, weed control, agronomic practices, disease management, crop nutrition, systems based crop sequences and livestock. BCG also undertakes R&D in climate variability and climate change adaptation and social R&D, investigating some of the social aspects of living and working in rural areas.

As technology rapidly changes and advances, one of BCG’s key tasks will be to keep on top of new and emerging technologies to identify which ones increase farm profitability and ensure their members remain informed. Another key challenge BCG is currently focusing on is helping growers to understand how their farm businesses have changed over the last two decades. This includes acknowledging that there have been significant rises in on-farm costs and the gap between this and farm income is narrowing. By understanding drivers behind these trends, BCG hopes farmers will be empowered to make decisions that will improve whole-farm outcomes and lower the risks that they face. A recent aspiration of BCG has been to facilitate the adoption of research into the paddock one-year sooner. How we achieve this is currently being contemplated as the BCG board reviews and sets the strategic plan for the next three years.


**Mallee Sustainable Farming Inc., Victoria**

Mallee Sustainable Farming Inc. (MSF) is a farmer-driven organisation delivering research and extension services to the less than 350mm rainfall Mallee cropping regions of NSW, Victoria and SA. MSF operates within a region of over four million hectares, extending beyond Balranald (NSW) in the east to Murray Bridge (SA) in the west, and has a membership of around 1000 and employs 2.5 FTE’s (an executive manager, a program manager, and an administration manager) and utilises the services of an agronomist and a technical project officer from Moodie Agronomy.

MSF was formed during 1997 in response to a recognition that conservation farming practices had not been widely adopted across the region. There was a need to identify the issues restricting the adoption of technology that would enhance the development of profitable and sustainable farming systems. MSF’s mission is to provide excellence in research, development and extension initiatives for the dryland Mallee of South Eastern Australia. The principal purpose is to protect and enhance the natural environment by the encouragement of sustainable dryland farming practices.

MSF is funded through project work and doesn’t receive any income from membership. Sponsorship is sought for specific events such as field days and the annual Tri-State Forums. This open membership allows MSF to work freely with other industry groups and through extensive collaborative networks MSF has been able to develop a scientifically rigorous research, development and extension program. The primary focus of MSF is to undertake, and bring-in, research and extension activities which are of relevance to Mallee. Current projects (20 in total) are related to Integrated Weed Management (IWM), break crops, legume management, GPS grazing and managing stubble retained systems, among others.

OTHER WA R&D MODELS

Western Australian Marine Science Institution

The WA Marine Science Institution’s (WAMSI’s) mission is to establish a world-leading research capacity that underpins the conservation and sustainable management of the marine environment and its resources, for the economic, social and environmental benefit of the State of WA and all Australians.

Its structure is like no other – a collaboration 15 partner organisations that include State, Federal, industry and academic entities working together to deliver large-scale marine research in a multi-disciplinary and holistic way.

Bio-physical research, structural engineering studies and economic analysis are all within the WAMSI joint venture capability.

WAMSI is independent and delivers public-good multi-disciplinary research, can broker work to others and is a trusted option for expert arm’s length advice and coordination activities. Strong and efficient governance ensures high quality peer reviewed research that remains on target to inform decision making.

Based at their new premises on the CSIRO site, WAMSI HQ oversee financial and science planning and provide full administration support for the WAMSI Board, committees and sub-committees. They coordinate collaboration and research activities, legal and financial management, data management and storage, research assessments, communication, conferences and symposia.

The WAMSI R&D Committee assists the WAMSI Board in its oversight of the research and development performance of WAMSI in line with the strategic science objectives for WAMSI set by the Governing Board.

The Indian Ocean Marine Research Centre

The development of the Indian Ocean Marine Research Centre (IOMRC) is the key new marine science capability being developed in WA. The IOMRC will develop two major marine science facilities at the UWA campus, and at Waterman’s Bay Marine Centre. It will provide a hub for capability and leadership in marine studies across the Indian Ocean, co-locating some of Australia’s largest marine research organisations. The IOMRC contributors are UWA, CSIRO, AIMS and the Department of Fisheries, are all partners in WAMSI and the new facilities and colocation will strongly complement WAMSIs activities.

Laboratories

- Aquaculture, Biomolecular, Microbiological, Geochemistry, Genetic and Analysis - Australian Institute of Marine Science co-located at UWA’s Ocean Institute.
- Oceans and climate, Ocean energy, Managing fisheries, Coastal information, Ocean diversity – CSIRO.
- Geophysical Fluid Dynamics, Biogeochemistry, Hydrodynamics and Environmental Research – UWA.
- Analytical Chemical Research – Chemcentre.
- Molecular, Fish Health, Marine Aquaria – Department of Fisheries.
• Hydrodynamics, Underwater acoustics, Marine ecology and biomonitoring - Curtin University.
• Marine and Freshwater Research - Murdoch University.
• Marine and Estuarine Ecosystems - Edith Cowan University.
• Aquarium, Marine laboratory - Kimberley Marine Research Station.

Libraries
• Bio resources library, Coral core collections – Australian Institute of Marine Science.
• WA Marine Bio resources library – WA Museum.

Research Vessels
• The Solander and the Cape Ferguson – Australian Institute of Marine Science.
• The Southern Surveyor and the Investigator – CSIRO.
• The Research Vessel Naturaliste – Department of Fisheries.
• The Southwind and the Atlanta IV, Research Vessels – Kimberley Marine Research Centre.

Aircraft
• Grob and Diamond airplanes – Airborne Research Australia.

Other
• Gliders – UWA.
• Sea Simulator – Australian Institute of Marine Science.
• Hyperspectral Imaging – Airborne Research Australia.
• Atmospheric and Remote Sensing Instruments – Airborne Research Australia.
• Remote Sensing – Curtin University.
• Diving equipment and pearl oyster hatchery – Kimberley Marine Research Centre.
• Data Management – Pawsey Supercomputing Centre.

Harry Perkins Institute of Medical Research
The Harry Perkins Institute of Medical Research was established during 1998 as the WA Institute for Medical Research (WAIMR) with the vision of creating a multi-site Institute that would enhance collaboration between WA medical researchers. Wesfarmers was the founding sponsor with a $5 million donation.

The UWA, Royal Perth Hospital and Sir Charles Gairdner Hospital were the founding partners and during July 2003, Fremantle Hospital also became a partner.

Facilities
Perkins north
The 10 storey building located at the QEII Medical Centre, Nedlands houses Perkins research laboratories that investigate a range of diseases including cancer, leukaemia, diabetes and melanoma.

It brought together research staff from the Perkins and other research groups including UWA and the Lions Eye Institute.

The community can experience medical research in a real life laboratory setting in the Lotterywest BioDiscovery Centre.
The Perkins South building located on the Fiona Stanley Hospital Campus at Murdoch will house 360 researchers.

One of the Perkins exciting new research centres, the Wesfarmers Centre for Translational Research, will be established at Perkins South.

The Centre will be designed to translate the latest research discoveries into clinical practice. It will focus primarily on cardiovascular disease, diabetes and obesity.

“Our vision, that WA will be a world leader in medical research, is driven by the knowledge that outstanding local medical research will accelerate the delivery of the latest breakthroughs to Western Australians and result in improved health of the community.

As WA’s premier adult medical research institute our priority is to recruit and build internationally renowned highly skilled research teams, comprising doctors, scientists, biostatisticians and pathologists, working together with cutting edge technologies to make new discoveries and translate this new knowledge into more effective treatments and cures.

Closely linked to the major teaching hospitals, we are uniquely positioned to fast track the development of new treatments and new ways to diagnose cancer and other diseases, including tests that enable doctors to select the best approach for each patient. This enhances our ability to match individual patients to the treatments most likely to work for them with the aim of making personalised treatment a reality at last.

In 2010, we established Linear Clinical Research Ltd, WA’s only dedicated and Australia’s most advanced early phase clinical trials facility. Linear provides us with a critical base for clinical trials of new medicines.

While we conduct research into a range of diseases we focus on:

- Cardiovascular disease
- Cancer and
- Diabetes

The research facilities co-house a number of research centres and offers genome discovery and gene sequencing, monoclonal antibody production, cancer imaging and proteomics research facilities.

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6 Perkins Institute of Medical Research, About Us, [www.perkins.org.au](http://www.perkins.org.au)
Western Dairy

Western Dairy is one of eight Regional Development Programs that are spread throughout the nation’s key dairy areas and operates under the auspices of Dairy Australia.

Western Dairy works closely with WA Farmers Dairy Section, DAFWA, the South West Catchment Council, the Department of Environment; the Department of Water, together with WA dairy processors and service providers, in implementing its annual operating plan, in the best interests of WA dairy farmers.

Outline

Legal structure: Not-for-profit incorporated industry association. Advisory body to Dairy Australia Limited and undertakes D&E in WA. Western Dairy reports directly to Dairy Australia but also formally to industry through WA Farmers Dairy Section.

Funding: An annual budget of $550,000 for RD & E programs 50:50 funded by Dairy Australia and DAFWA. DAFWA commitment on a sliding scale drops: $250,000 in 2015/16; $250,000 in 2016/17; $100,000 in 2017/18 and then 0. Dairy Australia also fund $240,000 for administration and other functions of Western Dairy.

Governance: Five-person Board of Management. Staffing (HR), IT and administration is provided under contract by South West Catchment Council (to save costs)

History: Western Dairy has been operating since 1997 to guide the strategic direction and implementation of dairy research, education and promotion programs in the Western Australian region.

Staffing: Western Dairy is managed by a part time Executive Officer (1.5 days per week). The Western Dairy Hub has three fulltime staff (two researchers and one technical extension officer) and a team of five-part time science and technical service contractors.

Western Dairy is charged with:

- Ensuring responsible and timely use is made of the Dairy Service Levy paid by WA dairy farmers and where possible using these funds to lever additional monies that can then add further value to current and planned research projects.
- Participating in national priority setting and strategic planning of Farm RD&E.
- Identifying and facilitating regional projects and relationships providing benefit for the local dairy industry – RD&E; HR; and other areas.
- Building local community awareness and ownership of RD&E.
- Facilitating communication between the WA Dairy farmers and the WA dairy research and extension community.
- Advocating best practise in animal welfare, environmental management and business management in the interests of the long-term sustainability of the WA dairy sector.
- Monitoring and evaluating the effectiveness of all the above.
Minerals Research Institute of Western Australia

The Minerals Research Institute of WA (MRIWA) exists to stimulate minerals research to support investment in, and operation of, a globally competitive minerals industry in WA.

MRIWA’s primary function is to provide and administer funding grants to carry out minerals research. MRIWA is also able to undertake and procure minerals research itself. It is able to collaborate with local, Australian and worldwide research and scientific institutions. As well as directly supporting minerals research projects, MRIWA funds are available for projects, programmes and events that promote public awareness of, and interest in, minerals research, and to support relevant academic activities.

Outline

Legal structure: Statutory body established by the WA Government under the Minerals Research Institute of Western Australia Act 2013.

Funding: An annual budget of between $3 and $4 million made up of core funding of $2-$3 million plus some carryover funds from previous related bodies.

Governance: Seven-person Board which reports to the Minister for Mines and Petroleum.

History: Established in 2013 it replaced the Minerals and Energy Research Institute of Western Australia

Staffing: Four staff

MRIWA co-invests in projects which it manages on behalf of investors according to a Research Priority Plan and leverages from 100% to 0%. Delivery can be through any research body (anywhere in the world) but the majority of the delivery is through CSIRO, Curtin and UWA. There are 10 current projects ranging in size from $66,300 to $2,580,000. The total value of the Institute’s portfolio of research projects (including scholarships for PhD students) at 30 June 2015 was $23.9 million (this value includes an estimate of $6 million other parties’ co-investment through the CRC ORE II project, which is yet to be finalised). This comprised $5.7 million MRIWA investments and other parties’ investments of $18.2 million (again including the assumed $6 million from the CRC ORE II project.)

MRIWA has a scholarships program for PhD candidates and for final year students’ Honours projects, where the field of study is relevant to the MRIWA objectives. Currently 10 PhD students are supported under this program.
Western Australian Energy Resource Alliance

The Western Australian Energy Resource Alliance (WA:ERA) was established by the CSIRO, Curtin University and UWA during September 2003. WA:ERA’s initial focus was on capability building, research and education in the areas of offshore gas technologies, facilities and subsurface technologies, particularly linked to the upstream petroleum industry. WA:ERA’s Mission is fostering collaboration and resourcing for petroleum and geosequestration related research that provides innovative, safe and sustainable solutions.

Outline

Legal structure: Unincorporated JV

Funding: The three participants: UWA, CSIRO and Curtin fund the administration. A WA Government grant of $20 million over five years from 2005-6 to 2009-10 helped in recruiting researchers and building the partner’s capabilities.

Governance: There is a rolling five-year JV agreement between the participants.


Staffing: Three management staff employed by CSIRO who provides Human Resources and Information Technology

Focus: Projects mostly with one partner but increasingly collaborative projects make up the portfolio as cost pressures come on (increased from five to 20% collaborative projects). WA:ERA essentially acts as a project contract manager using contract templates and taking funds from the partners and monitoring milestones and acquitting through the participants.

Strength: CSIRO is seen as a neutral ground for location and helps dissolve tension between universities. Also good leadership through the Chairman who has been there since the start-up of the Alliance.

An example of a collaborative project that is being administered by WA:ERA is the National Geosequestration Laboratory (NGL). The NGL is a collaboration between CSIRO, UWA and Curtin University established to conduct and deploy critical research and development to enable commercial-scale carbon storage options for Australia.

NGL complements and builds on the successes of WA:ERA and is funded by $48 million capital funding from the Australian Government through the Education Investment Fund.

The primary research focus of NGL is to advise government and industry regarding the viability and safety of large-scale geological carbon storage – a process that involves injecting carbon dioxide (CO₂) deep underground and trapping it in geological structures.

This will pave the way for the design and implementation of a commercial-scale carbon storage plan for Australia’s first carbon capture and storage (CCS) Flagship program – the South West Hub Carbon Capture and Storage project near Harvey that is being led by the WA Department of Mines and Petroleum and an industry consortium from the Kwinana area.
**Department of Fisheries**

The primary role of the Fisheries Research Division in the Department of Fisheries is to provide timely scientific research information and objective advice to support the management, conservation and sustainable use of the State’s fish resources and aquatic environment. Ongoing research, monitoring and assessment programs support the management of the State’s major fish stocks and the marine ecosystems that underpin these resources.

**Outline**

- **Legal structure:** State Government Department
- **Funding:** $27 million in total of which $21 million (78%) from Consolidated Fund (CF) (previous year $20 million), expect reasonably stable. Commercial sector pays access fees at 5.75% of GVP. Of this 0.5% goes to fund the WA Fishing Industry Council, and 0.25% to fund the Fisheries Research and Development Corporation. The 5% of GVP and pays around 60-70% of fisheries research for commercial sector, with the remainder coming from CF. Recreational sector fishing licence revenue goes 40% to Recfishwest and 60% to Fisheries for Research with about 50% of fisheries research is paid for from licence revenue and 50% from CF. Biosecurity research is 100% funded from CF.
- **Staffing:** 145 in total; 45 scientists, 90 technical and 10 admin and management.
- **Focus:** Five areas of research:
  1. Invertebrate
  2. Finfish
  3. Stock assessment and data analysis
  4. Biodiversity and biosecurity
  5. Fish health
- **Strength:** Locating staff together (95% are located at Hillary’s facility), 10 staff at DAFWA South Perth, five at Pemberton, two in Geraldton and one at Albany.

The Department uses a Risk Assessment Model and Fishplan to develop priorities for management, research and compliance activities. Fishplan is reviewed annually with the commercial fishing sector through annual management meetings (for the 40 or so managed fisheries) and the recreational fishing sector through Recfishwest. Fishplan is just used as a guide for Fisheries Research with the actual work program ultimately decided by the Department.
MODELS FROM OVERSEAS

Characteristics that have been seen to underpin successful agriculture research centres around the world include7:

- Face-to-face collaboration between participants from across the state, interstate and around the world.
- Visitations from the world’s best experts on each specialist area of investigation.
- Personal connections with business and the value adding chains that improve productivity and generate products of greater value.
- High speed internet connection.
- Robust consultative relationships with the farming community.
- A solid financial basis for continued operation.

New Zealand

New Zealand introduced a purchaser-provider model during the 1990’s.

Plant & Food Research, New Zealand

Plant & Food Research is a New Zealand-based science company providing research and development that adds value to fruit, vegetable, crop and food products.


Outline

Legal structure: Government owned limited-liability company. Crown Research Institute: Shareholding 50% Minister of Finance, 50% Minister of Business, Innovation and Employment.

Funding: Government funding of $60.2 million made up of core funding $43.1M (27.1%) and Contestable $17.1M (10.8%). This is leveraged with revenue from commercial sector $46.0M (28.9%), royalties $20.3M (12.8%) and other $2.4M (1.5%). “Our Shareholder, the Crown, expects Plant & Food Research to deliver research with demonstrable impact on New Zealand’s current and future prosperity, and to operate sustainably as a business.” Cereal breeding costs are fully recovered via royalty returns with 50% funds provided by industry and 50% from the institute. Other grants R&D is funded by a mix of core and contestable government funding.

History: Operating for 23 years (incorporated 1992).

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7 Doug McGhie, pers. comms, 2015
Research portfolios:

1. Breeding & Genomics – building knowledge of key traits at the molecular level to inform the development of new elite cultivars.
2. Bioprotection – effective control of pest and disease to protect export market access.
3. Sustainable production – systems that increase efficiency and retain quality across the supply chain.
4. Food innovation – identifying intrinsic health benefits in natural produce to develop new foods and beverages.
5. Seafood technologies – optimising the value and quality of seafood and aquaculture.

Staffing: 706 Research and technical staff. 148 management and administration staff. There are only an estimated 12.5 FTE’s working in grain farm production R&D in each of the following areas:

- pre-breeding/crop genetics, physiology, molecular breeding and genomics: 1.5
- plant breeding: 3.5
- agronomy: one
- farming systems: one
- crop variety evaluation: 1.5
- pests: 0.25
- diseases: one
- crop nutrition: 0.5
- water use efficiency: 0.5
- application of new technology (ag machinery, telecommunications, robotics, big data, telemetry): 0.25
- crop prediction models (based on soil type, weather and nutrition inputs): 1.5

Strategic focus:

- Better cultivars faster™
- Residue-free pest and disease control
- More sustainable and profitable systems
- Proprietary foods with premium prices
- Sustainable premium seafood and marine products.

Strengths: Strength from company structure which gives operating options not possible with public service protocols. Also a range of experiment stations that cover different growing environments.

Weaknesses: Inadequate unrestricted funding to enable optimal balance of long term research. Broad range of industries serviced means grains research must compete for resource with major export crops such as kiwifruit.

Assets: Nature and value of land, buildings and equipment used for grain farm production R&D: Cereal shed, specialised grain combines, drills, dryers and cleaning: NZD 4M, Glasshouse space, lab space, lab analysis equipment (various rheology instruments, NRI equipment, freezers etc.) NZD 2M. Necessary land to conduct research (roughly 1/3 of total rotation in grains) 40 has @ 40K NZD 1.6M.
With staff based at sites across New Zealand, as well as in the US and Australia, at the heart of Plant & Food Research is a goal to underpin the growth of plant and marine-based industry through the successful application and commercialisation of research-based innovation.

Plant & Food Research supports the sustainable production of high quality produce that earns a premium in international markets, as well as driving the design and development of new and novel functional foods that offer benefits to human health and wellbeing.

The most significant sources of contestable funding are the Ministry of Business, Innovation and Employment (the administrators of the New Zealand government's science and technology investment), the Ministry of Primary Industry's Sustainable Farming Fund, the International Science & Technology Linkages Fund and the European Seventh Framework Programme (FP7). Through this funding, there a number of co-funded research projects with commercial partners, Universities and other Crown Research Institutes.

Plant & Food Research works closely with industry bodies, such as Horticulture New Zealand, MPI Biosecurity and Horticulture Australia Limited, to identify and develop research programmes applicable across the horticultural industry. In addition, Plant & Food Research is a research provider to sector and grower organisations in New Zealand and internationally and provides research services for a number of scientific and commercial partners, on a fee-for-service basis or through collaborative agreements. Plant & Food Research receives royalties and licensing fees through the commercialisation, such as proprietary cultivars and for other IP.

For about the last 40 years Plant & Food Research has run an extensive winter nursery programme for northern hemisphere breeders from both public and private sectors. Subsequently, private seed companies in New Zealand have also serviced winter nurseries for northern hemisphere breeders.

This has had enormous benefit for grains research and the grains industry in that it has allowed PFR breeders to observe both advanced lines and segregating populations and advanced lines from major programmes in the New Zealand environment and to be able to select from either. Since most breeders came to NZ to make selections and harvest plots it also provided very strong and relevant science links to a small and isolated group of breeders. In effect this has boosted the size and scope of the PFR cereal breeding programme very substantially.

**Foundation for Arable Research (FAR)**

**Outline**

- **Legal structure:** Incorporated Society with 25 farmer members
- **Funding:** NZD 4M from levies, NZD 2.4M from contract services.
- **History:** Established 1995, wholly-owned subsidiary Far Australia established 2013
- **Staffing:** 15.5 research and 8.5 technical staff (including four staff in FAR Australia); 4.5 management and administration staff
- **Focus:** 100% adaptive systems research and extension on grain farms
- **Strengths:** Run by practising farmers for farmers, narrow focus on adaptive research and extension and avoidance of farmer politics. Five-year levy round is a considerable strength (demands close user involvement).
Weaknesses: Five-year levy round is also a weakness in that it can over emphasise short term needs and, if not carefully managed, diminish strategic focus.

Assets: Minimal, approx. 25ha leased land, two sponsored John Deere tractors, several utes.

Comments from Mike Dunbier, a Director of FAR.

FAR was established by cropping farmers as a result of their concerns over their ability to access appropriate technologies to assure the future of the industry. They approached Government to levy themselves to fund FAR as a ‘self-help’ mechanism.

The NZ grains industry is fortunate that although it is small, agro-climatically it is sufficiently similar to other larger scale areas of cool temperate agriculture that technologies developed elsewhere can be adapted and effectively utilised in NZ. FAR has become expert in accessing information and technologies through alliances, where necessary adapting technologies and getting them used here. This has resulted in dramatic yield increases over the past two decades, basically from using European systems.

It benefits from the involvement of leading (technically not politically) proficient farmers in engagement in setting priorities, providing land for on-farm trials and demonstrations and communicating the results. It rents or leases land, buildings and most equipment and tries to continually demonstrate short term gains for farmer levy payers. The 5 yearly referendum for continuity of the levy provides strong incentive for a ‘user’ focus and it has resulted in an organisation that is more effectively ‘bottom up’ driven than any other I have been associated in Australasia.

Unlike many other similar organisations FAR has stuck religiously to its core roles of adaptive research and extension in cropping systems and insisted that others in the grains technology development pipeline and political influencers undertake their roles. FAR’s success in NZ has been endorsed by requests from SE Australia growers to undertake similar roles which has led to the establishment of FAR Australia (based in Victoria) and direct GRDC contracts (e.g. high yielding wheat in Tasmania).

While FAR has been fortunate to extent that it has been able to adapt and leverage research that others have funded it has also been judicious in its choices, smart in its leadership and has executed very well.
The United Kingdom

In the United Kingdom (UK) model has moved substantially away from public funding so that much research is now in private businesses (for which it is difficult to obtain information) and private research organisations. Although the levy body (Agriculture and Horticulture Development Board – Cereals and Oilseeds (AHDB)) is a funder, its contribution is now smaller than funding from the private sector.

Funding

Agricultural production R&D in the UK is funded by the following bodies (listed closest to farm-ready to furthest from farm-ready):

1. Private industries (includes SMEs and multi-nationals) - £ unknown
2. AHDB – approx. £4 million p.a.
5. Devolved administrations (Scotland, Wales and Northern Ireland) – approx. £50 million p.a.

With the exception of AHDB, for which the spend shown above was for crops only, the sums above include all research related to agriculture including animals, horticulture, food etc.

The Biotechnology and Biological Science Research Council (BBSRC) was established by Royal Charter during 1994 by incorporation of the former Agricultural and Food Research Council with the biotechnology and biological sciences programmes of the former Science and Engineering Research Council. The overall BBSRC food security priority aims to encourage research that will enhance UK and global food security by providing knowledge and evidence that will enable food producers and processors, retailers, consumers and governments to respond to and manage the challenges facing the UK food system, and related global issues including those confronting the developing world.

It is the principal public funder of plant science and has a particular focus on wheat.

Of the £180 million p.a. spent by BBSRC, about £50 million p.a. is for crop science (i.e. 28%); this percentage of total is probably similar in the other organisations. Expenditure on farm-ready research is substantially greater in the private sector than public sector.

The last four organisations are funded by the UK taxpayer while the AHDB receives its funding from a levy on grain producers (cereals and oilseeds); this levy is regarded as ‘business’ funding for some purposes, but under European Union guidelines is regarded as a para-state tax (because it is compulsory) so is state money for some other purposes. There is no compulsory levy for legumes but growers pay a voluntary levy to the Processors and Growers Research Organisation (PGRO) for farm-based research (approx. £200,000 p.a.).

A feature of the UK funding environment is the increasing cooperation between funders so that many projects involve multiple funders with much production research comprising public/private partnerships.
To give two examples:

1. Innovate UK coordinated programmes are aimed at improving UK competitiveness through support for pre-commercial research leading to the development of new, innovative products (sensors, growing systems, improved products etc.). The Sustainable Agriculture and Food funding stream is funded jointly by Innovate UK, Defra and BBSRC and supports industry led projects; typically, it now requires two thirds of the budget to be provided by industry (although SMEs can receive more public funding) with up to one third provided by Innovate UK (usually mainly covering research costs). Similarly, the Catalyst Fund of the Agritech funding stream of Innovate UK (funded by Innovate UK, Defra, Department for International Development and BBSRC) requires industry funding but the split between private and public can be 50:50.

2. The total budget for AHDB approved projects relating to cereals and oilseeds commissioned in the period 2011-2014 was £38.58 million of which only £16.09 million was supplied directly by AHDB. The difference was supplied by a variety of sources including other public funding bodies (especially Defra and BBSRC) and cash plus in-kind contributions from businesses.

With the exception of funding stream one above, all other funding bodies have publicly available strategies for their research expenditure with clear objectives; typically, these are either for three or five years. Objectives for funding streams four, five and six are typically determined by policy priorities of the UK government with agricultural production per se only a minor component. For example, recent Defra objectives include “a world-leading food and farming industry” and “a cleaner, healthier environment which benefits people and the economy”.

The recently developed AHDB research strategy is more directly aligned with production and one of three objectives is to “inform on-farm decisions to improve productivity, build resilience and facilitate innovation and its uptake”.

**Agricultural R&D delivery entities**

There are many organisations able to deliver agricultural R&D in the UK and the AHDB alone had contracts with 27 different contractors during 2012-13. However, five organisations receive the majority (74%) of the AHDB funding for grains research; these organisations undertake the majority of the production related policy research in the UK. They are also among the major receivers of contracts for Innovate UK funded projects for grains-related innovation.
<table>
<thead>
<tr>
<th>Ownership</th>
<th>ADAS Holdings Ltd</th>
<th>Rothamsted Research</th>
<th>NIAB (The National Institute of Botany)</th>
<th>Scottish Rural University College (previously SAC)</th>
<th>John Innes Centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legal structure</td>
<td>Company Limited by Guarantee</td>
<td>Independent Charitable Company Limited by Guarantee</td>
<td>Independent Charitable Company Limited by Guarantee</td>
<td>Educational Institution (Charity)</td>
<td>Independent Charitable Company Limited by Guarantee</td>
</tr>
<tr>
<td>Length of operation</td>
<td>65 years – about 18 years since privatisation</td>
<td>170 years – about 8 years in current structure</td>
<td>93 years – about 12 in current structure</td>
<td>100+ years in various guises – 3 in current structure</td>
<td>In various guises 90 years – 4 in current structure</td>
</tr>
<tr>
<td>No. research and technical staff</td>
<td>40 – an estimate of number with crop research expertise</td>
<td>380</td>
<td>160</td>
<td>28 (principal investigators in Crop and Soils Systems only)</td>
<td>260</td>
</tr>
<tr>
<td>No. managerial and admin staff</td>
<td>Not available</td>
<td>167</td>
<td>60</td>
<td>Not available</td>
<td>50</td>
</tr>
<tr>
<td>Areas of expertise</td>
<td>Farm consultancy Crop management Soil, water and environment Energy and waste Animal health and welfare Planning and development Food and drink</td>
<td>Agroecology Computational and systems biology Sustainable soils and grassland systems Biological chemistry and crop protection Plant biology and crop science</td>
<td>Seed testing Crop variety trialling Laboratory testing Cereal pre-breeding Translational crop research</td>
<td>Animal and veterinary sciences Crop and soil sciences Future farming systems Land economy, environment and society</td>
<td>Pests, pathogens and symbionts Plant growth and development Wheat improvement Primary metabolism and synthesis of natural products</td>
</tr>
<tr>
<td>What makes it work?</td>
<td>Earlier links as a research and extension agency of the Ministry of Agriculture and Food have persisted, but new skills of working in the private sector have been acquired</td>
<td>Pursues mainly basic and applied research funded by a strategic programme grant from BBSRC. The breadth of research skills chimes with the sustainable intensification policy agenda</td>
<td>Earlier links as an agency implementing regulations on seed quality etc. of the Ministry of Agriculture and Food have persisted, but new skills of working in the private sector have been acquired</td>
<td>SRUC receives a 5-year research contract from the Scottish Government as a key research provider that underpins its policy objectives in the rural sector</td>
<td>Pursues mainly basic and applied research funded by a strategic programme grant from BBSRC. The skills available underpin UK progress in plant/crop science and pre-breeding</td>
</tr>
<tr>
<td>Weaknesses</td>
<td>Dependent on many short-term contracts from multiple sources</td>
<td>Very dependent on continued public funding</td>
<td>Dependent on short-term (mostly annual) contracts</td>
<td>Very dependent on continued public funding</td>
<td>Very dependent on continued public funding</td>
</tr>
</tbody>
</table>
Grain Farm Production R&D

Most research institutions are private companies they are only obliged to present their accounts in summary form and they do not list individual research projects in their annual reports. Values shown below are from 2014 reports. With the exception of ADAS, most of the research income of organisations is for basic and strategic research; only 4-12% is from AHDB for farm-ready research.

<table>
<thead>
<tr>
<th>ADAS</th>
<th>Rothamsted Research</th>
<th>NIAB</th>
<th>Scottish Rural University College (previously SAC)</th>
<th>John Innes Centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets</td>
<td>£18 million</td>
<td>Land at Harpenden owned by Lawes Agricultural Trust. Farms in Devon and Suffolk owned by BBSRC. Buildings owned by Rothamsted Research.</td>
<td>Some land and buildings owned by NIAB but most of the land is owned by the NIAB Trust</td>
<td>Buildings and land owned by SRUC</td>
</tr>
<tr>
<td>Funding of R&amp;D</td>
<td>Not available</td>
<td>Total research income £29 million. BBSRC grant 48.3% BBSRC competitions 18.8% Industrial 10.2% Defra 7.2% Others (includes Levy bodies) 5.4% Trusts etc. 4.4% EU 4.1%</td>
<td>Total research/service income £9 million</td>
<td>Total research income £17.8 million. Scottish government grant 40% EU 15% Levy bodies 12% Defra 10% Innovate UK 5% Crop research was £3.5 million</td>
</tr>
<tr>
<td>Areas of expertise:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The research entities do not give details of the nature of their near-farm research, but analysis of AHDB Cereals and oilseeds projects commissioned in the period 2011-14 yields the following:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Category</th>
<th>AHDB £ (000)</th>
<th>Project total £ (000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increasing crop yields</td>
<td>Variety testing</td>
<td>6,162</td>
<td>12,405</td>
</tr>
<tr>
<td></td>
<td>Nutrients (N&amp;P)</td>
<td>545</td>
<td>823</td>
</tr>
<tr>
<td></td>
<td>Soils</td>
<td>977</td>
<td>1,737</td>
</tr>
<tr>
<td></td>
<td>Disease control</td>
<td>1,299</td>
<td>3,283</td>
</tr>
<tr>
<td></td>
<td>Weed control</td>
<td>438</td>
<td>3,085</td>
</tr>
<tr>
<td></td>
<td>Pest control</td>
<td>563</td>
<td>1,982</td>
</tr>
<tr>
<td></td>
<td>Breeding and genetics</td>
<td>505</td>
<td>4,743</td>
</tr>
<tr>
<td></td>
<td>Other nutrients</td>
<td>51</td>
<td>225</td>
</tr>
<tr>
<td></td>
<td>Water management</td>
<td>20</td>
<td>38</td>
</tr>
<tr>
<td>Optimising inputs</td>
<td>Rotations</td>
<td>778</td>
<td>778</td>
</tr>
<tr>
<td></td>
<td>Diseases agrochemical</td>
<td>2,072</td>
<td>3,068</td>
</tr>
<tr>
<td></td>
<td>performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cost benefit analysis</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Integrated pest management</td>
<td>178</td>
<td>178</td>
</tr>
<tr>
<td>Increasing crop value</td>
<td>Grain quality</td>
<td>1,866</td>
<td>5,395</td>
</tr>
<tr>
<td></td>
<td>Industrial uses</td>
<td>320</td>
<td>329</td>
</tr>
<tr>
<td>Preparing the industry</td>
<td>Environmental change</td>
<td>120</td>
<td>424</td>
</tr>
<tr>
<td></td>
<td>Technology foresight</td>
<td>39</td>
<td>39</td>
</tr>
</tbody>
</table>

The United States of America

The United States of America (US) has a Land Grant University model that combines the function of research, education and extension at one institution located in each of the 48 States.

The US has a well-developed public sector agricultural research system coordinated by United States Department of Agriculture (USDA) through its Agricultural Research Service (ARS). ARS has 2200 research scientists, located at more than 100 centres around the country with half of these centres based at Land Grant universities; where ARS scientists are adjunct professors, who also supervise post graduate students.

Extension is provided by the State Agricultural Experiment Stations managed by the Land Grant Universities and State Extension Services which are funded and coordinated by the National Institute of Food and Agriculture (NIFA). This funds the employment of researchers/teachers and extension specialists work on adaptive research, extension and teaching. The State Extension Services are based at Land Grant Universities, and collaborate with staff from the State Agricultural Experiment Stations. In the transfer of technology, the extension specialists at the universities are key. These specialists, who have faculty appointments in their discipline, and often have split appointment with part of their salary paid by NIFA, do applied research and technology evaluation on farmers’ fields. Almost all of
the specialists have PhD degrees and are accomplished research scientists. Much of the adaptive research is in collaboration with grower groups who fund research.

The private sector is estimated to account for 50% of the expenditure on R&D in the US, but this is concentrated in research areas mainly in GM, and insecticide and herbicide chemicals for a few major crops (corn, wheat and soya beans in particular), improving the production and delivery of fertilisers and the development of drugs and vaccines for animal health.

**The University of Missouri**

*An example of a US Land Grant University.*

The University of Missouri (MU) owes its existence to 900 citizens of Boone County who, during 1839, pledged cash and land to win the bid to locate the new State university in Columbia.

The real impetus for growth occurred during 1870 when MU was awarded land-grant status and the College of Agriculture and Mechanic Arts, later renamed the College of Agriculture, Food and Natural Resources, opened its doors. The Missouri Agricultural Experiment Station began operation during 1888.

Today it encompasses a 500ha campus in Columbia, 10 centres and research farms totally 14,000 acres, allowing scientists to test discoveries from university laboratories and share their research results with the public.

Ranked 15th university in the world for animal and plant research; 58% of the College of Agriculture, Food and Natural Resources annual research funding comes from the federal government ($US24 million) and 10% from the State of Missouri ($US4 million).

Facilities focused on plant and grain farm production R&D include:

- Core Facilities include the Cell and Immunobiology Core, DNA Core, Electron Microscopy Core, Molecular Cytology Core, Nuclear Magnetic Resonance Core, Proteomics Core, Structural Biology Core.
- Variety testing – each year more than 600 corn and soybean varieties are tested at 32 locations throughout Missouri. Selection of varieties that best fit a farmer’s production goals and challenges is an essential part of profitable grain crop production.
- Plant Diagnostic Clinic – this clinic identifies and provides management solutions for insects, diseases and weeds. Samples can be sent directly to the clinic or submitted through a local extension office. The mission of the clinic is to provide accurate, timely answers and management recommendations to plant health questions and problems encountered by the citizens of Missouri. Management recommendations reflect research-based results and an integrated pest management philosophy.
- Plant Nematology Laboratory – this laboratory tests soil and plant samples qualitatively and quantitatively for the presence of plant parasitic nematodes. Recommendations are provided for management strategies to reduce the effect of nematodes on plant growth and yield.
- Plant Transformation Core Facility – the goal of this facility is to enhance both basic and applied research in plant biology for the public. The facility is also expected to foster funding opportunities and national prominence for various research groups through our efforts in generation of transgenic events. The Core’s staff assists in developing transgenic approaches to address research questions. They are making continued efforts in advancing transgenic technology to satisfy the needs of crop improvement and gene discovery. As part of an
educational role, the staff provides technical training in plant tissue culture and transformation for undergraduate and graduate students, post-doctoral researchers and other researchers.

- **Soil and Plant Testing Laboratory** – the laboratory, provides soil testing, fertilizer and lime recommendations, plant, water, manure, compost, and greenhouse media analyses to farmers, home owners, vegetable and fruit growers, golf course superintendents, lawn and landscape specialists, Agra Industry, and Government agencies.
- **Greenley Research Centre** – 280ha farm used to evaluate efficient, profitable crop production in northern Missouri while emphasising soil conservation, water quality ad energy efficiency. Researchers study the benefits of reduced tillage, alternative cropping practices, the effects of new technology and products, variety testing, soil fertility and study water quality and the environmental impact of crop production.
- **Hundley-Whaley Research Centre** – 150ha farm focused on best management practices and economics for corn and soybeans as well as pesticide evaluations and comparisons and sustainable agriculture concepts.

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**Canada**

“In comparing Canadian and Australian grains research funding, I think you will find less research funding in Canada that is effective, because of the close co-ordination of all of the players in Australia. There is a severe lack of comprehensive agricultural research expenditure data. There was a national data collection plan that was discontinued in the late 1990s. Since then there is no one classifying or adding up the data. I’m going to guess that total production related R&D and breeding is in the $CA150 million per year range”

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**Saskatchewan**

Saskatchewan at 651,900 km² has 44% of Canada’s total cultivated farmland and provides an interesting contrast to WA. During 2015 it produced 13 million tonnes of wheat, three million tonnes of barley, two million tonnes of oats, more than two million tonnes of pulses and nine million tonnes of canola.

In Saskatchewan, the federal government’s Agriculture and Agri-Food Canada (AAFC) is the largest, albeit shrinking, contributor. AAFC has a research station in Swift Current that is the primary wheat breeding institution. AAFC Saskatoon does some pre-breeding canola research. There were smaller research programs, mainly agronomy, in Melfort, Indian Head and Scott. These having been shrinking as they close up these programs. While AAFC used to provide a lot of base funding (including Clusters which are similar to Australia’s Cooperative Research Centres) it has been moving more towards project based collaborative research.

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8 Professor Richard Gray, University of Saskatchewan, pers. comms. 2015.

9 The equivalent of the Australian Government’s Department of Agriculture and Water Resources.

10 The Agriscience Clusters program is part of Growing forward 2 which is a federal–provincial initiative. The Growing Forward provides federal funding on a 60:40 basis for cost hared programs. These government sponsored clusters work...
The National Research Council (NRC)\(^{11}\) is a federal research institution with a large focus on biotechnology which also has a presence in Saskatoon. The NRC also leads the Canadian Wheat Alliance to improve wheat genetics. The Canadian Wheat Improvement (CWI) flagship program works to improve wheat varieties and serves as NRC’s contribution to the Canadian Wheat Alliance (CWA) which also includes Agriculture and Agri-Food Canada (AAFC), the province of Saskatchewan and the University of Saskatchewan as partners. By integrating their complementary areas of expertise in wheat breeding, genomics, biotechnology and pathology, CWA members develop new wheat varieties that produce stable and increased yields, better resist environmental and disease stresses, reduce agricultural input costs, lessen the environmental impact of fertilizers and improve prosperity for Canadian farmers.

Genome Canada is a not for profit national company funded by the federal government and set up to harness the transformative power of genomics. The presidents of five major federal research agencies, including the NRC, sit on the board. These are very competitive science based projects with public, producer and private funding. In the most recent round of funding for $CA66 million, there were around 70 letters of intent (EOI’s), 20+ full proposals and 11 funded projects.

The provincial government, the Saskatchewan Ministry of Agriculture (SMA) invests $CA27 million per year in research and development activities enhancing the diversification and profitability of agriculture in the province. The Agriculture Development Fund (ADF) was created to ensure that research relevant to Saskatchewan’s agriculture is undertaken to help farmers and ranchers become successful. It provides project funding of nearly $14 million per year on a competitive basis to researchers in public and private research and development.

The Ministry’s focus for research and development investments is the long-term sustainability of the agriculture sector in Saskatchewan. Therefore, the Ministry has taken an outcome based approach, targeting ADF to achieve the following outcomes:

- New crops and/or cultivars meeting market demands and consumer preferences.
- Increased livestock competitiveness.
- Optimized livestock feeding systems.
- New and innovative food, bioproducts, and processing technologies.
- Improved food quality.
- Innovative and sustainable farming systems and practices.
- Enhanced adaptive capacity of the Provincial soil and ecosystem resources.
- Utilization of biotechnology to enhance agriculture and value-added production.
- Decreased agricultural production risks.

The SMA uses the University of Saskatchewan (U of S) for most of its research that is administered through the Agricultural Development Fund (ADF). ADF funds 13-15 strategic positions per year in the College of Agriculture at the U of S. In addition, ADF has an annual project based funding. Total funding from the ADF to the U of S is about $CA10 million per year.

The U of S is the largest hub for agricultural production research, with private companies, AAFC and NRC located nearby.

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\(^{11}\) The National Research Council (NRC) has a similar role to the CSIRO in Australia.
There are producer check-offs (levies) for most commodities. The Saskatchewan Pulse Development Board operates a mandatory 1% levy and is arguably the most effective producer-funded organisation. They fund very effective breeding programs and the Crop Development Centre at the University of Saskatchewan, in lentils, chick peas, peas, and faba beans. Levies raise about $CA15 million per year with $CA10 million invested in breeding, agronomy etc.

All the other check-off are mandatory (it is deducted from sales) but refundable if the producer writes in to request a refund. While requested refunds have been less 10% these organisations have to keep their rates low to avoid free riding. The largest refundable check-off is the Western Growers Research Foundation (WGRF). WGRF is a farmer-funded and directed non-profit organisation investing in agricultural research that benefits western Canadian producers. WGRF manages an Endowment Fund of about $70 million that came from grain transportation penalties and the wheat and barley variety development check-off funds, investing over $13 million annually into variety development and field crop research. The current levy rate on wheat is $CA0.48 per tonne with 30 cents going to the WGRF, 15 cents to the Canadian International Grains Institute and three cents for administration. The current levy rate on barley is $CA0.56 per tonne with 50 cents going to the WGRF, three cents to the Canadian Malting Barley Technical Centre (based in Winnipeg, it provides support for the commercialisation of Canadian malting barley and malt through applied research and analysis in its pilot malting and pilot brewing facilities) and three cents for administration. During 2014 checkoff revenue was $CA8.6 million (it was $12 million in 2013) which could indicate a drop off in contributions.

There are also recently established wheat and barley commissions in Manitoba, Saskatchewan, and Alberta. Collectively they are slightly larger than WGRF. The Saskatchewan Wheat Development Commission is the largest. Representatives from these producer-elected boards on these organisations serve to make up the WGRF board. These groups are discussing models for producer involvement in breeding.

ADF, WGRF and these other organizations cooperate in research funding. They put out a common Request for Projects. Often they co-fund projects. Total check off funding would be about $CA30 million for Western Canada, or $CA20M for Saskatchewan.

Canola is managed in a very different than the other crops in western Canada. Hybrid Canola seed sells for $CA5 per kilogram or $CA136 per hectare – generating about $CA1 billion per year in seed revenue, most of it is rents going to the private seed companies, Bayer, Monsanto, Pioneer etc. About $CA65 million per year gets reinvested in research/breeding. AAFC is still involved in upstream research. There is a Canola

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13 The Saskatchewan Wheat Development Commission (Sask Wheat) is a producer-led organization established to grow the province’s wheat industry and ensure wheat is a stable, sustainable, profitable and internationally competitive crop, capturing the benefits for Saskatchewan farmers and the community. When Bill C-18, the Marketing Freedom for Grain Farmers Act, became law in August 2012, Western Canada’s wheat industry entered a new era. The new legislation led existing provincial commissions and farm organizations to call for new leadership of Saskatchewan’s wheat industry, which led to the creation of the Saskatchewan Wheat Development Commission. The check-off rate for wheat grown in the province is $0.52 per net tonne. The check-off is refundable upon request. In 2013-14 check off revenue was $6.4 million with $382,000 refunded on request representing 6%) The Saskatchewan wheat check-off collection is in addition to any provincial or federal check-off currently in effect. Check-off dollars administered by the commission go toward research and market development initiatives that improve wheat varieties, grow their marketability and provide higher value to producers.
Research Cluster. Producer checkoffs fund market development and agronomy research. They also have some of their own agronomists that develop extension materials.

Extension

There are very few federal extension activities – extension tends to be a provincial responsibility. Saskatchewan province operates 6 or 8 regional centres each staffed with a few specialists. The Saskatchewan Ministry of Agriculture (SMA) has a website that is well used. It does not provide R&D.

There are a few grower groups. The Indian Head Ag Research Foundation (IHARF) is the largest. It is located on a former AAFC research station. The Saskatchewan Soil Conservation Association, was a non-profit that received grants and took on extension related activities when zero tillage was being adopted. The SSCA is now much smaller as the technology has reached saturation.

Of interest, there is a national association called Grain Growers of Canada (GGC), based in Ottawa, which represents more than 50,000 active grain, oilseed and pulse producers through its 14 provincial and regional grower groups and representing wheat, durum, barley, canola, oat, corn, pea, lentil, soybean, rye, and triticale farmers from across Canada.

Ontario

The grain industry in Ontario is very different to WA and Saskatchewan. Production is dominated by Corn (eight million tonnes) and Soybeans (three million tonnes). Wheat production is just under one million tonnes, barley 186,000 tonnes and oats 63,000 tonnes.

Ontario Ministry of Agriculture and Food

The Ontario Ministry of Agriculture, Food and rural Affairs (OMAFRA) works in partnership with industry, academia and federal and provincial governments and agencies to advance and deliver research and innovation as a critical element in promoting growth of the agriculture and food sectors. Each year, OMAFRA invests more than $75 million in research and research infrastructure (about 50% of the $75 million) to support growth in the agricultural sector.

The Ministry's Partnership Agreement with the University of Guelph is an essential component of research in Ontario’s agri-food and bio-products sector. Through the Partnership Agreement, the ministry supports research, veterinary clinical education, laboratory services in animal health and agriculture and food, Highly Qualified Personnel (HQP) and knowledge translation and transfer (KTT). This long-term investment provides access to specialized expertise and facilities to address government, ministry and industry priorities.

The ministry also invests in open research programs. These programs are competitive programs, open to public and private research organizations, drawing from a wide-range of institutions through annual calls for proposals and address current gaps, priorities and emerging issues not covered in the University of Guelph Partnership. These are currently:

- Food Safety Research Program – the Food Safety Research Program is an open, competitive research fund which enhances food safety in Ontario through innovative research. The program addresses the Ministry's Emergency Management Research Theme which seeks to lessen the frequency and impact of agri-food emergencies. Projects are for up to three years
to a maximum grant of $250,000. Since 2001, the program has funded 108 projects to a total value of $CA9.5 million.

- **New Directions Research Program** - The purpose of the New Directions Research Program is to stimulate the sustainable growth and competitiveness of Ontario's agri-food and agri-business sectors, and to strengthen rural communities. The development of new and alternative products provides potential to increase the diversification of agriculture. New knowledge and new technologies help Ontario's agri-food and agri-business sectors address challenges, expand market opportunities at home and abroad, and support thriving rural communities. Projects are for up to three years to a maximum grant of $200,000. Since 1999 this program has funded 275 projects totalling $CA25 million.

- **Quebec-Ontario Cooperation for Agri-Food Research Competition** – this program offers funding for joint Ontario-Quebec projects supporting water management and integrated pest management research issues of interest to both provinces. Projects are for up to three years to a maximum grant of $150,000.

The Agricultural Research Institute of Ontario is a corporate body with Crown Agency status which reports directly to the Minister of Agriculture, Food and Rural Affairs. It was created during 1962 by the ARIO Act to provide advice to the Minister on strategic directions for research activities. ARIO is a corporation without share capital and its legal authority is set out in the *Agricultural Research Institute of Ontario Act, R.S.O. 1990, c. A.13* and a Memorandum of Understanding dated March 2011. An ARIO-led reinvestment strategy is currently being implemented to revitalize research infrastructure to support demand-driven research.

The Institute provides the foundation for, and is a key component of, the OMAFRA Research Advisory Network (ORAN) which identifies priorities for OMAFRA funded research and guides research program development. ORAN is a network of advisory bodies that provide long-term, strategic guidance for research program development as well as identification of short-term and emerging research priorities in the seven research theme areas.

Current priorities for crop production R&D are:

**Plant protection**

- Resistance identification and management strategies for fungicides in corn soybeans and cereals. Effective management of Fusarium pathogens, soybean cyst nematode, soybean sudden death syndrome, foliar diseases, oat crown rust, seedling diseases and root rots. Develop integrated weed management strategies that consider management of herbicide resistance, and/or biology and ecology of specific weed species for corn soybean and cereals.
- Agronomic influences on forage nutrient quality and yield in harvested forage and pasture - weed control, diseases, insect pests, fertility, establishment, etc. o Insect resistance, root and leaf disease management for edible beans o Swede midge and flea beetle control and effectiveness of boron in mitigating damage from extreme temperatures in canola.
- Develop alternative (non-neonic) management strategies for insect pests and/or define early-season soil insect pest thresholds.

**Production efficiency**

- Optimise plant use efficiency of nutrients in field crops, particularly nitrogen, phosphorus and potassium.
- Investigate harvest and storage technology for forages to reduce losses, improve quality and marketability.
• Validate precision agriculture technologies for use as agronomy research tools that improve efficiency and accuracy of data generation to better address experimental variables.

**Product diversification**

• Develop new bio products and new food uses for barley, corn, oat, soybean and wheat that are connected to existing and emerging market opportunities.

**Genetic technologies**

• Develop high-yielding, high-quality barley, corn, oat, soybean, and winter & spring wheat varieties adapted to Ontario, with genetic resistance to important pathogens including Fusarium in wheat and barley, Gibberella in corn, foliar pathogens, soybean cyst nematode, soybean sudden death syndrome (SDS), oat rust, and seedling diseases.

• Forage varietal effects on management factors, such as NDF and fibre digestibility (milk/beef/acre), Roundup Ready alfalfa, manure tolerance and yield response, intensive cutting schedules, and other parameters. Forage variety performance testing.

• High yielding edible bean varieties and varieties with resistance to the most important diseases; improved quality traits (seed size, seed coat integrity, seed coat colour).

• High yielding canola varieties with disease/insect resistance and reduced free fatty acids.

**Product quality improvement**

• Identify and characterize quality and functional parameters and identify production practices that improve barley, corn, oat, soy and wheat quality for specific end uses leading to value added markets.

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**University of Guelph**

Located in Guelph, Ontario, the University of Guelph (UofG) was established during 1964 and is considered Canada’s top agricultural University. Its three founding members – Macdonald Institute, the Ontario Agricultural College and the Ontario Veterinary College – are older than the University itself. Established in Toronto during 1862, the Ontario Veterinary College is the oldest veterinary school in Canada. The University also has a regional campus in Ridgetown, Ontario, and several research stations.

**The Ontario Ministry of Agriculture, Food and Rural Affairs and the University of Guelph partnership (OMAFRA-U of G Partnership)**

OMAFRA contracts the University of Guelph (UofG) to provide the majority of its research activities via a 10-year Agreement. The current Agreement runs from 2008 to 2018. This provides OMAFRA with readily available expertise to respond to priorities for the province’s agricultural sector.

Of the $CA70 million annual payment from OMAFRA to UofG approximately $50 million is for payment to support faculty scientific and technical staff and research station staffing, operation and maintenance.

The major programs in the Agreement are:

• Research in seven theme areas - Agricultural and Rural Policy; Bioeconomy-Industrial Uses; Emergency Management; Environmental Sustainability; Food for Health; Product
Development and Enhancement through Value Chain Collaborations; and, Production Systems (Plants and Animals);

- Animal health laboratory
- Agri-food laboratory
- Veterinary clinical education

The title to any IP remains with the UofG. However, OMAFRA shares in the IP protection costs and revenues generated.

In 1996, the U of G and OMAFRA commences an ‘Enhanced Partnership’ whereby OMAFRA would provide specified funding to the U of G to be expended over the course of the agreement. In return the U of G was required (effective April 1, 1997) to assume the operations of the regional agricultural colleges and provincial agriculture, food and animal health laboratories previously managed by OMAFRA. U of G was mandated to leverage the OMAFRA investment and progress towards creating industry advancements and developing new cost sharing opportunities. More than 400 OMAFRA staff were transferred to the U of G when it began in 1997. The Partnership Agreement was renewed during 2002 and then was subsequently renegotiated during 2007-08 for a ten-year term effective April 1, 2008 to March 31, 2018 (the ‘Partnership Agreement’ (PA)). Currently in the 7th year of a 10-year Agreement – it is reviewed at the end of every five years which was at the end of 2013.

The reliability and predictability of OMAFRA PA funding is viewed as an essential component to the generation of a critical mass of talent and infrastructure that enables the UofG to attract additional investment from the private sector and other public sector organizations. Attracting additional investment effectively magnifies the economic impact of OMAFRA-UofG Partnership funding.

**Research Program Allocation within the U of G**

There are four research programs under the agreement:

1. **Research Funding Program** – operating funding under the seven themes ($CA7.4 million per annum)
2. **Knowledge Translation and Transfer** – accelerates transfer of research knowledge (workshops, webcasts, apps, digital media, videos, forums, industry days)
3. **Highly Qualified Personnel Graduate Scholarship** – provides graduate students with agri-food business training through specialised course work, job placements, mentorship and research projects that support OMAFRA’s research priorities.
4. **Accelerated commercialisation of innovative research** – provides targeted support for projects focused on accelerating development and adoption of innovative technologies across Ontario’s agri-food and rural sectors.

The University operates a competitive process for allocating the $CA7.4 million per annum in its Research Funding Program to operating funding for projects across all seven research themes. In 2014-15 there were 168 Letters of Intent, 108 Full proposals received and 61 projects funded. Proposals for competitive research funds are expected to be collaborative, drawing on the combined strengths of more than one researcher at the UofG. By extension, the ministry is also interested in proposals that link with relevant research capacity and expertise with other universities and research institutions. The Principal Investigator must be faculty of staff from the UofG but there are opportunities for collaboration. In such cases, successful proposals may feature cross-institutional collaborations in which the primary investigator is at the UofG but related research activities in other institutions are funded under the same proposal.
The Research Funding Program is competitive within the University. Priority areas in the Plant Productions systems area for funding are:

- **Product Quality Improvement** – Research in this area includes studies focusing on the introduction of traits for human health (e.g. omega 3, lycopene, Vitamin E), the introduction of traits to enhance value – (higher oil content), new markets or new products, storability and post-harvest extension/shelf life.

- **Plant Protection** – Research in this area includes improving Integrated Pest Management (IPM), understanding the biology, ecology and management of current and invasive pests. This includes identification, tracking and monitoring, identifying biosecurity practices and protocols (especially related to maintenance of trade) and improving diagnostics and surveillance techniques to improve pest management and manage pathogen resistance.

- **Production Efficiency** – Research in this area includes profit enhancement and improved efficiencies, reductions in labour, energy saving technologies and processes, reduced input costs, more efficient use of land, labour, energy, etc., waste stream reduction and reuse, alternate livestock feeds.

- **Environmental/Ecosystem Impact** – Research in this area includes resource use, including water management, environmental impacts on natural and man-made environments, alternate pollinators, alternate energy generation, climate change induced challenges and opportunities, reduction of harmful emissions, maintain biodiversity.

- **Product Diversification** – Research in this area includes new product development and associated production systems, climate change response (e.g. different crops), or different production strategies, or expansion of crop production to different land, market research to determine market demand and/or consume preferences for new products and/or uses.

- **Genetic Technologies and Reproductive Technologies** – This research area focuses on genetic and reproductive technologies necessary to develop research in new products and specialty crops, enhance the marketability of existing products, improve productivity in pest management, environmental and end-use quality traits and to maintain our gene pool.

Each fall the researchers get to forward a letter of intent to the Office of Research – the Research Program (Plants) team under the Production Systems (plants) Research Theme typically submit 55-56 letters of intent annually of which 10-12 could be expected accepted.

The Production Systems-Plants receives an annual allocation of around $CA1.25 million and currently has 33 projects over six years totalling $3.6 Million in operating funding. Typical projects average $125,000 and there is a maximum limit of $375,000. Project costs covered are operating costs and overhead costs. Overhead costs charged will depend on the project’s significance, industry contributions and facility availability with the standard rate being 46%. Researchers find this system a bit burdensome and time consuming with uncertain outcomes.

**Research stations and infrastructure**

The OMAFRA – University of Guelph Partnership also provides funds for the maintenance, operation and management of 17 research stations and three agricultural campuses located across Ontario. These research facilities are owned (in trust) by the Agricultural Research Institute of Ontario (ARIO) and operated and managed by the University of Guelph with oversight from the ministry's Research and Innovation Branch.

The University has an agricultural and Food Laboratory Service as well as an animal health laboratory. The Agriculture and Food Laboratory provides microbiology, molecular biology including DNA
sequencing, residue testing and soil and nutrient testing services for soils, biosolids, water and plant tissue.

**Economic impact of the partnership**

Two impact studies on the Partnership have been published within the past ten years.

The 2012 report addressed three areas for the fiscal period May 1, 2008 to April 30, 2013: facilitative impacts, attributable impacts, and qualitative impacts and benefits. A key finding was that OMAFRA funding is foundational to the Partnership Agreement and provides the U of G a critical mass of experienced, multidisciplinary and internationally recognized research personnel and leading-edge infrastructure that has been successfully leveraged to obtain additional research contributions from the private sector and other public sector organisations.

In the 2007 report, the study focused on the formal ten-year funding relationship entered into during 1997. The conclusion noted the agreement had made significant contributions to the province in these four manners: economically, where it had an economic impact in excess of $1.1 billion; with non-economic contributions, through significant impact on the quality of life for the population of Ontario; for the creation of an economic cluster, for example, the Agri-food cluster in Guelph; and environmentally, for example, through development of the Environmental Farm Plan and Best Management Practices which assisted Ontario’s farmers in addressing environmental issues.

The last published cost benefit study of the agreement was done during 2012 by Price Waterhouse Coopers and estimated the total measurable benefit from the five years’ investment of $CA363 million by OMAFRA between 2009 and 2013 at $CA1,091 million (a 3:1 ratio).

**Grain Farmers of Ontario**

Grain Farmers of Ontario (GFO) is open to grain growers in Ontario. It has check-off system to raise funds and also operates a series of wheat pools. Revenue from licence fees (check-offs) are around $8 million per year. Check-off fees are determined using a formula based on a per acre basis with a fee per metric tonne derived from the five-year yield average and the seeded acres for the current year.

GFO invested $1.5 million in new and ongoing research projects during 2014-15 and was directly involved in 71 projects in the core priority areas of Agronomy and Production, Insects and Diseases, Crop Utilization and Quality, and Breeding and Genetics. One goal each year is to leverage grower checkoff dollars with other matching funding sources, and this past year the leveraged contribution to research was $5.4 million, meaning that every $1 invested by GFO was matched with $2.60 from other government and industry funding sources.

Of the $9 million budget for projects currently servicing the grains industry in Ontario, that GFO administer, around 60% is being delivered through the U of G.

“Each year, Grain Farmers of Ontario updates its research priorities and this past year we garnered feedback from delegate surveys at the 2014 Annual General Meeting, Certified Crop Adviser surveys, the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) field crops team, meetings with researchers, and scientific conferences. All of these information sources feed into the Grain Farmers of Ontario Research Committee discussions that firm up the priorities for recommendation to the Grain Farmers of Ontario Board of Directors for approval each year. These priorities are shared widely with government and private industry and they also serve as a core document for our annual Call for Proposals. In a new focus this year, our September 2014 call for research proposals targeted only three specific priority areas from our Research Priorities document to address current research investment...
gaps: Soil Health, Crop Utilization and Quality, and Insects and Diseases. The response to the call was very good with 45 proposals received, of which the Board approved 15 across all three priority areas. Many of these projects have matching funding through industry and government funding sources and also leverage national and international scientific expertise.”

GFO also operates a market development fund, providing grants of up to $50,000 to fund projects at up to 60% of costs – to open up new markets, promote Ontario grains and expand the use of Ontario grains.

**Netherlands**

The agri-food sector is prominent in the Netherlands’ economy, having a 10% share in the GDP and almost a 20% share in the export capacity. The Netherlands is the second ranked exporter of agri-food products by value in the world. Farmers, the food industry and the supplying industries (like greenhouse construction and energy management) are the primary actors in innovation. A number of leading national food companies have research facilities in the country. The term "golden triangle" (in Dutch; gouden driehoek) is a concept used in the Netherlands to describe the productive relationships between business (firms and farmers), government and knowledge institutes to stimulate innovation. The Netherlands spends in total about 2% of GDP on R&D – about half comes from the private sector and half from the government sector.

The Dutch agricultural sector has become more and more knowledge-intensive and has achieved a high level of productivity. Much of this is attributed to a continuous investment in innovation strategies and knowledge production and dissemination. The sector has benefitted from intensive cooperation between public research and education institutes, farmers, and agro-food firms and cooperatives. Entrepreneurs in the sector have become more and more specialised professionals, who have had higher education and training themselves. As a result, the whole agricultural innovation system has become more complex and the roles of actors have changed. Competition for contracts with companies – which are essentially competitive – is becoming more prominent. There is a growing budget for company contracts in the academic world in general and also in the agricultural innovation system. Again this is especially true and visible for the Wageningen university.

The success of the Dutch experience has been attributed to a number of factors.

- public co-funding in public-private partnerships,
- investment subsidies, including tax deductions,
- guarantee facilities to adopters to spread the risks of adopters and banks, and help innovations cross the so-called “Valley of Death” or funding gap between basic research in the public sector and commercialisation of a new product by the private sector,
- public (co-)funding of research, e.g. feasibility studies to demonstrate the (potential) value or to further develop the innovation,
- public (co-)funding of training, extension, innovation brokerage, and advisory services that can help adopters to select and implement innovations in a successful way,
- empowering entrepreneurs in a way that they become more skilled and confident to invest in innovative new products, services or even completely new concepts or business models,
• public (co-)funding of network activities that bring together entrepreneurs, researchers and intermediaries to learn from each other in order to co-create an innovation, rightly implement or further develop and innovation, and
• high levels of intellectual property protection. Patent protection in particular has increased significantly in the 1980s and 1990s. The Dutch government supports the agricultural innovation system by promoting public-private partnership in knowledge exchange in top sectors dedicated to agri-food and horticulture, offering tax facilities for entrepreneurs, financing R&D investments in publicly-funded education at all levels, and by funding research institutes and initiatives.

The rationale for government investment in R&D is market failures: the private sector tends to underinvest because agricultural research is often long term, large scale and risky. Moreover, the organisation and support of the knowledge and innovation system is one of the fundamental instruments of the government to support the transition towards a more sustainable agriculture, which is not necessarily a priority for the private sector as the price of environmental outcomes is often undervalued by markets. The relatively small-scale and diversity of primary agriculture also means that the sector does not have the capacity to invest in R&D unless it gets organised and pools its capacity with that of agri-food companies.

In 2011, the Dutch government introduced a new Research and Development strategy across the whole economy: the top sector policy. The government provides funding for R&D and education, in public and private institutions, and innovation support to businesses. The strategy starts with the observation that although public financing of R&D has a high priority, private investments by companies and firms lag behind. It concentrates public funds on key sectoral areas. The top sector approach involves public-private partnerships (PPPs) by sector, to facilitate co-ordination and increase the impact of public funds on economic performance. Public funds have to be matched with an equivalent contribution from the private sector (50-50), which can be in kind (access to facilities) or financial, in which case it can benefit from public support (investment or tax rebates).

Nine key sectors have been identified with strong market positions. Two agricultural top sectors are “Agri-Food” and “Horticulture and Propogation Materials”. They are capital intensive and particularly knowledge intensive sectors, and accounted for over 80% of business R&D in 2011 (96% in 2010), 55% of exports but under 30% of value-added and employment (OECD, 2014c). They form a significant part of the Dutch economy, with high productivity rates (35% above average), a strong position in international markets, and thereby contribute significantly to economic growth.

Investment in R&D is one of the key elements to achieve higher productivity and economic prosperity. In the top sector policy, the business world sets the agenda for R&D investments in its field. The government does not make its own proposals for the sectors, but invites businesses and scientists to draw up action plans, which serve as a base to develop concrete lines of actions. More and better public-private partnerships are expected to increase the innovative power of businesses, thereby generate new products and services to face the grand challenges of the future.

The top sector policy aims to promote closer co-operation between knowledge institutes, public authorities and business. All top sectors have a human capital agenda meant to strengthen the linkages between education institutes (from vocational training to university) in order to meet the needs of the sector itself.
Each top sector has created one or more top consortia (TKI) for knowledge and innovation where entrepreneurs and researchers work together in innovative products and concepts. Three strategic goals concerning the knowledge infrastructure were defined:

- More co-operation between knowledge institutes, business and government to strengthen the international strength of the sector concerned.
- Facilitating public-private partnership for R&D.
- Giving a structural financial base to public-private partnerships in the knowledge system.

Every TKI has a board with members from all three parties; government, business and knowledge institutes. Programming is done by calls to tender leading to a number of identifiable projects since 2012. The TKI allowance provides public co-funding, amounting to 25% of the private funding. In order to stimulate SMEs to participate the public co-funding is 40% for the first EUR 20 000 per project. Arrangements between government and TKIs are written in the so called innovation contracts.\(^{15}\)

### Wangeningen University and Research Centre

The Wangeningen University and Research Centre (Wangeningen UR) was formed in 1997 to integrate the (formerly governmental) DLO institutes and the Wageningen University because of the considerable overlap and unnecessary competition between the two (Peper, 1996). The process for this integration lasted almost a decade, and only involved the institutes that were under governance of the former Ministry of Agriculture.

Wageningen UR consists of a research university with chair groups for academic education and basic research and in total nine specialised research institutes for applied research (DLOs). Institutes like “Plant Research International”, “Livestock research”, “Imares” (marine ecology and fisheries research), “Rikilt” (food safety) and “LEI” (agricultural economic research) all contribute to the body of knowledge of the agricultural innovation system.

Food Valley NL is a public-private cluster network organisation of food companies and research companies and institutes launched in 2004. Overall, it includes 15,000 food scientists and engineers in a radius of 50 km from Wageningen. Seed Valley as a concept was introduced shortly thereafter in 2007. This valley is world leader in seed products and propagation materials.

*This material was sourced from Chapter 7: the Dutch Agricultural Innovation System from the publication cited as OECD (2015), Innovation, Agricultural Productivity and Sustainability in the Netherlands, OECD Publishing, Paris.*

### France

#### The National Institute of Agronomic Research

Agricultural research in France largely revolves around L’institut national de la recherche agronomique (INRA) which is ranked as the best in Europe. INRA is a large research institute (the largest in France) with a large budget and works in collaboration with universities. It consists of 14 research divisions, 19 regional centres and 150 research and experimental sites.

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\(^{15}\) *Source: Investing in top sectors | Entrepreneurship and innovation | Government.nl.*
There are 213 research units at INRA including 112 joint research units with other research organisations and universities (UMRs). INRA has nearly 8500 staff members consisting of 1837 scientists, 590 engineers, 4061 technicians and administrative staff. Approximately 2000 PhD students are conducting research at INRA. It is estimated that 11,700 permanent staff members work on agricultural research in France indicating that approximately 73% of this capacity is in INRA. Hence, agricultural research is largely concentrated at INRA. INRA’s 813 million Euro funding (in 2010) is largely from the government (Ministry of Higher Education and Research as well as the Ministry of Agriculture and Fisheries). During 2010 (the latest available statistics) 79% of INRA’s budget came from government funding, 14.7% from grants and contracts, and 6.3% from services and research product royalties.

Brazil

Brazilian Agricultural Research Corporation

Brazil has transformed from a food importer to one of the world’s largest agricultural producers over the past several decades, catching up with developed countries that have historically dominated grain exports. The Brazilian Agricultural Research Corporation (Embrapa) was a key reason for this extraordinary growth, literally changing the landscape of Brazil to increase the cultivation of the cerrado, Brazil’s savannah.

Although it is connected to the Brazilian Ministry of Agriculture, Livestock and Supply, Embrapa was established during 1973 as a public company. Its mission is “to provide feasible solutions for the sustainable development of the agricultural sector through knowledge and technology”. The company comprises a broad network of research and service centres across the country, and is engaged in a huge variety of activity in agro-energy, agribusiness, food technology, biotechnology, nanotechnology, animal production and forestry. It is present in all States of Brazil, and employs more than 9,000 people including more than 2,000 researchers, three-fourths of whom have doctoral degrees.

The organisation has created and recommended more than 9,000 technologies for Brazilian agriculture since its inception. Innovations include new seeds, edible wrapping paper for foodstuffs, and biodegradable fabrics and bandages, among other highly sophisticated product and process improvements in the agricultural sector.
Attachment One: Definitions of Research, Development and Extension

Definitions of Research, Development and Extension

The National Research, Development and Extension Strategy framework initiated during 2011 provided a dynamic framework enabling government and industry to work collaboratively in securing the future profitability of the Australian Grains Industry. The framework recognised a continuum extending from research (R) through experimental development (D) to extension (E) of regionally interpreted and validated research.

Research (R)

Encompasses the following definitions adopted by the Australian Productivity Commission:

- Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application of use in view.
- Applied research is also original investigation undertaken to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective.

Development (D)

Application of knowledge gained through basic and applied research to create new or improved materials, products, processes and services, commonly through partnerships with commercial entities in the supply chain. By definition, a significant proportion of D must occur at regional or local level.

Extension (E)

Field of communication, information exchange and promotion of learning in order to build capability and change practice. It includes a wide range of communication and promotion tools and activities, and encompasses the roles of advisory or consultant services, field days, update events and electronic delivery. Extension includes the development of practice change methods required to achieve high levels of adoption of research outcomes and new technologies. It is recognised that these tools and delivery mechanisms will by nature be diverse and vary according to the intended outcome sought, the target segment of the industry and the local situation.
Attachment Two:
Policy rationale for public sector support of agricultural R&D

The Productivity Commission Inquiry into Rural Research and Development Corporations during 2011 addressed the question of why should government support rural R&D?

“The benefits of investment in rural R&D have been extensively investigated. While hard to quantify with any precision, there is little doubt that the overall payoff for both producers and the community from past investments has been significant.

But such payoffs are not sufficient to justify public funding. If a producer can expect to capture sufficient benefits to make investment in a piece of research a financially attractive proposition, then a public funding contribution is unlikely to lead to a different investment outcome. Rather, it will simply shift part of the cost of the investment onto taxpayers. Thus, as most inquiry participants agreed, the main rationale for public funding support dovetails from the un-priced benefits for third parties (‘spillovers’) that often attach to investments in R&D — though even this broad argument requires further unpacking.

- Even in the presence of spillovers, public funding support will only be justified where the expected benefits for a producer/industry are insufficient to motivate investment in research that is of net benefit to the community as a whole.
- Public revenue raising has various administrative and efficiency costs. Hence the expected benefit for the community from any public funding for rural R&D must be sufficient to cover these costs as well as the direct funding expense. Also, there are many calls on government funds, meaning that the expected benefits from public investment in rural R&D must have regard to the likely payoff for the community from alternative spending options.

In addition, it may be possible to ameliorate the impacts of ‘policy relevant’ spillovers in other ways. In the case of rural R&D, for example, industry levy arrangements have long been recognised as a means to help ensure that all producers who benefit from research contribute to its cost.

However, as a means to address under-investment in rural R&D, producer levies are not a complete solution. In the first instance, their role is to address free-rider problems that could preclude worthwhile investment in R&D of direct benefit to the industry concerned. They are much less likely to facilitate investment in research where the benefits are either spread thinly across a wide range of industries, or mainly accrue to the wider community. General research into climate change or environmental issues are cases in point. As well, there are several reasons why producers might not contribute a sufficient amount of funding through levies — or other collective industry contribution mechanisms — even to allow all worthwhile industry-specific research projects to proceed.”

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Dr Richard Gray at Saskatchewan has also examined the case for government funding of rural R&D and notes the economic rationale for public support of R&D may be summarised in the following terms:

- Public intervention is justified on the basis of correcting a market failure – insufficient funds are invested in R&D by the private sector, including producers. Principal reasons for this type of market failure include:
  - Individual firms and producers are unable to capture the full returns on their investments in R&D
  - Limited availability of intellectual property rights
  - Lack of incentives for private sector R&D performers to take public benefits into account in their decision-making.
- The rationale for public R&D is generally strongest for basic research.
- Public R&D can be a catalyst or enabler for collectively funded R&D by producers, e.g., through levy or fee for service programs.
- Public research ideas/products can be used over and over. Access to technology benefits the whole sector.
- Less duplication. Increase sharing among researchers and research institutes.

The literature points to the spillover effects of R&D on the social good as one inhibitor to the optimal amount of investment by private industry in agriculture and agri-food R&D. A policy brief developed by the Canadian Agricultural Innovation Research Network (October 2007) summarises the rationale:

*It has been shown that private firms invest less in R&D than the socially optimal amount even with fully appropriate intellectual property rights because they cannot fully appropriate all the research benefits generated from their investment. Given that the research firm making the investment in research cannot capture the increase in surplus going to the buyers of their product (i.e., farmers), their private marginal benefit from research is less than the socially marginal benefit. Research firms are only concerned with their private benefits from an R&D investment and not the spillover effects that their action may have on others. Therefore, they will underinvest in R&D relative to the social optimum.*

The literature suggests that horizontal and vertical linkages between constituents making up an industry sector (i.e., from producer to processor) play an important role in agricultural innovation but that government also has a role. Gray et al (2008) suggest:

“The atomistic structure of the industry (particularly primary producers) requires horizontal and vertical linkages to coordinate and fund industry level initiatives. Without some government support, the tendency for parts of the industry to free ride will result in underinvestment in these critical activities.”

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Attachment Three: The role of WA grower groups in grain farm production R&D

The role of grower groups in the future RD&E environment
Submission to Grains Industry Group – 18 December 2015

WA grower groups are usually incorporated, not-for-profit organisations which aim to increase the production and profitability of their farm businesses; through the adoption of new technologies, and delivery of locally relevant research, development and extension; while providing a social hub supporting participatory research and farmer-to-farmer learning. Grower groups achieve this by understanding local priorities of their members.

Grower groups provide research, information and support to their members on agricultural production systems, business management and natural resource management. They usually have strong working partnerships with advisors, agribusiness, research partners and other grower groups.

Grower Groups in Western Australia
There are 42 grower groups within the GGA network in WA, with a combined grower membership of 3136 (**this doesn’t take into account growers being members of more than one group). Groups in the GGA network cover an area from Binnu in the north, Southern Cross in the East, down to Esperance in the South East; covering a majority of the broadacre cropping and livestock region.

There are various size and structure differences between the 42 groups within the network, but a commonality is their strong interest to be involved in RD&E. The level of involvement and capacity to deliver on RD&E projects also differs, but there are up to 15 larger groups within the network that have paid staff and a strong ability to deliver projects in their own right. These groups, in some instances, have also become support networks to the smaller, local groups in their region, and as such still have a large geographical spread.

The proceeding information in this document will focus on these larger grower groups. This is not to dismiss the value and role of smaller grower groups in the RD&E system, however in terms of informing GIG on the ability of grower groups to fill some gaps left by the public sector, these groups are more likely to be able to take on a leading role.

Role of grower groups in RD&E
Grower groups sit perfectly in the RD&E sector for a number of reasons. Firstly, they have regional spread and engagement unlike any other body or organisations; with more than 40 groups in WA alone, encompassing more than half of WA’s grain growers. Secondly, these growers are already engaged in improving the productivity and profitability of their businesses, seeking out information and trialling and adopting it in their farming systems. They understand their region like no others, including the technical, history and people.
The grower groups are professional and well run, making delivery of RD&E clear and simple. They have built a reputation and established themselves on the basis of their outputs, services and relevance to their members and communities, and believe strongly in maintaining these by delivering outcomes. They look to partner and collaborate with appropriate organisations and stakeholders, but not at the expense of their members, their priorities and their reputation, and with the continuing motivation of finding solutions. Groups have a strong track record of delivering RD&E projects and activities efficiently and effectively.

Some key roles grower groups take on within the RD&E sector are;
- Extension delivers
- Driving and supporting adoption of new practices
- Improving productivity and profitability of members
- Fostering innovation
- Connecting community
- Linking/coordinating researchers and growers
- Undertaking applied RD&E
- Identifying research priorities, and promoting them to industry and researchers for action
- Facilitating opportunities
- Industry development
- Partnership brokers

Grower groups’ strengths are in development and extension, with a future move into partnering and delivering more in the research space.

**Ability to take on new roles in future RD&E environment**
Grower groups are now taking a broader perspective on their fit in the agricultural RD&E landscape. Working with key partners and sponsors, groups are seeking to look at long term outcomes and five-year periods to add value to groups and research relationships.

In the future, grower groups think there will be more demand on their services as the public sector retreats from funding R&D, particularly around delivering more RD&E projects and activities and becoming a training ground for new graduates. Groups are keen to take on this new challenge and roles within the industry. They have the desire and capability, and will create the capacity.

Grower groups will continue to be a key extension deliverer, but believe they may have to think about alternative business models such as fee for service to remain sustainable in a changing RD&E environment (with increase in private sector involvement).

Finally, grower groups are an important, valued contributor to the RD&E sector, and their role should be recognised in a new model for grains RD&E going forward. For more information about grower groups in WA contact Rebeca Wallis, T: 6180 5759, E: rwallis@gga.org.au.
### Attachment Four: Information on selected Check-Off Programs in the USA

This table was supplied by Professor Richard Gray from the University of Saskatchewan. While not complete; it is reproduced here, as it was supplied, to provide some additional information about USA delivery models for agricultural R&D.

<table>
<thead>
<tr>
<th>Relationship With private and public research</th>
<th>Objectives, mission, strategies</th>
<th>Organization</th>
<th>Governance structure and Board appointment</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB considerably interact with both public and private sector. In the case of USSEC, both USB and federal government fund this organization to enhance the market share of US soybean. In the case of production research, USB mostly rely on universities and other public organizations researches.</td>
<td>-Increasing the values of soybean meal. -Enhancing the values of soybean oil. -Facilitating the freedom of operation for farmers -Increase in the quality of soybean products to increase the demand for US soybean</td>
<td>United Soybean Board United States</td>
<td>By law, USB can only spend up to 3% of its revenue on administration costs. To deal with this constraint, this organization has defined three projects to outsource an important parts of it administrations activities. These projects are related to production research (supply), market development and communication. These projects are contracted to Smith Bucklin, USSEC and Osborn Barr respectively. The directors of USB are the state levels boards and in the USB level, states recommend these people to the federal government for appointment in USB board. There are 73 directors involved in USB decision-making. The number of directors from each state is the function of soybean production in the state. For instance Iowa has four directors in USB board.</td>
</tr>
</tbody>
</table>

| MWBC extensively cooperate with Montana State University. MWBC supports Most of wheat and barley breeding programs in Montana State University. MWBC is also closely associated with Montana grower association. | **Mission:** benefiting wheat and barley farmers of Montana. | Montana Wheat and Barley Committee (MWBC) (US) | MWBC was established more than 40 years ago. In 1967 and by legislation MWBC officially became in charge of collecting wheat and later barley assessment. Currently wheat producers in Montana pay 2 cent per bushel of and barley producers pay 3 cents per bushel of hundred weight as the checkoffs. Directors in MWBC are the representatives of seven districts in state of Montana. |

<table>
<thead>
<tr>
<th><strong>Revenue:</strong></th>
<th><strong>Resource Investment portfolio:</strong></th>
<th><strong>Crop:</strong></th>
<th><strong>Crop:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>There are about 570,000 registered soybean producers in the US who pay 0.5 percent of their sales price as the non-refundable checkoff. Half of this amount is allocated to USB (national level program) and the other half to state level checkoff program. On average each year farmers collectively pay about $ 220 million as checkoff divided between national and state level. In 2014 USB revenue was $109,775,559 USD</td>
<td>Meal, oil, freedom to operate, customer focus</td>
<td>Wheat and Barley</td>
<td>Wheat and Barley</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Research investment portfolio:</strong></th>
<th><strong>Revenue in 2015:</strong></th>
<th><strong>Crop:</strong></th>
<th><strong>Crop:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>-New Variety development</td>
<td>4,550,808 US dollars where 90% of this amount is related to wheat assessment.</td>
<td>Wheat and Barley</td>
<td>Wheat and Barley</td>
</tr>
</tbody>
</table>
KWC has close collaboration with two other organizations in Kansas that are Kansas Wheat Alliance and Kansas Crop Improvement Association. These three organizations call for proposals in the same time, however the proposals are divided between these organizations based on their goals that might be different. In addition KWC collaborate with wheat commissions in other central states of the US to avoid overlapping.

**Objective:** enhance the profitability of wheat farmers in Kansas.

**Kansas Wheat Commission (KWC) (US)**

| Revenue in 2014: | 4,564,259 |
| Crop: | Wheat |

**Research investment portfolio:**
- New Variety development
- Production (agronomy)
- Trait discovery and biotechnology
- Testing new technologies and methods
- Industrial use
- Consumer preferences

KWC was established in 1957 by legislation and in 2012 it was privatized. Wheat farmers in Kansas voluntarily pay 2 cent per bushel “wheat assessment”. There are 9 directors in KWC elected by farmers. In general 7 of the directors represent 9 districts in Kansas and 2 of them are directors at large.

ICPB extensively cooperate with Iowa state university. ICPB mainly works with universities and private labs for conducting research. Based on the recent decisions in IC, a part of IPRs of the patented researches should belong to this organization as well. However before this decision, only the research partners would own the IPRs. IC is interested to differentiate itself form public and private sectors. By focusing on the researches that are in the interests of public. In addition ICPB tries to fund projects that improves industrial usage of corn in early stage of production.

**Mission:** enhancing corn industry in Iowa by investing in market development, research and education

**Iowa Corn Promotion Board (ICPB) (US)**

| Checkoff Revenue in 2015: | 17,213,411 US dollars |
| Crop: | Corn |

**Research investment portfolio:**
- Corn Utilization (Bio-Plastics)
- Genomic improvement
- Efficiency of Nitrogen use

ICPB’s checkoff is 1 cent per bushel and it is refundable. The checkoff is spent on research and development, market promotion, funding start-up companies and commercial deployment of technologies. Iowa corn encompasses two organizations that are ICPB and Iowa corn association. The former is in charge of that is in charge of market development and research and education and the latter pursues policy related issues and lobbying. These two organizations have separate board of directors but they meet in the same time and the staffs of Iowa corn works for both of them.
Iowa Soybean encompasses two organizations that are ISCP and Iowa Soybean Association where the latter focuses mostly on policy and it cannot use checkoff money for that purpose.
ISCP mostly collaborate with Iowa State University and in average it has invested $3 million dollars in this university per year from its establishment.
In addition it has close connection with other soybean checkoff programs in federal and state levels.
In the state levels ISCP collaborate with 11 states located at north and central parts of US. This collaboration is in the form of an organization called North Central Soybean Research Program (NCSRP). NCSRP includes 12 soybean checkoff programs and its job is the investments in the research gaps that are common between these states. ISCP’s research manager currently governs NCSRP.

**Mission:** enhancing corn industry in Iowa by investing in market development, research and education

**Iowa Soybean Checkoff Program (ISCP) (US)**

**Checkoff Revenue in 2015:**
17,213,411 US dollars

**Crop:**
Corn

**Research investment portfolio:**
- Corn Utilization (Bio-Plastics)
- Genomic improvement
- Efficiency of Nitrogen use

ISCP collects 0.5 of 0.5 cents per bushel as checkoff. There are nine crop districts in Iowa where each district has two representatives in ISCP and in general 21 member boards are elected from the whole state.

The directors are elected by farmers and represent specific districts in Iowa.
The board is divided into five committees including industrial usage, export, research and development, membership and checkoff and finally environmental issues.