Rural research, development and extension investment in Australia
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Research by the Australian Bureau of Agricultural and Resource Economics and Sciences
Research Report 17.11
September 2017
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Summary

Research and development (R&D) is central to the productivity, competitiveness and sustainability of Australia's agriculture industry but limited information is available on how much Australia invests in rural R&D. This study provides an updated estimate of the value of the Australian rural R&D system, which we define to include agriculture, fisheries and forestry, sustainable production and agricultural inputs and processing R&D.

We estimate that total funding for rural R&D in Australia increased over the 10 years between 2005–06 and 2014–15 from $2.3 billion to $3.0 billion, in real terms. Growth in total funding for rural R&D was driven by increased investment from the public sector and private firms (Figure S1).

Private funding of rural R&D grew strongly over the period. Total private R&D funding increased from $912 million in 2005–06 to $1,462 million in 2014–15, in real terms. This increase was mainly driven by greater investment by private firms in their own R&D, which nearly doubled from $681 million in 2005–06 to $1,185 million in 2014–15, in real terms. Private sector levy payments to the Research and Development Corporations (RDCs) grew more slowly, from $231 million in 2005–06 to $277 million in 2014–15, in real terms.

Public sector funding (from Australian and state and territory governments and universities) grew relatively slowly compared with private sector funding, increasing from $1,376 million in 2005–06 to $1,537 million in 2014–15, in real terms. However, it remains the largest overall source of rural R&D investment:

- Australian Government funding increased in real terms from $806 million in 2005–06 to $952 million in 2014–15. The main source of this growth was the increased cost of the R&D tax incentive provided to the private sector
- state and territory government funding declined in real terms, from $330 million in 2005–06 to $239 million in 2014–15
- university contributions to rural R&D (from student fees, royalties and income from assets) increased in real terms, from $240 million in 2005–06 to $345 million in 2014–15.
In addition to rural R&D funding, a further $316 million of funding was used in 2014–15 to support extension (activities designed to facilitate adoption of technologies produced by R&D). This comprised $179 million provided by the public sector and $137 million of private funding for extension. Total public sector funding for extension declined between 2005–06 and 2010–11. An increase in Australian Government funding between 2010–11 and 2014–15 helped reverse this trend.

To help validate the estimated value of funding for rural R&D, we also estimated expenditure on rural R&D—thus capturing investment as it entered and left the R&D system. In 2014–15 total rural R&D performed was valued at $3.1 billion (Figure S2). The similarity of the estimates indicates that the approach used to value the R&D system is sound.

**Figure S2 Simplified flow of investment through the rural R&D system, 2014–15**

The flow of funding through the R&D system is complex and was described by the Productivity Commission (2011) as a ‘money-go-round’. The flow of funding between parties (as the result of leveraging, collaborating and funding application processes) creates a risk of double counting the R&D investment. A number of other challenges were also tackled in estimating R&D investment, including aligning to statistical classifications and accessing appropriate data for each funder and performer of R&D. The method used in this study allows comparison of results with past studies. It also provides opportunity for future work to consider the long-term returns from R&D investment and the rural R&D priorities. We have developed comprehensive estimates but shortcomings in the data remain.
1 Introduction

Research and development (R&D) delivers new technologies and knowledge and is a key driver of productivity growth and competitiveness in international markets. In Australia, slower agricultural R&D investment growth during the 1980s has been linked to a slowdown in agricultural productivity growth during the 2000s (Sheng et al. 2011). This report describes trends in rural R&D investment in recent years and identifies the contribution of the public and private sectors.

In this research we developed a database, using a large number of sources, to identify the value of rural R&D investment—as it enters the system as funding and as it leaves the system as expenditure when R&D is performed. Although difficulties remain in estimating the value of rural R&D, we have analysed available data to provide the best possible estimate.

Defining rural R&D

We have adopted a wide definition of rural R&D, reflecting the national rural R&D priorities (see Department of Agriculture and Water Resources 2016a). Rural R&D is defined to include the research categories of agriculture, fisheries and forestry, sustainable production, agricultural inputs and rural processing. The definitions of each category were drawn from the ABS (2008) research classifications, based on the purpose of the research (specifically the socio-economic objective—see Appendix A for more detail):

- **Agriculture, fisheries and forestry R&D** includes ‘plant production and plant primary products’ and ‘animal production and animal primary products’.

- **Sustainable production R&D** includes ‘control of pests, disease and exotic species’, ‘land and water management’ and ‘soils’. It also includes climate and climate change where investment in rural climate research was identifiable.

- **Agricultural inputs R&D** includes ‘agricultural chemicals’ and ‘veterinary pharmaceutical products’ and ‘agricultural machinery and equipment’.

- **Rural processing R&D** includes processed food products and beverages, dairy products, processed non-food agricultural products, leather products, fibre processing and textiles, wood, wood products and paper, and biofuel (biomass energy).

Disaggregating rural R&D into these components helps provide a clearer understanding of investment trends; allows comparison with other studies that used different definitions of rural R&D; and provides an opportunity for future work to consider the long-term returns from R&D investment and the balancing of rural R&D priorities.

Investment in extension is not included in our estimate of rural R&D but is reported separately. We define extension as the application of scientific research and knowledge into practice through communication and education. In the context of the Australian rural sector, extension facilitates the uptake of technologies and innovations to increase productivity growth and generate other benefits such as improved quality and safety. A formal definition of extension is available in NPIRDEF (2011). Judgement was required in some instances to apportion funding between R&D and extension activities, given some research projects offered both (Mullen, Gray & de Meyer 2015).
Australia’s rural R&D system

Australia’s rural R&D system is made up of funders, intermediaries and performers (Figure 1). Funding is provided by the Australian and state and territory governments, universities and private firms and is supplied to the performers of rural R&D, namely Australian Government agencies such as CSIRO, state and territory government research facilities, universities and private firms.

Some R&D funds are channelled through intermediaries including Research and Development Corporations (RDCs) and Cooperative Research Centres (CRCs). The RDCs procure and facilitate joint investment in R&D on behalf of primary industries and the Australian Government. Similarly, CRCs facilitate collaborative research between the public and private sector that aligns with national R&D priorities.

A small amount of R&D is funded and performed by not-for-profit organisations (ABS 2015a, 2016a,b). This R&D was excluded from the study due to concerns about double counting the investment and difficulties identifying the funders and performers.

The remaining sections of this chapter provide more details about the individual funders and performers of rural R&D in Australia.

Rural R&D funders

R&D funders provide budget appropriations or outlays to R&D performers (including to self) or third parties for R&D activities. The main funding providers are the Australian and state and territory governments, universities and the private sector (including levies paid by primary producers to the RDCs).

Australian Government funding

The Australian Government funds R&D through five main programs and some smaller ones. The main programs focus specifically on rural issues or have a more general direction that includes rural issues.
1. Research and Development Corporations (RDCs)

The RDCs facilitate programs by directing research funds and fostering R&D coordination, cooperation and co-investment between industry and government. In 2016, 15 RDCs covered almost all agricultural industries, as well as the fisheries and forestry industries.

RDCs receive funds from primary producers through R&D levies (or charges on the sale of various commodities) and matched funding from the Australian Government. The government provides dollar-for-dollar matching of private funding for eligible R&D, generally up to a limit of 0.5 per cent of the gross value of production for each industry. In this report, government contributions to the RDCs excludes private levy payments to the RDCs, which are considered as private funding.

The RDCs commission research based on the identified needs and priorities of industry and the Australian Government. Pooling funding from many producers allows collective action to fund R&D that small producers are unlikely to undertake alone (Parliament of Australia 2013). Further information is available from Rural R&D Corporations (2016).

2. Cooperative Research Centres (CRC) Programme

The CRC Programme is a partnership between the public and private sectors. In 2014–15, 33 CRCs operated in Australia, six focusing on rural R&D. CRC collaborations include at least one Australian end user and a publicly funded research organisation (Department of Industry, Innovation and Science 2015a). Government funding matches contributions from participants in a CRC (Department of Industry, Innovation and Science 2015a). Further details are available in Cooperative Research Centres Association (2016).

3. Core funding for CSIRO

CSIRO is the national science agency for Australia. The majority of funding CSIRO receives is from Australian Government budget appropriations through the Department of Industry, Innovation and Science. CSIRO also receives Australian Government funding from other programs or for ad hoc requests. CSIRO receives funding from other sources but this was not included in the estimate of core funding to avoid double counting.

4. Core funding for universities

Research Block Grants (RBGs) help to fund research and research training at Australian universities. Universities are free to allocate this funding as they see fit and use some to support rural R&D, although they are not required to report how the funding is spent (Department of Education and Training 2015a). Additional government funding is also available to universities through the National Competitive Grants Program for specific fundamental and applied research projects. This funding is discussed in the section of this chapter titled ‘Other government programs’.

5. Foregone tax receipts arising from R&D tax incentive

The R&D tax incentive provides a tax offset for eligible R&D expenditure to encourage private sector investment in R&D (Box 1). This initiative reduces government tax revenue so can be viewed as government funding to foster the private sector’s research efforts.
Box 1 The R&D tax incentive

The R&D tax incentive was established in 1985 (as the R&D tax concession) and is designed to encourage business investment in R&D by providing a tax offset for R&D activities. The incentive is available to incorporated companies within Australia, public trading trusts and foreign corporations considered residents for tax purposes (ATO 2017). It is not available to sole traders, partnerships, tax exempt entities and non-publicly trading trusts.

The tax incentive depends on the annual turnover of a company. Firms with an aggregate turnover of less than $20 million can claim a refundable 43.5 per cent tax offset of their first $100 million of eligible R&D expenditure. For firms with an aggregate turnover of more than $20 million a non-refundable tax offset of 38.5 per cent is available. Where the R&D expenditure exceeds $100 million, the tax offset over this amount is reduced to the corporate tax rate of 30 per cent (ATO 2017).

To be eligible, R&D activities must be considered ‘core R&D’. That is, the R&D activity must be related to the purpose of the business, attempt to generate new knowledge, follow the scientific method and lead to outcomes that cannot be known in advance. Some R&D, such as market research, social science research, resource exploration and marketing, are not eligible for the tax incentive. Contributions to the RDCs (levy payments and voluntary contributions) are not eligible for the R&D tax incentive.

These rules are currently under review and the government is expected to release its response to the R&D Tax Incentive Review in 2017.

6. Other government programs

A number of other government programs fund rural R&D (Appendix B). These programs include economy-wide initiatives that allocate some funding to rural R&D (such as Australian Research Council administered grants); direct funding for rural R&D (such as the Rural Research and Development for Profit program and Australian Centre for International Agricultural Research); and funding for specific areas of R&D that benefit rural industries (such as the Biosecurity Centre of Excellence). In 2014–15 the Australian Research Council's competitively awarded National Competitive Grants Program was the most significant of these programs.

State and territory government funding

State and territory governments provide significant funding for rural R&D. Historically much of this funding has been directed to in-house research at state and territory research and experiment stations. Some governments are increasingly partnering with universities to undertake R&D on their behalf rather than performing this research directly. Examples include the Tasmania Institute of Agriculture and the Queensland Alliance for Agriculture and Food Innovation. The state and territory governments also provide funding or in-kind contributions to the RDCs, CRCs, universities and CSIRO.

Contributions from universities

Universities contribute their own funds (from student fees, royalties and other income) to support research efforts (ABS 2016b; Department of Education and Training 2016a). This funding is largely used to pay for in-kind time staff spend working on research grant projects. Universities also use their own funds to attract funding from other sources, such as RDCs and CRCs. The universities use their contributions to enhance their research capacity, international standing and visibility to attract domestic and international students (OECD 2016a).
Private sector funding
The private sector provides funding for rural R&D through two main channels—funding for privately performed R&D and funding collected through levies and voluntary contributions to RDCs.

1. Funding for in-house research
A large number of private entities fund and undertake their own R&D. In 2013–14, 445 agriculture, forestry and fishing businesses registered as undertaking R&D eligible for the R&D tax incentive (Department of Industry, Innovation and Science 2015b). Private R&D financiers typically fund and perform their own R&D (ABS 2015a).

2. Payments to the RDCs
Primary producers also fund rural R&D through payments to RDCs. For most commodities, a compulsory levy is applied to production quantity or value at a rate set by the industry. For example, wheat is levied at 1.02 per cent of the farmgate value and milk is levied at 2.9 cents per kilogram of milk fat and 7.1 cents per kilogram of protein.

Some RDCs also receive voluntary contributions from private firms. Horticulture Innovation Australia and the Rural Industries Research and Development Corporation receive voluntary contributions from small industries where a statutory levy is unviable due to the cost associated with collecting the levy. The meat processing sector makes voluntary contributions to Meat & Livestock Australia to fund R&D across the meat supply chain.

Overseas funding
Only a small amount of rural R&D performed in Australia is funded from overseas sources. The International Science Linkages program was developed by the Australian Government to facilitate international collaboration but accounts for a very small proportion of total rural R&D funding.

Rural R&D performers (expenditure)
Funding is supplied to the performers of R&D, who employ researchers to conduct research and create new knowledge. The main groups performing research are Australian Government agencies such as CSIRO, state and territory government research facilities, universities and private firms.

Australian Government performing rural R&D
Several Australian Government agencies perform R&D, although CSIRO is the principal agency. CSIRO’s agriculture and food research program directly contributes to rural R&D, as does work in environment, health and biosecurity programs. CSIRO has a strong, internationally recognised research profile in the field of agricultural sciences and is ranked ninth among research institutions globally (CSIRO 2016).

State and territory governments performing rural R&D
Historically, each state and territory had a primary industry department that operated experimental research stations. Some states still have these research stations—for example, the South Australian Research and Development Institute operates an extensive network of research facilities with a focus on plant sciences and aquatic sciences (SARDI 2016). The scope of activities undertaken by primary industry departments varies by state. In some states, rural R&D is performed in one department, several departments or as part of ‘super’ departments that also conduct R&D in other sectors.
Universities performing rural R&D
Of the 41 universities in Australia, 24 undertake rural R&D (Australian Research Council 2015). These universities are highly regarded for performing agricultural and veterinary science research, with five universities ranked well above the world standard (Australian Research Council 2015). Rural R&D takes place in a range of university faculties—for example, the chemistry faculty could develop new fertilisers or the engineering faculty could develop a new robot for farm work.

Private sector performing rural R&D
Rural R&D is undertaken by a large number of private sector organisations in different industries, including corporate farm businesses, chemical and fertiliser companies, plant breeders and agricultural machinery companies (Keogh & Potard 2011). Private firms largely undertake R&D to deliver new marketable products or technologies that generate increased profits.

Not-for-profit research sector performing rural R&D
Not-for-profit research organisations also undertake R&D, such as the Plant Breeding Institute and the Birchip Cropping Group. However, these research performers were excluded from our analysis because their expenditure is relatively small (Appendix B) and because of concerns with double counting.

Data sources
Identifying rural R&D funding is difficult because funding data are not kept in a single repository. For expenditure, difficulties with the central collection of data also complicate the estimation process. In this study, a database for funding and expenditure was developed from numerous sources, including those in Table 1. The process for compiling data from these sources to estimate the value of rural R&D funding and expenditure is outlined in Appendix B.
Table 1 Data sources

<table>
<thead>
<tr>
<th>Source</th>
<th>Primary data custodian</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research and Experimental Development Survey</td>
<td>Australian Bureau of Statistics (ABS)</td>
<td>A biennial survey that collects estimates of R&amp;D expenditure and human resources devoted to R&amp;D by government, universities, businesses and not-for-profit organisations in Australia. The data are collected to monitor and analyse the nature and distribution of R&amp;D activity in Australia. The data collected in this survey are classified by type of expenditure, source of funds, location of expenditure, type of activity, fields of research, socio-economic objectives and type of resource. The level of detail about the socio-economic objective of research collected in this survey has been reduced over time from the relatively detailed 6-digit level in 2008–09 to the highly aggregated 2-digit level in 2014–15. This change has significant implications for measuring rural R&amp;D (see Appendix A for more details).</td>
</tr>
<tr>
<td>Science Research and Innovation Budget Tables</td>
<td>Department of Industry Innovation and Science</td>
<td>An annual survey that collects estimates of Australian Government funding for R&amp;D programs and activities. The survey provides a central source of information on Australian Government R&amp;D support. The tables provide summaries by sector, government portfolio, socio-economic objective and method of funding allocation. Data classified by socio-economic objective are reported at the 2-digit level.</td>
</tr>
<tr>
<td>OECD Producer Support Estimates &amp; WTO Domestic support estimate survey</td>
<td>Department of Agriculture and Water Resources</td>
<td>An annual survey that collects estimates of Australian and state and territory government policy support to agriculture. These data are provided into the OECD ‘Producer Support Estimate’ and WTO ‘Domestic Support’ notification to meet our international reporting obligations for each. Support is composed of any market price support, budgetary payments or cost of revenue foregone across a variety of policy areas including R&amp;D, pest control and infrastructure.</td>
</tr>
<tr>
<td>Rural R&amp;D funding and expenditure survey</td>
<td>ABARES</td>
<td>A one-off survey of Australian and state and territory government agencies and universities that sought to fill data shortcomings. Data were collected on RD&amp;E funding and expenditure and classified by socio-economic objectives, source of funds and type of expenditure. Data on the socio-economic objective were collected at the 4-digit level.</td>
</tr>
<tr>
<td>Farm surveys</td>
<td>ABARES</td>
<td>ABARES annual surveys collect estimates on a broad range of information on the economic performance of farm business. Data on farm cash costs for ‘advisory services’ was accessed from the Australian Agricultural and Grazing Industries Survey (AAGIS), Australian Dairy Industry Survey (ADIS) and the Australian Vegetable Growing Farms survey.</td>
</tr>
<tr>
<td>Personal communications</td>
<td>ABARES</td>
<td>ABARES communicated with Australian and state and territory government agencies, universities, CRCs, RDCs and private consultants between 2015 and 2017.</td>
</tr>
<tr>
<td>RDC annual reports</td>
<td>RDCs</td>
<td>Each RDC’s annual report contains financial information on the performance of the RDC and reporting on how R&amp;D funding was allocated across the national science and research priorities and the rural RD&amp;E priorities.</td>
</tr>
<tr>
<td>Excellence in Research</td>
<td>Australian Research Council</td>
<td>A survey is conducted every three years to capture Australian university research effort and allow comparisons with international benchmarks. These data are classified by research outputs, external research income sources, staffing profile, number of patents and by fields of research and university. Data on the field of research are collected at the 4-digit level.</td>
</tr>
</tbody>
</table>
2 Results

Funding for rural research, development and extension

Annual funding for rural RD&E was $3.3 billion in 2014–15—$3 billion of this was for rural R&D and $316 million for extension (Table 2). Just over half (52 per cent) of the RD&E funding was provided by the public sector, namely the Australia Government, state and territory governments and universities.

The allocation of public and private investment in R&D varies across the value chain (Table 2). The public sector invests most heavily in R&D for agriculture, fisheries and forestry, and sustainable production. The private sector also invests in these categories and makes substantial investments in agricultural inputs and rural processing R&D—areas where the public sector has a relatively minor role.

The public sector focuses on R&D that has a greater likelihood of market failure occurring (that is, undersupply by the private sector). The farm sector is made up of many small firms, which are individually unlikely to capture all of the benefits from R&D including spill-over benefits to society. This has historically reduced incentives for individual farms to invest in agriculture, fisheries and forestry and sustainable research. In contrast, the input and processing sectors are dominated by a relatively small number of larger firms and the outputs of R&D can be more completely captured by those that perform it (for example, through patent protection on new chemicals). This creates stronger incentives for private investment in these kinds of R&D.

In the public and private sectors, the focus of R&D also varies depending on the funding mechanism used. For example, public investment through the R&D tax incentive is largely focussed on rural processing R&D because this funding is driven by the investment decisions of private firms (Figure 2). In contrast, public funding delivered through other mechanisms (such as grants to CSIRO) tend to focus on agriculture, fisheries and forestry, and sustainable production, because this is where public benefits are expected to be greatest. Similarly, private sector investment that is channelled through the RDCs has a greater focus on agriculture, fisheries and forestry, and sustainable production than that which is undertaken directly by firms.

Public and private investment in R&D are generally complementary. In some cases public investment in R&D can crowd out private investment but research in the United States suggests that the public sector tends to invest when the private sector has less incentive to do so (Clancy, Fuglie & Heisey 2016; King, Toole & Fuglie 2012). Evidence of high returns to research suggests that underinvestment in agricultural R&D remains a problem (Mullen 2011). The public sector still has a role to play in overcoming the market failure in agricultural R&D. As noted in the R&D tax incentive review, the government must encourage greater industry collaboration with research institutes to ensure R&D funding delivers ‘additionality and spill-overs’—thus maximising the benefits of funding (Ferris, Finkel & Fraser 2016).
### Table 2 Estimate of Australia’s rural RD&E funders, 2014–15

<table>
<thead>
<tr>
<th>Funding source</th>
<th>Agriculture, fisheries and forestry ($m)</th>
<th>Sustainable production ($m)</th>
<th>Agriculture inputs ($m)</th>
<th>Rural processing ($m)</th>
<th>Total R&amp;D ($m)</th>
<th>Extension ($m)</th>
<th>Total RD&amp;E ($m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australian Government</td>
<td>507</td>
<td>212</td>
<td>41</td>
<td>192</td>
<td>952</td>
<td>104</td>
<td>1,057</td>
</tr>
<tr>
<td>Research and Development Corporations (RDCs)</td>
<td>100</td>
<td>62</td>
<td>–</td>
<td>44</td>
<td>206</td>
<td>47</td>
<td>253</td>
</tr>
<tr>
<td>Cooperative Research Centres (CRCs)</td>
<td>13</td>
<td>14</td>
<td>–</td>
<td>–</td>
<td>26</td>
<td>3</td>
<td>29</td>
</tr>
<tr>
<td>CSIRO core funding</td>
<td>181</td>
<td>60</td>
<td>16</td>
<td>26</td>
<td>283</td>
<td>–</td>
<td>283</td>
</tr>
<tr>
<td>University Research Block Grant funding</td>
<td>71</td>
<td>34b</td>
<td>3</td>
<td>10</td>
<td>118</td>
<td>13</td>
<td>131</td>
</tr>
<tr>
<td>Foregone tax receipts from R&amp;D tax incentive</td>
<td>68</td>
<td>9b</td>
<td>21</td>
<td>97</td>
<td>195</td>
<td>–</td>
<td>195</td>
</tr>
<tr>
<td>Other government programs</td>
<td>77</td>
<td>33c</td>
<td>1</td>
<td>14</td>
<td>124</td>
<td>42</td>
<td>166</td>
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<td>State and territory governments</td>
<td>207</td>
<td>26</td>
<td>1</td>
<td>5</td>
<td>239</td>
<td>41</td>
<td>280</td>
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<tr>
<td>Contributions from universities</td>
<td>207</td>
<td>101b</td>
<td>10</td>
<td>28</td>
<td>345</td>
<td>34</td>
<td>379</td>
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<tr>
<td>Private</td>
<td>637</td>
<td>147</td>
<td>110</td>
<td>567</td>
<td>1,462</td>
<td>137</td>
<td>1,598</td>
</tr>
<tr>
<td>Payments to the RDCs (levies and voluntary)</td>
<td>134</td>
<td>83</td>
<td>–</td>
<td>60</td>
<td>277</td>
<td>63</td>
<td>340</td>
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<tr>
<td>Private funding of own R&amp;D</td>
<td>503</td>
<td>64b</td>
<td>110</td>
<td>507</td>
<td>1,185</td>
<td>74</td>
<td>1,259</td>
</tr>
<tr>
<td>Total</td>
<td>1,559</td>
<td>485</td>
<td>162</td>
<td>793</td>
<td>2,998</td>
<td>316</td>
<td>3,314</td>
</tr>
</tbody>
</table>

Note: Values have been rounded to the nearest $ million. Sum of components may not add to totals due to rounding.

- **a** CSIRO was also estimated to have received an additional $145 million in core funding in 2014–15 for other environmental R&D that is not included here.
- **b** Data on rural climate change research were not available for the universities and private sector. Data on funding for climate change research across the entire economy were available but were excluded because the proportion of these funds relating to the rural sector is unknown. For the private sector, rural climate R&D funding is expected to be relatively small, given economy-wide private funding for climate change was around $20 million. For university Research Block Grant funding and universities’ own funding, rural climate change research could be more substantial, with an estimated $150 million of economy-wide climate research performed in 2014–15.
- **c** Excludes climate change research from Australian Research Council grants to universities of $36.5 million because funding related to rural R&D could not be identified.
- **d** Excludes $9 million for funding other environmental research (such as ecosystem assessment R&D). We also did not include R&D funding for other objectives such as agriculture economic frameworks.
- **e** Estimate based on 2013–14 because 2014–15 figures were not available for R&D funding.
Over the past 10 years total funding for rural R&D increased from $2.3 billion in 2005–06 to $3.0 billion in 2014–15 in real terms (Figure 3). Both public and private sector funding increased between 2005–06 and 2014–15. The growth in total funding was driven mainly by the increase in private sector funding, which grew from an estimated $912 million in 2005–06 to $1.46 billion in 2014–15, in real terms. Over the same period, total public funding grew from $1.38 billion to $1.54 billion, in real terms. As a result of these trends, the private sector’s share of total funding increased from 40 per cent in 2005–06 to 49 per cent in 2014–15.
Trends in funding for individual research categories varied between 2005–06 and 2014–15 (Figure 4). Funding for agriculture, fisheries and forestry R&D increased dramatically over the 10 years to 2014–15. This increase was driven by greater private R&D funding, which almost doubled from $340 million to $637 million over the 10 years, in real terms. Public funding for agriculture, fisheries and forestry fell from $851 million in 2005–06 to $714 million in 2010–11, before increasing to $921 million in 2014–15, in real terms.

Funding for sustainable production research increased from $433 million in 2005–06 to $485 million in 2014–15, in real terms. Total investment in sustainable production R&D increased in the mid 2000s then declined from 2012–13 to 2014–15, largely driven by changes in public funding. Public funding of sustainable production and agriculture, fisheries and forestry R&D tend to move in opposite directions over time, likely reflecting re-categorisation of project funds within a fixed budget and changes in government priorities.

Funding for agricultural inputs research grew from $98 million in 2005–06 to $162 million in 2014–15. The private sector accounted for around 75 per cent of this funding over the period.

Total funding for rural processing grew from $565 million to $793 million between 2005–06 and 2014–15 in real terms, with the private sector conducting around three-quarters of this research over the period.

**Figure 4 Rural R&D funding, by research category, 2005–06 to 2014–15**

**Private funding**

The value of private R&D and private contributions to the RDCs both grew over the 10 years to 2014–15. Funding for privately performed rural R&D increased 75 per cent from $681 million to $1.19 billion between 2005–06 and 2014–15, in real terms. Private funding provided to the RDCs grew more slowly, from $231 million in 2005–06 to $277 million in 2014–15, in real terms (Figure 5).
The rapid growth of funding for privately performed rural R&D is consistent with growth across the economy and internationally. The private sector primarily funds its own research (rather than aggregating funds through entities such as the RDCs) and the share of own funds used for privately performed research has increased (ABS 2015a). In addition, private R&D performed across the Australian economy has increased rapidly over the past few decades (ABS 2015a). The proportion of global R&D private sector funding has also grown substantially and now accounts for a large proportion of agriculture and food R&D (Pardey et al. 2016).

Although the value of privately conducted R&D grew relatively rapidly between 2005–06 and 2014–15, growth in producer levies to RDCs was relatively slow. One reason for this is that the value of compulsory levies collected from private firms is proportional to the value of production for the industry as a whole. Growth in levy contributions is constrained by growth in the value and volume of agricultural production, which fluctuates over time depending on seasonal conditions and prices.

Voluntary contributions to the RDCs account for a relatively small share of total RDC funds. However, these contributions are an important source of R&D funds in some industries and sections of the supply chain. For example, the Meat & Livestock Australia (MLA) Donor Company has successfully attracted contributions from enterprises including pastoral companies, processors, breed societies and pharmaceutical providers (MLA 2017). Similarly, Horticulture Innovation Australia has received voluntary contributions from the canned fruit industry and small-scale horticulture industries that do not have a compulsory levy (Hort Innovation 2015). Most other industries do not report any voluntary contributions for R&D. This may reflect historic policy arrangements in these industries or the preference of many firms to conduct their own research where possible.
Public funding

Public funding for rural R&D also increased between 2005–06 and 2014–15, driven by growth in funding from the Australian Government and universities. The Australian Government remains the major public funding source for rural R&D. Universities have overtaken the state and territory governments in providing funding for rural R&D (Figure 6).

Figure 6 Rural R&D funding, public sector, 2005–06 to 2014–15

Australian Government funding for rural R&D increased from $806 million in 2005–06 to $952 million in 2014–15, in real terms. The main source of this growth was funding provided to the private sector through the R&D tax incentive. Box 2 contains more information about trends in the various components of rural R&D funded by the Australian Government.

Funding from state and territory governments for rural R&D fell from $330 million in 2005–06 to $239 million in 2014–15, in real terms. This decline in funding is consistent with anecdotal evidence presented by the Productivity Commission (2011). Likely explanations for this decline include ongoing pressure on budgets and a broadening of the focus of R&D funded by state and territory governments. For example, in 2014–15 state and territory government departments responsible for primary industry reported providing an additional $9 million for funding other environmental research (including ecosystem assessment, natural resource evaluation and environmental rehabilitation). This funding was excluded in this study for consistency in defining rural across funding sources but it is likely to have links to agricultural production.

Contributions from universities to rural R&D increased from $240 million in 2005–06 to $345 million in 2014–15, in real terms. Some uncertainty surrounds these values (see Appendix B) but this growth is consistent with changes in university revenue and the proportion of revenue spent on R&D over the past 10 years (Universities Australia 2015).
Changes in overall funding of rural R&D (excluding extension) by the Australian Government between 2005–06 and 2014–15 reflect changes in the six main funding initiatives (Figure 7).

**Funding for CSIRO** is the main mechanism through which the Australian Government currently supports rural R&D. This funding increased steadily from $222 million in 2005–06 to $295 million in 2012–13, before declining to $283 million in 2014–15 in real terms. Funding did not increase consistently over this period for all research categories considered—for example, trade-offs occurred between agriculture, fisheries and forestry, and sustainable production research. This is likely the result of changes in government priorities regarding research funding.

**RDCs funding** from the Australian Government declined from $237 million to $206 million, in real terms, between 2005–06 and 2014–15. Changes in the value of this funding over time reflect variation in the value of production from primary industries and policy changes such as closure of the Land and Water Resources Research and Development Corporation (Land and Water Australia) in 2009.

The value of the **R&D tax incentive** contributed by the Australian Government (in foregone tax revenue) increased for rural R&D from $75 million in 2005–06 to $195 million in 2014–15, in real terms. Growth in the tax incentive over time reflects greater expenditure on R&D by private firms and a policy change that increased the value of the tax offset available to firms engaging in R&D. The total value of the R&D tax incentive across the economy increased from $1.1 billion in 2005–06 to $2.8 billion in 2014–15, in real terms (Department of Industry, Innovation and Science 2016).

**University Research Block Grant** funding from the Australian Government for rural R&D increased from $108 million in 2005–06 to $118 million in 2014–15, in real terms. Funding for rural R&D is estimated to account for an average of 7 per cent of the total Research Block Grants provided to universities each year and growth in this rural R&D funding reflects increases in the total funding pool.

Funding for rural **CRCs** decreased from $73 million in 2005–06 to $26 million in 2014–15, in real terms (Figure 7). This reduced funding reflects a fall in the total investment in CRCs by the Australian Government and a fall in the number of rural-focused CRCs (from 21 in 2005 to six in 2015).

A variety of **other government programs** support rural R&D. The combined value of these programs has increased over time, from $91 million in 2005–06 to $123 million in 2014–15, in real terms. Annual fluctuations in the value of this funding reflect the often short-term nature of these funding programs (see Appendix B for a list of included programs).
Funding for extension, 2005–06 to 2014–15

Both the public and private sectors fund rural extension—the facilitation of knowledge and scientific research uptake through education and communication. The public sector provided $179 million in funding for extension in 2014–15, up from $161 million in 2005–06 in real terms. The private sector contributed $137 million for extension in 2014–15, up from $112 million in 2005–06 in real terms. Further work is needed to refine estimates of extension funding, in particular the assumptions used to separate extension and R&D (see Appendix B).

The Australian Government provides the majority of public funding for extension. The value of this funding increased from $76 million in 2005–06 to $104 million in 2014–15, in real terms (Figure 8). This increase mainly reflects an injection of funds from the Carbon Farming Futures programs ‘Filling the Research Gap’ and ‘Extension on the Ground’ since 2011–12.

Funding for extension from state and territory governments declined in real terms from $61 million in 2005–06 to $41 million in 2014–15.

Contributions from universities for extension increased from $24 million in 2005–06 to $34 million in 2014–15, in real terms. University extension activities are strongly linked to specific research projects. Extension was assumed to account for 10 per cent of universities’ RD&E activities (Appendix B). This estimation would benefit from further investigation.

Funding provided by primary producers to deliver extension is estimated to have increased over the 10 years to 2014–15 from $122 million to $137 million, in real terms. Of this private sector funding, just under half (45 per cent on average) was provided to the RDCs. The remainder directly funded on-farm advisory services (for example, through employing agronomists). The increase in private sector funding reflects an increase in funding provided to the RDCs and an increase in expenditure on advisory services directly by farmers.

Figure 8 Value of extension funding, 2005–06 to 2014–15
Expenditure on rural R&D

The value of rural R&D performed in 2014–15 was $3.06 billion (Figure 9 and Table 3). The R&D expenditure estimate closely matches the $3 billion in funding for rural R&D in 2014–15, indicating that our method has captured the flow of funds through Australia’s complex R&D system. In addition to providing this assurance, estimates of expenditure on rural R&D provide insight into what R&D funding is used for and where it is spent. Our analysis of expenditure does not include extension, which is only considered in the funding estimates.

Figure 9 Simplified flow of investment through the rural R&D system, 2014–15

The flow of funding through the rural R&D system generally results in multiple funders supporting each research performer. This is particularly true for public R&D agencies—the Australian and state and territory governments and universities (Figure 9). In the public sector, collaboration and harnessing of expertise in different agencies is encouraged and funding applications often require matching of cash or in-kind contributions (leveraging).

In contrast, private businesses fund nearly all of the R&D they perform themselves, with little funding received from other sources. Private firms have a greater incentive to perform their own research because they are often seeking improvement in technologies or knowledge in which they already have a commercial interest (Box 3). This incentive is further heightened by measures such as patent protection, which limit access to new technologies or knowledge (King, Toole & Fuglie 2012).
Table 3 Estimate of rural R&D expenditure (R&D performed), 2014–15

<table>
<thead>
<tr>
<th>R&amp;D performer</th>
<th>Agriculture, fisheries and forestry ($m)</th>
<th>Sustainable production ($m)</th>
<th>Agriculture inputs ($m)</th>
<th>Rural processing ($m)</th>
<th>Total rural R&amp;D ($m)</th>
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</thead>
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<td>70</td>
<td>22</td>
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<td>226</td>
<td>19</td>
<td>57</td>
<td>766</td>
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<td>616</td>
<td>64</td>
<td>142</td>
<td>651</td>
<td>1,473</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,723</strong></td>
<td><strong>410</strong></td>
<td><strong>183</strong></td>
<td><strong>745</strong></td>
<td><strong>3,061</strong></td>
</tr>
</tbody>
</table>

Note: Values have been rounded to the nearest $ million. Sum of components may not add to totals due to rounding.

a Estimate based on 2014 calendar year (rather than 2014–15 financial year). b Data for climate change research focusing on rural industries alone were not available for the universities and private sector. Only economy-wide data were available, which were excluded. Private sector, economy-wide expenditure on climate change research was estimated at around $25 million in 2014–15. For universities, economy-wide climate research was estimated at around $150 million in 2014–15. c Estimate based on 2013–14 because 2014–15 figures were not available.

The objectives of public and private R&D performers vary substantially (Figure 10). The public sector has a greater focus on agriculture, fisheries and forestry, and sustainable production research but has limited involvement in agricultural inputs or rural processing. The private sector has a relatively strong focus on rural processing and inputs. These trends mirror those observed in the funding estimates.

The public and private sectors also perform different types of research. The private sector tends to focus on applied research and experimental development. The public sector has a much stronger focus on basic and applied research (Box 3). This reflects the private sector’s concentration on marketable technologies like those related to seeds or chemicals that are more likely to generate additional profits. In contrast, the public sector generally performs research where market failure is likely, given difficulties protecting intellectual property and large spill-over benefits to other industries or the environment. A mixture of both kinds of research and development is required to sustain innovation over time, and concerns have been raised that...
'private investment alone is insufficient to keep Australia at the cutting edge of global agricultural technology' (Marslen 2014). Supporting this concern, a study in the United States found that the private sector puts less value on the rapid and widespread disclosure of new knowledge and delivers limited expansion of the knowledge base for further innovation (King, Toole & Fuglie 2012).

Box 3 Type of R&D performed

Research and development can be defined by the type of knowledge it creates (ABS 2008; OECD 2002):

- **Basic research** is undertaken to advance knowledge without any particular application or use in view.
- **Applied research** is undertaken to acquire new knowledge directed primarily towards a specific practical aim or objective.
- **Experimental development** uses existing knowledge to produce new materials, products, devices, policies, behaviours or outlooks; to install new processes, systems and services; or to improve substantially those already produced or installed.

In Australia, basic and applied research is mostly performed by the public sector and experimental development is largely performed by the private sector (Figure 11). Similarly, in the United States, public agricultural research tends to focus on pre-technology research, which is difficult to commercialise, whereas private R&D focuses on applied research and product development (King, Toole & Fuglie 2012). R&D performed by the private sector is generally geared towards providing tangible outcomes, exploiting the existing knowledge base. Over time, the focus of Australian universities has shifted towards applied research and away from basic research (ABS 2016b). This trend may reflect changes in the government grants allocation, such as the Australian Research Council linkages program, that encourage university collaboration with the private sector and not-for-profit organisations. The increase may also reflect greater funding from the private sector for university research and for rural R&D, a greater dependence on RDC funding.

Figure 11 Type of R&D performed for all Australian R&D, 2014–15

Note: University data relate to 2014 for all university activities. Private sector data reflect agricultural businesses reporting in 2013–14.

Sources: ABS 2015a, 2016a,b
R&D expenditure, 2006–07 to 2014–15

Expenditure on rural R&D increased from $2.4 billion in 2006–07 to $3.1 billion in 2014–15, in real terms (Figure 12 and Figure 13). The public sector is the dominant performer of rural R&D, accounting for 52 per cent in 2014–15, although this share has declined from 59 per cent in 2006–07.

Figure 12 Value of rural R&D performed, 2006–07 to 2014–15

Notes: Values are not provided for 2005–06 because data were not collected by the ABS in that year.

The value of rural R&D performed by the private sector increased rapidly from $980 million in 2006–07 to $1.47 billion in 2014–15, in real terms. The increase in R&D performed by the private sector mainly reflects a significant increase in own funding, rather than an increase in funding from other sources (for example, government grants).

The Australian Government is the main public funder of rural R&D but plays a smaller role in conducting rural R&D (Figure 9). The value of R&D performed by the Australian Government increased from $383 million in 2006–07 to $429 million in 2014–15, in real terms (Figure 13). Approximately 85 per cent of this R&D was performed by CSIRO.

State and territory governments have historically been the major public performers of rural R&D but have now been overtaken by the Australian Government and universities. The value of rural R&D performed by the state and territory governments declined from $535 million in 2006–07 to $393 million in 2014–15, in real terms. This decline reflects greater outsourcing of state and territory R&D efforts through partnerships with universities and a decline in funding from state and territory governments.

Universities are now the largest performers of public rural R&D in Australia. Total university expenditure on rural R&D for 2014–15 was estimated at $766 million, up from $469 million in 2006–07, in real terms. The increase in expenditure by universities was primarily driven by growth in funding contributions from universities.
Although total expenditure on rural R&D has increased over the 10 years, trends for individual research categories varied (Figure 14). For example, our results show public agricultural R&D expenditure fell until 2008–09 and ‘sustainable production’ R&D increased. These trends were largely reversed after 2010–11—agricultural R&D grew at just under 5 per cent annually between 2010–11 and 2014–15. The decline in expenditure on agricultural R&D in the 2000s is consistent with Mullen’s (2011) findings for agriculture R&D.
3 Future directions

This paper has shown that total funding for rural R&D increased between 2005–06 and 2014–15 from $2.3 billion to $3 billion, in real terms. Funding from the private sector increased but growth in funding from the public sector was comparatively limited.

This study also provides a comprehensive estimate of funding for extension, a key part of Australia’s rural innovation system. Funding for extension increased from $273 million in 2005–06 to $316 million in 2014–15, in real terms. Estimates of the value of private expenditure on extension could be further refined.

Looking ahead, growth in funding of rural RD&E has mixed potential. In the public sector, Australian Government funding is likely to increase for some programs and decline for others (Box 4). Funding from state and territory governments is unlikely to increase because many jurisdictions face greater budget pressures. Contributions from universities could be a source of greater rural R&D funding because growth in exports of education is expected to continue (Deloitte Access Economics 2015) and universities are expected to seek to improve their international standing through R&D (OECD 2016a).

In the private sector, increased globalisation has intensified competition among firms and is a primary driver of private R&D investment, as firms seek to reduce costs and create new markets (Department of Industry and Innovation 2008; King, Toole & Fuglie 2012). Globally, growth in private agricultural R&D has been driven by rising commodity prices (King, Toole & Fuglie 2012; Pray & Fuglie 2015). However, recent falls in many commodity prices mean price expectations may be insufficient to support long-term private sector R&D investment (Fuglie 2016). Private investment in Australian rural R&D has increased but still lags behind the share and absolute amount reported in the United States. This suggests some potential for the private sector to play a greater role in Australia but this is not guaranteed because Australia remains a relatively small market. Based on the trends presented here and international experience (Clancy, Fuglie & Heisey 2016; Pardey et al. 2016), the private sector is likely to be the main source of growth in funding for rural RD&E in the future.

Governments will continue to play an important role as a funder of R&D and as a facilitator of private investment. Public funding is important to support long-term fundamental sciences and other research areas where private incentives are relatively limited. Effective use of the funding mechanisms employed by governments can influence the direction of both public and private R&D and contribute to innovation and productivity growth. Funding provided through direct grants (such as funding to CSIRO, RDCs and CRCs) offers greater opportunities for governments to direct how the funding is spent. The Australian Government R&D tax incentive helps drive R&D expenditure by private businesses (Department of Industry and Innovation 2008). As noted by the authors of the R&D tax incentive review, the Australian Government must look for ways to ensure funding delivers additionality and spill-overs to maximise the benefits of the funding (Ferris, Finkel & Fraser 2016).

In addition, the regulatory framework governments provide can also affect private R&D investment. The Australian intellectual property system is highly developed and provides incentives for businesses to undertake R&D by rewarding and protecting innovation (IP Australia 2015). Governments will also continue to consider the effects on private R&D investment when regulating use of specific technologies, such as genetically modified crops or drones.
Box 4 Future Australian Government funding

For the Australian Government growth in R&D funding in the future has mixed potential.

Matched funding delivered through the RDCs could increase with good seasonal conditions, strong prices or if all RDCs accessed the full funding cap. In 2014–15 not all industries received the full 0.5 per cent of industry GVP. Our analysis shows that the RDCs could have received an additional $28 million in Australian Government matching funds. In December 2013 the Australian Government enabled all RDCs to request matching payments for voluntary contributions. This could provide an additional means to increase private contributions to the RDCs.

Under the current R&D tax incentive arrangements, the foregone tax revenue will also continue to grow if trends in increasing private R&D expenditure continue. The Australian Government released the R&D Tax Incentive Review in 2016 to improve the effectiveness and integrity of the program, encourage additional R&D expenditure and improve collaboration between businesses and researchers. The Australian Government is expected to release its response to the review in 2017 and could change the nature of the tax incentive.

Three of the six rural CRCs operating in 2014–15 ended in 2016 or will end in 2017. The Developing Northern Australia CRC started in 2017 and funding for new rural CRCs was also announced in 2017 including for the High Performing Soils, Food Agility and Honey Bee Products CRCs. In addition, seven rural CRC projects (short-term grants) were funded in 2016–17 (Department of Industry, Innovation and Science 2017a,b). Successful bidding for new CRCs and CRC projects in ongoing funding rounds could help reverse the decline in funding observed over the sample period.

Changes to how university Research Block Grants are allocated could increase the contribution to rural R&D. In December 2016 the Australian Government introduced new arrangements for allocating Research Block Grants (Department of Education and Training 2016b). The new funding formula increases the focus on research income and student completions (where agriculture, fisheries and forestry performs well, accounting for over 5 per cent of the national totals for each) and removes the focus on research publications (where agriculture, fisheries and forestry performs less well, accounting for less than 3 per cent of national publications). However, this does not guarantee that agriculture, fisheries and forestry would receive an increased share of funding when universities apportion the grants.

Annual changes in funding for other government programs partially reflect the often short-term nature of these R&D funding programs (see Appendix B for a list of included programs). The Department of Agriculture and Water Resources Rural Research and Development for Profit program, which commenced in 2014–15, will inject over $180 million into RDCs across eight years to 2022.

Scope for improving estimates

We have made significant progress in identifying how much funding for rural R&D is available and where that funding comes from. In particular, this study demonstrates the importance of concurrently valuing the funding and expenditure sides of the rural R&D system through the integration of piecemeal datasets. However, like other studies (Australian Farm Institute 2010; Keogh & Potard 2011; Productivity Commission 2011) we found that some aspects of the data remain problematic. Appendix C contains a description of the key differences between our estimates and those generated in previous studies.

Improvements in future reporting could overcome some of the data issues encountered in this study and would allow improved regular reporting of estimates. Costs of collecting additional data need to be considered but key areas include:

- **Improve R&D funding data for the Australian and state and territory governments** with consistent annual reporting. A mechanism similar to the US Current Research Information System (CRIS) could provide a one-stop shop for more detailed reporting of government research funding. This would improve the transparency of funding and the extent to which grants funding can be searched. This reporting should also include the RDCs and CRCs. Such a database would streamline multiple data collections, assist policymakers in understanding R&D investment and could help researchers avoid research duplication.
• **Improve R&D expenditure data through detailed ABS surveys.** In the past the ABS provided a comprehensive dataset on R&D expenditure at the detailed level of six-digit socio-economic objective. Currently, the two-digit socio-economic objective collection allows for expenditure on agriculture, fisheries and forestry to be identified but other components of rural research investment cannot be identified. Ideally the ABS R&D expenditure survey would return to collecting data at the six-digit socio-economic objective with the same biennial frequency. This would increase the cost of the survey but the data would be more useful for various agencies including ABARES, universities, CSIRO, the Department of Industry, Innovation and Science and the Australian Research Council. More detailed collection would also allow improved alignment with the OECD for international comparability.

• **Improve university funding and expenditure reporting** which was particularly difficult to obtain. No mechanism for reporting the socio-economic objectives funded by Research Block Grants or contributions from universities is currently available. Further consultation between universities, ABARES, the Department of Education and Training, the ABS and the Australian Research Council is needed to understand the data collection requirements, mechanisms and incentives for reporting.

• **Correct errors in Australian Government reporting** identified in this report. The ABS should amend the state and territory government R&D expenditure survey to address errors in 2012–13 reporting (see Appendix B). In addition, the Department of Agriculture and Water Resources and the Department of Industry, Innovation and Science should correct or explain discrepancies between the Science Research and Innovation Budget Tables and reporting to the OECD and WTO on R&D farm support (see Appendix C Box C1).

To provide more regular reporting on rural R&D funding, less intensive estimation methods could be used in the future. One option would be to aggregate funding estimates across the different research sub-categories (for example, counting all RDC funding as agriculture, fisheries and forestry R&D). This would significantly reduce the cost and effort of identifying funding but would reduce the understanding of where funding is targeted and increase the risk of including non-relevant (or excluding relevant) R&D. Alternatively, ABS reporting on the source of funds reported in the R&D expenditure survey could be used. Our analysis suggests this approach generates broadly consistent estimates with total funding.

**Future work**

The data compiled for this report could be used to analyse the benefits of public and private R&D investment. Studies in Australia and the United States have indicated that the lags in agricultural productivity gains associated with public R&D investments are around 35 to 50 years (Mullen 2010; Sheng et al. 2011). This means that data on R&D investment and farm productivity are needed for at least this length of time to estimate the returns to investment in R&D. Further work would be required to add the data collected in this report to existing data series, such as Mullen’s (2010) estimates of broadacre R&D investment since 1953.

Future work could also look more closely at the areas of R&D in which the public and private sectors invest. For example, studies in the United States show that private sector R&D investment tends to focus on a narrower range of crops and environments than public sector investment (King, Toole & Fuglie 2012). This work could help shed light on the potential for private and public sector investment to be complementary or crowd each other out.

This report has not considered how funding available for rural R&D in Australia compares with that available in other sectors of the economy or in other countries. Future examination of this
could generate insight into opportunities to further strengthen and improve Australia’s rural R&D system and boost our international competitiveness.

In this report, private investment in R&D only included payments to the RDCs and expenditure eligible for the R&D tax incentive. Few farm businesses in Australia are eligible to claim the R&D tax incentive so the R&D conducted on farms is likely to be underrepresented in our estimates. Future work could examine the magnitude of on-farm R&D efforts and the role of private extension providers (such as agronomists). The estimate of farmers’ expenditure on R&D and extension could potentially be improved with additional data collection as part of an ABARES farm survey, if there is sufficient demand for these data.
Appendix A: Research socio-economic objectives

Research is typically classified by its objective, the method used in the analysis or by the type of knowledge that is generated. In this report, we defined rural R&D based on socio-economic objective category groupings from the ABS Australian and New Zealand Standard Research Classifications (Table A1).

The socio-economic objective focuses on the purpose or outcome of the research—for example, defence, health, transport or agriculture. The ABS (2008) and OECD guidelines (OECD 2007, 2015, 2016e) also classified research based on the method used (the field of research)—for example, engineering, mathematics or chemistry—and based on the type of knowledge generated (type of activity)—for example, basic, applied or experimental development. These classifications are described further in ABS (2008).

Table A1 ABARES definition of rural research based on socio-economic objective codes

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<tr>
<th>ABARES rural category</th>
<th>ABS socio-economic objective classification codes and description</th>
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<tr>
<td>Agriculture, fisheries and forestry</td>
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<td>8399 Other Animal Production and Animal Primary Products</td>
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<td>Sustainable production</td>
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<td></td>
<td>9604 Control of Pests, Diseases and Exotic Species</td>
</tr>
<tr>
<td></td>
<td>9609 Land and Water Management</td>
</tr>
<tr>
<td></td>
<td>9614 Soils</td>
</tr>
<tr>
<td>Agriculture inputs</td>
<td>8607 Agricultural Chemicals</td>
</tr>
<tr>
<td></td>
<td>8609 Veterinary Pharmaceutical Products</td>
</tr>
<tr>
<td></td>
<td>861401 Agricultural machinery and equipment</td>
</tr>
<tr>
<td>Rural processing</td>
<td>850501 Biofuel (Biomass) Energy</td>
</tr>
<tr>
<td></td>
<td>8601 Processed Food Products and Beverages (excl. Dairy Products)</td>
</tr>
<tr>
<td></td>
<td>8602 Dairy Products</td>
</tr>
<tr>
<td></td>
<td>8603 Processed Non-Food Agriculture Products (excl. Wood, Paper and Fibre)</td>
</tr>
<tr>
<td></td>
<td>8604 Leather Products, Fibre Processing and Textiles</td>
</tr>
<tr>
<td></td>
<td>8605 Wood, Wood Products and Paper</td>
</tr>
</tbody>
</table>

Note: First two digits of the socio-economic objective code indicate the division: 82–Plant production and plant primary products, 83–Animal production and animal primary products, 85–Energy, 86–Manufacturing and 96–Environment. For two categories the 6-digit classification was used because the 4-digit level was not primarily focused on rural R&D (for example, 8614–Machinery and Equipment includes appliances and electrical, industrial, mining, agricultural and other).
Source: ABS (2008)
Several difficulties arise when classifying rural R&D funding and expenditure using socio-economic objective codes.

1) The detail in the ABS R&D collection has been progressively scaled back, from 6-digit socio-economic objective classification until 2008–09, to a 4-digit classification until 2011–12 and then to a 2-digit classification from 2012–13 (ABS 2015b, 2016a, b). The reduced detail resulted in some challenges for identifying rural research investment. The main consequence is that research undertaken for purposes other than agriculture cannot be easily excluded from estimates. For example, at the 4-digit socio-economic objective, the codes for ‘Soils’ or ‘Land and Water Management’ are likely to include some research conducted for the purpose of mining and construction that could be excluded at the 6-digit level. At a 2-digit socio-economic objective the data are even more aggregated, making it harder to identify rural R&D. For example, rural manufacturing and agricultural input classifications are included in the all ‘Manufacturing’ research classification (which also includes other types of manufacturing such as aerospace, smelting and cosmetics).

2) The classifications change over time. The Australian and New Zealand Standard Research Classification (ANZSRC) has been used to classify R&D since 2008 (ABS 2008). Between 1998 and 2008 the Australian Standard Research Classification (ASRC) was used to categorise research. Where possible, data for earlier years were aligned to the ANZSRC classification for consistency.

3) Other important sources of data on R&D funding provide estimates at the aggregated 2-digit socio-economic objective level of detail (for example, Science, Research and Innovation Budget Tables in Department of Industry, Innovation and Science (2016)) or report by field of research (Department of Industry, Innovation and Science (2014) and Australian Research Council (2015)). Where possible, we used a consistent classification system and obtained additional data to help measure rural R&D funding.

4) The socio-economic objective categories used to define ‘rural’ exclude some relevant research investment. For example, research on ecosystem assessment and management, and economic frameworks were excluded from our estimates but this investment may be related to rural R&D for some R&D funders or performers.

5) The socio-economic objective for climate change encompasses all R&D across the economy. Even the 6-digit socio-economic objective categories for climate change only define whether the research relates to adaptation or mitigation. As such, climate change R&D investment was only included in our estimates where funding or expenditure for rural-related climate change R&D could be identified.
Appendix B: Data for funding and expenditure

This appendix describes the data sources and methods used to construct our estimates of rural R&D funding and expenditure.

**Rural R&D funders**

Funders of R&D provide appropriations or outlays to performers of R&D and third parties (including to self) for rural R&D activities. We have derived estimates of the value of rural R&D funding provided by the Australian Government, state and territory governments, universities and the private sector (including primary producer RDC levies).

**Australian Government funding**

The Australian Government provides funds to rural R&D through:

1. Rural Research and Development Corporations (RDCs)
2. Cooperative Research Centres (CRCs)
3. CSIRO core funding
4. University Research Block Grant funding
5. Foregone tax receipts arising from the R&D tax incentive
6. Other government programs.

**Research and Development Corporations (RDCs)**

**Key data sources**

- Department of Industry, Innovation and Science 2016, Science, Research and Innovation Budget Tables—Rural tab
- Department of Agriculture and Water Resources, levies finance and processing unpublished data.
- RDC annual reports

Primary producers contribute to RDCs through R&D levies and the Australian Government provides funding to match these levies. The Australian Government generally matches levies for eligible R&D up to a limit of 0.5 per cent of the gross value of production (GVP) by industry. Data for Australian Government funding contributions were primarily collected from the Department of Industry, Innovation and Science (2016) Science, Research and Innovation Budget Tables and categorised according to RDC annual reports.

A number of assumptions were necessary to estimate Australian Government funding for RDCs and the allocation of these funds between the rural research categories. First, adjustments were made to account for missing forestry and egg data (Table B1) based on data received from the Levies Finance and Processing team in the Department of Agriculture and Water Resources.

Second, Australian Government funding for RDCs was apportioned into the various categories of rural R&D based on the shares of funds allocated by the RDCs to the national rural R&D priorities as reported in the RDCs' 2014–15 annual reports. These shares were applied to the total value of funding for each RDC in earlier years to construct time series data (Table B2).
In our estimates, research classified by the RDCs as related to the ‘productivity and value added’ national rural R&D priority was assumed to represent our ‘agriculture, fisheries and forestry’ research category. This category accounted for 39 per cent of total funding across the RDCs in 2014–15. The RDC’s ‘supply chain and markets’ priority was assumed to represent our ‘rural processing’ category and accounted for 18 per cent of RDC funding in 2014–15. The RDC priorities of ‘natural resource management’, ‘climate variability and climate change’ and ‘biosecurity’ were assumed to represent our ‘sustainable production’ category and accounted for 25 per cent of RDC funding in 2014–15. Based on our analysis of the annual reports, extension was assumed to be represented in the priorities of ‘innovation skills’, ‘technology’ and ‘other’ and accounted for 19 per cent of RDC funding on average. RDC funding for the category of agricultural inputs was assumed to be zero.

The allocation of RDC funding across the R&D categories is based on judgements from material presented in the RDCs’ annual reports. This is an area for improvement in future studies. From 1 July 2016, the RDCs have been reporting against new Rural Research, Development and Extension Priorities. This change will make identifying extension funding easier, although separating rural processing and agriculture, fisheries and forestry R&D will be more difficult. No other agencies or funding sources are required to report against these rural priorities. Reporting against a more comparable classification, such as the socio-economic objective, should be considered.
<table>
<thead>
<tr>
<th>RDC</th>
<th>Government matching ($m)</th>
<th>Levy contributions ($m)</th>
<th>Voluntary industry contribution ($m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australian Grape and Wine Authority</td>
<td>12.35&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11.85</td>
<td>–</td>
</tr>
<tr>
<td>Cotton Research and Development Corporation</td>
<td>7.30&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.30</td>
<td>–</td>
</tr>
<tr>
<td>Fisheries Research and Development Corporation</td>
<td>18.71&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.16&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.21&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Grains Research and Development Corporation</td>
<td>67.85</td>
<td>117.59</td>
<td>–</td>
</tr>
<tr>
<td>Rural Industries Research and Development Corporation</td>
<td>12.74&lt;sup&gt;e&lt;/sup&gt;</td>
<td>4.48</td>
<td>–</td>
</tr>
<tr>
<td>Australian Egg Corporation Ltd</td>
<td>1.78&lt;sup&gt;f&lt;/sup&gt;</td>
<td>2.03</td>
<td>–</td>
</tr>
<tr>
<td>Meat &amp; Livestock Australia Ltd</td>
<td>42.26&lt;sup&gt;a&lt;/sup&gt;</td>
<td>28.53</td>
<td>26.80&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Australian Livestock Export Corporation Ltd</td>
<td>–</td>
<td>0.94</td>
<td>–</td>
</tr>
<tr>
<td>Australian Meat Processor Corporation Ltd</td>
<td>–</td>
<td>14.21</td>
<td>–</td>
</tr>
<tr>
<td>Australian Pork Limited</td>
<td>5.19&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.18</td>
<td>–</td>
</tr>
<tr>
<td>Australian Wool Innovation Ltd</td>
<td>12.48&lt;sup&gt;a&lt;/sup&gt;</td>
<td>19.36&lt;sup&gt;b&lt;/sup&gt;</td>
<td>–</td>
</tr>
<tr>
<td>Dairy Australia Ltd</td>
<td>21.39</td>
<td>25.81&lt;sup&gt;h&lt;/sup&gt;</td>
<td>–</td>
</tr>
<tr>
<td>Forest and Wood Products Australia Limited</td>
<td>3.30&lt;sup&gt;r&lt;/sup&gt;</td>
<td>2.59&lt;sup&gt;h&lt;/sup&gt;</td>
<td>–</td>
</tr>
<tr>
<td>Horticulture Innovation Australia Ltd</td>
<td>41.02</td>
<td>26.32</td>
<td>16.80&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Sugar Research Australia Ltd</td>
<td>6.06&lt;sup&gt;a&lt;/sup&gt;</td>
<td>22.68</td>
<td>–</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>252.72</strong></td>
<td><strong>296.02</strong></td>
<td><strong>43.81</strong></td>
</tr>
</tbody>
</table>

<sup>a</sup> RDCs government matching funding grouped under ‘other rural research’ or ‘meat research’ in Department of Industry, Innovation and Science (2016) SRI budget tables. Accrual data for individual RDCs provided by Department of Agriculture and Water Resources.

<sup>b</sup> The Fisheries RDC receives matched funding based on the industry contribution of up to 0.25 per cent of GVP ($6.217 million) and the Australian Government makes a further contribution of 0.5 per cent of GVP for their fisheries stewardship role ($12.49 million).

<sup>c</sup> Data sourced from Fisheries RDC (FRDC 2005–2015) as Department of Industry, Innovation and Science (2016) only include levies collected by the Australian Government (the Northern Prawn Fishery), and exclude levies for other fisheries that are collected or paid by the state and territory governments.

<sup>d</sup> The Australian Government matches voluntary contributions received by Meat & Livestock Australia, Horticulture Innovation Australia and the Fisheries Research and Development Corporation. Data for these contributions were provided by the Department of Agriculture and Water Resources. The estimates provided may underestimate the total value of voluntary payments, since RDCs are not required to report voluntary contributions when they are not seeking matched funding. These data were available for 2008–09 to 2014–15.

<sup>e</sup> The Rural Industries RDC received Australian Government matched funding for levies worth $3.29 million and core funding of $9.45 million in 2014–15 (RIRDC 2015, p.136).

<sup>f</sup> Government funding data for eggs and forestry were missing in the Science, Research and Innovation Budget Tables. Data were provided by the Department of Agriculture and Water Resources.

<sup>g</sup> Australian Meat Processor Corporation and Livcorp levies were only matched by the Australian Government when funds were channeled through Meat & Livestock Australia.

<sup>h</sup> Levies for marketing are not collected separately from the R&D levy for wool, dairy and forestry. The values reported here excludes levies used for marketing based on the proportion of funds used for R&D as reported in RDC annual reports (FWPA 2008–2015; Dairy Australia 2009–2015; Australian Wool Innovation 2005–2015).

Source: Adapted from Department of Industry, Innovation and Science (2016) Science, Research and Innovation Budget Tables.
### Table B2 RDCs reporting of RD&E expenditure against the rural R&D priorities, 2014–15

<table>
<thead>
<tr>
<th>RDC</th>
<th>Productivity and adding value (%)</th>
<th>Supply chain and markets (%)</th>
<th>Natural resource management (%)</th>
<th>Climate (%)</th>
<th>Biosecurity (%)</th>
<th>Innovation skills (%)</th>
<th>Technology (%)</th>
<th>Other (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains RDC</td>
<td>55</td>
<td>5</td>
<td>8</td>
<td>3</td>
<td>18</td>
<td>10</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Australian Grape and Wine Authority</td>
<td>4</td>
<td>5</td>
<td>15</td>
<td>8</td>
<td>5</td>
<td>3</td>
<td>60</td>
<td>0</td>
</tr>
<tr>
<td>Fisheries RDC</td>
<td>18</td>
<td>7</td>
<td>48</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Rural Industries RDC</td>
<td>62</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>11</td>
<td>14</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Australian Egg Corporation</td>
<td>37</td>
<td>31</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>8</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>Australian Pork Limited</td>
<td>28</td>
<td>28</td>
<td>8</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Australian Wool Innovation</td>
<td>14</td>
<td>73</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dairy Australia</td>
<td>44</td>
<td>3</td>
<td>8</td>
<td>13</td>
<td>0</td>
<td>31</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Forest and Wood Products Australia</td>
<td>28</td>
<td>29</td>
<td>28</td>
<td>11</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Horticulture Innovation Australia</td>
<td>36</td>
<td>26</td>
<td>7</td>
<td>3</td>
<td>12</td>
<td>8</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Meat &amp; Livestock Australia</td>
<td>37</td>
<td>17</td>
<td>10</td>
<td>2</td>
<td>5</td>
<td>19</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Sugar Research Australia</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Cotton RDC</td>
<td>33</td>
<td>8</td>
<td>16</td>
<td>10</td>
<td>19</td>
<td>8</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td><strong>Weight average (%)</strong></td>
<td><strong>39</strong></td>
<td><strong>18</strong></td>
<td><strong>10</strong></td>
<td><strong>4</strong></td>
<td><strong>11</strong></td>
<td><strong>12</strong></td>
<td><strong>6</strong></td>
<td><strong>1</strong></td>
</tr>
</tbody>
</table>

*Data for Sugar Research Australia were not available from the annual report and was excluded from this estimate.

Cooperative Research Centres (CRCs)

Key data sources

- Department of Industry, Innovation and Science, funding for primary industries CRCs—special data request
- Personal communications with ongoing CRCs

The CRC Programme is a partnership between the public and private sectors in which Australian Government funding is matched to contributions from other participants (Department of Industry, Innovation and Science 2015a). These contributions can include cash or in-kind contributions and participants must include a public research organisation (including universities) and an end user. Other possible partners in CRCs include RDCs, industry representative bodies and government organisations.

CRC funding data for 2005 to 2015 were obtained from the Department of Industry, Innovation and Science (CRC Co-ordination Branch [Department of Industry, Innovation and Science] 2016, pers. comm., 16 September). To avoid double counting, only Australian Government funding contributions were obtained from the Department of Industry, Innovation and Science, since contributions from other entities are reflected in estimates for other sources of funding.

Australian Government funding for CRCs was allocated into the various research categories based on the overall aim of the CRC. Allocating funds based on the aim of each sub-project within a CRC would be more accurate, but data on sub-projects were not available. Using this method, CRCs engaged in agriculture, fisheries and forestry and sustainable production research were identified but no CRCs engaged in rural processing or rural inputs research were found (Figure B1). This method may have excluded some CRC funding for rural-related research. For example, the CRC for Remote Economic Participation Enterprise Development program developed an indigenous bush tomato enterprise.

Deriving an estimate of CRC funding for extension was relatively difficult because the CRCs are not required to report this component separately. However, several ongoing rural CRCs were able to provide funding estimates of their extension activities for 2014–15. Based on an average of these reported extension estimates, we inferred that the value of CRC extension funding in 2014–15 was equivalent to 13 per cent of total CRC funding.
**CSIRO core funding**

**Key data sources**

- Department of Industry, Innovation and Science 2016, Science, Research and Innovation Budget Tables—SEO tab
- Direct survey

The Australian Government provides funding to CSIRO for R&D through annual budget appropriations, other programs and for ad hoc requests. Appropriation funding is reported in the Science, Research and Innovation Budget Tables (Department of Industry, Innovation and Science 2016), although these data are reported at a broad level (socio-economic objective 2-digit classification). As a result, apportioning funding between our rural R&D categories was not immediately possible. Data on non-appropriation Australian Government funding for CSIRO are not reported in the Science, Research and Innovation Budget Tables.

We directly surveyed CSIRO to obtain more detailed information about the categories of rural R&D that CSIRO performs and the value of non-appropriation funding from the Australian Government. We addressed the risk of double counting by cross-checking the Department of Agriculture and Water Resources (2016b) grants register to ensure that grants funding was not captured in the estimates of other government program funding for CSIRO.

CSIRO does perform some extension but this is largely embedded within projects and could not be identified separately. CSIRO noted that ‘extension is not currently a significant feature of CSIRO work, although it does occur at project level on a case by case basis’ (CSIRO 2015, pers. comm., 21 December). Our estimate of the value of extension performed by CSIRO is zero.

**University Research Block Grant funding**

**Key data sources**

- Department of Education and Training, 2015, Block grants funding
- ABS, Research and Experimental Development, Higher Education Organisations, cat no 8111.0.
- ABS, Research and Experimental Development, Higher Education Organisations, special data request 8111.0.
Universities receive funding to undertake rural R&D from a number of government sources. These include Research Block Grants funding, Australian Research Council grants, CSIRO and other government grants. However, the primary source of funding for universities from the Australian Government are Research Block Grants. We have accounted for the value of other programs elsewhere in this appendix. In this section we focus only on the value of Research Block Grants. These grants are designed to support ‘research’ and ‘research training’. It was not possible to separate funding for these two components and so we have assumed that all Research Block Grant funding delivers R&D.

The total value of the Research Block Grants provided by the Australian Government was $1.8 billion in 2014 (Department of Education and Training 2015b). However, universities are not required to report on how the funding is spent (Department of Education and Training 2015a). To apportion the funding estimates to rural R&D and by research category, we first surveyed the universities directly. This proved largely unsuccessful because of difficulties in integrating survey results with ABS data (Box B1). We concluded that the most robust approach was to assign Research Block Grant funding using the shares of research performed in each category at universities, as reported by socio-economic objective in the ABS R&D expenditure survey. This approach gave results consistent with using the Research Block Grants formulas but was less data intensive and more applicable across the rural categories.

Based on anecdotal evidence it was assumed that 10 per cent of funding for universities was used for extension. The Australian Research Council is currently considering options for collecting data on extension activities undertaken by universities as a means of encouraging greater engagement between universities and industry. If collected, these data would help improve the accuracy of our estimates.

Box B1 Difficulties with universities survey data

On behalf of ABARES, the Australian Council of Deans of Agriculture (ACDA) sought data on the value of rural R&D from 32 Australian universities via each university’s Deputy Vice Chancellor for Research or Research Offices. The Australian Council of Deans of Agriculture invested considerable time and resources in trying to overcome the significant data deficiencies ABARES identified. A number of unexpected difficulties were encountered:

- Universities only collected data on a calendar year basis, not a financial year basis.
- Our survey requested information on both expenditure and income data, but the universities did not hold data on income allocated against relevant socio-economic objective codes. Income data are stored by ‘field of research’ codes for external grants and could not be compiled by socio-economic objective.
- Our survey sought data at a more detailed level than more recent ABS surveys but with the scaling back of the ABS collection and no other incentives tied to reporting by socio-economic objective, few universities were able to provide the data at a more detailed level.
- Universities do not routinely collect data on their extension activities. Where relevant data are collected, these are not recorded against socio-economic objective codes. Extension has received little attention from universities because it is not required in any other data collection. The Research Offices were unable to provide any information on the value of the extension activities conducted by the universities.

As a result of these difficulties, the survey effectively replicated the ABS survey but could not be reconciled with the ABS results. Unfortunately this meant the process did not result in useable data. This was disappointing for both ABARES and the Australian Council of Agriculture Deans. The difficulties encountered highlight the importance of a central repository, like the ABS, for collecting and compiling data in sufficient detail.
Foregone tax receipts arising from the R&D tax incentive

Key data sources

- Department of Industry, Innovation and Science 2016, Science, Research and Innovation Budget Tables—SEO tab
- ABS 2015, Business Expenditure on R&D, ABS cat. no. 8111.0,
- ABS, 2015, Business Expenditure on R&D special data request cat. no. 8111.0

The R&D tax incentive provides a tax offset for eligible R&D expenditure to encourage private sector investment in R&D. The foregone tax revenue from the tax incentive therefore represents Australian Government funding for private R&D. The value of R&D tax incentive is reported in the Science Research and Innovation Budget Tables (Department of Industry, Innovation and Science 2016), although the level of detail required to apportion tax incentive across our rural R&D categories was not available. Therefore, we allocated the tax incentive to the research categories using the shares that apply to total private sector expenditure on rural R&D (see Private sector performing rural R&D). This method is consistent with the allocation of the tax incentive to ‘agriculture’ in the Science, Research and Innovation Budget Tables (Department of Industry, Innovation and Science 2016).

Other government programs

Key data sources

- Department of Industry, Innovation and Science 2016 Science, Research and Innovation Budget Tables—MasterTable
- OECD 2016b, Producer Support Estimate
- WTO 2016, Domestic Support Notification
- Personal communications with Department Agriculture and Water Resources, Department of Industry and Innovation, Department of Infrastructure, Productivity Commission and Australian Research Council.

The Australian Government funds a large number of other programs that support rural R&D (listed in Box B2). The primary data source used to estimate the value of these programs was the Department of Industry, Innovation and Science (2016) Science, Research and Innovation Budget Tables. This source was supplemented using the World Trade Organisation (2016) Domestic Support Estimates and OECD (2016b) Producer Support Estimates, although some programs reported in these sources were excluded (Box B3). To apportion funding between the rural R&D categories, further information was collected through personal communications with program managers in various Australian Government departments. The share of funding directed to extension was also collected for several programs through personal communications.
These programs were included in the estimate of funding provided for 2005–06 to 2014–15:

- Animal Welfare, Biosecurity and Exotic Disease Preparedness programs
- Australian Institute of Marine Science
- Australian Nuclear Science and Technology Organisation
- Australian Research Council grants
- Australian Centre for International Agricultural Research
- Bureau of Meteorology
- Carbon Farming Futures—Action on the Ground
- Carbon Farming Futures—Extension and Outreach
- Carbon Farming Futures—Filling the Research Gap
- Carbon Farming Initiative
- Caring for our Country Reef Rescue program
- Caring for our Country Reef Rescue Research and Development Water Quality Program
- Centres of Excellence—Biosecurity Risk Analysis
- Centres of Excellence—National Food Industry Strategy
- Climate Change Adaptation Partnerships Program
- Climate Change Research Program
- Fisheries Resources Research Fund
- Food Innovation Grants—National Food Industry Strategy
- Forest Industry Climate Change Research Fund
- National Collaborative Research Infrastructure Strategy
- National Environmental Research Program—Tropical Ecosystems Hub research
- National Landcare Innovation grants
- National Weeds and Productivity Research Program
- New Industries Development Program
- Plant Biosecurity and Response Reform
- Rural Research and Development for Profit
- Regional Food Producers/Seafood Industry Innovation and Productivity Program
- River Murray Sustainability Program—SA Regional Economic Development Element
- Securing The Future: Protecting our Industries from Biological, Chemical and Physical Risks
- Tasmanian Community Forestry Agreement
- Torres Strait Prawn Fishery Program.
Box B3 Excluded funding programs

Funding reported in a number of public sources was excluded from the estimates of Australian Government funding for rural R&D:

- **Science Research and Innovation Budget Tables**: Funding for the Science and Innovation Award was excluded because it is funded from industry contributions rather than by the Australian Government. Funding for the Australian Centre for International Agricultural Research was only included where it was reported to the Australian Research Council (2016) as being received by an Australian university.

- **OECD Producer Support Estimates**: The Australian Farming Future Community Networks and Capacity Building and Industry Skills Councils—Agrifood Skills Australia programs were excluded. Both were assessed as providing advisory services on skills development to industry and the government, rather than being an extension of research and development.

- **WTO Domestic Support Estimates**: A number of the programs reported to the WTO are financial advisory services rather than the extension of research. This reflects the WTO reporting requirements to include ‘advisory services...transferring information’ (WTO 1995a, 2016), which was assessed as not relevant for this report. As such, funding was excluded for the Rural Financial Counselling Service, Exceptional Circumstances Professional Advice and Planning Grant, Sugar Industry Reform Program, Irrigation Industries Workshop Program, Farm Help and the Industry Partnership Program.

- **Productivity Commission (2011)**: It was not possible to identify funding for all of the research programs supporting rural climate change research in 2008 that were identified by the Productivity Commission (2011), so these programs were excluded.

- **R&D funding for ABARES**: The majority of the work performed by ABARES was deemed to be outside the scope of R&D (such as commodity analysis). Estimating the value of rural R&D that is conducted (mainly in the form of methodological improvements) was not considered worthwhile, given the difficulty associated with doing so and the relatively small effect it would have on the estimates.

### State and territory government funding

**Key data sources**

- Direct survey
- ABS 2016a, Research and Experimental Development, Government and Private Non-Profit Organisations cat. no. 8109.0
- ABS 2015b, Research and Experimental Development, Government and Private Non-Profit Organisations, special data request cat. no. 8109.0
- OECD 2016b, Producer Support Estimate
- WTO 2016, Domestic Support Notification

State and territory governments provide significant funding for rural R&D. Historically, much of this funding has supported in-house research, such as that conducted on research stations owned by departments of primary industry (or equivalents). The state and territory governments also provide funding and in-kind contributions to other performers of rural R&D, including the RDCs, CRCs, universities and CSIRO.

The value of funds provided by state and territory governments to others for rural R&D cannot be identified in the ABS R&D expenditure survey because these funds are often channelled through intermediaries. To resolve this shortcoming, we surveyed the state and territory government departments of primary industry (or equivalents) to obtain estimates of their total funding for rural R&D.

Data from the survey were used to estimate the funding provided for in-house research and for research conducted by others in 2014–15. However, estimates of funding for these two types of research prior to 2014–15 could not be obtained for all states. Estimates of the value of in-house research in earlier years were generated using data on the value of ‘own funds’ reported by state and territory governments as performers of R&D in the ABS R&D expenditure survey (see [State and territory governments performing rural R&D](#)). To implement this approach, a custom dataset was purchased from the ABS. The estimates obtained are broadly consistent with the value of...
state and territory government support for agriculture R&D as reported to the OECD and WTO (Figure B2).

However, this approach did not capture the value of funds provided by state and territory governments to others for rural R&D. Historically, the value of this funding has been very small ($8 million in 2008–09) but, with increased R&D outsourcing, funding provided to others has increased over time and accounted for over 10 per cent of funding ($25 million) in 2014–15. Using the value of ‘own funds’ from the ABS R&D expenditure survey as the estimate of total funding is likely to increasingly understate the value of state and territory government funding for rural R&D. This highlights the importance of public reporting of funding by the state and territory governments.

The value of state and territory government funding for extension was estimated using directly collected survey data and the WTO Domestic Support Estimates. The value of extension funding reported to the WTO was halved, based on the survey results and personal communications with a number of agencies, who noted that around half of their extension activities were funded from external sources.

Figure B2 State and territory agriculture R&D funding

![Graph showing state and territory agriculture R&D funding from 2005–06 to 2014–15](image)

Notes: Estimates include fisheries and forestry R&D for ABARES and ABS
Sources: ABS 2015b, 2016a; Keogh & Potard 2011; OECD 2016b; WTO 2016

**Contributions from universities**

**Key data sources**

- Direct survey
- ABS, Research and Experimental Development, Higher Education Organisations, cat, no. 8111.0; ABS special data request 8111.0
- Australian Research Council 2015, Excellence in Research for Australia, grant income sources and publications reported by field of research
- Department of Education and Training 2015, Research Block Grants funding

Universities report the funding they provide to support rural R&D in the ABS R&D expenditure survey. Results from this survey suggest that 55 per cent of total university R&D expenditure...
was sourced from general university funds over the past 10 years (ABS 2016b). However, based on funding reported at the national level, we believe this is an overestimate caused by the way university funds are reported to the ABS. Accordingly, we used data from the ABS R&D expenditure survey to estimate the value of contributions from universities for rural R&D.

In particular, we assumed that reported total expenditure on R&D by universities is funded by (1) the Research Block Grants (reported by Department of Education and Training 2015b); (2) other external income sources (reported to the Australian Research Council’s Excellence in Research for Australia); and (3) the contribution from universities. In applying this approach, we found that funding contributions from universities accounted for around 45 per cent of funding for university research performed over the past 10 years. The annual share of contributions was multiplied by the total value of R&D expenditure by the universities for each research category (see Universities performing rural R&D) to estimate total university funding by category. Based on anecdotal evidence we assumed that 10 per cent of rural R&D funding from universities was directed to extension activities.

**Private sector funding**

**Funding for own research**

### Key data sources

- ABS 2015, Business Expenditure on R&D, ABS cat no 8111.0, ABS special data request 8111.0

A large number of private entities fund and undertake their own R&D, including farmers, processors and input manufacturers. Data on the value of this R&D are reported to the ABS by private entities. To avoid double counting, we reduced the reported value of R&D expenditure by the annual proportion of research funding obtained by agricultural businesses from external sources (as reported to the ABS). Further, private expenditure reported by the ABS reflects the gross value of R&D funding (before taxation and deductions) rather than net expenditure. To further reduce double counting, we reduced the reported value of private R&D expenditure by our estimate of government payments made through the R&D tax incentive (see Australian Government funding – Foregone tax receipts arising from the R&D tax incentive).

Some uncertainty surrounds our estimates of private funding for rural R&D. The ABS survey relies on Australian Taxation Office data, which may contain some spurious R&D claims. The ATO (2015) identified some non-research farm expenditure being claimed under the R&D tax incentive (for example, soil treatments using off-the-shelf fertiliser products). The Department of Industry, Innovation and Science issued guidance to alert companies against claiming the R&D tax incentive for business-as-usual farming activities in 15 October 2015 (Department of Industry, Innovation and Science 2015c).

However, Keogh & Potard (2011) noted that the ABS survey sample does not include agricultural businesses investing less than $100,000 per year in R&D. It is unclear how many agricultural businesses are being excluded from the estimates but, as Keogh & Potard (2011) discuss, ‘there are few farm businesses in Australia that would be included within the sample based on the threshold of expenditure’. This aspect of the ABS survey potentially underestimates the value of private contributions to rural R&D.

The private sector also funds extension—for example, through employment of agronomists. Our estimate of this funding was derived from ABARES farm survey data on the value of ‘advisory services’ purchased by farmers. Several aspects of these data require explanation.

First, the ABARES survey data do not provide any insight into the nature of the advisory services that farmers are purchasing. Expenditure on accounting, veterinary, legal and administration
services are collected elsewhere in the surveys so the ‘advisory services’ variable is likely to mainly reflect the cost of employing agronomists and other farm advisors. However, the services provided by these advisors are likely to include both financial and technical advice, of which only technical advice should be counted as extension.

Although no data are available to directly measure the value of technical advisory services purchased by farmers, ABARES survey data show that growth in advisory services over the past 20 years has occurred almost solely in the cropping industry (Figure B3). Keogh & Julian (2014, p.50) examined the nature of private advisory services in the cropping industry and found that crop advisors ranked:

Providing advice about herbicides as the most important service they provided for farmer clients. Also important were crop nutrition and fertiliser advice; weed, disease and insect identification; and crop rotation and paddock planting. Some of the least important services were those associated with environmental outcomes or the commercial aspects of grain production including marketing and transport.

This suggests that the main role played by crop advisors is to provide extension services for technologies and research that may be of use on farms. It is likely that advisors in other agricultural industries such as livestock and vegetable growing also mainly provide advice on the use of fertilisers, pest and weed control and new crop and pasture varieties.

Figure B3 Expenditure on advisory services by industry, 1989–90 to 2015–16

Notes: Annual expenditure per farm on advisory services multiplied by total population for the industry.
Source: ABARES farm surveys

ABARES data on advisory services does not capture the entire value of private investment in extension. Many input suppliers provide free or discounted advice with the purchase of products. Keogh & Julian (2014) found that approximately two-thirds of private sector crop advisors are employed by farm input suppliers or by chemical, fertiliser and seed manufacturers and that sales commissions account for a large proportion of total income for these advisors. These commissions are not captured in the ‘advisory services’ variable so make underestimation of total expenditure on extension likely.
Another limitation of these data are that, although ABARES surveys cover the broadacre, dairy and vegetable industries, they do not cover the entire agriculture, fisheries and forestry sector. For example, intensive livestock farms are not surveyed. No alternative sources of data on the value of privately funded extension services were identified for industries not covered by the ABARES farm survey program.

Despite these limitations we consider that the ABARES farm survey data provide a sufficiently accurate approximation of the value of private expenditure on extension to include these data in the estimates.

**Payments to the RDCs**

<table>
<thead>
<tr>
<th>Key data sources</th>
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</thead>
<tbody>
<tr>
<td>• Department of Industry, Innovation and Science 2016 Science, Research and Innovation Budget Tables—Rural</td>
</tr>
<tr>
<td>• Levies Finance and Processing, Department of Agriculture and Water Resources, unpublished data.</td>
</tr>
<tr>
<td>• RDC annual reports</td>
</tr>
</tbody>
</table>

The RDCs provide a mechanism for pooling R&D funding from many producers, allowing the industry to take action collectively on issues that would not otherwise be possible for small producers to undertake alone (Alston & Pardey 2014; Industry and Investment NSW 2010; Productivity Commission 2011). Our estimates of the value of private payments to the RDCs were primarily obtained from data on R&D levies reported in the Science, Research and Innovation Budget Tables (Department of Industry, Innovation and Science 2016). This source was supplemented with reporting from RDC annual reports to remove marketing levies and add in fisheries levies collected by state governments (see notes on Table B1).

The proportions of industry levy funds allocated to the research categories of agriculture, fisheries and forestry, sustainable production, rural processing, agricultural inputs and extension were estimated using information from RDC annual reports in 2014–15, in the same way as the estimates for Australian Government payments to RDCs were constructed (Table B2). These proportions were then applied to the total value of funding in other years to construct the time series.

**Measuring extension**

Extension is often embedded in research projects, which means it can be difficult to separate from reporting on funding and expenditure. This difficulty has been previously discussed in Mullen, Vernon & Fishpool (2000), who estimated the value of extension by state and territory government departments of agriculture by applying a budget share to the total expenditure of the department. They estimated that agriculture extension accounted for between 20 per cent and 30 per cent of total budgets. The relatively wide range reflects the uncertainty associated with estimating the value of extension.

More generally, the decision to include or exclude extension in estimates of the value of rural R&D has been a contentious issue in the past. For example, the Productivity Commission (2011) decided not to separate extension from their rural R&D estimates because of difficulties associated with the statistical delineation of extension (Productivity Commission, 2011, p.14). Mullen & Keogh (2013) described data on public and private extension as scarce. Our approach was to derive an estimate of the value of extension funding wherever possible for each research funding source. Details of our estimation procedures are provided in preceding sections of this appendix.
Rural R&D performers (expenditure)

The rural R&D funding estimates are the focus of this report. However, we also estimated rural R&D expenditure. The R&D expenditure helped to validate the funding estimates and to better understand the flow of funding through the R&D system. The value of R&D expenditure is the spending on R&D by the performers of R&D. Expenditure also includes the value of in-kind contributions for collaborative work. For example, Tasmanian Government funding for the Tasmanian Institute of Agriculture pays for researchers at the University of Tasmania to perform agricultural R&D for the state.

R&D expenditure data are primarily available through the ABS R&D expenditure survey. The ABS collects these data every two years. We applied a simple average to impute missing years over the nine-year period investigated in this study. The reduced level of detail on the socio-economic objective of research in the ABS R&D expenditure survey data in recent years means that separating rural R&D into the different research categories is no longer possible. To overcome this and other gaps in the data, additional sources were used to collect data from R&D performers (Table B3).

Table B3 Expenditure data sources (R&D performed)

<table>
<thead>
<tr>
<th>R&amp;D performer</th>
<th>Expenditure data source</th>
</tr>
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<tbody>
<tr>
<td>Australian Government</td>
<td>ABS cat. no 8109.0 (ABS 2016a)</td>
</tr>
<tr>
<td></td>
<td>Survey sent to CSIRO</td>
</tr>
<tr>
<td>State and territory</td>
<td>ABS cat. no 8109.0 (ABS, 2016a)</td>
</tr>
<tr>
<td>government</td>
<td>ABS special data request cat. no 8109.0 (ABS 2015b)</td>
</tr>
<tr>
<td></td>
<td>Survey sent to state governments</td>
</tr>
<tr>
<td>Universities</td>
<td>ABS cat. no. 8111.0 (ABS 2016b)</td>
</tr>
<tr>
<td></td>
<td>ABS Special data request cat no 8111.0 (ABS 2016b)</td>
</tr>
<tr>
<td></td>
<td>Survey sent to universities via the Australian Council of the Deans of Agriculture</td>
</tr>
<tr>
<td>Private sector</td>
<td>ABS cat no 8104.0 (ABS 2015a)</td>
</tr>
</tbody>
</table>

Australian Government performing rural R&D

A number of Australian Government agencies perform R&D. The ABS R&D expenditure survey collects data of expenditure on R&D by these agencies. The ABS has reduced the level of detail collected in this survey on the socio-economic objective of research. This reduction means that beyond 2011–12, data are only available for the agriculture, fisheries and forestry category of rural R&D.

To overcome the reduced detail in the ABS survey data since 2011–12, we surveyed the main Australian Government performer of R&D, CSIRO, to capture the value of research it performs in each of the rural R&D research categories. CSIRO provided data for 2008–09, 2011–12, 2012–13 and 2014–15. Missing years were inferred using a simple average. CSIRO was found to account for around 85 per cent of rural R&D performed by the Australian Government.

The ABS was unable to identify which other Australian Government agencies perform rural R&D because of data quality and confidentiality constraints. As such, research expenditure by these other agencies on the categories of sustainable production, rural processing and agricultural inputs could not be estimated after 2008–09.
To align ABS data to the revised ANZSRC classification, total expenditure on R&D in 2006–07 was apportioned to the rural R&D categories using the proportions reported to the ABS R&D survey in 2008–09.

**State and territory governments performing rural R&D**

State and territory governments undertake rural R&D largely through experimental research stations. The value of expenditure by these governments on R&D is collected through the ABS R&D expenditure survey. The reduced level of detail on the socio-economic objective of research collected in this survey since 2011–12 means it was not possible to identify R&D performed for all rural research categories in all years.

To overcome the lack of information on the individual rural research categories since 2011–12, we sent a survey to state and territory departments of primary industry and equivalent agencies. In addition, custom ABS datasets were purchased for 2006–07, 2008–09, 2011–12 and 2012–13 to further assist with apportioning expenditure data between the rural research categories. To align ABS data to the revised ANZSRC classification, the custom ABS datasets for 2006–07 were re-categorised based on the ABS concordance tables (ABS 2008).

ABS data for 2012–13 were adjusted after we identified an error in the publicly reported values. The value of state and territory government expenditure on agriculture, fisheries and forestry R&D was reduced by $215 million (from $553 million to $315 million). This change was made based on personal communications with a state agency, which indicated that their reporting to the ABS for that year had mistakenly included the whole lifetime budget allocation of a large infrastructure project, rather than only the annual expenditure.

**Universities performing rural R&D**

Of the 41 universities in Australia, 24 undertake rural R&D (Australian Research Council 2015). These universities are highly regarded for performing agricultural and veterinary science research, with five universities rating well above the world standard (Australian Research Council 2015).

Data on the value of agriculture, fisheries and forestry R&D performed by universities are collected through the ABS R&D expenditure survey. The reduced level of detail on the socio-economic objective of research collected in this survey since 2011–12 means it was not possible to identify R&D performed for our rural research categories in all years. We surveyed the universities in an attempt to obtain data on individual research categories. However, this survey did not generate usable data (see Box B1). Custom ABS datasets were purchased for 2008, 2010 and 2012 (reported by calendar year) to assist with apportioning expenditure data between the rural research categories. For 2006–07 and 2014–15 we apportioned expenditure to the rural research categories using the proportions that were reported to the ABS in 2008.

**Private sector performing rural R&D**

Rural R&D is undertaken by a large number of private sector organisations in different industries, including corporate farm businesses, chemical and fertiliser companies, plant breeders and agricultural machinery companies (Keogh & Potard 2011). These private firms largely undertake R&D to deliver new marketable products or technologies. The reduced level of detail on the socio-economic objective of research collected in the ABS R&D survey since 2011–12 means it was not possible to identify R&D performed for our rural research categories in all years.
To overcome this shortcoming we used the shares of total R&D expenditure by the private sector that were reported to the ABS in 2008–09 to derive estimates of expenditure for the rural R&D categories in later years. It was also assumed that expenditure for 2014–15 was the same as in 2013–14. Given the trend of increasing private sector R&D expenditure, this is likely to underestimate the contribution of the private sector in 2014–15 to some extent.

**Not-for-profit sector performing rural R&D**

Although some not-for-profit organisations undertake rural R&D, they were excluded from this analysis for two reasons. First, these R&D performers have historically accounted for a relatively small share of rural R&D activities. For example, in 2014–15 they performed $14 million of agricultural R&D and before 2011–12 they performed less than $1 million of agricultural R&D each year (ABS 2016a). Second, the R&D performed by these organisations is likely to be double counted because it is likely to be part of bigger R&D projects managed and reported by others (such as the RDCs). Given the recent growth in the value of research performed by not-for-profit organisations, it may become necessary to investigate this source of funding in the future.
Appendix C: Comparison to other results

A number of previous studies have valued investment in Australian rural R&D. These studies have produced different estimates. Differences reflect variation in the definition of rural R&D that is used (Table C1) as well as differences in methods and data. In this analysis we have used a relatively broad definition of rural R&D that includes agriculture fisheries and forestry, sustainable and value chain RD&E (see the final column of Table C1).

Table C1 Rural definition spectrum

<table>
<thead>
<tr>
<th>Definition includes:</th>
<th>Agriculture RD&amp;E</th>
<th>Agriculture, fisheries and forestry RD&amp;E</th>
<th>Agriculture, fisheries and forestry, and sustainable production R&amp;D</th>
<th>Agriculture, fisheries and forestry, sustainable and value chain RD&amp;E</th>
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<tbody>
<tr>
<td>Extension</td>
<td>–</td>
<td>–</td>
<td>Extension</td>
<td></td>
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<tr>
<td>Pest control; sustainable production</td>
<td>–</td>
<td>Pest control; sustainable production</td>
<td>Pest control; sustainable production; climate change</td>
<td></td>
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<tr>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Rural processing</td>
<td></td>
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<tr>
<td>–</td>
<td>–</td>
<td>Agricultural chemical and mechanical</td>
<td>Agricultural chemical and mechanical</td>
<td></td>
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<tr>
<td>–</td>
<td>Forestry and fishing</td>
<td>Forestry and fishing</td>
<td>Forestry and fishing</td>
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</tbody>
</table>

Notes: Mullen (2010) built on Mullen, Lee & Wrigley (1996), which considered agriculture (excluding fishing and forestry) and excluded extension. ABS (2008) separates agriculture, forestry and fisheries into plant and animal primary production research. RRDC (2011) also included additional outcomes, including ecosystem assessment, physical and chemical conditions of water, food safety, and economic framework R&D.

Previous estimates of rural R&D funding

Regular estimates of public funding for rural R&D in Australia are available from four sources:

- WTO Domestic Support notifications (WTO DS)
- OECD Producer Support Estimates (OECD PSE)
- Department of Industry, Innovation and Science—Science Research and Innovation (SRI) Budget Tables
- Department of Industry, Innovation and Science also reports this funding to the OECD Government Budget Appropriations or Outlays for Research and Development (OECD GBAORD).
Two research reports also developed estimates of funding for rural R&D in 2008–09—Keogh & Potard (2011) and Productivity Commission (2011).

The estimated value of funding for rural R&D varies substantially between these sources (Figure C1). For example, reported values of agriculture, forestry and fisheries R&D in the Department of Industry, Innovation and Science SRI Budget Tables are larger than the values reported to the OECD GBAORD, which excludes foregone revenue from the R&D tax incentive (as per OECD reporting requirements). Reported values to the OECD on Producer Support Estimates and to the WTO on Domestic Support should include research supporting agriculture and exclude fishing and forestry. However, differences exist between the values reported to each source (more details are in Box C1).

![Figure C1 Reported total annual rural R&D funding estimates, 2008–09](image)

Notes: More recent estimates are available for all government reporting, but for comparisons between sources are not presented here. * Reported for 2008 calendar year.
Sources: Department of Industry, Innovation and Science (2016); Keogh & Potard 2011; OECD 2016b,c; Productivity Commission 2011; WTO 2016

Our total estimate of rural R&D funding is higher than the estimates in both the Productivity Commission (2011) and Keogh & Potard (2011) for several reasons. First, our study includes additional sources of funding, such as other government programs not previously identified, and the value of contributions from universities. Second, we used a consistent definition for ‘rural’ across funding providers, which led to a significantly greater estimate of private funding for rural R&D. Third, apportioning funding according to our rural RD&E research categories resulted in variations between the ABARES estimates and those of the comparable past studies. For example, unlike Keogh & Potard (2011) we did not treat all government funding for RDCs as agriculture research.

In addition, differences in the sources of data have resulted in variations in the estimates. Similar to the Productivity Commission, we largely relied on publicly reported data to estimate private investment and supplemented public reporting with personal communications to capture the value of government investment. In contrast, Keogh & Potard (2011) relied on publicly reported values to estimate government funding and used a survey of businesses to estimate the value of private investment.
Box C1 Inconsistent government reporting

Inconsistencies were identified in the reporting of Australian Government funding for three funding programs: CSIRO, RDCs and CRCs. We believe reporting to the OECD and WTO by the Department of Agriculture and Water Resources should be reviewed and harmonised where possible.

Reporting to the WTO should include support ‘provided through a publicly-funded government program...including general research’ (WTO 1995a), where support includes “budgetary outlays” or “outlay” includes revenue foregone” (WTO 1995b). This suggests that agriculture R&D appropriations funding to CSIRO, CRCs and RDCs should be reported. Similarly, we believe that reporting producer support to the OECD of ‘budgetary payments and the cost of revenue foregone by the government’ (OECD 2003) should include agriculture R&D appropriations funding for CSIRO, CRCs and RDCs.

Current reporting shows:

CSIRO - the Department of Industry Innovation and Science (2016) Science, Research and Innovation Budget Tables reported agriculture appropriations (government funding) for CSIRO as $166 million in 2014–15. Funding for CSIRO is excluded in the WTO (2016) Domestic Support notification, but is recorded for the OECD (2016b) Producer Support Estimate as $360 million in 2015—which reflects research performed and includes other external funding used by CSIRO for R&D. For our estimate we used the Science, Research and Innovation Budget Tables estimate of agriculture funding and additional data from CSIRO to identify the other categories of rural R&D.

RDCs - Government investment in the RDCs was reported in the Department of Industry, Innovation and Science (2016) Science, Research and Innovation Budget Tables at $218 million, in the OECD (2016b) Producer Support Estimate at $29 million and the WTO (2016) Domestic Support at $168 million. Errors in the government reporting in the Science, Research and Innovation Budget Tables of eggs and forestry contributions were also accounted for in this report (see Appendix B).

CRCs - the Department of Industry, Innovation and Science (2016) Science, Research and Innovation Budget Tables reported total funding for the CRC Programme but did not identify agriculture funding for CRCs. Agriculture R&D funding through CRCs is reported to the OECD (2016b) Producer Support Estimate as $40 million, but excluded in WTO (2016) Domestic Support estimates. For this report we relied on data provided by the Department of Industry, Innovation and Science, which broadly aligned with OECD reporting.

Previous estimates of rural R&D performed

Regular reporting of R&D performed (or expenditure on R&D) is available from three sources (Figure C2):

- The ABS Expenditure on Research and Experimental Development Survey collects data on R&D expenditure by governments, universities and the private sector.
- The ABS reports these data to the OECD Gross Domestic Expenditure on Research and Development (GERD).
- Innovation Australia reports on business expenditure eligible for the R&D tax incentive (Department of Industry, Innovation and Science 2015b).

Two research reports have estimated the value of rural R&D performed in 2008–09. These are the Rural Research and Development Council (RRDC 2011) and Mullen (2010). Both reports relied on ABS survey results but used different definitions of ‘rural’. The RRDC (2011) report includes estimates for agriculture, fisheries and forestry, as well as for a definition of rural that includes R&D on value chains, sustainable production, food security and economic frameworks. Mullen (2010) used a narrower definition of agriculture to update his long-running time series, which extends back to 1953–54 (Mullen et al. 1996; Mullen et al. 2000; Mullen 2010; Sheng et al. 2011). Mullen’s time series of agriculture data excludes forestry, fisheries and value chain R&D but includes environmental R&D related to agriculture. The recent scaling back of the ABS socio-economic objective reporting means that the extension of Mullen’s time series is no longer...
possible. Differences in the definition of rural between these studies limits the extent to which our results can be compared, but they are similar at a broad level (Figure C2).

Figure C2 Annual rural R&D performed (expenditure) estimates, 2008–09

Note: Data for the OECD (2016d) GERD are reported by calendar year for 2008 and reporting for agriculture are available to 2010. ABS and tax incentive data continues to be reported. Mullen (2010) reporting for 2007.
Sources: ABS 2016b; Mullen 2010; OECD 2016d; RRDC 2011
## Glossary

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>ABARES</td>
<td>Australian Bureau of Agricultural and Resources Economics and Sciences</td>
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<td>ABS</td>
<td>Australian Bureau of Statistics</td>
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<td>ANZSRC</td>
<td>Australian and New Zealand Standard Research Classification</td>
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<td>ATO</td>
<td>Australian Taxation Office</td>
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<tr>
<td>CRC</td>
<td>Cooperative Research Centres—provides funding for up to 10 years</td>
</tr>
<tr>
<td>CRC-P</td>
<td>Cooperative Research Centres–projects—provides funding for up to 3 years.</td>
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<tr>
<td>CSIRO</td>
<td>Commonwealth Scientific and Industrial Research Organisation</td>
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<td>GDP</td>
<td>Gross domestic product</td>
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<td>GERD</td>
<td>Gross expenditure on research and development</td>
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<tr>
<td>GVP</td>
<td>Gross value of production</td>
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<td>NSW</td>
<td>New South Wales</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
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<td>OECD PSE</td>
<td>OECD producer support estimate</td>
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<tr>
<td>R&amp;D</td>
<td>Research and development</td>
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<tr>
<td>RD&amp;E</td>
<td>Research, development and extension</td>
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<tr>
<td>RDC</td>
<td>Research Development Corporations</td>
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<tr>
<td>RRDC</td>
<td>Rural Research and Development Council</td>
</tr>
<tr>
<td>SARDI</td>
<td>South Australian Research and Development Institute</td>
</tr>
<tr>
<td>SRI</td>
<td>Science, Research and Innovation</td>
</tr>
<tr>
<td>SEO</td>
<td>Socio-economic objective—classification based on the purpose of the R&amp;D</td>
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<tr>
<td>USDA</td>
<td>United States Department of Agriculture</td>
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<td>WTO</td>
<td>World Trade Organization</td>
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<tr>
<td>WTO DS</td>
<td>WTO domestic support notification</td>
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</table>
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