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The Rationale for Taxpayer Support for Primary Industry Research and Innovation in Western Australia: A report to the Department of Primary Industries and Regional Development

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The Rationale for Taxpayer Support for Primary Industry Research and Innovation in Western Australia

Abstract: During the 2000s a common view in government circles in Australia was that governments were over-investing in primary industry research and innovation. In agreement with this view, the Western Australian government lessened its support for primary industry research and innovation over the last decade. However, so great has been the erosion of funding and capability in research that the pressing problem is now perceived to be government's underinvestment in primary industry research and innovation. Nonetheless, the government's adverse current fiscal environment still constrains departmental budgets, so the case for government expenditure on primary industry research and innovation needs to be made and soundly argued. This report outlines the case for government expenditure on primary industry research and innovation.

Key words: agricultural R&D, R&D investment, taxpayer funds, co-investment

JEL classification: Q16, Q18

Executive Summary

During the 2000s a common view in government circles was that governments were over-investing in primary industry research and innovation. In agreement with this view, the Western Australian (WA) government lessened its support for primary industry research and innovation over the last decade. The impacts of this reduced support are seen clearly in the Department of Primary Industries and Regional Development (DPIRD). In 2008–09 its agricultural staff count was 1518, yet by the end of 2017–18 this will be under 800, with remaining staff working mostly in regulation, biosecurity and corporate services rather than research. So great has been the erosion of funding and capability in research that the pressing problem is now perceived to be government’s underinvestment in primary industry research and innovation.

Government’s current fiscal environment constrains departmental budgets, so the case for government expenditure on primary industry research and innovation needs to be made and soundly argued. This report outlines the case for government expenditure on primary industry research and innovation.

Primary producers often are beneficiaries of research and innovation and so should fund some or much of that research and innovation activity. However, importantly, this report highlights that primary producers are not the sole beneficiaries. Rather, local consumers and households are also major beneficiaries of primary industry research and innovation and therefore (as taxpayers) they should also contribute to the cost of those activities.

Primary industry research and innovation contribute to the prosperity of WA in a number of ways:

1. Direct benefits to WA households
 - a. Efficient agricultural production systems lower the cost of food, making it more affordable.
 - b. Greater variety and availability of food ingredients and products (e.g. new apple varieties, new wines, more dairy products).
 - c. Improved health and safety of food. Food scares are rare in WA.
2. Job creation
 - a. More affordable food releases more of each household’s budget to spend on other things, thereby creating new employment opportunities.
3. Export revenue
 - a. Primary industry exports bring billions of dollars into the WA economy each year. These revenues help lift the living standards of WA households.
 - b. Our primary industry exports cement strategically useful economic relationships with our Asian neighbours.

National and international appraisals of publicly-funded agricultural research almost always conclude that the research is economically worthwhile, typically generating high rates of return. This report outlines investment opportunities for primary industries' research and innovation and gives historical examples of the worth of such investments in WA in crop research, market-securing research, organisational and policy innovation, soil resource research, pasture research and animal research.

Overview

WA's primary industries play a role in the State's economic development, but so do many other sectors. Hence, in an environment of constrained budgets, why does the government's primary industry agency (DPIRD¹) require funding? The case for expenditure on biosecurity is easily argued and well understood, if only to avoid economically catastrophic losses due to a disease or pest outbreak (e.g. foot and mouth disease) that suddenly shuts WA primary products out of lucrative export markets and/or prevents products being sold on local markets. Government funding to administer regulation is also easily argued, as governments are charged with the duty of being designers, custodians and practitioners of the law related to natural resource management, farm chemical use, biosecurity, animal welfare, etc. However, a third area of traditional government activity in primary industries is involvement in research and innovation, usually as a funder and provider. The case for government having a role in primary industry research and innovation needs to be made.

It is true that DPIRD's former foundation departments (agriculture and fisheries) have had a rich history in the funding and provision of research services. The State's agricultural and fisheries development over the last several decades owes much to the teams of researchers and extension staff who were once a feature of those departments. The logic behind government involvement in research and innovation at that time was sound. The atomistic nature of farm and fish production meant that these businesses would likely individually under-invest in research and innovation due to the cost, difficulty and inadequacy of IP protection. Research also needed to play a fact-finding role to facilitate design of regulation of the management of natural resources (fish stocks, land and water) and biosecurity that underpin WA's primary industries.

In the case of agricultural research, its main funders are state and national governments, private businesses and collaborations between both groups. Major examples of the latter are 15 commodity-based primary industry R&D corporations set up under national legislation in the 1980s. These corporations are based on funding partnerships between industry and government and are subject to national coordination via the National Primary Industries Research, Development and Extension Framework. Under this framework particular states and organisations have opted to take lead, support or linkage roles in particular industries' R&D, supported by the relevant industry corporation. The WA government and its key state research organisations, including DPIRD, have elected to take lead and support roles in research and innovation regarding grains, wool, soils and plant biosecurity.

The formation of these primary industry R&D corporations², when combined with the strengthening of IP protections and the ability to embed research in patentable technology have encouraged and caused increased investments into R&D by industry. However, it has caused some governments to step away from their previous strong support for research and innovation. The situation is now reached in WA, for example, where government reductions in its support for research and innovation have become so great that the pressing problem is now perceived to be the state

¹ Department of Primary Industries and Regional Development. See Appendix One for a brief history. Appendix Two lists DPIRD's current strategic priorities.

² For a description of these corporations see http://www.agriculture.gov.au/ag-farm-food/innovation/research_and_development_corporations_and_companies

government's underinvestment in research and innovation [1], not overinvestment as was the thinking during the 2000s [2]. In effect, the persistent goal of government cost-cutting is now proving counter-productive.

The WA governments' persistent withdrawal of resources from its agricultural agency (DPIRD) is easily illustrated. In 2008/9 its agricultural FTE count was 1518, yet by the end of 2017/18 it is likely to be under 800 and dominated by regulatory, biosecurity and corporate staff rather than research or research support. No other state has experienced as significant a withdrawal of recurrent government support for agricultural research and innovation as has occurred in WA over the last several years. For example, DPIRD's staff count of grains industry researchers fell by 19% from 2007 to 2011 whilst over the same period in the rest of Australia the number of grain researchers increased by 32%; yet WA, and in particular its state government agency DPIRD, was meant to be taking the lead role in grains research and development. The overall expenditure on agricultural research and development by all governments in Australia has been maintained in real terms [3], but WA is a marked exception.

In WA, the increased relative and absolute importance of primary industry R&D corporations (see footnote 2) as funders of research and innovation poses both an opportunity and a problem for government in WA. These national R&D corporations receive primary producer levies pooled across the states and matched by federal government funding. The corporations then co-invest with any partners in any state where the research will generate value for that national industry (grains, fisheries, livestock, wool, etc). By illustration, each dollar spent by the Grains R&D Corporation includes a 5 cent contribution from WA taxpayers and about a 22 cent contribution from WA graingrowers. Interstate taxpayers and grain producers provide the other 73 cents. The issue for government in WA is firstly, does it want to attract R&D corporation expenditure to WA and if so, for what purpose and at what additional cost to taxpayers?; and secondly, if it does not, then the WA government is allowing WA taxpayer and WA graingrower funds to increasingly head interstate in the hope that WA taxpayers and graingrowers will eventually benefit from activity in those interstate research centres. For key primary industries in WA, like grains, fisheries, cattle and sheepmeat; placing their futures mostly in the hands of interstate research centres would seem strategically and politically unwise; but that is the path on which current WA government funding places some of these primary industries that are economically significant to WA.

Primary producers often are beneficiaries of research and innovation, especially where that research is conducted under local conditions involving local expertise, and therefore via their R&D corporations they should fund that research and innovation activity. But, importantly, primary producers are *not* the sole beneficiaries of research and innovation outcomes. Local consumers and households are also major beneficiaries of primary industry research and innovation and therefore (as taxpayers) should also contribute to the cost of those research and innovation activities.

How do urban households benefit from primary industry research and innovation?

1. Improved affordability, quality and safety of WA food

These outcomes are a direct product firstly and principally of investment in primary industry research and innovation, and secondly, of enabling regulation and policy, and post-farm gate

technology and innovation. Greater affordability of food comes via households now paying less for foodstuffs. The national and international evidence is convincing. Primary industry research and innovation underpins productivity gain that lowers costs of production that in turn lowers the sale price of the agricultural and fisheries products that are the foundation of foods consumed by households. As an example, real prices of grains (e.g. wheat, barley, lupins), the main agricultural industry in WA, have consistently declined over the last several decades (see Figure 1). As a result, foods based on grains are now more affordable due to the decline in real prices of these grains.

Plant breeding and agronomic research have helped lower the cost of producing grains and improved the efficiency of grain production. Wheat which is the main grain grown in WA is now produced more efficiently. In the 1980s about 5 kilograms of wheat were produced from each millimetre of growing season rainfall, whereas now over 9 kilograms of wheat are produced from each millimetre of growing season rainfall (see Figure 4).

Animal breeding and veterinary research have increased the efficiency of animal production. For example, in 1975 2.5 kilograms of feed grains were required to produce one kilogram of liveweight in chickens; whereas now only 1.75 kilograms of feed grains are required. The lesser cost of grain and animal breeding improvements have helped lower the real cost of chicken (See Figure 1), the main meat consumed in WA.

Also adding to the affordability of food are improvements in post-farm gate activity. Examples are reduced logistics costs, more efficient refrigeration and storage, and electronic monitoring for just-in-time supply chains; as well as economies of scale from purchasing by supermarket chains.

In Australia in 1984 the average household spent 14.9% of their household income on food and non-alcoholic beverages. By 2015/16 only 11.4% of household income needed to be spent on those items [4]. A separate national study [5] showed a similar trend. Food purchases comprised 18 per cent of Australians' average consumption expenditure in 2000, yet by 2015 only 10 percent needed to be devoted to food purchases.

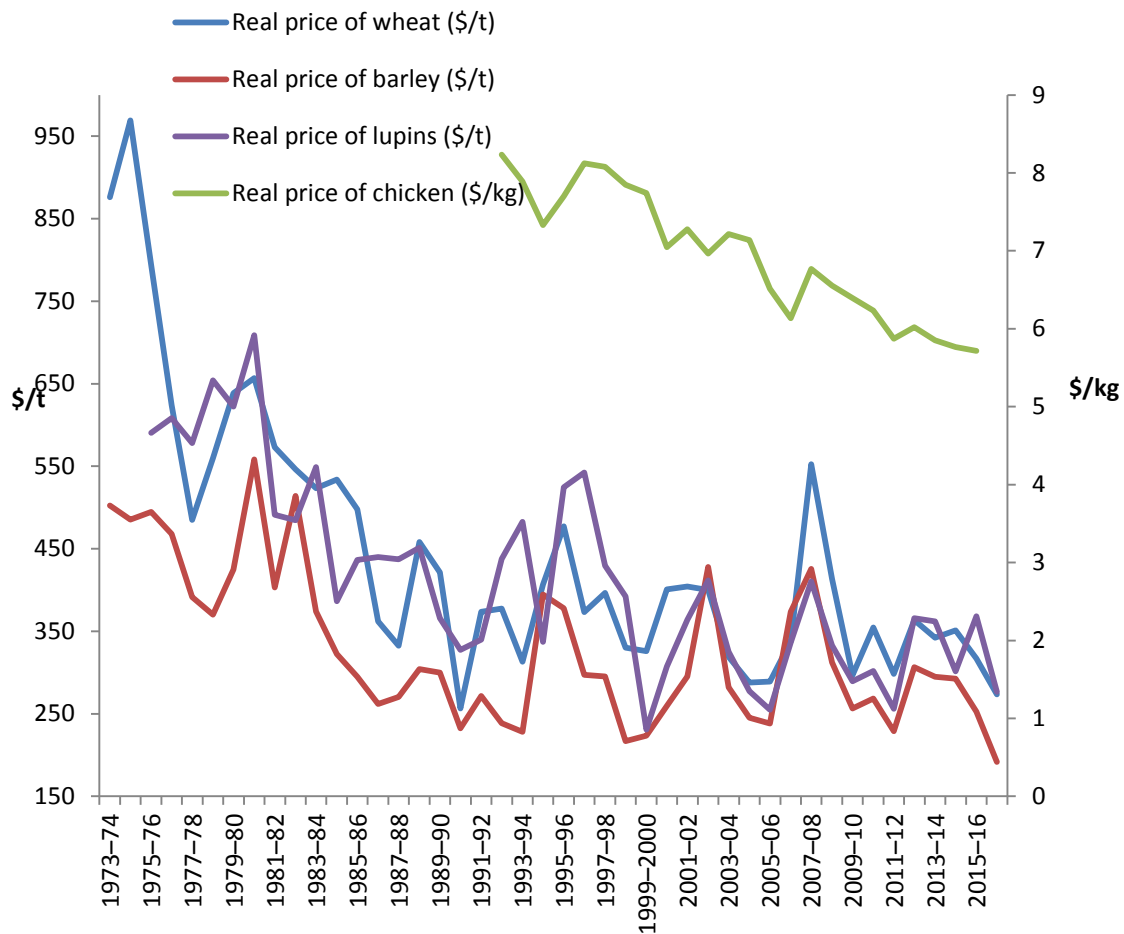


Figure 1: Real prices of wheat, barley, lupins and chicken meat (constant 2016/17 dollars).

To illustrate how valuable to households is the improved affordability of foods, attributable in part to agricultural productivity gain that depends on research and innovation, consider the following. In the 2016 census of population and housing, there were 1,070,962 households in WA with a median household weekly income of \$1,595. These households' average weekly expenditure on food and non-alcoholic beverages as a percentage of goods and services expenditure and other payments was 11.2% yet back in 1998/9 these households spent 13.3% of their household income on food and non-alcoholic beverages. If there had been no change in the affordability of food since 1998/8 then in 2016 WA households would be forced to spend an additional \$1.87 billion each year on food and non-alcoholic beverages for their families.³

The greater affordability of food means that WA households can now spend \$1.87 billion each year on other things like health, education, housing and leisure. In particular, poorer households can now better feed their families due to the greater affordability of food made possible, in part, through research and innovation that lowers costs of producing the raw food ingredients. More affordable food means a greater diversity of food purchases and potentially better nutrition outcomes for these poorer households. It is important to stress that the greater affordability of food is due to many factors not just agricultural research and innovation. However, the decline in real prices of many farm commodities obviously helps make those products more affordable when processed or packaged into consumer goods.

³ \$1.87 billion = 1.070962 (million) * \$1,595 (\$'000/wk) * 52 (wk) * (0.133 - 0.112)

WA households in the lowest 20% of the state’s income rankings spend over 18% of their income on food and non-alcoholic drinks. The top 20% of households spend only 8% of their household income on food and non-alcoholic beverages; even though each week they spend double what lowest income households spend (Table 1). Households since 1998/99 in general are now able to spend less of their household income on food and non-alcoholic beverages.

Table 1: Perth household food expenditure by income grouping in 1998/99 and 2015/16

		WA householder income quintile groupings					All households
		Lowest	Second	Third	Fourth	Highest	
Average weekly expenditure on food and non-alcoholic beverages (\$)	2015/16	154	198	237	303	316	237
	1998/99	68	102	120	148	192	125
Average weekly expenditure on food and non-alcoholic beverages as a percentage of goods and services expenditure and other payments (incl. income tax, mortgage principal payment, superannuation) (%)	2015/16	18.1%	14.2%	11.4%	11.5%	8.0%	11.2%
	1998/99	17.7%	18.5%	14.7%	12.7%	10.5%	13.3%

Low income households especially benefit from agricultural research. These households spend more of their weekly incomes on food so any research and innovation that helps make food more affordable is of benefit to these households. These households are in many parts of Perth but are more heavily concentrated in a few localities (Figure 2); Armadale, Cannington, Bassendean, Gosnells, Mirrabooka and Kwinana.

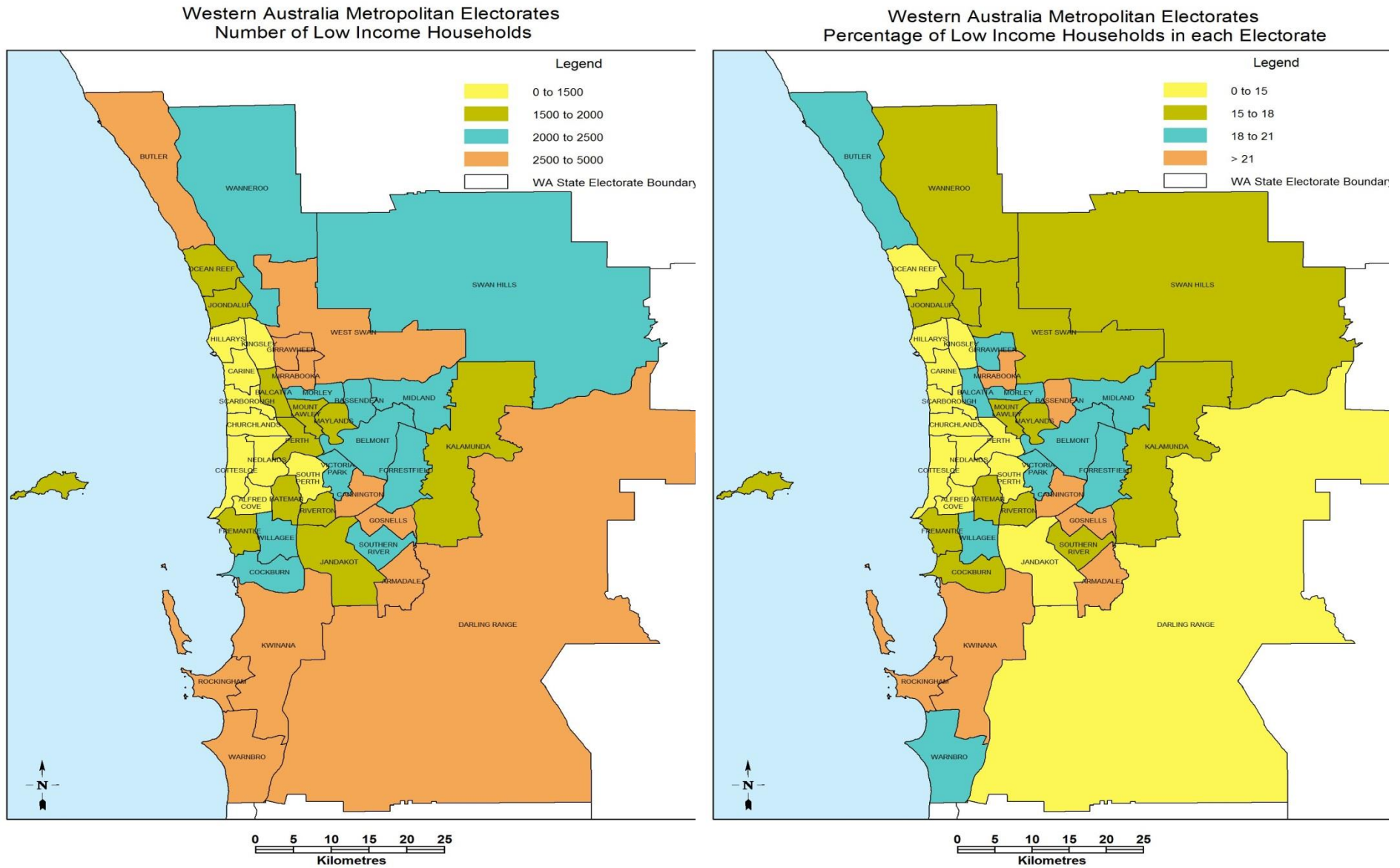


Figure 2: Numbers of low income households in Perth electorates and the percentage of these households in the population of each electorate.

The elderly especially benefit from research and innovation that helps lower the cost of food.

People over 75 in WA, on average spend 20% of their income on food and non-alcoholic drinks [6]. By contrast 35-44 year olds use only 10% of their income on food and non-alcoholic drinks [6]. The elderly in Perth mostly are scattered across its suburbs but there are some concentrations of their numbers in Bateman, Cottesloe, Kalamunda, Rockingham and Willagee (Figure 3). Moreover, there are relatively high proportions of the elderly and low income households in Balcatta, Kalamunda, Morley, Rockingham and Willagee.

The elderly will form an increasing proportion of Perth's population, and food purchases are a major component of the elderly's weekly expenditures. Demographic projections suggest Perth's population will grow to around 2.3 million by 2026; and those over 70 years will form 11% of that population. The number of people in Perth in that age group in 2026, compared to their numbers in 2011, represent a 75% increase in the elderly population. There will be over a quarter of a million people , aged over 70, residing in Perth by 2026; and food prices will matter to many of them.

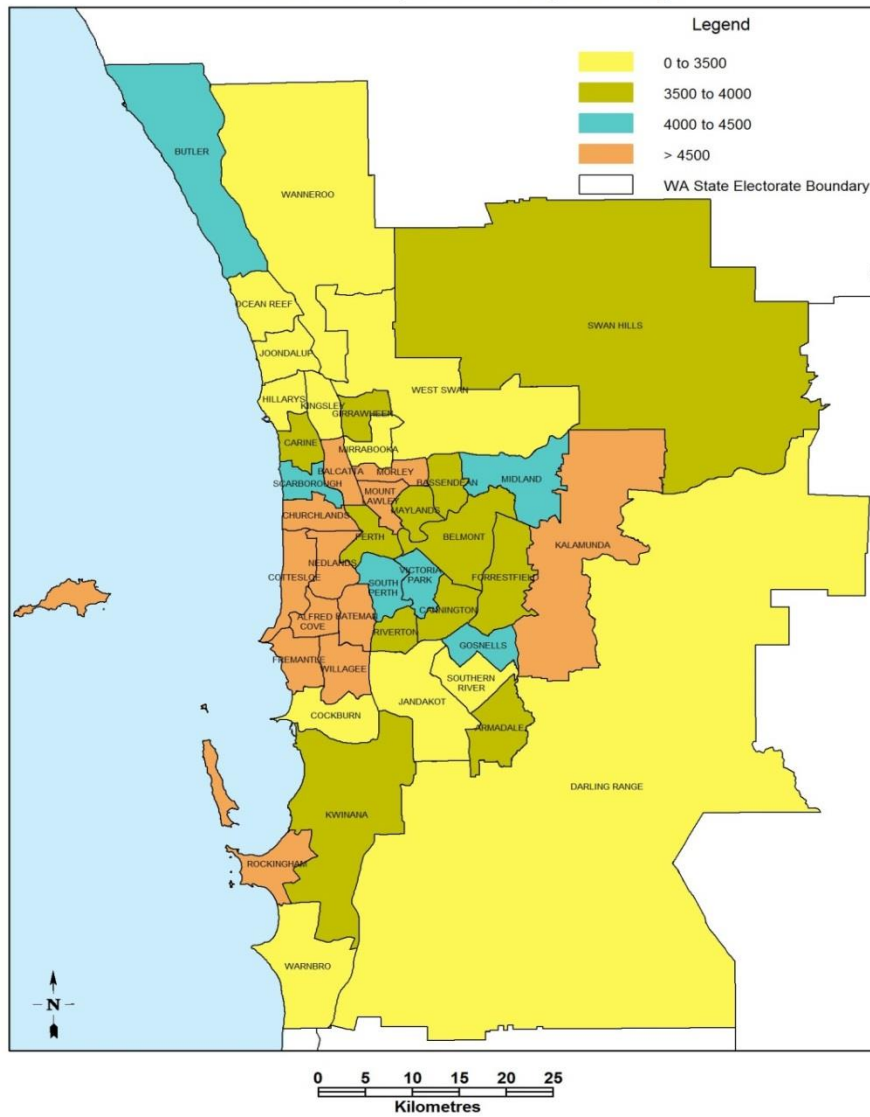
The focus of research and innovation, however, is not solely the lowering of costs of production. Research and innovation also helps create better qualities and greater diversity of food products. Research and innovation has brought many new foods to be grown in WA (e.g. canola, chia, chickpeas, noodle wheats, new wine varieties, new apple varieties (Pink Lady, Bravo), Brahman cattle, Dorpa and Dohne sheep, new tropical fruits, etc). The quality of produce has also improved; For example, 60% of cattle slaughtered in WA and around 900,000 lambs annually are MSA-graded⁴. Many food producers ensure their products are subject to quality assurance certifications such Freshcare and Safe Quality Food (SQF), or the Heart Foundation's tick program that includes over 2,000 food items.

Consumers and households also benefit from less price volatility due to research and innovation. A focus of research is to improve the reliability and availability of production. Hence, due to research and innovation, primary producers are now able to more reliably produce many foodstuffs. For example, in the severe drought in 1969 the average wheat yield in WA was only 0.66 tonnes per hectare and feed prices skyrocketed. Yet in 2010 when the same low rainfall occurred, the average wheat yield was 1.08 tonnes per hectare and feed prices increased far less. Science and innovation over the 40 years lifted the wheat yield by 63%, even though the rainfall was unchanged. Also, in fruit production there are more varieties, some ripening early whilst others ripen very late, thereby lessening gluts on the market and allowing fresh local product to be available over longer periods.

Research and innovation helps build resilience in food production systems. This is illustrated by the increase in WA wheat yields over the last 40 years, despite a downward trend in growing season rainfall (Figures 4 & 5). Technologies such as reduced tillage, better weed control to enable dry sowing, better varieties, higher capacity machinery and greater rates of application of lime and nitrogenous fertilisers; in combination have increased the efficiency of use of rainfall to generate more grain yield. Hence, although a warming and drying trend is evident in the south-west of WA (Figure 5), nonetheless research and innovation have enabled crop yields to increase in the face of this climate challenge, thereby supporting the resilience of farm businesses.

⁴ Meat Standards Australia (MSA) was developed by the Australian red meat industry to improve the eating quality consistency of beef and sheepmeat. The system is based on almost 800,000 consumer taste tests by more than 114,000 consumers from 11 countries and takes into account all factors that affect eating quality from the paddock to the plate. The system ensures retailed meat will be of the best-eating quality.

Western Australia Metropolitan Electorates
Number of Population > 70 years of age



Western Australia Metropolitan Electorates
Percentage of the Population in each Electorate that is >70 years of age

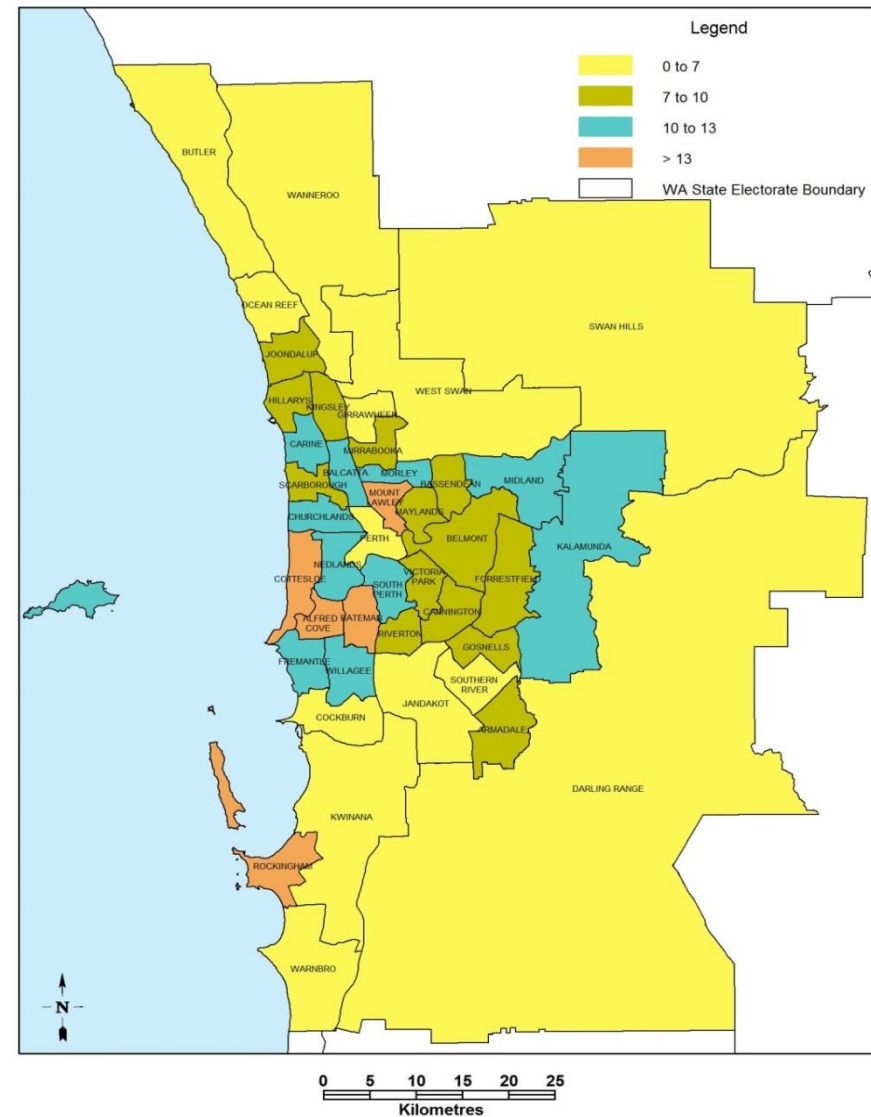


Figure 3: Numbers of the elderly in Perth electorates and the percentage of the elderly in the population of each electorate.

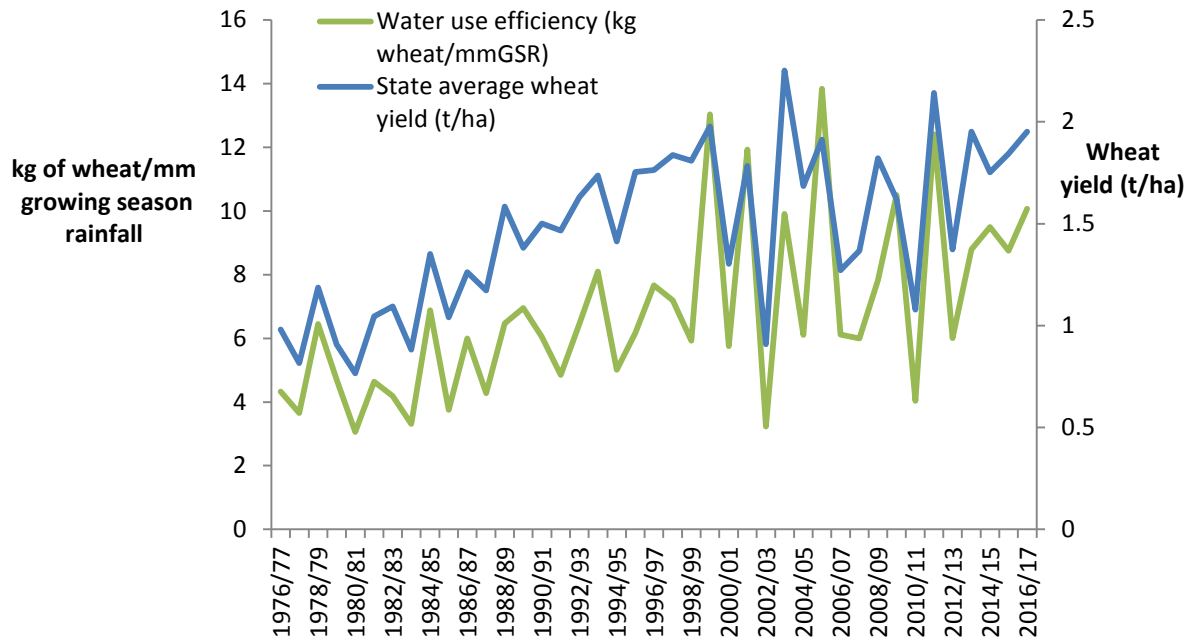


Figure 4: WA wheat yields since 1976 and the associated water use efficiency.

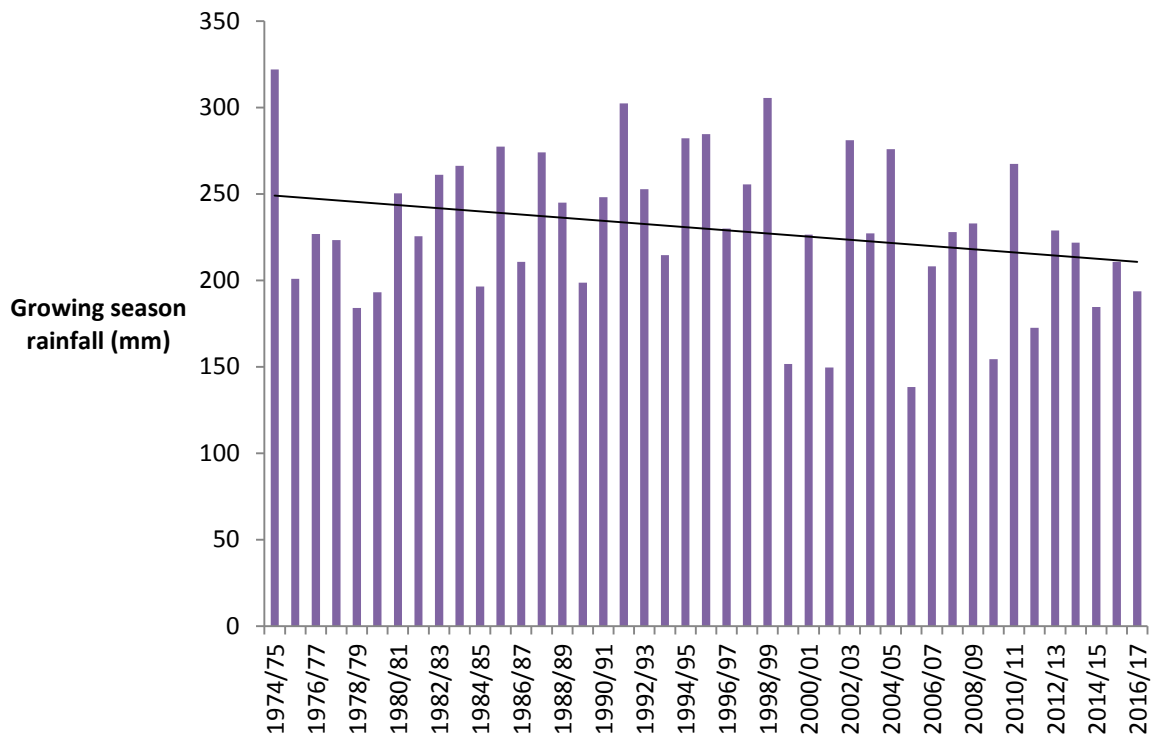


Figure 5: Growing season rainfall in the WA grainbelt since 1974 and its best-fit time trend.

Growing season rainfall is rainfall from May to October.

In spite of six of the ten driest winter growing seasons since 1890 occurring this century in 2000, 2002, 2006, 2007, 2010 and 2012; nonetheless WA farm businesses have prospered [7].

Technologies, practice change and plant breeding enable WA farmers to achieve higher yields now compared to the mid-1970s, despite on average now receiving around 40 mm less growing season rainfall.

Another focus of research is food safety from which households benefit. Reducing spoilage, extending shelf-life, facilitating quality assurance, reducing chemical use and enabling traceability, all improve food safety. Local agriculture and fisheries, unlike their overseas counterparts, can be more easily monitored to ensure their practices are as sustainable and humane as possible and their products are safe to eat; traits valued by many households when purchasing food products (e.g. eggs, lamb, pork, fish, milk and vegetables). Research and innovation can improve animal welfare, sustainability and food safety aspects of local primary production.

2. A more diverse, richer and resilient WA economy leading to more jobs (and more tax revenues)

Research and innovation in WA's rich set of climatic zones, from tropical Kununurra to the coolness of Denmark, has helped deliver a diverse suite of foodstuffs to Perth households and in turn has generated new jobs in these regions, both in primary production and support industries. The greater diversity in food production has also enabled some regions to become renowned as food precincts (e.g. Margaret River). Perth households and interstate and overseas tourists can all enjoy these food precincts and their expenditure unleashes further employment opportunities and additional business and tax revenues.

As one small illustration of a new food industry attracted to WA's food precinct, let's ask: Who is the world's largest producer and exporter of black truffles outside of Europe? The answer is Western Australia! Another example of WA being a world's leading exporter of a new food is Chia. It's exported to 36 countries and is principally grown in the Kimberley region.

Besides underpinning food precincts, locally produced food also forms a key part of the food service sector. Nationally this sector annually is worth \$142 billion in consumer sales (Appendix Three), so the WA portion of this sector is worth around \$14 billion and is mostly underpinned by local foods and its associated processing. **Employment in food processing is on the rise, opposite to the general trend of shrinkage in manufacturing jobs.** For example, nation-wide between 2011 and 2016 the workforce in factory bread-making increased by 10,000 to 24,000. Employment in meat processing increased by 4,000 to 29,000 and employment increases were also recorded in poultry processing, saw log milling and beer manufacture.

Salt (2018) observes that Australia's manufacturing future could ride on its ability to add value to its raw agricultural products [8]. In WA, food processing is by far the main source of employment for manufacturing sector workers (see Figure 6), yet WA exports of processed food are only a third of that from South Australia and under a fifth of those from Queensland and Victoria. This suggests an as yet unrealised potential for additional exports of processed foods out of WA, with all the employment benefits surrounding food processing.

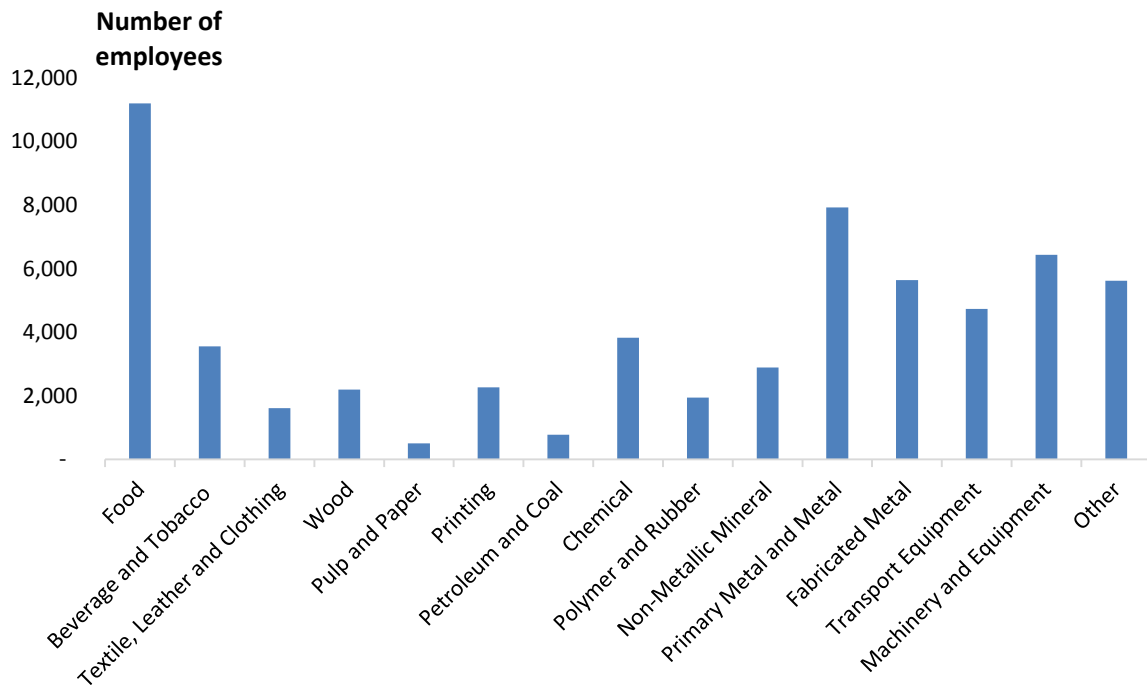


Figure 6: Employment by manufacturing product in WA.

Food made more affordable by primary industry research and innovation means that many families can now spend more of their household income on other things (housing, education, health, transport, entertainment). Being able to spend more on things other than food lifts their standard of living. Employment and employment diversity prospects also improve because, in aggregate, when lots of households spend more on other things besides food, then additional jobs are created in the sectors experiencing increased sales demand.

Research and innovation also makes WA agricultural commodities more affordable to overseas consumers and underpins the international competitiveness of WA's main agricultural export industries (e.g. wheat, lobsters, canola, live cattle, sheepmeat and barley). Local employment and income prospects are improved by export earnings. Explaining further, there is an important economic distinction between local and export sales. Developing and releasing a new apple variety (e.g. Bravo) onto the local market may increase consumers' choice over apples but any increase in consumption of that new variety will usually be at the expense of an older variety (e.g. Granny Smith) or at expense of some other item in the food budget. In short, revenues from local food expenditure will hardly change. However, sales of the new apple variety in overseas markets will bring to WA additional revenue into those businesses that locally grow and export the new apple. These additional revenues will create multiplier effects throughout the WA economy and households will indirectly benefit from those effects.

Over half of Australia's wheat and barley exports come from WA. Two-thirds of all canola and oats exported from Australia come from WA. A third of all malt and forage exports come from WA. A quarter of all vegetable, essential oils, and milk and cream exports come from WA. These export earnings of the WA agri-food sector bolster the living standards of WA households, not just farmers. Other Australian households, outside of WA, also benefit as the WA agri-food sector is a main source of export earnings for the nation (Figure 7).

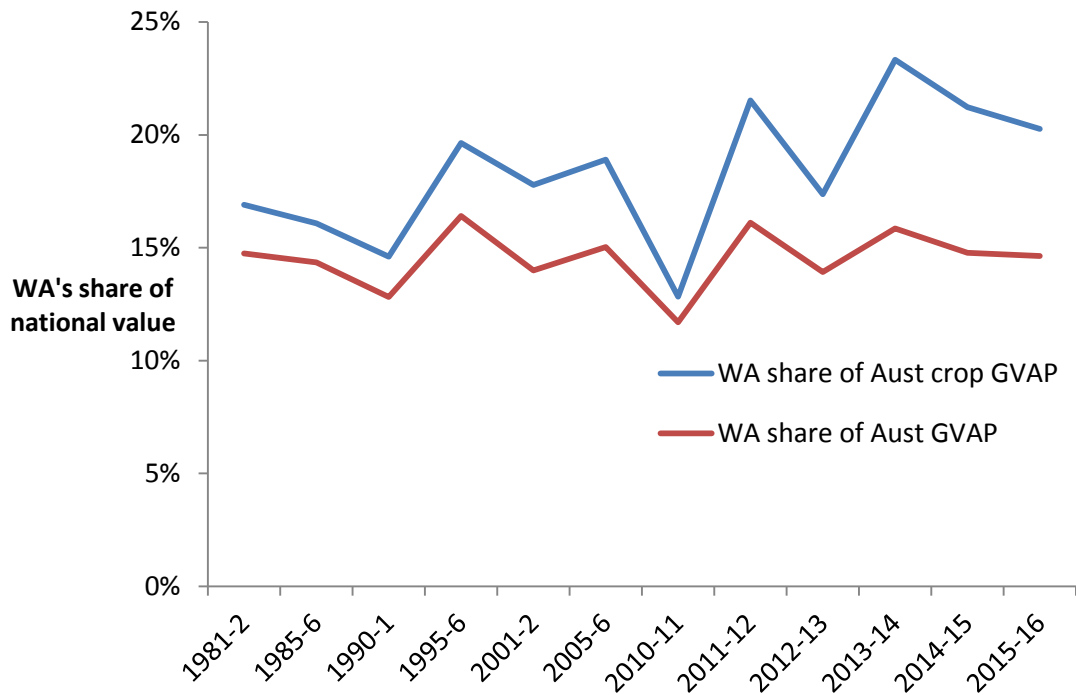


Figure 7: WA's share of Australia's gross value of crop production and gross value of all agricultural production since 1981-2.

The export performance of the WA broadacre cropping industry (wheat, barley, canola, oats), is especially notable. Over the last 30 years WA has generated an increasing share of the nation's value of crop production (which also includes horticultural crops). A potentially worrying sign, however, perhaps linked to the withdrawal of support for agricultural research and innovation by WA governments over the last decade, is an erosion of WA's share of the national value of crop production since 2013.

It is widely acknowledged that farm production increasingly is underpinned by mechanisation and economies of scale and therefore is unlikely to be a source of growth in employment of rural labourers, although replacement of the ageing population of farm owners and operators will be a renewed source of employment over the next decade [9]. Less well-understood is the diverse employment prospects generated by the input and service requirements that increasingly underpin farm production. As shown in Figure 8, often the farm business sector has only a few sources of income, mostly sales of a few main agricultural products. However, farm businesses rely on an array of inputs and services that in turn are sources of employment in rural metropolitan regions.

Annually broadacre farm businesses in WA spend around \$5.8 billion on a range of inputs and services, with the annual expenditure on services being over \$2 billion, entailing payments to contractors, farm workers, transport operators, storage and handling services, port fees, research fees, accountancy and legal services and marketing and advisory services. Many of these service providers operate out of regional and metropolitan centres and provide direct and indirect employment for thousands of people.

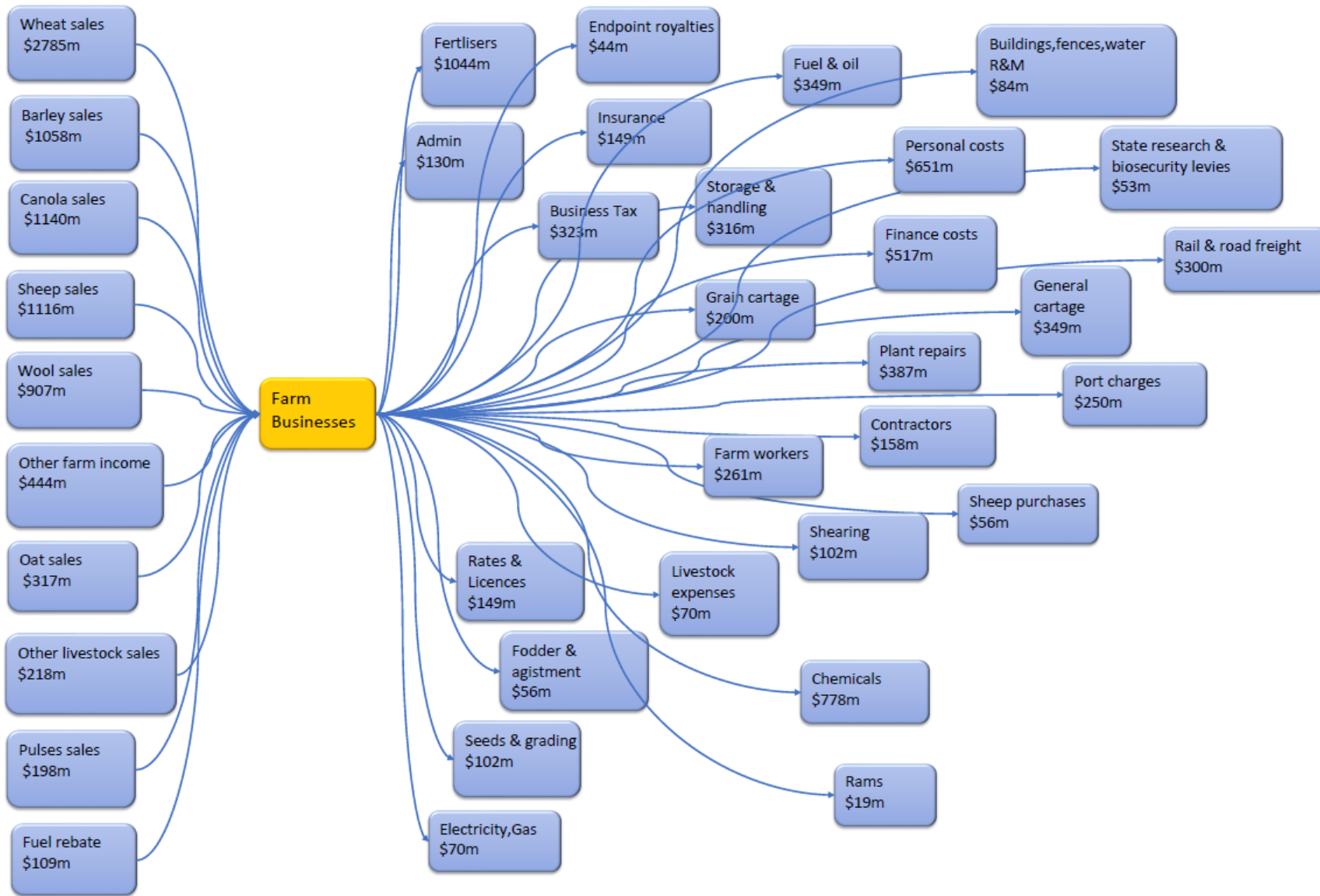


Figure 8: The flow of funds into and out from the broadacre farm sector in WA (based on 2016/17).

3. Less tangible benefits

Primary industry exports to our south east and east Asian neighbours help sustain trade ties with these countries and facilitate regional security. Nations value having friendly neighbours and mutually beneficial trade helps build and cement those friendships. Regional security, supported by primary industry trade, is worthwhile politically and economically but it is not simple to accurately value. Indonesia is the main export destination of WA wheat and WA is the sole provider of noodle wheat to Japan. WA is a main supplier of malt barley to China and WA's lobster and wool production primarily goes to China. WA's competence in broadacre farming and land management also is an exportable skill. In parts of China where serious dryland degradation occurs, WA expertise in land management aids their land rehabilitation.

Some households see value in agriculture, unlike mining, being a non-extractive sector. Agriculture's on-going reliance on natural resources, complemented by science, technology and human ingenuity, delivers persistent export and local revenues into the WA economy. These revenues flow through the state economy, and underpin some regional economies such as those in the Kimberley, the south-west and the mid-west. These 'sustainability' credentials of agriculture are valued by some households and by their nature deliver consistent enduring economic benefits to the state, without the volatility characteristic of the mining sector.

An often under-appreciated fact is how much agricultural activity takes place in the Perth region where 1.8 million of the state population resides. As shown in the attached report from ACIL Allen, the gross value of agricultural production in the Perth region is greater than the combined value of agricultural production from the Kimberley and Gascoyne regions. A great deal of fruit, vegetable and intensive livestock production occurs on the outskirts of Perth suburbs and is a main source of those agricultural products for the households of Perth. Additionally, some of these Perth-based agricultural precincts, such as the Swan Valley's grape and wine production, serve as tourism and heritage attractions, adding to the vibrancy of Perth.

An additional perceived merit of primary industries in WA is that they are mostly owned and operated by WA families. Hence, profits are largely retained and spent in WA, rather than being repatriated to overseas shareholders whose expenditure rarely benefits the WA economy. The dominant minerals and energy businesses, by contrast as listed companies, attract a high proportion of foreign ownership with the associated repatriation of profits.

In summary, there are several ways in which research and innovation deliver benefits to households. The principles of efficiency and equity dictate that beneficiaries should pay. Hence, taxpayers, as households, need to contribute to the research and innovation from which they benefit. Similarly, producers of primary products also need to contribute to research and innovation, for they also are beneficiaries of research and innovation.

If Taxpayer Support for Primary Industry Research and Innovation is Rekindled, where are the Opportunities?

In a world of constrained public funding, obviously wherever public funds are spent it needs to generate leverage and valuable impact; be that additional revenues, or costs avoided. *Sole* investment by government is a luxury unaffordable in the current environment, so co-investment is the preferred and perhaps only viable option. Finding and retaining private or industry sector research partners is the current challenge.

How best to encourage and link to private sector investment in agricultural research, development and extension in Australia has been the subject of recent review [3]. Current arrangements surrounding agricultural R&D in Australia and in several other countries were examined and Australian agribusinesses with a history of investment in agricultural R&D in Australia were consulted. The resulting examination and analysis [3] lists 8 recommendations; several of which have direct relevance for governments. The most relevant for WA's government is the recommendation that governments should commit to sustain and ideally increase the availability of public funding for agricultural R&D and associated infrastructure in Australia, as private sector researchers and funders readily acknowledge that a robust public sector R&D system actually *incentivises increased agricultural R&D investment by the private sector*. In short, private sector investors in agriculture view the public sector's involvement as complementary, not as competitive crowding-out. It is an essential resource not a source of competition. The marked decline in WA business expenditure on agricultural R&D in recent years supports this view (see Appendix Four).

So, faced with constrained budgets and acknowledging the need for effective private-public partnerships as the vehicle for primary industry research and innovation, governments do need to directly invest. Cost-cutting in the hope of triggering private investment is flawed thinking, based on these recent research findings. So, what are the future opportunities for jointly-funded research that benefits taxpayers and industry?

Firstly, wherever possible, the priority needs to be on viable, sustainable export growth opportunities and value-adding opportunities. Most of those export opportunities are likely to be based in Asia, particularly South East Asia (SEA), due to its growth in population and incomes (Table 2).

Table 2: Changes in population and per capita GDP in SEA countries and Australia over the next decade.

	Population (mln)				GDP per capita (constant AUD)			
	2018	2028	Change in pop. (mln)	Change in pop. (%)	2018	2028	Change in per capita GDP (\$)	Change in per capita GDP (%)
Indonesia	264.1	289.1	25.0	9.5%	5180	8701	3521	68%
Other SEA	385.6	421.5	35.9	9.3%	6184	11394	5210	84%
Australia	24.8	25.4	0.7	2.7%	54950	74248	19298	35%

Note: Other SEA countries are Brunei, Lao, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam. Other SEA per capita GDP is a weighted average.

Source: [5] and OECD <https://data.oecd.org/gdp/gdp-long-term-forecast.htm>

South East Asian (SEA) countries will experience a rate of population growth 3-times that of Australia over the next decade, off a larger base. The increase in the SEA population will amount to two new Australias being established in the SEA region over the next decade. In addition the rates of increase in per capita GDP in SEA countries will be at least double or in some cases treble that projected for Australia. Moreover, segments of populations in several of these countries will have levels of household income commensurate with income levels in many Australian households and their requirements will increasingly centre on food safety, food quality and convenience [10].

Over the next decade there will be expanding food export opportunities for WA's primary industries in SEA and east Asia. Asian imports of grains, red meat, wool, wine and certain fruits and vegetables will greatly increase. Resource limitations in WA will probably cause WA's share of Asian food imports to lessen, in spite of WA experiencing an *absolute* increase in its primary industry exports; but it will allow WA exporters to focus on premium-paying customers.

Important for WA are the twin impacts of greater populations and higher incomes. Diets change with income (Table 3). More fruit, milk, red meat and processed meats are consumed as incomes increase. In WA we produce exportable surpluses of several of these agricultural foodstuffs. The proximity and trustworthiness of Australian production and the timeliness of our logistic operations bestows on WA's agri-food sector a degree of advantage.

In the case of grains, WA's main primary industry export, at higher incomes whole grain consumption strongly increases as consumers become more health conscious. It is these wealthier Asian consumers who are the likely future purchasers of the favoured wholegrain white wheat produced in WA. By contrast other wheat exporting nations mostly produce red wheats that are less suited to wholegrain uses.

Table 3: Changes in diets as wealth changes (g/capita/day)

	Quintile of GDP per capita				
	←----Poorest nations	-----	-----	-----	-----Richest nations----→
	1	2	3	4	5
Food type (g/capita/day)					
Fruit	95	115	140	146	168
Vegetables	264	198	194	204	167
Whole grains	35.9	22.6	20.5	19.1	40.8
Milk	41	62	113	129	187
Nuts&seeds	5.3	5.7	5.5	6.1	5.3
Fibre	25.0	22.8	22.0	21.1	20.5
Red meat	24	39	49	61	68
Processed meat	7.0	7.9	12.4	22.1	27.1
Sweet drinks	95	93	116	119	104

Source: Extracted from W.A. Masters (2016) Assessment of Current Diets: Recent Trends by Income and Region, Working Paper No. 4, Friedman School of Nutrition Science and Policy, Tufts University. Results are based on data for 180 countries for the year 2013. See www.nutrition.tufts.edu/profile/william-masters

In the case of livestock, the increase in red meat consumption signals a potentially bright future for northern beef production in WA. Undertaking research to deliver lower-cost transport routes, feed

supply enhancement, improved animal husbandry and greater genetic gain in animals will provide further competitive advantages to those export businesses with all the multiplier benefits that flow from greater export revenues.

Another market opportunity, not listed in Table 3 as it excludes alcoholic beverages, is the likely increase in sales of manufacturing barley used to produce malt for beer production. Beer consumption is on the rise in many Asian countries, with South Korea, Vietnam, and India, for example, having annual growth rates of beer consumption of 11.7%, 6.4%, and 6.4% respectively. China overtook the USA as the world's largest beer market in 2003 and younger Chinese drinkers are now switching away from cheaper local brews to premium and imported beers. Research is needed to ensure that barley can be affordably produced in WA with traits that yield the malt characteristics most preferred in key Asian growth markets for beer.

China has become the dominant outlet for WA exports of western rock lobster; an industry now worth over \$0.5 billion. China is also our main wool export customer. Younger, richer Chinese have a preference for natural fabrics and Australian wool faces little international export competition. Identifying how to more cheaply and quickly grow volumes of wool with properties for which price premia apply should be part of a future agricultural research agenda. Wool and sheepmeat are joint products and WA is well-positioned to also benefit from research and innovation that boosts sheepmeat production.

New Zealand and Australia are the world's largest exporters of sheepmeat, accounting for approximately 70% of global exports of sheepmeat. New Zealand breeding ewe and lamb numbers have been in decline over the last decade, as many producers have switched into dairy production. So New Zealand's reduced capacity for export growth means WA is competitively positioned to supply more of the growing global demand for sheepmeat, particularly in Asia and the Middle East. Increased sheep production means more meat-processing and commensurate increases in regional employment and value-adding.

Another important growth market for WA is the export of oats and associated value-added opportunities, locally and overseas. WA is Australia's main source of high quality milling oats. Research has helped breed new oat varieties that when processed deliver greater flavour and aroma. Oats contain a specific type of soluble fibre known as beta-glucan and studies show that consuming just 3 grams of beta-glucan a day (the amount in one bowl of oatmeal) lowers total blood cholesterol levels and reduces heart disease risk. Health-conscious consumers, locally and in Asia, are increasing in number and are increasing their consumption of oat-based products, and WA already has a comparative advantage in oat production.

A role for government is to help co-fund and co-ordinate research that will allow WA primary industries to best capture some of these emerging market opportunities in Asia. As explained earlier, Perth households and taxpayers will also benefit from the outcomes of this research. An overarching challenge for industry and government is to also co-invest and co-ordinate in infrastructure provision that facilitates business activity and allows export market opportunities to be embraced. Logistic services (road, rail, ports) or telecommunication services may require upgrade, otherwise the benefits of research are not fully expressed. More efficient commercial interchanges (e.g. blockchain technology) and traceability systems will require reliable and high-capacity electronic infrastructure.

A further cooperative role for government and industry is to use research and innovation to build greater business performance and resilience in primary industries. Market turbulence and variable and changing local climate form the backdrop for agricultural business in WA. Collaboratively-developed research products and innovations need to deliver enduring value for businesses operating in such a testing environment. Greater business performance and resilience will have spillover benefits to these businesses' regional communities. For example, a decadal study of over 500 WA farm businesses found that the top-25% and bottom-25% of businesses generated an average annual return to capital of 10.7% and 0.9% respectively, with both groups receiving a 2.1% annual appreciation of land values [7]. A separate study examining many of those same businesses found that farm families' investment in training and their human capacity positively and significantly affected their financial performance [19]. Hence, any joint investment by farm businesses and government in enhancing farmers' managerial skills is likely to generate sizeable economic benefits to those businesses and the wider economy. Given the generational renewal of farm managers and owners that will occur over the next decade [9], due to the demographic age bubble in farming, such investment in capacity-building is likely to create enduring benefits. By illustration, the average net worth of a broadacre farming business in WA is around \$7 million and there are around 2,000 such businesses. Hence, an overall 2% improvement in the average rate of return to capital is worth around \$280 million each year.

Although WA primary industries face more market opportunities in Asia in coming years, in some regions the ramifications of economies of size, automation and remote monitoring may mean less social vibrancy. Again this challenge can be an opportunity for co-investment and cross-department activity to discover, based on research activity, innovative ways of better serving the social needs of communities and businesses engaged in regional primary production and value-adding. That is, the future of WA agriculture and its value-adding will not just depend on biological and technology research but also on social and managerial science; for primary production and some value-adding activity will always be amid regional and peri-urban communities. Hence, for example, there will need to be research on furthering our knowledge of community understandings of and attitudes towards farming, farmers and farm practices as these views will impact on farmers' social licence to operate and affect the way food is produced and its cost [11].

Investment in primary industry research and innovation will take place against the backdrop of Australian agribusiness already having being identified as an attractive investment opportunity for local and international investment. Deloitte Economics identifies Australian agribusiness (see Figure 9) as the sector in Australia offering the highest strategic advantage to investors [12]. Deloitte developed an Australian advantage score, linking relative productivity (what Australia is good at) with relative advantage (where it is difficult for others to match or imitate our advantages). Agribusiness was the top-ranked sector.

The challenge for government is to ensure its collaborative investment in primary industry research and innovation ensures Australia's relative productivity (what Australia is good at) in primary production is cost-effectively maintained in order to attract further investment in the agribusiness sector.

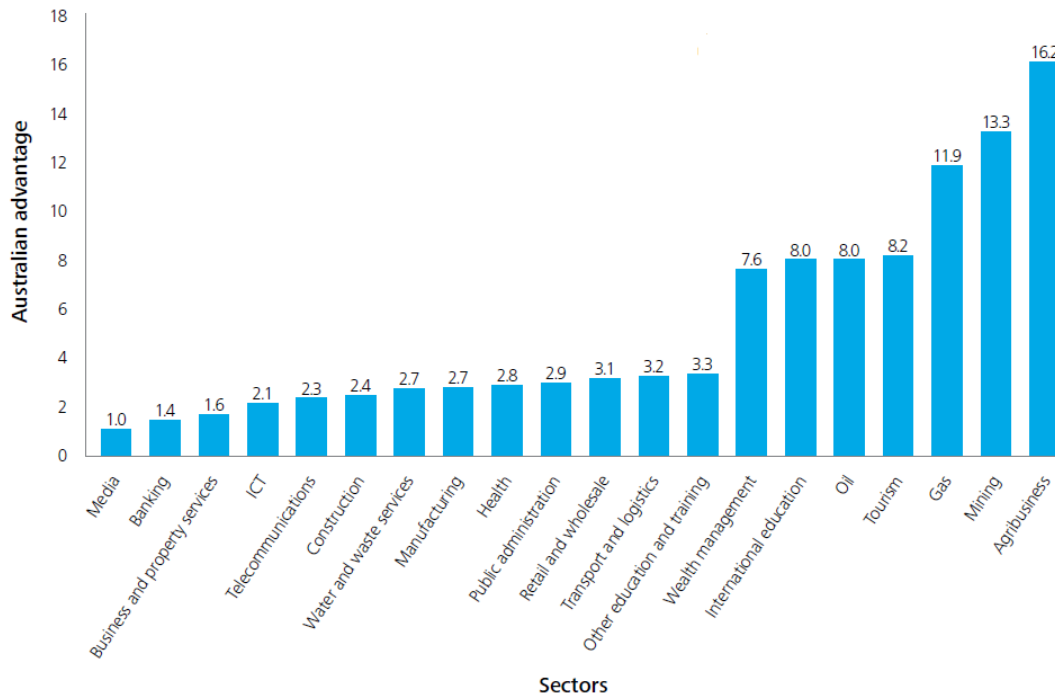


Figure 9: The relative advantage of industry sectors in Australia. Source: [12]

Not captured by the Deloitte study is the likely further advantage bestowed on the export-orientated primary industries of WA of recently signed free trade and bilateral trade agreements. Australia has ten free trade agreements with China, Japan, Republic of Korea, New Zealand, Singapore, Thailand, USA, Chile, the Association of South East Asian Nations (ASEAN) and Malaysia. In addition, the Trans-Pacific Partnership was signed by 11 countries, including Australia in March 2018. Lastly, the proposed tariffs on USA agricultural exports to China, if implemented, will provide further trade advantages to Australia.

Case Studies of Research and Innovation

National and international appraisals of publicly-funded agricultural research almost always conclude that the research is economically worthwhile [13,14,15,16], typically generating high rates of return. Even allowing for the complex issue of attribution, where an outcome depends on a range of influences and stakeholder actions, investment in agricultural research and innovation is almost always shown to be a sound and profitable use of public and industry funds [17,18]. An illustration of the chain of impact or attribution is contained in a recent study of WA farm businesses [19]. The study found that farmers’ use of cropping innovations crucially affected their profitability. In turn, however, farmers’ use of these innovations depended on their investment in training and capacity-building within the farm family. Hence, research that creates cropping innovation, if complemented with investment in training and capacity-building, is more likely to boost farm business performance.

In Australia, the rationale for government funding and support for primary industry research and innovation has been examined by the Productivity Commission [19,20], its predecessors the Industry Commission [21] and Mullen[32] (see Appendix 5). In general the economic justification for public investment in primary industry research and development is supported. For example, the Industry Commission [21] assessed returns to research and development investments in Australia and concluded that the returns “range from 25 to 90 per cent”.

There are different kinds of research and innovation that governments engage in and fund. The focus of research and innovation can be on products, practices, technologies, policy, biosecurity, management and environmental impacts. The following are examples of research and innovation activity in DAFWA (note, following departmental amalgamations DAFWA is now subsumed into the agriculture and food portfolio of DPIRD), chosen to illustrate the value and effectiveness of different types of research and innovation in WA.

1. Crop research

Canola oil, along with olive oil, is acknowledged to be one of the healthiest oils. Like olive oil, canola oil is very low in saturated fats. It contains linoleic (omega-6) and α -linolenic acid (omega-3) essential fatty acids at a 2:1 ratio, marking it as one of the healthiest cooking oils.

A spring drive in the WA countryside reveals the yellow-flowered fields of canola and shows how widespread canola is grown in WA. WA now produces about half of the nation's canola. In 2017/18 1.9 million tonnes were produced in WA, worth around \$1.04 billion to the state economy. Most of WA's canola is exported, although there are two local crushing plants, at Pinjarra and Kojonup, which use about 60,000 tonnes of seed each year and provide oil for the local market. What is rarely known and appreciated is the role of research and innovation in WA that has enabled canola to become a major cropping industry in southern Australia. In WA, in 1990 only 2,000 hectares of canola was grown, a far cry from the over 1.2 million hectares grown in each of the last two years.

In the early 1990s when Ernie Bridge was the Minister for Agriculture, the WA government and industry annually committed \$140,000 to canola research and development programs. These funds employed two full-time canola specialists. One investigated the rotational value of canola in farm systems, the advantages of herbicide-tolerant canola, and the identification of blackleg resistant and early flowering genetic material. The second researcher interacted with farmers to discover their information and agronomic needs in order to better inform future research.

The upshot of this research, and the subsequent several years of research and innovation funded by the WA government and industry, was the development of varieties and agronomic packages that enabled farmers to profitably include canola in their farming systems. In addition, householders had increasingly affordable access to canola oil and all its health benefits. Plus export earnings grew strongly and delivered benefits to the state economy.

1. Market-securing Research

Associated with WA's canola industry has been very recent research that has secured WA's access to the lucrative European Union (EU) biofuel market. The EU is a major market for the export of canola from WA. In 2016/17 and 2017/18 2.3 mmt and 1.9 mmt of canola respectively was produced in WA, or about half of all canola grown in Australia. Most of the canola grown in WA is exported to the EU where due to its non-GM status it receives a price premium of at least \$30 per tonne, and canola regularly is priced above \$500 per tonne. So canola is a valuable crop and it serves a useful role in rotational farming in WA. About 70% of WA's exports of canola to the EU go into the EU biofuel sector as the EU has mandated that at least 10 per cent of all fuels used in the EU transport sector need to be sourced from renewable energy such as canola.

However, biofuels made from biomass crops such as canola are only accepted if they provide sufficient savings in greenhouse gas emissions relative to the fossil fuels they replace. Canola crops only had to meet a 35 per cent saving in emissions to be acceptable to the EU biofuel market; but in

2013, the EU announced tighter emission regulations that would come into force on January 2017 (later amended to January 2018) [22]. A DAFWA researcher in the Australian Export Grains Innovation Centre became aware of this regulation change and realised that unless it could be scientifically shown that emissions associated with canola production in Australia were low by international comparison, canola would no longer be able to be exported to the EU. This would mean loss of the \$30 per tonne premium available in the EU biofuel market and Australian canola would need to be exported to other markets in which no premiums applied. In 2016/17 the value to WA canola producers of this premium in the EU biofuel market was worth around \$40 million.

DAFWA funds, complemented with industry funds supplied by the Australian Oilseed Federation, were used by the DAFWA researcher to oversee and coordinate CSIRO research that verified that WA was a source of low emission canola. This research was critical for retaining market access. In late December 2017 the EU formally announced that Australia and its states were acceptable low emission sources of canola and so imports of canola into the EU could continue from January 2018.

The actions of the DAFWA researcher in identifying the threat of loss of market access, their organising of the research and its funding, and overseeing the national and EU assessment of that research led to an EU decision worth around \$40 million to canola producers in WA this year. Moreover, the on-going access to this EU market, made possible by the research and its findings, means every year the \$40 million of price premiums will flow back to WA canola producers, and the WA economy will enjoy all the multiplier benefits associated with that revenue inflow.

2. Organisational and Policy Innovation

A remarkable example of organisational and policy innovation undertaken by DAFWA staff is the introduction of end point royalties that has transformed cereal breeding in Australia and saved the public purse millions of dollars each year. End point royalties are royalties on grain harvested for sale. These royalties have enabled Australia to become a global leader in cereal breeding, with commercial firms now applying cutting edge technologies to deliver superior cereal varieties across the grain-growing regions of Australia. It has entirely shifted the funding of cereal breeding away from previous almost complete reliance on taxpayer funding to sole funding by varietal users. Previously DAFWA needed to allocate \$6-\$9 million a year to support and undertake cereal breeding. Following the introduction of end point royalties, that impost on the DAFWA budget has been removed, yet the cereal industry continues to be well served by access to higher-yielding, sound quality varieties.

Through legislative reform, industry persuasion and stakeholder engagement, a small group of DAFWA staff were able to introduce structural and policy change in the financing and organisation of cereal breeding in WA that has also had interstate ramifications. By illustration, Australian wheat breeding alone now has an annual national investment of over \$45 million. Australian Grain Technologies, Australia's largest wheat breeding company, annually operates over 250,000 yield plots, whereas by international comparison the entire wheat breeding programs in Canada, the United Kingdom, and France only have annual numbers of yield plots of approximately 80,000, 100,000, and 120,000, respectively [23]. The wheat varieties Mace and Scepter, released by Australian Grain Technologies in 2008 and 2015, respectively, were 3% and 7% higher-yielding than the highest yielding varieties available to growers in those years [24]. Just a 1% increase in the yield of wheat in WA is worth around \$28 million each year, so a 7% increase, available with Scepter, is

worth to WA almost \$200 million each year. These additional annual revenues flow into the WA economy mostly via increased export sales.

3. Soil Resource Research

The ancient soils in WA's principal agricultural regions are widely acknowledged to be relatively infertile by international comparison and are subject to problems such as salinity, erosion, compaction and acidity. Over many years DAFWA scientists have worked with farmers to develop land use practices to lessen or combat these problems. Techniques such as liming, direct drill technologies and deep-ripping have been introduced or developed by DAFWA researchers as part of soil management and soil amelioration.

The upshot of this research is that crops can now be sown earlier, yielding more, and with far less loss of valuable top soil through erosion or salinization. Moreover, applied inputs become more effective following deep-ripping and/or following liming.

Economic assessments [e.g. 25,26,27] of soil-improving practices such as liming, deep-ripping and controlled traffic methods reveal they are commercially attractive. Hence, it is welcome news but not surprising that over 80% of grain farmers in WA use techniques like direct drill sowing of crops that minimise soil disturbance [28], 90% use machinery guidance systems to reduce compaction and more accurately apply inputs; and WA farmers apply much more lime than most farmers in other states [29].

4. Pasture Research

Pasture legumes have a major role to play in maintaining the profitability and sustainability of farming systems in WA. Their ability to fix nitrogen increases soil fertility and delivers benefits to subsequent crops. Their inclusion in rotations with crops provides the opportunity to break disease and pest life cycles and improve weed control. Their high nutritive value also benefits livestock through greater wool production, liveweight gains and increased carrying capacity. Hence, research to improve pasture production can enhance animal production whilst providing spillover benefits to subsequent rotational phases.

DPIRD researchers have introduced and improved at least 10 pasture species to WA. These pastures have enabled more pastures to be grown on soils unsuited to cropping and enabled pastures to better co-exist with intensified cropping. Over a decade around \$20m has been spent on this research, and assessments of its economic worth [30] reveal a cost benefit ratio of 2.7. Moreover, given the likely prospect of persistent higher prices of sheepmeat and wool over the next few years, the returns from this research will actually be greater.

5. Animal Research

Together with 95 farmers, DPIRD researchers embarked on the "Rylington Merino" project to select sheep resistant to worms. This was a long-term research project that ultimately produced highly worm resistant sheep at a level never previously attained nationally or indeed internationally. Field trials compared worm resistant flocks against standard control flocks. Financial analyses of the trial results showed that worm resistance had several positive impacts on most production traits and improved both wool and carcase income. The income from the resistant group was 10% higher than that for the control group, and that was in a production year when wool prices were low and drenching was not required as it was a year of low worm challenge [31]. Hence, in years where the

worm challenge arises and sheepmeat and wool prices are high, as is currently the case, then the income increase from worm resistance will be substantially greater.

The research has found that worm resistance increases flock productivity, reduces farm use of veterinary chemicals and generates long-lasting production advantages. Moreover, worm resistance is heritable and has no antagonistic genetic correlations with other production traits. Farmers now have access to the genetics of this flock via SheepGenetics (see <http://www.sheepgenetics.org.au/Home>).

The Regional Economic Benefits of Agriculture

A separate report from ACIL Allen details the State-wide and specific regional economic impacts of agriculture. As expected, in some regions agriculture is a key sector and therefore plays a dominant role in the economy of the region. Overall, as is true of most highly developed economies, agriculture plays a relatively minor role in the State economy. In 2015-16, the total Gross Value-Added (GVA)⁵ in Western Australia was \$266 billion, of which the agriculture, forestry and fishing industry contributed \$5.4 billion or just over 2 per cent of the total value. This equates to 3.5 per cent of Gross State Product, with over half of this value (\$4.3 billion) coming from the grains industry. In addition, consistent with the scale and mechanisation technologies that lessen unit costs of production, the agriculture, forestry and fishing industries employed just over two per cent of the total WA workforce.

The ACIL Allen report describes the employment multipliers associated with agricultural activity and the regional economy impacts of agriculture. Agriculture performs an especially important economic role in the Wheatbelt, Great Southern, Esperance-Goldfields and Mid-West regions. In these regions agriculture is a key source of employment and value-adding.

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⁵ Gross Value Added (GVA) is a measure of the value of goods and services produced in an industry or sector of an economy, and represents the output of an industry or sector minus intermediate consumption. GVA therefore represents the value of all goods and services produced, minus the cost of all inputs and raw materials used to produce that good or service. Unlike Gross Product, GVA does not include the value of taxes minus subsidies.

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Appendix One: A Recent History of the Department of Primary Industries and Regional Development

Nature and timeline of DPIRD amalgamation

Following the March 2017 election outcome, the Premier announced the first round of machinery of government changes in the public sector in June 2017. Amalgamated departments were created, as outlined in the Government's 2017 election commitments. The Department of Primary Industries and Regional Development (DPIRD) was formed in July 2017 through the amalgamation of the Departments of Agriculture and Food, Fisheries, Regional Development and staff of the nine Regional Development Commissions. DPIRD spent 3 months after the March 2017 WA State election outcome preparing for amalgamation.

Recent and Current Departmental Reviews

The last significant set of reviews of the Department of Fisheries was in 2009-2010, under the then Minister Norman Moore – leading to a major funding reform and a major consultation reform. These reviews have shaped the way Fisheries operated up until amalgamation. The key stakeholders appear to have been supportive and the reforms have promoted stability and clear lines of engagement.

Throughout 2015-2016, the Department of Regional Development undertook a reform agenda for the entire regional development portfolio. This allowed activity to be aligned under the new Regional Development Strategy, launched by the then Minister Redman in June 2016.

In late 2015, the Department of Agriculture and Food undertook the Stocktake and Future directions review, initiated by the then Minister Baston. The review examined the critical and core functions of the department and its capacity to deliver on the government priorities. The review, backed by extensive industry consultation, supported the agency's critical role to grow and protect the WA agriculture and food sector. However, the report highlighted a number of issues, including the effect of successive budget and staff cuts on capacity and capability and loss of stakeholder confidence. The review identified that government was not adequately supporting the sector's development. It also expressed concerns about the agency reducing its involvement in traditional services, such as on-farm research and development. The report made 12 recommendations based on two key principles:

1. science and innovation underpin DAFWA's capacity to develop and defend WA agriculture and food, and
2. all activities be done in partnership with industry.

At the same time, at the request of the Minister, the WA Biosecurity Council carried out a review into the resource prioritisation and allocation within the agency. The report made three strategic recommendations to support robust decision-making and a resilient biosecurity system for WA:

1. A clear, consistent and agreed framework for prioritisation.
2. Increased resources for biosecurity and related functions.
3. Attract and retain appropriately skilled staff.

Despite these reviews, government fiscal priorities forced DAFWA to start a redundancy and part-renewal program in December 2016. The redundancies occurred, but the renewal was halted through the necessities of the machinery of government amalgamation processes (March-June 2017), and only some of those capabilities are being filled, often in an ad hoc fashion.

Grants Reviews

Each of the former departments administered and continue to administer a number of different funding/grant programs and loan schemes, including the Royalties for Regions (RfR) Fund. Potential synergies between the various funding/grant programs and loan schemes are now being explored. This is occurring in two phases:

1. Phase 1: capture and document the processes and functionality associated with the funding/grant programs and loan schemes.
2. Phase 2: analyse the information obtained to determine any potential synergies with a view to harnessing these to gain administrative efficiencies.

Following the 2017 change in government, a comprehensive review of RfR projects and commitments was undertaken, and in a budget repair process, significant projects were de-committed, new priorities announced, and the fund is now fully committed in the out years (to 2021).

DAFWA Staff Numbers and Turnover

The Stocktake review, mentioned previously, found that:

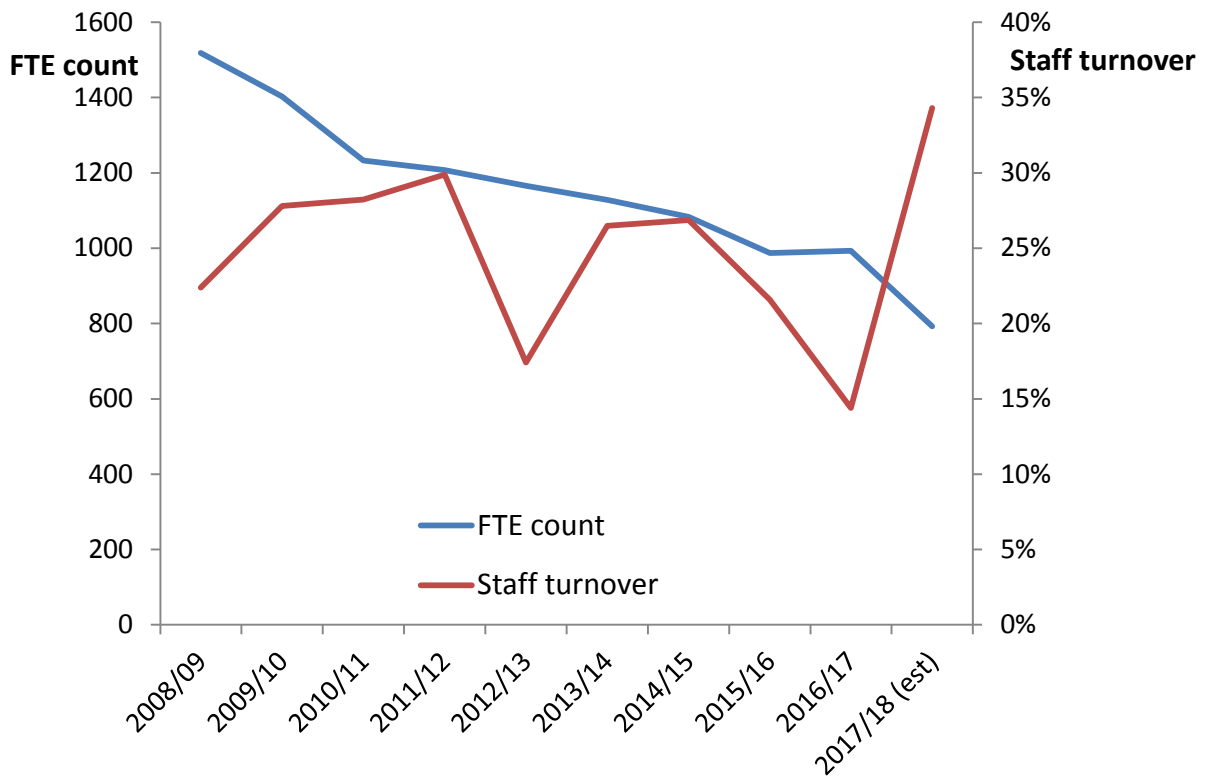
- Declining government investment in DAFWA had eroded its capability.
- Elements of DAFWA's current approach to industry engagement – in part a response to recent budget cuts – had led to a loss of confidence by industry and stakeholders.
- If DAFWA's budget were to fall further – as proposed in its forward estimates – then DAFWA would be unable to fulfil its agreed growth function.

This was highlighted by DAFWA's largest co-investor, the Grains Research and Development Corporation's stated intention to stop co-investing with DAFWA unless the department was able to assure its future commitment to grains research. This co-investment is currently around \$20 million per annum.

Successive budget cuts since 2008 caused DAFWA to dispense with all discretionary expenditure by 2013, with subsequent reductions impacting on core capabilities. DAFWA had cushioned these losses by effectively delivering some core functions through the RfR funded "Seizing the Opportunity – Agriculture" initiative. However, this temporary funding measure was not sustainable and provided no confidence to investors, industry or the staff involved, that core functions would be maintained. The Stocktake and Future Directions review stressed the importance of technical and research staff, their personal experience and industry standing which would take many years to replicate should they leave.

Although the current Minister for Agriculture has announced the need to rebuild the research capacity in her department, the current forward estimates point to the opposite being more likely. Chart 1 shows the rapid and persistent decline in the FTE count of the former DAFWA, now part of DPIRD. Worsening this decline is the remarkably high staff turnover rate, based on resignations and terminations as a proportion of the FTE count. Most healthy businesses require staff turnover rates around 5 to 15 percent. By contrast DAFWA (now the agriculture part of the DPIRD portfolio) has staff turnover rates consistently above 20 percent. Thus far in 2017/18 there have been 272 resignations and terminations, out of a workforce less than 800.

Chart One: The full time equivalent (FTE) staff count of the former Department of Agriculture and Food and its staff turnover (%)



Appendix Two: Current Strategic Priorities of the Department of Primary Industries and Regional Development (DPIRD)

DPIRD has developed a draft Strategic Intent 2018-2021. The purpose of DPIRD is to create enduring prosperity for all Western Australians and its role is to ensure that WA's primary industries and regions are key contributors to the government's agenda for economic growth and diversification, job creation, strong communities and better places.

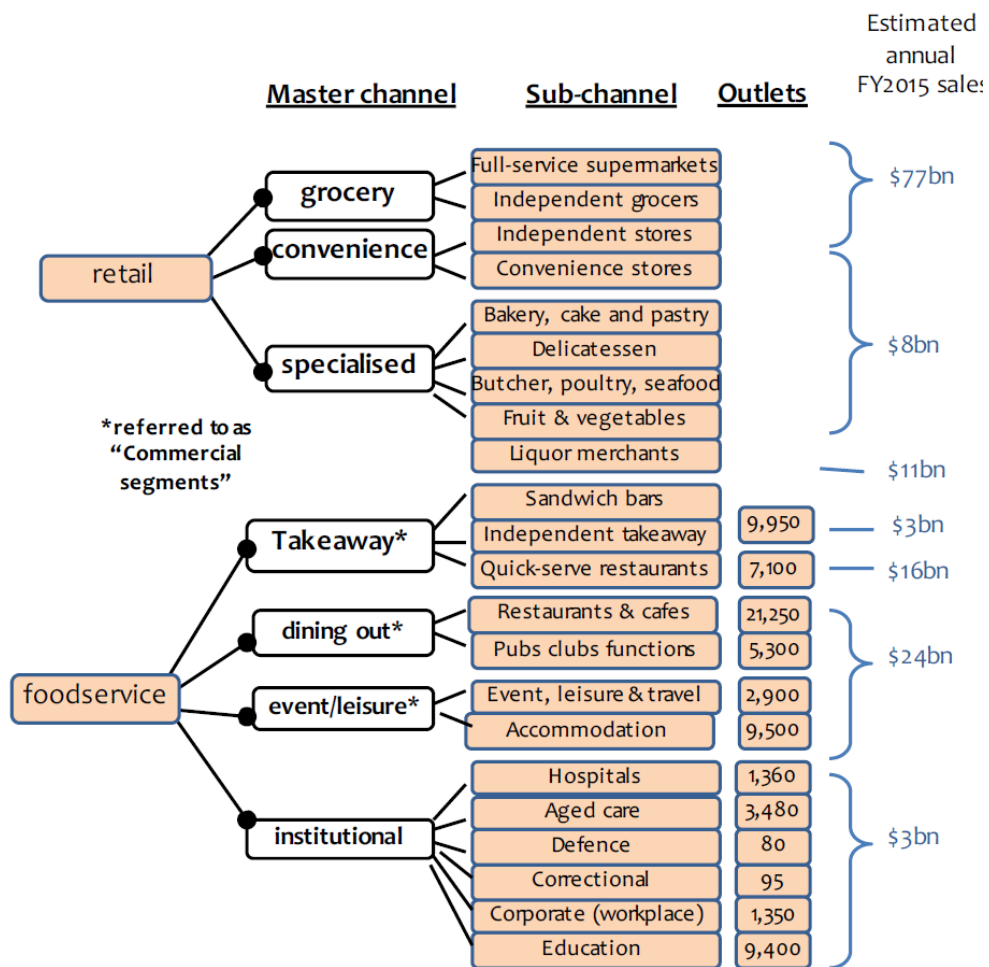
The strategic intent is informed by the following key facts:

- 25% of WA's workforce is employed in the regions
- Around one-third of WA's gross state product is generated in the regions
- Agrifood (including fibre) and fisheries industries produced \$7.6b in exports in 2015/16
- WA has 750,000 recreational fishers
- 97% of our merchandised exports volume is through our regional ports.

DPIRD's six strategic priorities are addressed through 25 key initiatives that are being developed and implemented over the next three years.

STRATEGIC PRIORITY	KEY INITIATIVE
1. BIOSECURITY Delivering respected and recognised state biosecurity	A responsive and robust biosecurity system
	Surveillance for market access and early detection
	Traceability of agri-food products
	Biosecurity response preparedness
2. SUSTAINABILITY Sustaining the state's land, water and aquatic resources, reputation and competitive advantage	Sustainable fisheries management
	Natural resource management planning and assessment
	Increasing the value of our pastoral sector
	Animal welfare strategy
3. INTERNATIONAL COMPETITIVENESS Growing internationally competitive industries and businesses	Enterprise-grade digital connectivity
	Primary industries supply chain development
	Trade and investment facilitation
	Market and consumer insights
	Aquaculture industry development
4. REGIONAL OPPORTUNITIES Capturing regional opportunities to drive economic growth, job creation, local capability and social amenity	Regional growth opportunities and project pipeline
	Local content in regional WA
	Southern fisheries development
	Recreational fishing development
	Energy futures
5. RESEARCH, DEVELOPMENT & INNOVATION Harnessing the science and technology required to grow WA's primary industries, food processors and regions	A dynamic RD&I environment
	New regional RD&I capacity
	Rebuild DPIRD science capability
6. ENABLING ENVIRONMENT Creating an enabling environment for primary industries and regions (legislation, policy, business systems and practice)	Unlocking land and water expansion opportunities
	<i>Aquatic Resource Management Act 2016</i> implementation
	<i>Biosecurity and Agriculture Management Act 2007</i> review
	<i>Animal Welfare Act 2002</i> review

Appendix Three: The value of consumer spending on food in different food service channels in Australia in 2015

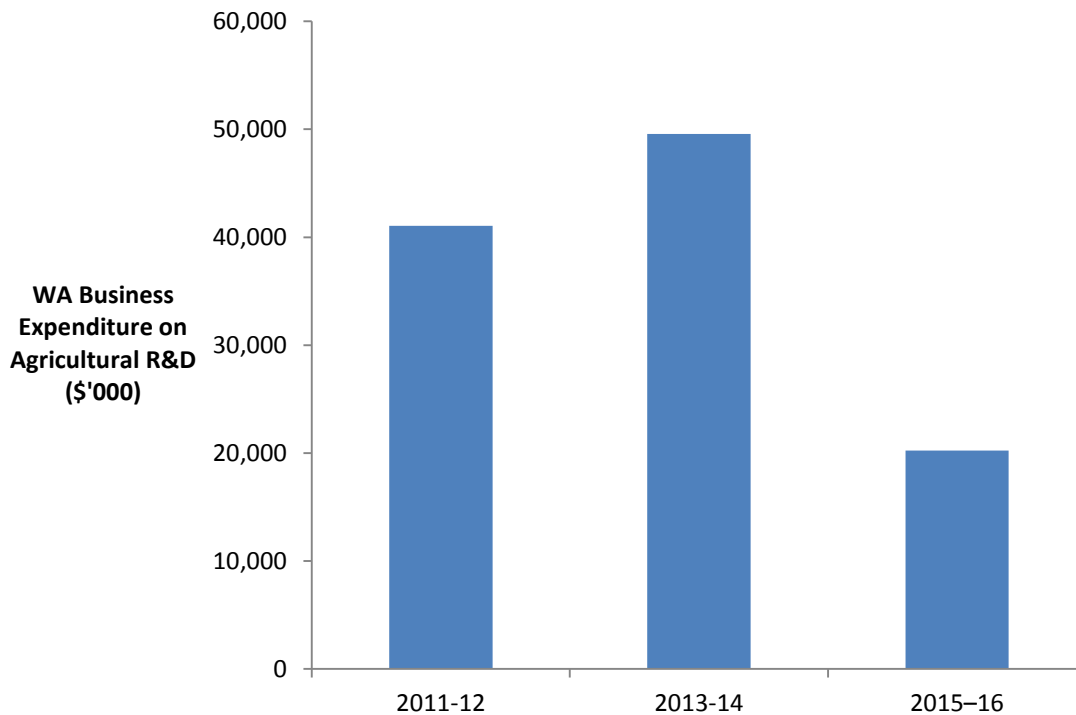


Source: Freshagenda analysis drawing on ABS, IBIS

\$142bn Total

Source: Abstracted from Spencer, S. (2016) Understanding food markets outside retail. Part 1: What is Foodservice? RIRDC Publication No.16/040 Available at <http://www.agrifutures.com.au/publications/understanding-food-markets-outside-retail-part-1-what-is-foodservice/>

Appendix Four: WA business expenditure on agricultural R&D



Source: Based on Australian Bureau of Statistics data, Research and Experimental Development, Businesses, Australia, 2015-16 & earlier years

The marked decline in WA businesses' expenditure on agricultural R&D in recent years mirrors the decline in WA government support for agricultural R&D over the last 5 years. At a time when the state government was looking to agriculture to help underpin the state's economic development following the downturn in mining, the state was disinvesting in agricultural R&D. Hence, businesses dependent on government co-investment or collaboration were also being forced to reduce their spend on agricultural R&D. No other state in Australia has experienced the magnitude of reduction of business expenditure on agricultural R&D as has occurred in WA; and no other state has experienced as significant a withdrawal of government support for agricultural R&D.

Appendix Five: Main reviews of investment in Australian rural research and development

The Productivity Commission [19] reviewed public support for research and innovation in Australia, including agricultural research and development, and concluded that “There are widespread and important economic, social and environmental benefits generated by Australia's \$6 billion public funding support of science and innovation. On the basis of multiple strands of evidence, the benefits of public spending are likely to exceed the costs.”

The Productivity Commission also [20] reviewed the current structure and funding principles of Rural R&D Corporations. They concluded that “This co-investment model has important strengths” and that “the broad model should be retained”. The Commission stated that “Strong public support of Rural R&D Corporations with a public good orientation is justified.” However, the Commission did point out some inadequacies in the funding model and advocated a greater role for industry funding. They considered that in some areas of rural R&D, public funding may crowd-out of private investment in R&D. Mullen [32] observed that the Commission provided little empirical evidence to support this view, and Mullen then provided counter-arguments. Regarding possible crowding-out, more recent evidence gathered by the Australian Farm Institute [3] in 2016 shows crowding-out is not an issue. The Institute found that public support for agricultural research and development actually enabled greater funding by industry.

Mullen [33], in a broad review of returns from investment in Australian agricultural research and development, concluded that “returns to investments in domestic research are likely to have been in the order of 15 – 30 percent.”