

Human capital

- 5.1 This chapter examines barriers to technology adoption which arise from the human capital side of the innovation system. These barriers arise firstly through workforce issues such as access to leaders, labour and skills; and secondly through the extension and adoption processes.

Workforce

- 5.2 This section of the chapter considers the adoption barriers caused by limited access to leadership, and skilled and unskilled labour. This section also examines the development and retention of university research professionals in agricultural fields.

Access to leaders

- 5.3 Mr Tyran Jones, Chair of the Policy Committee and Director of Australian Dairy Farmers, was among those to identify the role of local leaders in driving community buy-in to innovation and adoption of technology.¹
- 5.4 Evidence to the inquiry also noted that local leadership potential is limited by factors such as the ageing farmer demographic. The Australasia-Pacific Extension Network noted that since 1976, the number of farmers under the age of 35 has fallen by more than 75 per cent.²
- 5.5 Submissions suggested that local leaders could be developed from three segments of agricultural communities: women, young people, and farmers' groups. The first two are discussed here and the third is considered throughout the chapter.

1 Mr Tyran Jones, Chair, Policy Committee and Director, Australian Dairy Farmers, *Committee Hansard*, Melbourne, 29 January 2016, p. 35.

2 Australasia-Pacific Extension Network, *Submission 95*, p. 8.

Women as leaders

- 5.6 The Rural Industries Research and Development Corporation (RIRDC), Australian Women in Agriculture (AWiA) and the National Rural Women's Coalition (NRWC) emphasised that women can make valuable contributions as local leaders of agricultural innovation.³
- 5.7 Ms Rachel Hay and Mr Philip Pearce's research has found that rural women are ready adopters of innovation and are more likely to use some technologies than men are. They noted that women are becoming local leaders as attitudes towards women's use of technology change.⁴
- 5.8 Meanwhile, the NRWC, Ms Hay and Mr Harrington recommended targeting women with flexible and tailored training in technology and business skills to enable them to take up leadership roles in encouraging the adoption of emerging technologies.
- 5.9 The NRWC submission commented that:
- Rural women would like to expand their knowledge and skills in using emerging digital technologies as and when they become available if they are to become digital disruptors that will lead to strong business innovation in agriculture.⁵

Young people as leaders

- 5.10 The Alpine Valleys Dairy Pathways (Alpine Valleys) project, RIRDC, and the Winemakers' Federation of Australia identified young people as a source of leadership in agricultural innovation.⁶
- 5.11 The Australasia-Pacific Extension Network, Rabobank and the RIRDC Horizon Scholars elaborated on the value of young people as local leaders of innovation through their familiarity with technology, their focus on future thinking, and their readiness to accept change.⁷

- 3 RIRDC, *Submission 74*, p. 7; Mrs Sarah Parker, Director, Australian Women in Agriculture, *Committee Hansard*, Canberra, 3 March 2016, p. 8; Dr Patricia Hamilton, President, National Rural Women's Coalition Ltd, *Committee Hansard*, Canberra, 3 March 2016, p. 8; Ms Rachel Hay and Mr William Harrington, *Submission 91*, p. 4, att. 1, p. 319.
- 4 Ms Rachel Hay and Mr William Harrington, *Submission 91*, att. 1, R Hay and P Pearce, 'Technology adoption by rural women in Queensland, Australia: Women driving technology from the homestead for the paddock', *Journal of Rural Studies*, vol. 36, 2014, p. 326.
- 5 NRWC, *Submission 5*, p. 4.
- 6 Mr Patten Bridge, Project Consultant, Alpine Valleys Dairy Pathways project, *Committee Hansard*, Wodonga, 28 January 2016, p. 24; RIRDC, *Submission 74*, p. 7; Mr Anthony Battaglione, General Manager, Strategy and International Affairs, Winemakers' Federation of Australia, *Committee Hansard*, Canberra, 4 February 2016, p. 2.
- 7 Australasia-Pacific Extension Network, *Submission 95*, p. 8; Rabobank, *Submission 48*, p. 8; RIRDC, *Submission 74*, p. 11.

- 5.12 However, Ms Hay and Mr Pearce cited research that fewer young people are entering agriculture.⁸ The Primary Industries Education Foundation Australia attributed this trend to negative perceptions of farming and particularly a failure to connect agriculture with innovation.⁹
- 5.13 Mr Ian Haggerty, Manager of Prospect Pastoral Company, and Mr Stuart Crosthwaite, Chair of the Project Steering Committee of the Alpine Valleys project, explained that young people often have inaccurate perceptions of agriculture as hard and risky work with few rewards and a poor lifestyle.¹⁰
- 5.14 Evidence to the inquiry proposed several options to improve attitudes towards agriculture and attract young people into agricultural careers.
- 5.15 Ms Jenny Anderson, Production Manager of Rutherglen Lamb, and the Primary Industries Education Foundation Australia recommended the introduction of agricultural science and the promotion of agricultural careers throughout school curricula.¹¹
- 5.16 The RIRDC recommended leadership programs to excite students about the prospects for innovation and growth in agriculture. It gave the example of its Horizon Scholars program which supports university students studying agriculture or related degrees.¹²

Access to skilled labour

- 5.17 The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) predicted that demand for skilled labour will increase to help farm businesses adopt sophisticated technology and become more innovative.¹³
- 5.18 However, submissions to the inquiry established that skilled labour is difficult to access. Some of the causes of this shortage, such as the ageing workforce, are felt across the economy. Other causes which are more particular to the agricultural sector are discussed below.

8 Ms Rachel Hay and Mr William Harrington, *Submission 91*, att. 1, R Hay and P Pearce, 'Technology adoption by rural women in Queensland, Australia', p. 320.

9 Primary Industries Education Foundation Australia, *Submission 111*, p. 1.

10 Mr Ian Haggerty, Manager, Prospect Pastoral Company, *Committee Hansard*, Wodonga, 28 January 2016, p. 14; Mr Stuart Crosthwaite, Chair, Project Steering Committee, Alpine Valleys Dairy Pathways project, *Committee Hansard*, Wodonga, 28 January 2016, p. 25.

11 Ms Jenny Anderson, Production Manager, Rutherglen Premium Lamb, *Committee Hansard*, Wodonga, 28 January 2016, pp. 30-32; Primary Industries Education Foundation Australia, *Submission 111*, p. 2.

12 RIRDC, *Submission 74*, p. 7.

13 Gray, E.M., Oss-Emer, M. and Sheng, Y. (2014) *Australian agricultural productivity growth: past reforms and future opportunities*. ABARES research report 14.2, Canberra, p. 37, cited in DAWR, *Submission 88*, p. 10.

Geography

- 5.19 The inquiry heard of the scarcity of skilled labour in regional, rural and remote agricultural communities. For example, Deakin University noted the trend of skilled workers moving from agricultural areas to cities.¹⁴
- 5.20 Ms Deborah Kerr, General Manager for Policy at Australian Pork Limited, noted that it is difficult to reverse the trend and attract labour from cities:
- There are not a lot of people who would like to move to small rural towns where they are away from family and friends and the enjoyment that they would have in a capital city.¹⁵
- 5.21 The Australian Controlled Traffic Farming Association and Southern Farming Systems recommended a partial waiver of student fees to attract graduates to agricultural communities.¹⁶ Other submissions also proposed incentives to retain skilled labour in agricultural communities.¹⁷

Telecommunications

- 5.22 Chapter 4 considered the impact of telecommunications access on the adoption of innovative technologies. The Australian Academy of Technological Sciences and Engineering (ATSE) made particular note of its impact on access to skilled labour.¹⁸
- 5.23 Likewise, the Victorian Farmers Federation submitted that:
- ... without adequate mobile and internet services [rural] communities are limited in their ability to attract and retain the increasingly skilled labour force they demand.¹⁹

Succession

- 5.24 Rabobank's submission identified succession in farm ownership to younger generations as a key enabler of the adoption of innovative technologies. It also acknowledged that succession is dependent upon proper planning by current owners and the successful identification of new owners.²⁰

14 Deakin University, *Submission 28*, p. 1.

15 Ms Deborah Kerr, General Manager for Policy, Australian Pork Limited, *Committee Hansard*, Canberra, 29 February 2016, p. 3.

16 Australian Controlled Traffic Farming Association and Southern Farming Systems, *Submission 61*, p. 9.

17 Dr David John Halliwell, Director, Centre for Regional and Rural Futures, Deakin University, *Committee Hansard*, Melbourne, 29 January 2016, pp. 13-14; Plant Biosecurity Cooperative Research Centre, *Submission 36*, p. 8.

18 Australian Academy of Technological Sciences and Engineering, *Submission 56*, p. 11.

19 Victorian Farmers Federation, *Submission 57*, p. 2.

20 Rabobank, *Submission 48*, p. 8.

- 5.25 Evidence from the Alpine Valleys project, Cotton Australia and Ms Hay and Mr Pearce held that succession planning is critical to identifying new farm owners and prosecuting effective generational change.²¹
- 5.26 The Alpine Valleys project found that few of its members had clear succession plans and some had retired without successfully transferring ownership to younger dairy farmers. The project's trial to support succession planning may prove a useful model for other farmers' groups.²²
- 5.27 Meanwhile, the barriers to entry into farming for the next generation are considered above in the access to leaders section.

Access to unskilled labour

- 5.28 The agricultural sector also struggles with access to unskilled labour. Agromillora Australia explained that the cost and scarcity of unskilled workers has made robotics and automation a focus for agricultural innovation, particularly in labour-intensive areas such as horticulture.²³
- 5.29 The Cattle Council of Australia, Sheepmeat Council of Australia and Australian Lot Feeders' Association concurred and noted that labour saving technologies are already reducing labour costs and workplace injuries in their industries.²⁴
- 5.30 During the inquiry's site inspection with the Alpine Valleys Project, the Committee heard that increased mechanisation can make farm work more interesting, more profitable, and less labour-intensive. All of these factors encourage young and skilled workers to consider the industry for their careers.
- 5.31 The University of Sydney concurred that robotics and automation technology is likely to replace repetitive tasks and to increase the variety and interest of agricultural work, in turn aiding the retention of skilled labour.²⁵
- 5.32 However, the University of Melbourne and Professor Stewart Lockie identified the potential for increased unemployment among particularly

21 Alpine Valleys project, *Submission 10*, p. 3; Cotton Australia, *Submission 72*, p. 11; Ms Rachel Hay and Mr William Harrington, *Submission 91*, att. 1, p. 320.

22 Alpine Valleys project, *Submission 10*, p. 3.

23 Agromillora Australia, *Submission 38*, p. 2.

24 Cattle Council of Australia, Sheepmeat Council of Australia and Australian Lot Feeders' Association, *Submission 84*, p. 7; Growcom, *Submission 67*, p. 3; Grains Research and Development Corporation, *Submission 87*, p. 10; Australian Centre for Field Robotics, *Submission 94*, p. 8.

25 University of Sydney, *Submission 40*, p. 4.

unskilled workers if robotics and automation technology is adopted more broadly.²⁶

- 5.33 Robotics and automation may improve workers' conditions if they have the skills required to operate the new technology. Addressing the skills requirements of agricultural labour, as addressed below, will be key to maximising the positive impacts of these technologies.

Access to skills

- 5.34 Just as employers struggle to access skilled labour in the agricultural sector, workers struggle to access the skills they need to support the adoption of new technologies. Access to skills is limited by the content and delivery of training in the sector.

Training content

- 5.35 The RIRDC Horizon Scholars identified the need for skills development for all agricultural occupations to allow the sector to understand and exploit opportunities to adopt innovation.²⁷
- 5.36 AWiA and the NRWC submitted that this demand for skills is not being met due to the limited training content available in the agricultural sector.²⁸
- 5.37 ABARES noted that inadequate training content stems from the sector's historical lack of emphasis on formal training.²⁹ Some submissions suggested ways to overcome this trend. For example, AWiA proposed that agricultural training could be made a priority of the Industry Skills Fund.³⁰
- 5.38 A further barrier to supplying training is that the skills demanded to support the adoption of innovation are very broad. The inquiry heard of the importance of skills in fields as varied as biology, chemistry, engineering, data science, information technology, finance, and change management.
- 5.39 The University of Melbourne recommended enhancing the content of agricultural training. Mr Michael Santhanam-Martin, Lecturer in Agricultural Production Systems, gave the example of the University's own Bachelor of Agriculture degree which has been relaunched to include

26 The University of Melbourne, *Submission 4*, p. 4; Professor Stewart Lockie, *Submission 100*, p. 2.

27 RIRDC, *Submission 74*, p. 13.

28 NRWC, *Submission 5*, pp. 4-5; AWiA, *Submission 63*, pp. 4-7.

29 Gray, E.M., Oss-Emer, M. and Sheng, Y. (2014) *Australian agricultural productivity growth: past reforms and future opportunities*. ABARES research report 14.2, Canberra, p. 37, cited in DAWR, *Submission 88*, p. 10.

30 AWiA, *Submission 63*, p. 6.

interdisciplinary material on topics such as sustainability, ethics, and commerce.³¹

- 5.40 Dr Matt Wenham, Executive Manager of Policy and Projects at the ATSE, suggested that agricultural stakeholders should also pursue non-agricultural courses:

The people who are going to work in agriculture in the digital age are not necessarily just ag science graduates; they are mechanical and robotics engineers, computer scientists and hydraulic engineers. We need to expand the definition of what a career in agriculture involves and make sure we are training people in the right areas.³²

- 5.41 An on-farm training barrier identified by the University of Melbourne was that farmers require specific technical skills to implement and use individual technologies.³³ Deakin University commented that such training usually requires only modest investment to be provided by technology suppliers, industry groups or the like.³⁴
- 5.42 Finally, AusBiotech, Entrevators Pty Ltd and the NSW Farmers' Association recommended that farm owners be offered skills in cost-benefit analysis, entrepreneurship, and general technological skills.³⁵

Training delivery

- 5.43 ABARES noted that workers struggle to access skills because traditional, face-to-face training programs require a substantial time commitment and involve travelling significant distances to reach training facilities.³⁶
- 5.44 The NRWC submission recommended the use of webinars and gave the example of its 'E-Leaders Programs'. It noted that webinars are of particular benefit to women because these courses are flexible and can accommodate caring and business responsibilities.³⁷

31 Mr Michael Santhanam-Martin, Lecturer in Agricultural Production Systems, University of Melbourne, *Committee Hansard*, Melbourne, 29 January 2016, p. 49.

32 Dr Matt Wenham, Executive Manager, Policy and Projects, ATSE, *Committee Hansard*, Melbourne, 29 January 2016, p. 23.

33 The University of Melbourne, *Submission 4*, p. 3.

34 Deakin University, *Submission 28*, p. 5.

35 AusBiotech Ltd, *Submission 33*, p. 5; Entrevators Pty Ltd, *Submission 62*, p. 4; NSW Farmers' Association, *Submission 45*, p. 16.

36 Gray, E.M., Oss-Emer, M. and Sheng, Y. (2014) *Australian agricultural productivity growth: past reforms and future opportunities*. ABARES research report 14.2, Canberra, p. 38, cited in DAWR, *Submission 88*, p. 10.

37 NRWC, *Submission 5*, p. 5.

- 5.45 The Australasia–Pacific Extension Network also supported the use of information technology for interactive remote learning.³⁸
- 5.46 Professor Andrew Reeves, Senior Research Advisor to the Vice-Chancellor of Deakin University, proposed a method to reduce the burden of traditional training programs. The University partners with the Riverina Technical and Further Education (TAFE) college to offer the first years of some degrees in the Riverina area to reduce students’ costs and travel.³⁹

Researchers

Career paths and retention

- 5.47 The Committee received consistent evidence that it is generally difficult to attract and retain people with expertise in fields relevant to agriculture.⁴⁰
- 5.48 For agricultural researchers, three year contracts are the norm – what Professor Banks describes as a ‘three-yearly internship model’ – rather than secure, long-term career paths. This makes comparable work in other sectors or countries relatively more attractive.⁴¹
- 5.49 Greater continuity of research funding would help to attract and retain the highest calibre of researchers in the agricultural field.⁴² Reducing the prevalence of short-duration projects, especially in the public service agencies, would preserve relevant expertise in those agencies.⁴³
- 5.50 The Ag Institute of Australia suggested that one possible solution would be to support longer-term projects, through a model similar to that adopted by the National Health and Medical Research Council (NHMRC).⁴⁴
- 5.51 The NHMRC supports broad-based, multi-disciplinary and collaborative research projects. Significantly, these grants are typically five years in duration.⁴⁵ Increasing the length of research projects in agriculture to five years, as commented on by the Committee in Chapter 6, may help to retain talented research staff.

38 Australasia-Pacific Extension Network, *Submission 95*, p. 6.

39 Professor Andrew Reeves, Senior Research Advisor to the Vice-Chancellor, Deakin University, *Committee Hansard*, Melbourne, 29 January 2016, pp. 13-14.

40 Ag Institute Australia, *Submission 73*, p. 17.

41 Professor Robert Banks, *Submission 115*, p. 1.

42 The University of Queensland, *Submission 2*, p. 1.

43 Ag Institute Australia, *Submission 73*, p. 17.

44 Ag Institute Australia, *Submission 73*, p. 17.

45 National Health and Medical Research Council, ‘Program Grants’ <www.nhmrc.gov.au/grants-funding/apply-funding/program-grants> viewed 16 April 2015.

- 5.52 Chapter 6 also examines Cooperative Research Centres (CRCs), noting that the Committee heard evidence supporting the CRC model as an effective means of driving innovation and supporting longer-term research.
- 5.53 However, this model could be improved to address structural career issues for researchers. The ATSE made a number of important recommendations in its submission to the CRC Review.⁴⁶ Among these, two stand out: first, providing greater flexibility as to the duration of a particular CRC may assist; second, implementing a simpler, cheaper and quicker process for processing CRC proposals should also be implemented, reducing the resources required to be allocated to the bidding process.

STEM and agriculture education

- 5.54 Dr Mark Trotter, of the University of New England, identified the need to educate the next generation of agricultural workers and graduates, which is particularly important given the increasing complexity of technological advancements in the field.⁴⁷
- 5.55 According to Professor Roseanne Taylor, Dean of the Faculty of Veterinary Science at the University of Sydney:
- World-leading innovation in our food and land management sectors requires us, as universities, to attract and educate highly skilled, multidisciplinary, multicultural, diverse student groups who will then be ready to approach jobs and create jobs and to work in jobs that do not exist right now. That is the future we face.⁴⁸
- 5.56 AusBiotech stated in its submission that the prosperity of Australian agriculture relies on a steady stream of specialist science, technology, engineering and mathematics (STEM) skills in the workforce, and general science and mathematical literacy in the community.⁴⁹ There is an undersupply of graduates suitably qualified to do much of the available work in agriculture.⁵⁰

46 ATSE, *Submission to the Cooperative Research Centres Programme Review* (2014) <www.atse.org.au/Documents/submissions/cooperative-research-centres-programme-review.pdf> viewed 16 April 2016.

47 Dr Mark Trotter, Senior Lecturer, Precision Agriculture, University of New England, *Committee Hansard*, Armidale, 14 April 2016, p. 28.

48 Professor Roseanne Taylor, Dean of the Faculty of Veterinary Science, the University of Sydney, *Committee Hansard*, Sydney, 14 April 2016, p. 20.

49 AusBiotech, *Submission* 33, p. 5.

50 Mr Andrew Smart, Managing Director, Precision Cropping Technologies, *Committee Hansard*, Armidale, 13 April 2016, p. 14.

- 5.57 A number of stakeholders suggested that there is a need to engage students in agriculture from primary school age.⁵¹
- 5.58 Mr Jones argued that there is a need to promote agriculture as an exciting career path attracting a ‘young, passionate and new skill base to the industry’.⁵²
- 5.59 A large component of the strategy for attracting young students to explore careers with agricultural applications is to dispel outdated preconceptions about agriculture. Dr Trotter cited a 2012 survey by the Primary Industries Education Foundation Australia, which found that 55 per cent of students and teachers did not associate innovation with agriculture and that 43 per cent of students did not associate science with agriculture.⁵³
- 5.60 Mr Christopher Russell, Chairman of the Ethics Committee at the ATSE, suggested that agriculture is often viewed as an unsophisticated career path with limited prospects, particularly for talented students. He said that it was particularly important to challenge this kind of ingrained thinking in the parents of promising students.⁵⁴
- 5.61 Professor Alex McBratney, Dean of the Faculty of Agriculture and Environment at the University of Sydney, suggested that innovation is required in the development of educational resources that attract the brightest students to careers in the field.⁵⁵
- 5.62 Dr Trotter described the successful ‘Smart Farm Learning Hub’ as an example of a strategy that links universities and leading agriculture industry technology developers to reach students at secondary and tertiary levels.⁵⁶ In the program, students across Australia will be able to log in and watch the video footage or access data from farms across Australia to gain a better understanding of the intersection between agriculture and technology.⁵⁷
- 5.63 Professor Friend described the ‘enrichment days’ run by Charles Sturt University, where students from different schools are able to witness

51 Ag Institute of Australia, *Submission 73*, p. 17; Australian Centre for Field Robotics, *Submission 94*, p. 8; Primary Industries Education Foundation Australia, *Submission 111*, p. 1.

52 Mr Tyran Jones, Chair, Policy Committee and Director, Australian Dairy Farmers Ltd, *Committee Hansard*, Melbourne, 29 January 2016, p. 29.

53 Dr Mark Trotter, Senior Lecturer Precision Agriculture, University of New England, *Committee Hansard*, Armidale, 14 April 2016, p. 28.

54 Mr Christopher Russell, Chairman, Ethics Committee, Australian Institute of Agricultural Science and Technology, *Committee Hansard*, Sydney, 14 April 2016, p. 10.

55 Professor Alex McBratney, Dean, Faculty of Agriculture and Environment, University of Sydney, *Committee Hansard*, Sydney, 14 April 2016, pp. 19-20.

56 University of New England, *Submission 11.2*, p. 1.

57 University of New England, ‘SMART Farm Data’ <www.une.edu.au/research/research-centres-institutes/smart-farm/smart-farm-data> viewed 16 April 2016.

agricultural science applications first-hand. Professor Friend also noted programs, such as AgVision, which have similar objectives although they are targeted at metropolitan schools in Sydney.⁵⁸ With respect to the science curriculum in schools, he recommended incorporating examples of the agricultural applications.⁵⁹

5.64 The Primary Industries Education Foundation Australia suggested that using examples of innovation in agriculture would provide a way of engaging students of STEM subjects, and to incorporate food and fibre production systems within the mainstream curriculum.⁶⁰

5.65 The Australian Centre for Field Robotics noted that it had an 'extremely positive' experience when running STEM-based robotics courses with young students, noting:

... a growing awareness by the younger generation that agriculture can be a rewarding experience when coupled with the digital experience.⁶¹

Universities, teaching and the publication imperative

5.66 Professor McBratney suggested that university education in agriculture would need to reflect a growing multidisciplinary, with a focus on technology and engineering.⁶²

5.67 Professor Paul Wood, representing AusBiotech, suggested that even those graduates with relevant PhDs still needed guidance on how to effectively interact with industry.⁶³

5.68 Universities focus more on their publication rate rather than outcomes for industry.⁶⁴ Professor Taylor suggested that it is particularly difficult to

58 Professor Michael Friend, Director, Graham Centre for Agricultural Innovation, Charles Sturt University and NSW Department of Primary Industries, *Committee Hansard*, Wodonga, 28 January 2016, p. 35.

59 Professor Michael Friend, Director, Graham Centre for Agricultural Innovation, Charles Sturt University and NSW Department of Primary Industries, *Committee Hansard*, Wodonga, 28 January 2016, p. 35.

60 Primary Industries Education Foundation Australia, *Submission 111*, p. 1.

61 Australian Centre for Field Robotics, *Submission 94*, p. 8.

62 Professor Alex McBratney, Dean, Faculty of Agriculture and Environment, University of Sydney, *Committee Hansard*, Sydney, 14 April 2016, pp. 19-20.

63 Professor Paul Wood, Chair of the Ag and FoodTech Committee at AusBiotech Ltd, *Committee Hansard*, Melbourne, 29 January 2016, p. 6.

64 Professor Roseanne Taylor, Dean of the Faculty of Veterinary Science, the University of Sydney, *Committee Hansard*, Sydney, 14 April 2016, p. 23; Ag Institute of Australia, *Submission 73*, pp. 11-12.

capture funding for industry-specific research because it has generally not been seen as sufficiently 'blue-sky'.⁶⁵

- 5.69 The push for university publications is compounded by the fact that universities derive a substantial amount of their revenues from overseas students. From the perspective of the majority of international students, the attractiveness of a particular university depends on its international ranking;⁶⁶ the majority of international rankings systems operate on publications metrics.⁶⁷
- 5.70 In addition, the limited prospect of publications in agricultural research is probably deterring talent from pursuing careers in the field.⁶⁸
- 5.71 AusBiotech praised the ATSE proposal to measure outcomes in agricultural R&D, noting the need to 'focus on outcomes, not just publications'.⁶⁹
- 5.72 Mr Richard Webb from the Department of Agriculture and Water Resources (DAWR) noted the work undertaken, as a part of the National Innovation and Science Agenda, to alter the model by which universities receive research funding. The new model provides incentives for universities to undertake research in partnership with industry or for industry outcomes.⁷⁰

Extension and adoption

- 5.73 This section of the chapter considers barriers to adoption which arise from the human capital elements of the extension and adoption processes. Extension is the process of linking newly developed technologies with end users. Adoption is the process where end users select, implement and use technologies on-farm.

65 Professor Roseanne Taylor, Dean of the Faculty of Veterinary Science, the University of Sydney, *Committee Hansard*, Sydney, 14 April 2016, p. 23.

66 Professor Paul Wood, Chair of the Ag and FoodTech Committee at AusBiotech Ltd, *Committee Hansard*, Melbourne, 29 January 2016, p. 6.

67 Mr Michael Keogh, Executive Director, Australian Farm Institute, *Committee Hansard*, Sydney, 14 April 2016, p. 5.

68 Ag Institute Australia, *Submission 73*, pp. 3-4; Dr Matt Wenham, ATSE, *Committee Hansard*, Canberra, 29 January 2016, p. 20.

69 Mr Michael Blake, DAWR, *Committee Hansard*, Canberra, 17 March 2016, p. 4.

70 Mr Richard Webb, DAWR, *Committee Hansard*, Canberra, 17 March 2016, p. 4.

Extension

- 5.74 Many submissions named extension issues as barriers to the adoption of innovation. The key extension issues identified are discussed below.

Educating farmers

- 5.75 For adoption to be effective, farmers must understand a particular technology; this includes its strengths and weaknesses, how to dovetail that technology into existing operations, and also how that technology might be developed further.⁷¹
- 5.76 The Committee heard that farmers are used to the imperative to innovate.⁷² However, often the absence of on-farm skills necessary to adopt new technology is one barrier to innovation.⁷³
- 5.77 Precision Agriculture Pty Ltd suggested in its submission that complexity is one of the key factors influencing successful adoption.⁷⁴
- 5.78 In particular, the Committee heard that there is a need to educate current growers about advances in technology pathways and the rapid growth of various sub-technologies (for example, 3D printing, computing, robotics and sensing).⁷⁵
- 5.79 The average age of Australian farmers is 52 years old, which is 12 years above the average for other occupations. This may pose a unique barrier to adoption. Many older farmers have not grown up in the digital era, making it more difficult for them to participate in online education even if the infrastructure existed.⁷⁶
- 5.80 There are examples of industry groups collaborating to educate producers. For instance, the red meat industry has collaborated through programs such as ProGraze, Grain&Graze and EverGraze to develop new pastures and to educate producers on pasture and animal assessment, as well as climate risk management and environmental benefits.⁷⁷
- 5.81 Professor Robert Banks, of the University of New England, noted the need for public and private support and training:

71 Professor Tony Sorensen, *Submission 114*, pp. 4-5.

72 Mr Kim Russell, Chairman, Southern Farming Systems, *Committee Hansard*, Canberra, 22 February 2016, p. 2.

73 DAWR, *Submission 88*, p. 9.

74 Precision Agriculture Pty Ltd, *Submission 106*, p. 1.

75 Australian Centre for Field Robotics, *Submission 94*, p. 8.

76 AWiA, *Submission 63*, p. 6.

77 CCA-SCA-ALFA, *Submission 84*, p. 8.

... to ensure that farmers and others in agricultural value chains and communities have the skills and confidence to make use of the information tools and knowledge.⁷⁸

- 5.82 The Australian Food Sovereignty Alliance recommended that the Committee support local agricultural extension services for small farmers, to enable them to access information in order to educate themselves on best practice models.⁷⁹

Provision of services

- 5.83 Extension services were previously largely provided by state governments. Over the past decade, the states have significantly reduced their commitments and other players have been moving in to fill the void. The Council of Rural Research and Development Corporations (Council of Rural RDCs) noted that the transition has caused some uneven provision of services.⁸⁰
- 5.84 Australian Dairy Farmers and Dairy Australia (ADF-DA) commented that the future of extension should involve a balance of private and public sector support to make the most of available resources.⁸¹
- 5.85 FarmLink and the Cattle Council of Australia supported the continued expansion of private sector extension, in part because the private sector can be more flexible and responsive.⁸²
- 5.86 The Ag Institute of Australia (AIA) submission recommended that the public sector continue to significantly support extension.⁸³ Grain Growers Ltd and the University of Melbourne recommended an inquiry into the future of extension services to determine the appropriate level of public sector support.⁸⁴
- 5.87 Various RDCs and industry groups indicated that they have been providing extension in the gap between public and private services.⁸⁵ The

78 Professor Robert Banks, *Submission 115*, p. 1.

79 Australian Food Sovereignty Alliance, *Submission 99*, p. 5.

80 Council of Rural RDCs, *Submission 90*, p. 9.

81 ADF and Dairy Australia, *Submission 65*, p. 7.

82 FarmLink, *Submission 101*, p. 4; CCA-SCA-ALFA, *Submission 84*, pp. 17-18.

83 Ag Institute of Australia, *Submission 73*, p. 12.

84 Grain Growers Ltd, *Submission 82*, p. 4-5; University of Melbourne, *Submission 4*, pp. 4-5.

85 Council of Rural RDCs, *Submission 90*, pp. 6, 10; RIRDC, *Submission 74*, p. 6; Mr Selwyn Snell, Chairman, Council of Rural RDCs, *Committee Hansard*, Canberra, 25 February 2016, p. 4; Mr Jed Matz, Chief Executive Officer, Cattle Council of Australia, *Committee Hansard*, Canberra, 3 December 2015, p. 2.

Australasia-Pacific Extension Network recommended that extension should be permanently integrated into research and development bodies.⁸⁶

- 5.88 Finally, FarmLink identified farmers' groups as a useful means for providing extension which would not be profitable for the private sector. Because these groups support members and regional agriculture, they can complement the activities of other players.⁸⁷

Coordination of services

- 5.89 The University of Melbourne commented that the fragmentation of extension services has reduced the level of coordination between the various providers.⁸⁸
- 5.90 The University of Sydney recommended industry and multi-disciplinary programs to improve collaboration and coordination.⁸⁹ The RIRDC named the Rice Industry Extension Coordination Project as a successful example of such a project.⁹⁰
- 5.91 The Council of Rural RDCs, the Sheepmeat Council of Australia and the NSW Farmers' Association noted that technology could be used to improve the coordination and provision of extension to rural and remote end users.⁹¹

Quality of services

- 5.92 Dr Jane Weatherley, of Meat and Livestock Australia, noted the variable quality of extension services from the private sector, and that farmers are unwilling to pay for [poor quality] services.⁹²
- 5.93 Mr Paul Morris, Acting Deputy Secretary of the DAWR, concurred that farm businesses must adjust their expectations from the free services offered by the States to the commercial model of private sector extension.⁹³
- 5.94 The AIA noted that the withdrawal of the states from extension has compounded issues of private sector service quality. Private extension

86 Australasia-Pacific Extension Network, *Submission 95*, p. 4.

87 FarmLink, *Submission 101*, p. 5.

88 University of Melbourne, *Submission 4*, p. 3.

89 University of Sydney, *Submission 40*, p. 6.

90 RIRDC, *Submission 74*, p. 6.

91 Mr Mark Harvey-Sutton, Acting Chief Executive Officer, Sheepmeat Council of Australia, *Committee Hansard*, Canberra, 3 December 2015, p. 7; Mr Tim Lester, Operations Manager, Council of Rural RDCs, *Committee Hansard*, Canberra, 25 February 2016, p. 5.

92 Dr Jane Weatherley, Meat and Livestock Australia, *Committee Hansard*, Canberra, 3 December 2015, p. 7.

93 Mr Paul Morris, Acting Deputy Secretary, DAWR, *Committee Hansard*, Canberra, 17 March 2016, p. 5.

consultants often served in public sector positions first but this source of capacity building is no longer available.⁹⁴

- 5.95 FarmLink and the Australasia–Pacific Extension Network recommended the expansion of opportunities for formal tertiary and vocational training in extension to improve the quality and sustainability of private services.⁹⁵

Adoption

- 5.96 Evidence to the inquiry indicated that human capital matters affect the final adoption processes where end users take up new technologies.

Selection

- 5.97 The first phase of end users' adoption of innovation involves the selection of technologies which are appropriate to their business context.
- 5.98 The University of Melbourne and others identified a range of demographic, business, and social factors driving individual adoption decisions.⁹⁶ The Council of Rural RDCs recommended that extension services be tailored to the different needs and objectives of farmers.⁹⁷
- 5.99 However, submissions identified some circumstances that can unnecessarily impede the selection of new technologies for farmers.
- 5.100 Growcom, the Grains Research and Development Corporation (GRDC), and ADF-DA noted that farmers are deterred from choosing technologies by the time cost of evaluating the plethora of options available.⁹⁸
- 5.101 Some of the business and technological skills discussed earlier in this chapter would help farmers manage this process more efficiently. Additionally, Deakin University identified a role for extension agents and advisors to help match end users' needs with technological solutions.⁹⁹
- 5.102 A further adoption barrier is the lack of performance data available to inform the selection of technologies. The University of Melbourne, Charles Sturt University and ADF-DA noted that performance data from suppliers

94 Ag Institute of Australia, *Submission 73*, p. 12.

95 FarmLink, *Submission 101*, p. 6; Australasia-Pacific Extension Network, *Submission 95*, p. 8.

96 The University of Melbourne, *Submission 4*, pp. 2-3; CCA-SCA-ALFA, *Submission 84*, p. 16; Ms Hay and Mr Harrington, *Submission 91*, pp. 4-5; AWiA, *Submission 63*, p. 6.

97 Council of Rural RDCs, *Submission 90*, p. 9.

98 Growcom, *Submission 67*, p. 5; GRDC, *Submission 87*, pp. 13-14; ADF-DA, *Submission 65*, pp. 8-9.

99 Deakin University, *Submission 28*, p. 2.

is often limited or based on inapplicable field conditions and is not fully trusted by farmers.¹⁰⁰

- 5.103 Charles Sturt University, the GRDC, and the Council of Rural RDCs all recommended grower participatory approaches. These approaches make farmers partners in the evaluation process while providing the trusted local data needed to support informed decision making.¹⁰¹

Integration and use

- 5.104 The second phase of the end user adoption process involves the technology being integrated and actually used on-farm.
- 5.105 Deakin University explained that the process of integrating technologies into a farm system context adds complexity, a time cost, and a delay before the benefits of adoption are realised.¹⁰²
- 5.106 ADF-DA described the integration challenge using the example of technology 'lock out' through the incompatibility of data formats.¹⁰³ SST Software Australia noted that this problem will worsen as technologies proliferate.¹⁰⁴
- 5.107 Beyond integration, the inquiry heard that useability is key to the ongoing adoption of technologies to drive productivity improvements and growth.
- 5.108 Professor Friend described the risk that technologies are only temporarily adopted but then discontinued because benefits have not been realised to offset the cost of using the technology.¹⁰⁵
- 5.109 The GRDC explained that complexity is a defining factor in useability. It noted that complexity is a time cost for both management and labour in farm businesses. As such, simplicity, ease of use and convenience are all highly desirable factors for emerging technologies.¹⁰⁶
- 5.110 Finally, Deakin University recommended that additional effort be spent on providing useable interfaces for new technologies to promote adoption. It considered that interfaces are an often overlooked part of the development process but pose a significant adoption barrier.¹⁰⁷

100 University of Melbourne, *Submission 4*, p. 2; Charles Sturt University, *Submission 17*, p. 5; ADF-DA, *Submission 65*, p. 9.

101 Charles Sturt University, *Submission 17*, p. 5; GRDC, *Submission 87*, pp. 11-13; Council of Rural RDCs, *Submission 90*, p. 9.

102 Deakin University, *Submission 28*, p. 4.

103 ADF-DA, *Submission 65*, p. 9.

104 SST Software Australia Ltd, *Submission 13*, p. 4.

105 Professor Michael Friend, Charles Sturt University, *Committee Hansard*, Wodonga, 28 January 2016, p. 9.

106 GRDC, *Submission 87*, p. 13.

107 Deakin University, *Submission 28*, p. 5.

Support

- 5.111 A final human capital feature overlaying the adoption process is the support networks available to farm businesses. A number of submissions identified these networks as mechanisms to overcome adoption barriers.
- 5.112 The University of Melbourne identified support networks such as grower groups as drivers of adoption.¹⁰⁸ The Australasia-Pacific Extension Network expanded on their benefits:
- In addition to the research value, it appears that ... these groups provide the 'like-minded' people that farmers identify as helping to maintain motivation, provide access to other innovative farmers, and function as an effective network for information exchange and moral support.¹⁰⁹
- 5.113 The Alpine Valleys project was presented to the inquiry as a useful example of a farmers' group in action.¹¹⁰ Its membership encompasses farmers, their communities, peak bodies, milk processors, and government, all working towards increasing the sustainability of the local dairy industry.
- 5.114 One of the project's functions is accelerating the uptake of technologies and practices that will increase profitability. To this end, the project coordinators have developed a culture of information-sharing so that farmers can support one another to adopt technology. Mr Crosthwaite identified this as one of the most attractive features of the project:
- I would say that the overall response has been incredibly positive. People just want to climb on board, because the model that we have developed has been an attractive and inclusive way of people sitting around the table.¹¹¹
- 5.115 Farmers' groups may also offer benchmarking or demonstration farms where members can observe the implementation of a new technology. The Committee's site inspection of the Alpine Valleys project canvassed the sharing of experiences with technologies between farmers. Professor John Hamblin also provided examples of farming benchmarking.¹¹²
- 5.116 Mr Ian Haggerty, Manager of Prospect Pastoral Company, described the value of demonstration farms to socialising new technologies:

108 The University of Melbourne, *Submission 4*, pp. 2-3; Dr Jane Weatherley, Meat and Livestock Australia, *Committee Hansard*, Canberra, 3 December 2015, p. 7.

109 Australasia-Pacific Extension Network, *Submission 95*, p. 7.

110 Alpine Valleys project, *Submission 10*, p. 1.

111 Mr Stuart Crosthwaite, Chair, Project Steering Committee, Alpine Valleys project, *Committee Hansard*, Wodonga, 28 January 2016, p. 27.

112 Adjunct Professor John Hamblin, *Submission 3*, p. 6.

How you get that example out there is probably more demonstrations – farm examples – so people can actually see, because a lot of farmers, when they are doing something unique, do not do a lot of talking over the fence. The way agriculture is run at the moment is like the Titanic: it will take a bit to turn.¹¹³

Committee comment

- 5.117 The evidence received by the inquiry emphasised that the people of the agricultural sector are essential to converting innovation into the meaningful adoption of new technologies on farm.
- 5.118 The Committee notes the importance of ensuring that the agricultural industry can attract and retain appropriately trained and qualified people to enable the transformation of the industry through the adoption of emerging technologies. Coincidentally, it would appear that these same technologies will be the key to attracting the right people to the farm businesses of the future.
- 5.119 Access to labour is a longstanding challenge for the sector. The Committee notes that skilled labour will be particularly important to enabling increasingly sophisticated technologies. Securing the range of skills required will be a complex task, particularly as they will be in high demand in other parts of the economy.
- 5.120 The Committee commends the development of a range of creative solutions to the skills problem, from online training to multidisciplinary university courses. Future efforts should continue to make use of local leaders among women, young people and farmers' groups.
- 5.121 Another facet of the skills challenge is ensuring that the sector can access the full human capital resources available. In particular, the Committee recognises the significant contribution of women in agriculture. The Committee notes evidence that women feel they are not able to participate sufficiently in the policy- and decision-making processes of the sector.
- 5.122 It is the Committee's opinion that the Australian Government should include rural women's groups, such as Australian Women in Agriculture and the National Rural Women's Coalition, in future government-led inquiries and policy-building activities.
- 5.123 The Committee will also ensure that rural women's groups are invited to make submissions to all of its inquiries.

113 Mr Ian Haggerty, Manager, Prospect Pastoral Company, *Committee Hansard*, Wodonga, 28 January 2016, p. 17.

Recommendation 6

The Committee recommends that the Australian Government ensure that rural women's groups are included in future government-led policy-building activities and inquiries.

- 5.124 The Committee notes the challenge of securing the successful transition of farm business ownership to younger people. It commends the work of the Alpine Valleys Dairy Pathways Project to support succession planning. The Committee is also of the opinion that the Australian Government should support CSIRO research into improving succession planning.
- 5.125 The Committee notes the challenge of retaining researchers within the agricultural sector. The Committee considers this issue further in Chapter 6 and makes a recommendation which will assist in increasing the job security for researchers.
- 5.126 The Committee notes that there are Australian Government initiatives such as the Industry Skills Fund and the 457 visa scheme for skilled labour migration.
- 5.127 A shortage of unskilled labour has led to an increase in robotics and automation technology in the agricultural sector. The Committee notes the advantages that such technologies present to employers in reducing costs, improving workplace safety and the like.
- 5.128 However, the Committee acknowledges the potential impact on the unskilled, seasonal, and working holiday workforces. It encourages agricultural communities to contemplate the labour outcomes of new technology as part of regional development strategies and programs.
- 5.129 The Committee acknowledges the benefits associated with engaging school students – particularly those in rural areas – on STEM subjects, especially when taught in conjunction with agricultural applications. The Committee was encouraged by the Australian Centre of Field Robotics' 'Wallabot' project, which seeks to make low-cost robots and an associated programming interface available to rural school students to demonstrate the potential of the interface between technology and agriculture, while also teaching valuable STEM skills.
- 5.130 The Committee sees considerable scope for enhancing STEM education for future members of the agricultural industry, and sees some role for government in facilitating this.

Recommendation 7

The Committee recommends that the Australian Government target funding for the development of innovative education strategies for agriculture, within the current science, technology, engineering and mathematics funding program.

- 5.131 Evidence to the inquiry highlighted the significant shift in the provision of extension services over the past decade and its impact upon the adoption processes of farm businesses. The private sector, industry bodies and farmers' groups have stepped in to fill much of the void left by the withdrawal of state government services.
- 5.132 The Committee supports a vibrant and varied extension industry within the agricultural sector comprising a blend of private, industry and community providers as appropriate to the particular circumstances. Of particular interest is the role for RDCs and industry groups to increase coordination of extension as discussed in Chapter 6.
- 5.133 Finally, the Committee notes evidence to the inquiry which discussed the complexity of selecting, integrating and using new technologies for farmers. It supports an increased focus on useability throughout the research and development process.
- 5.134 The Committee also commends the role of farmers' groups in supporting farmers through the adoption process. In particular, it notes the value of farmers' groups as a mechanism for providing benchmarking or demonstration farms for new technologies. Such benchmarking can be difficult to establish without some external support.

Recommendation 8

The Committee recommends that the Australian Government provide assistance and support to farmers' groups to pursue farming benchmarking and support the development of national data sets.

