All the talk is about technology, but what about the people? How do we train our workforce to deal with increasing complexity?

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Executive Summary

Investment in technology in agriculture has driven enormous productivity gains throughout history, with the pace of gain increasing exponentially in the 20th century through mechanisation.

A major part of these gains has been the reduction in the number of people required to operate modern farms, which in turn has reduced the proportion of the population in first world countries living in rural areas. Agricultural employers around the first world are now facing serious challenges in attracting people back to these areas to work.

Agricultural technology (agtech) is often seen as a potential solution to some of the labour challenges in agriculture, however this is not entirely accurate. Technology is great at taking over the simple repetitive tasks but often fails at the complex, and by introducing more technology, agricultural businesses can often become more complicated.

People looking for permanent jobs in agriculture are more likely to have no tertiary education and lack the skills to operate complex equipment. A comment often repeated overseas was that “it’s difficult to get *skilled* staff”, as opposed to staff. Technology is just a tool, and the return on investment (ROI) into it is entirely dependent on the capacity to operate those tools.

While recruiting skilled staff may be ideal for many farming businesses, there are a limited number of quality people actively looking for jobs. There is a competitive advantage for businesses that can actively train people well, and to do this well there has to be capacity to teach within the business.

While it is possible to outsource some aspects, most vocational training systems in Australia – and other western countries – rely on the workplace for the majority of the teaching.

Taking on unskilled trainees does not have to be complicated. It can be as simple as identifying the key attributes required for someone to get to the point where they can work independently for some of the time and then teach those skills. That in turn becomes the foundation for teaching further skills.

Along with developing the capacity to teach unskilled employees, increasing the scale of the business if the opportunity presents itself has a major benefit in terms of both improving workforce and applying technology. With greater scale brings greater job specialisation, ability to spread the cost of technology further and reduce the teaching load on any one person.

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Foreword

I began my Nuffield Scholarship journey looking at on-farm technology implementation after frustration in being able to collect reliable and accurate data for livestock genetic improvement. I spoke to a friend, also in agriculture, and made the comment of needing more highly skilled staff, and his response was that “the staff you have are the staff you have – the technology needs to be better”.

As I progressed through the scholarship, firstly on Zoom through COVID19, then in person at the Contemporary Scholars Conference (CSC), Global Focus Program (GFP) and individual travel components, I realized that I couldn’t look just at technology without looking at how we recruit, and most importantly how we train/teach our staff.

Without continued innovation and investment into new equipment and processes, our businesses stagnate. However, without competent staff we are constrained in our ability to make the most of that investment and grow our businesses.

Technology is one vital tool but just as important – or perhaps more so – is the capacity to teach and convey knowledge on how to operate effectively and efficiently.

Both people and agtech are enormous fields in their own right and it was apparent very quickly that the study topic needed boundaries. I have tried to remain focused on technology use at a farm production level and have attempted to understand the challenges to training with staff who may not have the education and broader experience that many farm owners/managers do.

Every industry in Australia, as well as the agriculture in the countries visited, is facing labour pressures and the factors behind this are complex. There are no black and white solutions and much of my report is based on many conversations with people around the world.

I have avoided looking at cultural changes and highlighting any changes to laws, preferring to focus on what individual businesses can do immediately to improve ROI into technology and deal with labour pressures.

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Table 1. Travel itinerary

Travel date	Location	Visits/contacts
Week 1 March 15-20, 2022	United Kingdom: Canterbury Romney	Overland Farms AC Hulme Frank Langrish
Week 2 March 21-25 2022	United Kingdom Suffolk Buckinghamshire	Matthew Blyth Richard Copas
Week 3 March 26-29, 2022	Germany	Ortovox Outdoor wear
Week 4 July 2022	United States/Canada	Tom Merwin – Silt Wines Charlie and Linda Van Schaik – Dairy
Week 5 February 19-25, 2023	Australia	Penley Estate Evoke Agriculture Alistair Just
Week 6 March 21 – April 1, 2023	New Zealand	Triennial Genesmith AI Ross and Jess Bowmar – Redcliffs Station Cloudy Bay Winery Forrest Wines Bragato Research Institute Marlborough

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Acknowledgments

There are a number of people I would like to thank.

Firstly, to Nuffield Australia and my investors the Tasmanian Institute of Agriculture and the JM Roberts Trust for this opportunity.

To Jodie and Nicola in particular, thanks for your efforts to keep us all engaged through the uncertainty of 2021 and the enormous amount of work that went into the virtual Global Focus Program (GFP) sessions.

My wife Sally and family for the encouragement and holding the fort while I was away on each trip. Without that support it would not have been possible.

To the staff that work in our business who kept everything ticking over while I was away.

And finally, to my GFP group, and the other scholars I've met along the way. There have been many highlights on the journey, but bouncing ideas off you all has been at the top.

Global Focus Program Group in Washington DC

Abbreviations

AFF – Agriculture, Forestry and Fishing

DAFF – Department of Agricultural, Fisheries and Forestry

GFP – Global Focus Program

GFF – Growing Future Farmers

PALM – Pacific Labour Mobility

ROI – Return on Investment

RTO – Registered Training Organisation

TAFE – Technical and Further Education

VET – Vocational Education and Training

WHM – Working Holiday Makers

Objectives

- To identify ways that on farm technology can be implemented so that it works for staff with less support from the owner/manager.
- To understand the likely demographic profile of potential employees and how to target training to profiles.
- To understand how to teach new employees in business so that unproductive time is minimised.
- To identify a framework for investment into technology that addresses training, support and technical help when things go wrong.
- Overall, how to employ the best technology in a business to maintain downward pressure on cost of production, while still allowing the business to recruit and train from the widest possible range of job applicants.
    - And do this with the least amount of administrative burden!

Introduction

Throughout human history agriculture has relied on technology to feed and clothe the expanding population. Continued innovation has been essential to increase productivity from a finite resource base and allow farm businesses to maintain profitability.

The pace of change has rapidly increased in the 20th and early 21st centuries and now digital technology is increasingly being talked about as offering enormous productivity gains to agriculture.

Technology in agriculture has reduced the number of people required for farm operations. Worldwide, the number of people employed in agriculture has fallen from 44% in 1991 to around 26% in 2021 (World Bank, 2021). In Australia, the number of people employed in agriculture is approximately 350,000, allowing for around 35,000 overseas workers (DAFF, 23 May 2022). The number of people employed in agriculture declined by 19% from 1996 to 2016 (DAFF, 2 December 2020).

The decline in the number of people employed in agriculture reflects the productivity increase through technology. However, the downside to this is that in some areas there is no longer a critical mass of people with some connection to agriculture to sustain, let alone replenish the workforce.

There have been multiple articles and commentary that the skills needed in the agricultural workforce need to improve for agriculture to continue to produce food and fibre at a competitive cost of production. However, many of these articles assume that tertiary education will solve this and that attracting more people into studying agriculture will work. At present, the reality for most farms in Australia is that staff who are on the ground day-to-day fixing fences, driving tractors and providing livestock care are more likely to have finished school at year 10 and have no further education.

Don Norman, in The Design of Everyday Things (2013 p213), identified “the paradox of automation”, that automation can take over the dull, dreary, repetitive tasks but fail at the complex. And in many cases introducing new technology changes the operation from simple to complex, in turn making the workplace more difficult for staff who may not have the appropriate skills and making recruitment of appropriate staff more difficult.

The more complicated the processes and technology brought into a business the more difficult it is to find staff that have the appropriate skillsets to make use of it. In the USA, Canada, the UK, Germany and New Zealand there was huge reliance on imported workers to operate farms. A question asked by the author at each farm visited that had invested in technology was: “*Has increased investment in technology made it harder to find staff?*” The answer was almost unequivocally “yes”, but this was often followed by “*it’s harder to get the right staff*”.

Technology is just another tool. For it to have any benefit to individual businesses, owners and/or senior managers need to be able to identify, attract and retain staff who already have a higher skill level; and/or effectively teach existing employees to use the tools available, and carefully consider the implementation of the technology into the business.

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The solution is likely to be a mixture of both – setting up a business as an attractive place for highly skilled people to work, but also to have an adaptable framework for teaching less skilled staff to use more complex tools. There are four key themes around this:

1. investment into and adoption of production farm technology;
2. the demographic profile of the likely workforce;
3. the existing vocational training system; and
4. how can business owners/managers improve their ability to teach.

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Chapter 1: On Farm Technology

1.1 Agtech Investment

Investment into agricultural technology is growing rapidly. Figure 1 from www.agfunder.com shows the change in investment into the agtech sector globally over the past decade.

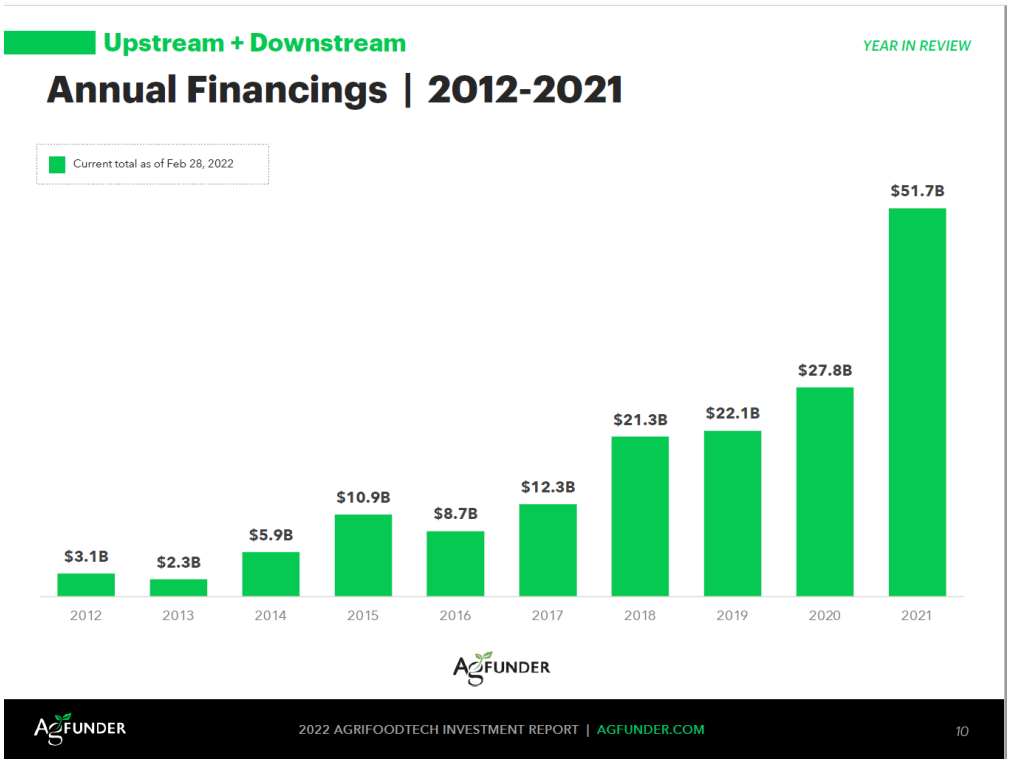

Figure 1: Annual financings of agtech (source: agfunder.com)

In 2021, according to agfunder, of the $51 billion in total agricultural technology investment, approximately $19 billion was invested into upstream agriculture, such as biotech, robotics, farm software and alternative meat. The remainder went to the downstream processing and delivery of products to the end consumer.

Of that $19 billion, 1.7% went to farm robotics, 2.2% went to management software, sensors, internet of things (IoT); and 4% to novel farming systems. The amount of money is still enormous, but it appears from the data that people making decisions on where to invest see greater opportunities in the agrifood value chain other than production agriculture.

1.2 On-farm application of agtech

1.2.1 Objectives

The application of technology on farm is usually based on several factors including making life easier, controlling costs and/or boosting yield. Finding people to work in farming businesses is a constant challenge and technology is often seen as a solution to this problem. There are some cases where additional technology may exacerbate staff shortages rather than be a solution.

Even though the level of investment into upstream agriculture is much less than downstream, there are a plethora of options of which to investigate to meet farmers' objectives. However, finding the right solution is often challenging and adoption rates of available technologies are inconsistent.

1.2.2 Adoption and return on investment (ROI)

A global survey of cropping farmers by McKinsey and Co in 2022 found that 61% of European and North America farmers were using, or intending to use, at least one form of technology in their business in the next two years. That still leaves a substantial number of farmers not using any of the mature technology in cropping that can help their business. According to the same article, the barriers to adoption were primarily cost and uncertain ROI. There was a direct correlation between farm size and adoption rates with over 80% of farmers over 5,000 acres taking up technology compared to 36% of farms less than 2,000 acres.

ROI depends on the ability of the business to leverage that investment and continually make it work. New processes and technologies are often evaluated in agriculture through field trials. These are supported by researchers who are generally well educated, who understand the technology, can articulate what they need a product or service to do, and can adjust as they go to ensure it works. This is a contrast to the process of adoption in a farm environment where the requirement or problem may not be black and white. There are many varied products or services to address it, which are often expensive. The person who intimately understands the technology is unlikely to be on the ground to support the farmer during use, which forces support to be provided remotely. The skills of the farmer, let alone the employees, may not good enough to troubleshoot along the way. Growing business scale is crucial to being able to manage and support the adoption of new technology.

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1.2.3 Support

Matt Blyth is a livestock consultant and 2021 Nuffield Scholar based in Suffolk in the UK. His business is based on supporting farmers to use precision livestock equipment and data in their business decision making. He stated that "*you need a clear picture of what you are going to do with the data and then you need to invest in training to support the use of the hardware*".

One of Matt's comments in respect of data collection was that "*if it doesn't work properly the first time, the hardware 'goes over the hedge!' and people are distrustful of the next trial*" (pers. Comm 2022). A key component of Matt's consulting business is providing support for livestock related technology and assisting farmers to use the data generated. In his experience there have been many products offered to farmers, but the support from the manufacturers has not been effective.

Figure 2: Livestock Data Collection (source: Matt Blyth)

Support for products and services is crucial to aid adoption of technology into farming businesses. Business owners/managers need to be putting pressure on vendors and equipment resellers need to provide quality training to farmers to effectively use their products. Following this the cost of the provision of support and training needs to be openly discussed with vendors.

1.2.4 Business scale

The scale of the business makes an enormous difference in having the capacity to invest into technology, and train staff to use it.

AC Hulme is a family fruit packing business near Canterbury in the UK. The managing director is Tom Hulme. They are one of the five largest growing/packing businesses in the UK, primarily supplying Lidl supermarkets. They are heavy investors into technology, taking the view to invest now to solve tomorrow's problems, even if a positive ROI is uncertain. With 75 permanent staff, they can support the investment and adoption (Tom Hulme, pers. Communication 2022).

In many situations, especially with larger and more expensive equipment, contracting provides a solution where growers don't have to buy infrequently used equipment. This also aids training and support where an operator will find it much easier to use something with repetitive practice.

An increase in the scale of contracting would improve the adoption rates of technology across the industry and allow more sophisticated training as people would be able to specialise in roles.

An example of this is Overland Farms in the UK. This business primarily provides contract services to greenhouses to remove old crop residue and install growing medium for each new crop. The owner, Henry Miles, has developed the business servicing a very large Dutch owned complex (approximately 50 hectares under glass) in the Canterbury region. As the business has grown in scale, Henry has been able to invest into better machinery to make the job of removing old crop residue more efficient, but then also invest further down the value chain to recycle much of the growth medium into potting mix.

Henry stated that he relies almost completely on people from eastern Europe as it is so difficult to find locals prepared to carry out manual work (pers. communication 2022). Henry currently employees 15 people, and has made a conscious effort to develop business scale to retain good staff as he believes this is a better business model than having to continually find casual staff through busy periods.

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Figure 3: Overland Farms screening plant for recycling greenhouse growth medium

Chapter 2: The Primary Industry Workforce

2.1 Demographics

Figure 4 shows change in the demographic profile of the Agriculture, Forestry and Fishing (AFF) workforce in Australia over the past 20 years.

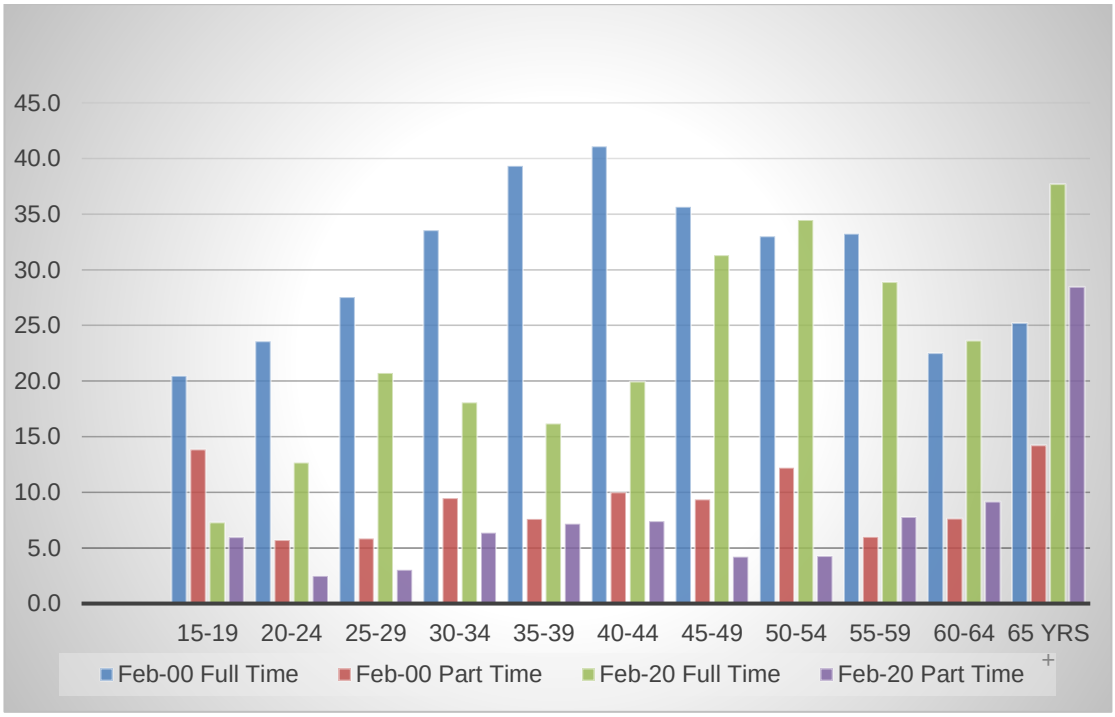

Figure 4: Age profile of agricultural workforce (ABS 2023)

The graph clearly illustrates the ageing trend in the Australian AFF workforce. The largest declines are people employed in AFF are in the 15-19 year and 20-24 year age bracket, a concerning trend which suggest younger people are not interested in pursuing a career in primary industry. There are many anecdotal comments from farmers within Australia and other countries around their inability to find staff which would suggest that trend shown in the table is broadly accurate.

Pratley et al (2022) identified a lack of leadership on the value of education to agriculture in the latter part of the 20th century as perpetuating a negative image of agriculture. Vocational training was not encouraged and the focus of much management and policy was to reduce labour cost. The negative image remains, and primary industry is not seen as an attractive career path.

The population living in regional areas has not changed substantially since 1960 but the urban population has grown, as shown in Figure 5. Natural population increase and immigration have been concentrated in urban areas where there are more jobs and services.

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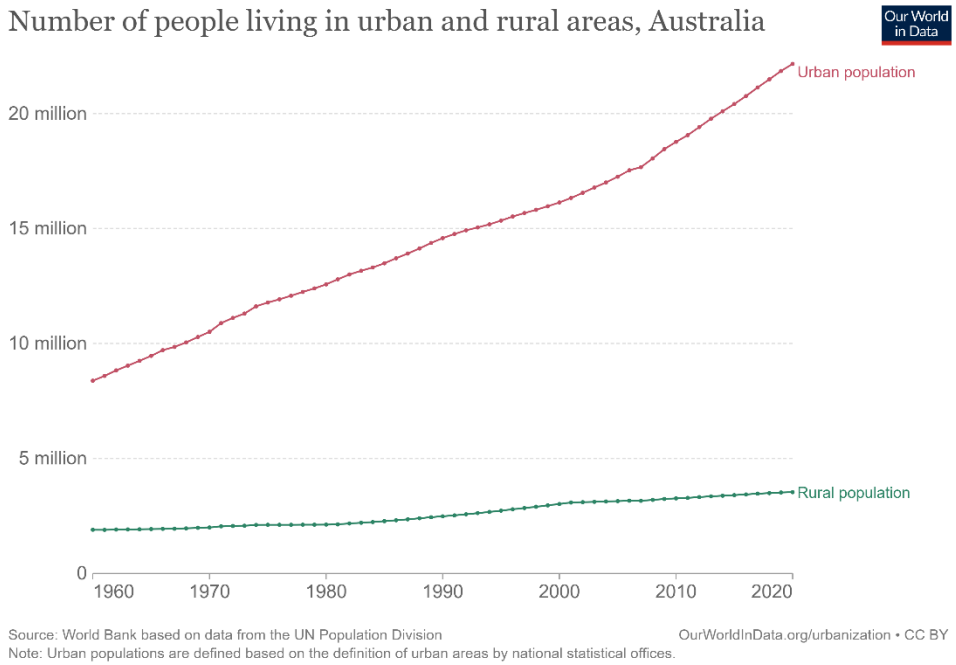

Figure 5: Australian Urban and Regional Population 1960–2020. Source Ritchie and Roser (2018)

There was estimated to be 5,000 on farm jobs and another 4,000 off farm jobs available in 2021, however there are only approximately 900 agricultural graduates from universities each year (Pratley et al, 2022). The job ads for on farm staff that these figures are based on increased by over 50% from 2020 to 2021.

Some graduates from other disciplines may find their way into agriculture from other field, however it is likely that well over half the positions in agriculture will be filled by people with either a Vocational Education and Training (VET) qualification, or no qualification at all.

In that situation, how do farmers set up their businesses to teach increasingly complex skills and use increasingly complex technology to people with limited formal higher education?

2.1.1 Education levels and skill gaps

Given the negative perception of agriculture as a desirable career path it is not surprising that education levels are lower than Australia as a whole. According to DAFF (2016), 55% of people employed in agriculture had no post school qualification compared to 33% of the total population, and only 10% had a bachelor's degree compared to 22% of the general population.

Even though the level of education around the world rises constantly, a common complaint from farm business owners around the world was that "*it's hard to get skilled staff,*" as opposed to staff in general.

The Foundation for Young Australians publication The New Work Reality in 2018 identified four barriers to work for young people – not enough work experience, lack of appropriate education, lack of career management skills and not enough jobs. Given that there is a ratio of 9 to 1 of agriculture/agribusiness jobs available to university graduates, and that there are proportionately far less people living in rural

areas, farm owners need to be proactive in addressing the skill gaps between what they need and what their potential employees currently have.

There is an advantage for businesses that can provide a good environment for teaching as they can recruit from the widest possible range of people. While it may be desirably to recruit only skilled staff, there is a limited pool of those people and much higher competition for their services.

A report by Lisa Denny for the Tasmanian Seafood Industry found there was a large disconnect between younger Australians between the educational level expectations and their desired occupation (Denny L, 2020). The majority of younger Australians (90%) also believed that school had not prepared them well for working life. These issues among several others have increased the level of anxiety felt by younger people toward work and life.

Twenty years ago, there were many more younger people employed in some capacity in agriculture. This was likely to be due in part to more kids having parents or close relations employed in agriculture which would in turn provide some exposure to farm jobs, and possibly school holiday jobs. Exposure to farming from a younger age would have provided some practical skills that allowed kids to get entry level farming jobs. Another anecdote often heard is that he or she "*has no common sense*". Could the term common sense be replaced with exposure to agriculture and the development of some practical skills from an early age?

2.1.2 Attracting youth into agriculture

There are several programs designed to tackle the demographic problems of the agricultural workforce and attract more youths into considering a career in agriculture.

Both Growing Future Farmers (GFF) in New Zealand, and AgCAREERSTART in Australia are programs to link new farm employees and prospective employers. Both are targeted at school leavers who have no experience whatsoever in agriculture. While the specific details for each program differ, they are commonly designed to both attract new entrants to agriculture and provide a more professional training program with support for both trainee and farmer.

There are explicit expectations of the farmer to provide suitable accommodation and an appropriate training environment for someone with no experience.

AgCAREERSTART actively checks prospective employers to ensure that they are entering the program with the right intentions rather than just looking to fill seasonal vacancies. Consistent with research findings into a gap between expectations and actual work, AgCAREERSTART has noted that the outcomes are far better when job descriptions are actively spelt out before starting work.

These pathways provide another avenue for farmers to find potential new employees if the business can provide a well-structured learning environment to build people's skills.

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2.1.3 Immigration and temporary workers

Australian is highly reliant on overseas working holiday makers (WHM) and Pacific Australia Labour Mobility (PALM) workers, particularly in the horticultural industries. Due to COVID19, the number of WHMs in Australia dropped from an estimated 143,000 in February 2020 to 18,600 in March 2022 (DAFF 2022). The government is intending to increase the number of overseas workers under the PALM scheme to 35,000 in 2023.

By the end of 2022, the number of WHMs and PALM workers in Australia were approximately 70,000 and 20,000 respectively, still significantly lower than pre-COVID19.

This trend is not limited to Australia. Several countries visited relied heavily on migrant labour. Tom Merwin, the manager of Merwin Vineyards in California (Figure 6), relies primarily on Mexican labour to run the vineyards. The family have managed to retain immigrants from one village in Mexico since Tom's father operated the vineyard and their workforce are primarily returning workers. This has made further recruitment of staff and training and far easier (Tom Merwin, pers. Communication 2022).

Hector Delanghe of Delhaven Orchards in the Ontario region of Canada spoke of the region's immigrant labour partnership with Jamaica. The partnership is extremely important for fruit growers in the area and Canadian farmers have worked hard to ensure that the Jamaican workers value the program. One of the novel points was that workers are given a return airline ticket before they start work to ensure that they are not stuck in a terrible job with no ability to return home (pers. Communication 2022).

With the return to normal travel post-COVID19, it is likely that itinerant temporary workers will continue to be an important part of the agricultural labour landscape. Many of these people are skilled and/or willing to learn, and businesses that have the capacity to quickly teach relevant skills will be able to make use of this labour resource.

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Figure 6: Merwin Family Vineyards, Clarksburg, California

2.2 Considerations for employers

According to the author, when researching the demographic profile of agricultural employees, the following is apparent:

- On farm employees are less likely to have post high school education.
- If a younger person is being considered for a role, they are likely to have limited work experience and probably no opportunity to develop “common sense”.
- There may be a pronounced disconnect between a person’s expectations of a role and their ability (especially younger people) and an increased level of anxiety about potential new roles.
- When advertising for employee’s, agriculture is likely to have a negative perception which businesses must be aware of.
- There is likely to be a labour pool of working holiday makers, but they are short term employees.
- These issues are common to many countries, not limited to Australia.
- While it is desirable to try to recruit people with a higher skill level, there is a lower probability of that happening so how well is a business set up to teach foundational skills?

There have been – and continue to be – many programs designed to encourage more people to consider agriculture as a viable career. These are to be commended and should be supported by farmers wherever possible. At the same time, it should be front of mind for farms that cultural change is a slow, drawn-out process and individual businesses should be concerned on ensuring that new employees can rapidly build appropriate skills.

Chapter 3: Education and Training Systems

3.1 Existing agricultural training

3.1.1 On the job

Training in agriculture at the farm is generally either on-farm through VET institutions, or both. VET education is usually a combination of on-the-job training with blocks of theory throughout the course. Historically VET education has been carried out by agricultural colleges which morphed into wider TAFE (Technical and Further Education). There are now many Registered Training Organisations (RTOs), both government and privately run. Students carrying out VET training are generally classed as apprentices or trainees.

A search of The National Register on Vocational Education and Training for RTOs associated with agriculture (accessed 5 May 2023) found there were 1069 RTOs accredited to deliver some form of training in the agriculture, horticulture and conservation and land management field. Of this, 772 were private businesses.

The vast majority of these VET courses specific to agriculture are part time, with relatively few on campus blocks, and the majority of training undertaken on farm. Both students and employers' benefit in that the courses are taught to a nationally consistent curriculum, however the result of all the training is heavily dependent on the ability of the other workers/managers in the workplace to teach.

3.1.2 Short courses

Short courses can be an effective way of teaching specific skills and are offered by RTOs. Some of these contain elements of box ticking, where the course effectively provides evidence that an employee has been "trained' in a particular skill. In these instances, there is a disconnect between the training and the development of the actual skill. The competency of the trainer is critical to the usefulness of the training, which then needs to be followed up again by someone in the workplace.

3.2 Other vocational training systems

3.1.1 Other countries

The apprenticeship system was originally developed in Europe in the Middle Ages, and the idea followed European colonialism around the world. Many countries have apprenticeship programs, albeit with varying levels of success.

Smith and Kemmis (2013) looked at apprenticeship systems around the world producing a comparison of the various models across ten countries, one of which was Australia. The European countries generally had less weaknesses or issues within the apprenticeship system than the Asian, north American or Australian systems, and had a higher social regard for the system.

The key problems in Australia that this research identified in comparison to other countries were training quality, attention to training policy at a national level, divergent policy between states, and high attrition rates.

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The commonality between all apprenticeship systems around the world was that the apprentice, or trainee, needs a workplace to learn in and appropriate teaching in that workplace.

3.1.2 Other industry examples

The healthcare system Australia offers a certificate in clinical education from a number of institutions. The objective of the certification is to “teach the teachers”, to ensure that new healthcare practitioners are better able to provide care for their patients and to ensure that healthcare students can effectively improve their skills.

There are multiple providers offering courses in clinical education. One of these, Clinical Education Australia (2023), identified a number of characteristics of effective student supervisors including:

- demonstrate clinical competence.
- demonstrate reflective practice.
- provide detailed orientation.
- provide a graded program of learning.
- provide modelling and opportunities for practice.
- demonstrate consistent and transparent assessment procedures.
- acknowledge students' capabilities and limits.
- demonstrate respect, empathy and understanding.
- communicate clear and consistent expectations.
- demonstrate a motivating and positive attitude.

While care needs to be taken when comparing agriculture and healthcare employees due the generally quite different education levels, the above list is very relevant to farm owners when formulating a framework for training staff.

One of the key contrasts between agriculture and health (or other large workplaces) is the lack of scale. If a single operator takes on an unskilled employee, all their available working hours are taken up by teaching which can be extremely wearing on both people. Bigger businesses can share the training load over several people, and the capacity to invest in people in specialist roles. As in the adoption of technology, scale becomes important in providing appropriate training.

3.3 Teaching framework

In conversations with farmers around the world, one of the most repeated comments was that it is difficult to find skilled staff. And following that is that it’s too expensive to train someone because they don’t provide any benefit for months. As an employer there should be a framework for teaching the critical knowledge within a business than minimises that unproductive time.

There is much more career mobility that there was a generation ago, and often the pool of employees has a number of working holiday makers within it, meaning that the expectations of trained people remaining with an employer are likely to be

disappointed. The Foundation for Young Australians in 2018 estimated that “today’s 15-year-olds will likely navigate 17 changes in employer across five different careers”!

A business can have a competitive edge if there is the capacity to quickly move new employees from a net cost to a net benefit. For each business the key characteristics are different, but having a defined list of key knowledge should be a starting point.

Chapter 4: People and Technology: Putting it Together

4.1 What does an on-farm training model look like?

4.1.1 Objective

The objective of any system to bring employees up to speed quickly is primarily to get them to the point of being able to safely carry out required tasks on their own to a satisfactory standard, known as the 'productive inflection point', and build foundational skills and knowledge that can be expanded on for as long as they remain with the business.

The average farm manager/owner's skills cover a wide range of disciplines. Russell Platschka (pers comm. 2023) suggested the starting point is to write down what skills you use each day and then rank them according to skill level. The comment was that for a 17-year-old straight out of school with no farm experience, opening a gate might be a level one skill, that we all take for granted!

4.1.2 Effective design

Whether a piece of technology or a business system, effective design is crucial in the ability of people to gain understanding. A system for teaching staff – whether long or short term – needs to be designed to suit the person being taught.

Don Norman (2013) identifies the conceptual, or mental model, which represents in someone's mind that represents their understanding of how something works. The conceptual models are formed through peoples' experience, training and instruction.

Employers have a conceptual model of what an effective employee is and what skills they need. A training framework needs to take the conceptual model and allow any new employees to replicate that in their own minds, at the same time building foundational skills that can improved on for as long as those employees remain with the business. Often farm business owners or managers have grown up on farms and practical farm skills are second nature. It's important to be aware that this isn't the case for everyone.

The design of a teaching model for agriculture needs to be flexible – every farm business is different, and every business owner/manager operates differently. There are however certain attributes that should be common to everyone to arrive at the productive inflection point:

- Identify skills needed and rank them in order of difficulty.
- Identify what resources are needed to assist with teaching these skills – people, technology, written material etc.
- Be able to explain and demonstrate the required skills to the required standard.
- Flexibility in delivery to suit differing learning styles.
- Be graded, so that basic (Level 1 skills are taught before more advanced skills).
- Provide feedback on results of actions.
- Cover employer's duty of care in safety matters.

- Be cost effective to the business.
- Keep employees engaged.

4.1.3 Styles of learning

Table 2 shows the four commonly cited methods of learning:

Table 2: Four common learning styles

Style	Meaning
Visual	Learning through images, maps, spatial information
Auditory	Listening, speaking, group discussions
Reading/Writing	Reading notes, papers, manuals etc, taking notes
Kinaesthetic	Learning by doing, manual practice

Source: Teach.com (2020)

Understanding the way people learn is important in ensuring that critical information is presented effectively and quickly and determines what resources are required. An operations manual may help a university level employee but is unlikely to be useful to year 10 leaver who prefers to learn by doing and will lead to frustration on both sides.

Given that it is likely that someone applying for a farm position has little tertiary education, the suggestion is that any training framework minimises the reading/writing requirements. With that in mind the focus for the farm owner/manager becomes demonstrating each task, especially the level 1 skills. Written information becomes a backup.

4.1.4 Resources

An effective teaching model can come from simply having a list of beginner's required skills and teaching to that. The more complex the business the more detailed the system needs to be. The model doesn't need to be complex or require an enormous amount of time. However, it requires business owners/managers to put some thought into the required skills. Having this written down provides a basis for how new employees are to be trained and any extra support (short courses, technological aids etc) that may be required.

Once the required skills are identified, then it is a matter of working out what resources are needed for the employees to acquire these skills as quickly as possible. Some examples of resources are:

- An experienced person demonstrating a skill.
- A YouTube video of how to do a task.
- An interactive farm map that shows a person's location.
- A well-maintained vehicle and/or tool kit.
- A list of where things are with a building map.

Appendix A contains a hypothetical graded list of basic skills in a simple sheep grazing operation, created by the author. Every business will have different priorities leading to a different effectiveness point however the most important part is to have written down the correct information to allow the transfer of the conceptual model of what makes a good employee from the farmer to the employee.

4.1.5 Induction

There are a number of commercial pre-employment induction programs offered for agriculture to ensure prospective employees have a basic knowledge of farm safety.

Farmsafe Australia provide a free induction tool on their website (https://farmsafe.org.au/induction-tool), to cover safety information common to most businesses, although businesses still need to provide a site-specific induction process to cover localised safety issues. The advantage of outsourcing the basic induction is that it can be done before anyone starts working in the business and the platforms often track that people have checked off induction units.

A site-specific induction is still required to ensure that new employees understand unique safety requirements but also so they know where to find things and access resources to help them learn and do their jobs.

4.1.6 Feedback and performance standards

An effective written training plan can act as the basis for measuring performance standards and giving feedback to employees. If given to the employee at the commencement of employment, the business owner/manager has a strong position if someone cannot grasp the key skills required to be effective.

Feedback is crucial to rapidly building skills, particularly if people are employed with no exposure to agriculture. They need to know whether they have done a job properly or not, as well as informing the business owner/manager if there is a skill or conceptual gap.

It is important that performance standards are set because not every person hired is going to be suitable, and the sooner this is recognised the better.

All the talk is about technology, but what about the people? How do we train our workforce to deal with increasing complexity?

4.2 Case Study: Vulgamore Family Farms, Kansas, USA

Vulgamore Family Farms (VFF) is a large family cropping business based in western Kansas. The business farms their own land, lease farmland and carrying out contract farming operations for other landowners who either don't have the capacity, or no longer wish to operate themselves. The business farms approximately 90,000 acres and employs 60 people. The Vulgamore family has been involved in farming for six generations and have undergone a very large expansion in the past 20 years, from 12,000 acres to the present area (Brian Vulgamore/Ben Spare, pers. Communication 2022).

Figure 7: Vulgamore Family Farms Yard

The Vulgamore family members operating the business had a terrific relationship with their staff and there were a number of second-generation families employed. Education and further training were actively encouraged and some of these second-generation employees had been supported to study agriculture at Kansas State University before returning to VFF.

VFF had several characteristics that set it apart from so many businesses in terms the ability to teach staff and use technology:

- The business owners were genuinely engaged and interested in their staff. The head offices, board room, staff kitchen, workshop and accommodation for staff during harvest were all in one building and most staff met each morning to ensure everyone's plans were on the same page.
- The commitment of business owners to encourage further learning, to the extent of supporting employees through university.
- Massive scale – giving the following advantages:
    - Specialisation of roles for multiple people.

    - Able to spread the training of new employees across a number of people.
- Where technology was employed, there was someone on the staff intimately involved with it allowing the maintenance and troubleshooting to be dealt with on farm. Their chemical mixing facility was automated with a lot of electronics. When the facility was being installed, an employee shadowed the technician to be able to understand how everything worked (Ben Spare, 2022, pers. Communication).
- Technology platforms were consistent. All the farm machinery was John Deere using the John Deere technology platforms, making training far simpler.

Figure 8: Vulgamore Family Farms Automated Chemical Mixing Plant

Conclusion

The tools available to run businesses are becoming more complex and do require different skills. However, the demographic profile of the potential agricultural workforce mean that it is unlikely that most job applicants are going to possess those skills.

There are approximately 10 jobs in agriculture/agribusiness for every university agriculturally based graduate in Australia. The high probability is that potential farm workers will be either not skilled, a short-term working holiday maker, not be well educated or a combination of the above. There are several programs to encourage more youth to consider a career in agriculture which is to be applauded. However, it is increasingly common for people to have multiple careers and the concept of a career for life is disappearing. Expecting someone to stay for years at a business to repay the training is unrealistic.

The capacity of farm business managers and/or other senior staff to teach new employees is critical and does not appear to be fully appreciated. Taking on a new employee is initially a net cost to a business, as they take time to learn the skills and processes that are required to add value. Farm business managers need to have a clear picture of what information needs to be imparted to new employees to enable them to be productive as quickly as possible. This is likely to be unique to each business.

There is a competitive advantage to businesses that have the capacity to teach well as they can recruit from a wide range of potential people, in contrast to businesses that require skilled staff immediately.

The existing vocational training system in agriculture provides a national curriculum designed to ensure that trainees have consistent skills at completion. However, this system relies on the ability of the individual workplace to teach the skills to practical completion.

A teaching model for agriculture does not have to be complex. It requires that business owners and managers spend some time to think about the basic skills that they use often, and have a well-defined conceptual, or mental, model of what a useful employee looks like. Once this is defined it is much easier to provide the information in a graded manner to new employees.

Recommendations

Individual Business Level

The most important recommendations at an individual business level are:

- Increase business scale. Scale necessitates more people but allows for a greater range of skills and specialisation of roles.
- Consider the capacity within the business to teach new employees. If that is possible, be open to employing unskilled people.
- Clearly understand what each employee needs to do. This determines who to recruit and what skills are required.
- Identify the skills required each day and rank them from basic to most advanced and identify how these skills are to be taught.
- Develop a framework for teaching the key information to prospective employees that takes them from being someone else's shadow to independently productive in the shortest possible time.
- Understand where the 'productivity inflection point' is where an employee can contribute independently to the business without being someone else's shadow.

Industry Level

There are several things that could happen at an industry level to improve the skill level and adoption rates of technology with the agricultural industry.

- Product and/or service vendors to invest heavily in supporting their products to farmers and discount the cost of this.
- An increase in the level of large-scale contracting:
    - There is better equipment that is well used.
    - Training becomes more professional and sophisticated.
    - Increasingly complex work becomes better resourced.
    - There is a better fit of person and role.

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Appendices

Appendix A – Example training model – sheep grazing

Example Basic Training System Sheep grazing				
What is the learning style?				
Skills	**How to Teach**	**Can outsource Y/N**	**Tech Aids Y/N**	**Direct Supervision Required**
Pre Start Induction	**Outsourced**	**Y**	**Y**	**No**
On Farm Induction				
Specific Farm Safety	Demo/Written	N	N	
Farm Map	Demo/Written	N	Y - app with farm map	
Where things are	Demo/Written	N	N	Yes
Names of basic tools	Demo	N	N	Yes
Level 1 Skills				
Opening a gate	Demo	N	N	Initially yes
Cleaning a trough	Demo	N	N	Initially yes
Operating a manual vehicle	Demo	Y	N	Yes
Operating an ATV/Side by Side	Demo/Formal Training	Y	N	Yes
Observation - how to teach?	Demo	N		Yes
Recording information	Demo	N	Y - note taking app	Initially yes
Level 2				
How to use wire strainers	Demo	N	Y - youtube	Yes
Tie a simple knot with tie wire	Demo	N	Y - youtube	Yes
How to join poly pipe	Demo	N	Y - youtube	Yes
Livestock handling	Demo/Video	Y?	Yes - youtube	Yes
Introduction to tractor	Demo	N	No	Yes
Safety checks				
Oil - what is oil for?				
Tyres				
Damage				
Loader				
PTO				
Hydraulic system				
Level 3				
Operate livestock scales and retrieve information	Demo	Y - vendor support		
Drench sheep	Demo	N		
Move sheep from paddocks	Demo	N	N	Initially yes