Advancing agricultural opportunities through higher education: empowering youth, especially those from non-agricultural backgrounds, to pursue careers in agriculture

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Executive Summary

The quote, 'Imagine a world where we understand our food system, where it is also tech empowered' (Yarger, pers.comm., 2022), serves as a powerful symbol of the rapidly evolving agricultural landscape, both in Australia and globally.

This report underscores the urgent importance of nurturing young individuals' participation and experiences in agriculture, recognising their pivotal role in driving innovation, sustainability, food security, and addressing the changing dynamics of the agricultural workforce. Agriculture and agrifood higher education degrees globally provide students with a wide range of subjects, learning experiences, and industry engagement opportunities, offering a diverse array of career pathways within the agrifood supply chain.

The agricultural and agrifood sectors are undergoing transformative changes, driven by advancements in technology and the increasing pressures of environmental and societal demands. Professionals in these sectors require new skills to adapt and thrive. Over the past decade, the number of agricultural university graduates in Australia has stagnated, while job opportunities in the sector continue to outpace graduate supply. Attracting and retaining skilled individuals in agriculture must be a top priority.

Staying current with technical innovations is essential for the progress of agriculture. Ensuring students and young people entering the workforce are well equipped to lead in this rapidly evolving field is critical. Opportunities for students studying agriculture to gain real world experiences through work placements, internships and graduate programs are vital. These experiences lead to increased confidence, maturity, and problem-solving skills.

The report emphasises the need to champion diversity, welcoming young people from diverse backgrounds into the agricultural sector to inject fresh perspectives and ideas. It highlights the importance of dispelling misconceptions and stereotypes surrounding careers in agriculture. Collaborative efforts involving educational institutions, industry stakeholders, consumers and students are instrumental in creating environments that foster the success of young people in agriculture.

The report features success stories and case studies of individuals and programs, that can assist in encouraging and supporting young people in agriculture, particularly those from non-agricultural backgrounds. Industry support programs, including mentoring and graduate programs are vital links in attracting and retaining agricultural graduates.

In conclusion, this report emphasizes the crucial role of young individuals in shaping the future of agriculture, technology and sustainability. By embracing diversity, encouraging collaboration and providing meaningful opportunities, the agricultural industry can inspire and equip the next generation to become leaders in this evolving landscape. Ensuring that tomorrow's agricultural leaders are well prepared and supported is essential for a thriving agricultural sector in Australia.

Keywords:

Agricultural education, work placement, internship, course, students, diversity

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Foreword

Growing up on a family farm gave me an appreciation and understanding for food and fibre production at an early age. I have always loved sharing my passion with others, from friends with no farming background, to strangers at agricultural shows and children at local primary schools.

In 2018 during my time as CEO at the Mingenew-Irwin Group (MIG), a farmer driven Grower Group based in Mingenew, Western Australia, I noticed the curiosity and questions from tourists travelling from urban areas about the 'fields of white and yellow flowers', in their pilgrimage to view the famous midwest wild flowers. Taking time to explain, provide context and information on the farming systems in the region, I was intrigued at the interest generated from a simple conversation. Conversations ensued that created interesting questions, and challenged me to think about the opportunities and questions that could be asked from those with no preconceived ideas about the agricultural industry.

The following year I decided to create a living 'mini' demonstration of the crop types and varieties grown in the region, displaying information about the importance of the sector, and later displays of the food products that are created from the crops grown. The importance of starting a discussion was highlighted, it showed that a simple, easy method can create interest, understanding and curiosity around an industry they had no knowledge of. In addition I created a small agricultural experience program for the local primary school, which involved shearing demonstrations with local farmers, lessons on dung beetles, soil science, crop growth and seed storage, all topics relevant to farming in the region.

During my time at MIG I encouraged a number of extension projects, trialing new ideas, concepts and products on farm, working with farmers to improve their farming systems. Working in rural communities and within the agricultural sector since graduating from university, I have experienced the immense reward from working in a diverse range of roles, in the grains and mixed farming sector in Western Australia, with many inspirational farmers, researchers and agri professionals providing guidance, encouragement and support. I have been involved in roles that involve applied agricultural research and development, extension, farm management, agronomy and team management.

Over the past 12 years, I have been actively involved in recruitment of farm staff, seasonal employees, agri professionals and graduates. There is a changing skill set required in the agricultural and agrifood industries due to an increase in technology. I believe roles in agriculture are for everyone, and with different experiences, skill sets and beliefs, the agriculture sector can continue to grow, innovate and succeed in the face of political challenges, climate challenges, land use change, and advances in technology. My aim is to continue to provide the opportunities for young people into the sector, and in particular the grains and mixed farming sector.

My varied experiences throughout my agricultural career have shown me the importance of educating the consumer, children and young adults about agriculture in any way we can. Young people are vital for the continued growth of the sector, and as an active member in the agricultural sector, I have a passion for bringing new people into the workforce, and for them to have a rewarding experience in agricultural roles. The topic of encouraging careers in agriculture combines these personal experiences, of sharing, educating and supporting people to learn more about agriculture, the importance of rural communities, and trends I have

experienced, with new graduates and people within the sector. I believe as a sector, we can do more, especially connecting people with a background that does not include agriculture with the career options in the agriculture and agrifood industries.

Table 1. Travel itinerary – Individual Travel Summary

Travel date	Location	Visits/contacts
Week 1 September 1 – 10, 2022	United States of America: Salinas Lodi Davis	Dennis Donohue, Western Growers, King City High School, Rancho Cielo, Hartnell College, Lodi Wine, Stephanie Bolten, UC Davis, Carrie Peterson, Digital Nest
Week 2 February 26 – March 6, 2023	Canada: Olds Lethbridge Mannville	Olds College, Ken Coles, Farming Smarter, 2022 Nuffield Scholar, Lethbridge College, Arvel Lawson, Bayer, Brian Tischler, AgOpen GPS
Week 3 July 26 – 31, 2023	Ireland: County Clare County Cork	Ray O'Foglu, 2021 Nuffield Scholar, Sam Deane, Arable Farmer, Brian McCartney, 2021 Nuffield Scholar, Charles Dowding, No Dig Garden Educator, Ballymaloe Organic Farm
Week 4/5 August 1 – 13, 2023	United Kingdom: Oxfordshire Chipping Norton Derby Peterborough York Newcastle	Will Brown, 2023 Nuffield Scholar, Kate Henderson, FarmEd, Megan Dugdale, Eurofins, Hannah Fraser, 2023 Nuffield Scholar, MDS, Nicola Cannon, 2007 Nuffield Scholar, Royal Agricultural University, David Marsland, Mixed Farmer (York), Simon Parker, Newcastle University, Hannah Batty, 2023 Nuffield Scholar, Chester, Alex F, Clare Toogood, Harper Adams University
Week 6 August 13-19	France: Pensol Jonzac Trevarn Plouedern	Chloe Pellergin, 2019 Nuffield Scholar, Olivier Glinec, Craig Garcia, Dominique Fave
Week 7 August 20 -	Netherlands: Aalten Wageningen University, Aeres Hogeschool, Dronton Lelystad	Suzanne Ruesink, 2016 Nuffield Scholar, Xander Becks, 2023 Nuffield Scholar, Alfonds Beldman, Wageningen University, Carina Van de Beek 2023 Nuffield Scholar, Rogier

		Scherpbier, 2023 Nuffield Scholar.

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The Nuffield experience during COVID times has been a challenging one. I would like to acknowledge the following organisations and people for their support over the past three years.

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My incredible Global Focus Program (GFP) group, John Foley, Lynsey Stratford, Vanessa Chiamulera, Rob Bell, Ray O'Fouglu, Brendan Crosse, Mikey Denshem, Hans Loader. The insights, knowledge, conversations and perspectives were life changing, and I will forever be grateful for the experience I had with you all.

My family and friends for providing me with positive support and encouragement.

To past and current Nuffield scholars, industry contacts, universities, colleges, training providers and organisations I visited and stayed with in the United States of America (USA), Canada, France, United Kingdon (UK), Netherlands and Ireland, your generosity, openness and fulfilling conversations were incredible. Dennis Donohue, Ken Coles, Will Brown, Olivier Gilnec, Suzanne Ruesink, Linda Kopczinski, Ray O'Foghlu, for your extra assistance in organising many extra visits and connections during my individual travels.

Abbreviations

AI	Artificial intelligence
GFP	Global Focus Program
GLP	Good Laboratory Practice
MDS	Management Development Services
MIG	Mingenew-Irwin Group
PIEFA	Primary Industries Education Foundation Australia
UK	United Kingdom
USA	United States of America
USDA	United States Department of Agriculture
UWA	University of Western Australia

Objectives

The objectives of my research project were to:

- Examine the evolving skill requirements of professionals in agriculture
- Investigate graduate programs in the agriculture and agrifood sectors
- Investigate how agricultural higher education course and degrees are evolving with the changing workforce requirements in agriculture
- Seek examples of and understandings of the importance of work placements and internships in the agricultural sector.

Chapter 1: Introduction

In 2021 85% of Australians lived in urban areas (Australian Bureau of Statistics (ABS), 2023). Many Australians have never interacted with a farm, other than recognising that it is another part of the regional landscape with little to no connection as a critical source of food productions. This is contributing to the rising disconnect between farming, agriculture and food production in the population. The word agriculture is commonly referenced to farming, or producing food and fibre, rather than the full production pathway of the agrifood and fibre supply chain. Creating an understanding of agriculture and it's link to food is important to create connection and demonstrate the professional job opportunities that are available in the sector, not just on farm. Higher education providers offering agricultural studies such as universities, colleges and vocational institutions must develop ways to not only attract people into studying agriculture and agrifood courses, but to encourage and ensure they are ready for the workplace. Likewise, agricultural and agrifood businesses employing young people need to be able to provide the support to new employees to ensure staff retention.

The Australian agricultural industry directly employs around 239,000 people (Department of Agriculture Food and Forestry (DAFF), 2022). *Building the Agricultural Workforce of the Future* paper highlights the importance of improving community perceptions of agriculture, the need to create awareness and showcase pathways to the diverse careers in agriculture (Department of Agriculture, Water and Environment, 2021). Labour shortage in the Australian agricultural industry, and the impact this has on the country's agrifood supply chain has been extensively reported in the past three years. During this time, the impact of the COVID-19 pandemic saw a disruption to the food supply chain, bringing agricultural production to the forefront of Australian's minds (McDonald et al., 2022). While much of the media focuses on the seasonal, unskilled labour, required for planting, harvesting and mustering the nation's agricultural produce, the labour shortage extends to agri-professionals and skilled workers.

Attracting people into the agricultural sector in Australia is difficult. For students from an urban background, that have had limited or no childhood exposure to agriculture, have a limited understanding of how food is produced, and limited or no school-based education in food, agriculture or agribusiness, they simply do not know the careers that are available. There are many excellent school and industry programs being adopted in Australia at the primary and secondary level. Past Nuffield reports have focused on this level of education, but improvement in this area is still needed to attract people into both the agricultural workforce and post-secondary school education and training in agriculture. There is a role everyone currently involved in agriculture can play in changing this narrative. Being a positive advocate for your industry, creating conversations, around food production, your experiences, your connections and passions, the opportunities in tech, environment, and entrepreneurship, may inspire someone who is listening to consider a career in agriculture.

Changes to the agriculture and agrifood workforce have been discussed extensively worldwide in the past decade, with increased development of technology and automation being at the forefront of these discussions. The Food and Agriculture Organisation of the United Nations paper titled *The State of Food and Agriculture 2022*, states that as automation and technology becomes more prevalent on farms, the traditional workforce will change, becoming smaller and more skilled to meet the demands of understanding and working with complex technologies. Agricultural technologies are being designed and driven by the need to make traditional labour-intensive tasks more efficient and cost effective. To support the rise of technologies in agriculture, the agricultural workforce needs to have a new skill set to support

farmers and supply chains adopting technology, but also support different and changing farming methods, such as an increased focus on the environment.

Preparing the work force for the future extends beyond primary production, and applies to aspects of the agrifood supply chain, such as logistics, processing, research and distribution. To meet the changing requirements of this workforce, suitable education and training is crucial to develop people with knowledge and understanding of the food and agricultural systems.

There are many universities, vocational institutions and training providers educating the next generation of agricultural professionals and employees providing a range of degrees, diplomas and certificates. Although agricultural university degrees have increased over time, with an increase in the universities offering courses, the increase in all other degrees has been greater (Pratley, 2022). This provides an unclear picture of the reality of the proportion of people studying higher education agriculture. However, the number of students choosing to study these disciplines is declining, and combined with the reduction in Australian higher education agricultural colleges, is leaving a shortfall in the staff available to take on roles in the sector. With the agricultural work force skill set changing at a fast pace, due to technological advances and environmental challenges, the sector must think outside the square to attract and support new entrants from all backgrounds, allowing new ideas, perspectives and concepts to the industry. Training providers have a responsibility to provide courses and units that are both industry relevant and follow advances in agricultural policy, technology and environmental regulations, allowing students to be engaged in pursuing a career in agriculture after graduating.

Education systems differ throughout the world, and comparing systems, techniques and outcomes is difficult to contextualise. Different learning styles, teaching styles and student experiences throughout post-secondary training can shape the student experience. Throughout my travels I have explored agricultural education through meetings with schools, colleges, universities, students, lecturers, farmers and agribusinesses, in order to gain a well-rounded understanding of the wider picture, specifically in the higher education agricultural space.

Chapter 2: Consumer Education

Education continues throughout an individual's life, from childhood through to adulthood, with experiences building on past learnings. While studying this topic, I categorised agricultural education into four levels; primary school, secondary school, higher education (tertiary/vocational) and consumer education. All levels of education are linked and contribute to the success of each other. The focus of my topic was around higher education, however I acknowledge the importance of the three other levels of education in contributing to the engagement of individuals as future participants in the agricultural workforce.

2.1 The consumer link

When consumers are not connected to agricultural food production, they have a severe lack of understanding about how food is produced, processed and distributed. This is a barrier to engaging new entrants into agriculture and food industries. Examples of consumer disconnect are evident throughout the world, with the narrative often focusing on city dwellers and the perceived lack of understanding of their rural 'relatives' in the agri-food system.

Consumer education around food production occurs using everyday food items as a platform for information branding and certification that recognises good farming practices are also helping to bridge the gap on where their food products are coming from and the way in which they are produced (Kopczinski, pers.comm., 2023). Environmental and welfare regulations in the Netherlands are seeing dairy companies reward farmers for meeting targets on cow and calf welfare and environmental stewardship. Linking responsible farming practices to milk production and sharing this with the consumer on the back of a carton of milk through the farmer's eyes, creates consumer connection to the product - initially a personal connection to the farmer, but also a link to their wider beliefs around welfare and the environment.

From the many conversations I have had, there is a strong belief in Europe and the UK that agricultural education through consumer exposure and experiences, is fundamental to creating awareness of agriculture and farming. Farm shops selling locally grown or manufactured products from the farm gate in the UK allow a range of experiences to the public. Experiences include:

- Paddock to plate products being produced and sold on farm
- Open dairy sheds, allowing milking viewings
- Open greenhouses
- Cooking schools
- Animal petting experiences
- Vending machines offering a selection of fresh food and produce.

These experiences are always where farmers are connecting with the consumer, which can lead to greater understanding of agriculture, normalise the industry and food production, and create curiosity for a range of generations. Examples of food tourism and food trails can be found throughout the world, creating an educational experience for consumers in regional areas where food production occurs on a large scale, and in urban areas, where vertical farming, lab based meat and bees are produced. The urbanisation of agriculture in some aspects of food production provides a unique opportunity to engage the future workforce.

Suzanne Ruesink, Netherlands has created a unique farm to fork experience with her restaurant Suzie's Farm. The restaurant aims to connect consumers with food, and focuses

on seasonal produce, with an aim to serve food sourced from within 25 kilometres. This form of consumer education highlights the production of food within the Netherlands, and the seasonal aspects of growing food. Located in a rural setting, customers are surrounded by agricultural crops and farm animals, and also have the opportunity to visit the family's 160 cow dairy. The dairy has high welfare and environmental certification, which demonstrates the certification system and the emphasis placed on sharing the environmental and welfare story to consumers. By allowing consumers access to the dairy, they can create a connection between the produce they are eating, the production aspect, and the way it aligns with wider consumer values such and the environment, and welfare (Ruesink, pers.comm., 2023).

Figure 1: Kathryn Fleay and Suzanne Ruesink, at Suzie's Farm Restaurant, Netherlands, 2023. (source: author)

In the heart of Tokyo, there is a rooftop bee farm that provides more than honey, beeswax and a fun tourist experience. Non-profit organisation Ginpachi bees, the brainchild of bee keeper Fujiwara Seita, also creates an educational space for the public to learn about nature, ecosystems and the possibilities of urban agriculture. Since demonstrating the success of Ginpachi bees, and the ecosystem benefits such as the increased pollination of fruit trees, the reintroduction of swallows, over 100 inner city businesses in Japan are following the lead and creating rooftop gardens to attract bees. Customers can purchase honey, pollen and other bee products from retailers located throughout the city, creating a direct link from product to the consumer.

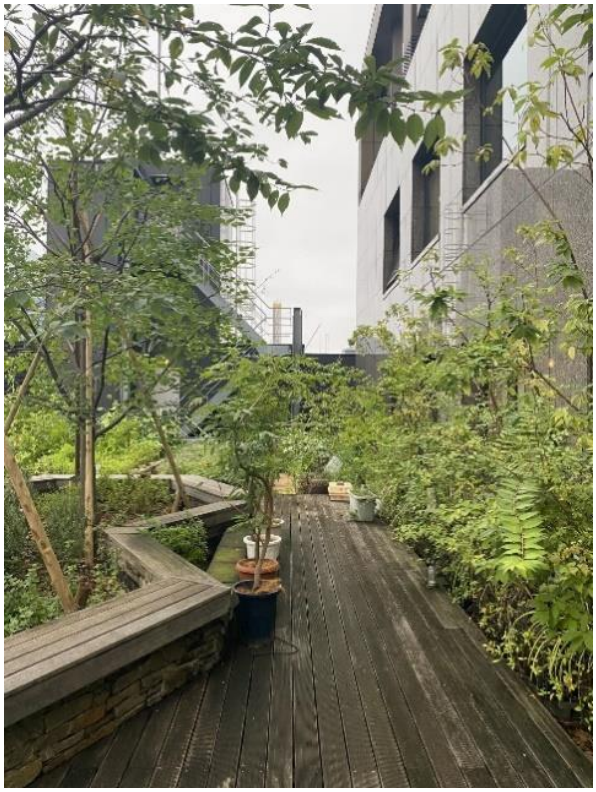

Figure 2: Rooftop garden, the location of Ginpachi bees, Tokyo. (source: author)

The consumer link has importance in attracting the next generation of agricultural workers, but also developing the recognition of agricultural production and other industries such as technology, engineering and robotics. It plays a huge role in policy development, with greater consumer understanding contributing to increased depth of discussions politically.

Chapter 3: The changing agricultural workforce

Throughout the world, the production systems for food and fibre are constantly evolving. Where mechanisation were drivers in the past, transformation in current food production systems are driven by increased automation, utilising data capture, environmental and social considerations and technology, such as artificial intelligence (AI). These aspects require new skillsets for the agricultural employee, some of which will need to come from outside of traditional training sources. The continual change of agricultural supply chains reflects the multidisciplinary nature of the industry, which demands a diverse workforce. While automation is often touted as a solution to the labour shortage, this is not accurate in all or many aspects of food and fibre production and throughout the supply chain. While automation and technology can alleviate the reliance and dependence in some cases on manual agricultural labour, it can also bring challenges, such as new skill requirements in areas where they have not been required in the past. In addition, the reduced requirement for unskilled, entry level farm labour changes traditional pathways to attract people into the industry (McDonald et al., 2022). These changes highlight the importance for the need of skillsets to be developed before people enter the workforce, as opposed to taking the unskilled pathway. This can subsequently impact negatively to the initial exposure of people into the industry.

Agricultural education providers need to ensure teaching resources continue to be updated, with emerging technologies, coding, augmented reality, sensors, drones, AI, robotics, big data, environment and social aspects having a greater relevance and importance to the agricultural sector (Connelly, 2022). Skills required by the workforce will continue to adapt and change, and it is essential that training and education remains relevant to not only prepare students for the workforce, but to attract them into the workforce. The changing skillset, technologies and environmental links associated with agriculture, are also providing new opportunities to link and encourage people from non- agricultural backgrounds to step into the industry, bringing interests and skill sets from other disciplines. Application of external ideas to an agricultural context will create new and innovative solutions to agriculture and agri-food sectors.

European policies are seeing farmers in many industries having to change their practices in order to meet environmental targets and follow government legislation. Dominque Fave, owner of SAS FAVE Limited, a piggery located in Brittany, France explained how environmental restrictions have changed. The way they farm has had to adapt and find solutions to allow them to keep farming in profitable way, that also aligns and meets animal welfare and environmental requirements. In addition to his immediate on farm workforce, Fave also readily uses external consultants to bring in new ideas and solutions to the farm. Consultants are drawn from a range of agribusinesses, banks and customers and help inform the company of future trends, new ideas and potential upcoming changes to government policy. This exchange of information allowed the company to think outside the square, develop internal environmental goals for the company, such as reducing ammonia output by reducing soy consumption and starting a grower group ‘think tank’ to exchange information amongst farmers. Fave employs seven managers in various pig facilities on his farm and has an incredible employee retention statistic of the current employees staying in the roles between 20 and 47 years. Long term employees allow the transition and adaptation to a changing supply chain simpler by having a complex understanding of the business and the changes that have continued throughout the years.

3.1 Automation and technology

‘Agriculture is the least digitised industry in the world. With technology, do we have less doctors are nurses?’ (Connelly, pers.comm., 2023). This comment challenges the sometimes generalised belief that the rise of automation and technology will reduce the need for labour. The rise in Ag-tech startups worldwide has shown how the potential advances in technology

could help address the physical labour requirements in agriculture. However, with new technologies and ways of undertaking work, comes the need for new and varied skill sets. While there is some concern the increase in automation may lead to the displacement of current roles, it also has the potential to assist agricultural sectors to undertake the roles that are becoming increasingly difficult to fill. Technology advances that are being adopted in agriculture include 3D printing, robotics, drones, data analytics, augmented reality, virtual reality, blockchain and the Internet of Things (Connelly, pers.comm., 2023).

Nick Elferink and Linda Kopczinski, farm dairy cows and arable crops in Losser, Netherlands. The family operation is currently undergoing a succession phase, and during this transition, the family have recognised the importance of a work life balance. Currently milking 180 cows, the family have recently upgraded their dairy facility to complement and support their robotic dairy, by implementing a robotic feeder, minimising that time spent on important, but repetitive tasks, and eliminating the requirement for hiring an additional person. The Lely robotic and automatic systems this farm has invested in, allow for the reduction of repetitive tasks such as milking and feeding by humans, with the human element of the business, allowing to focus on the cows that need attention, in addition to utilising the data generated to inform future business decisions (Elferink, pers.comm., 2023). Seen in many agricultural industries, the rise of data and automation is, in some cases reducing the need for unskilled workers on farm and in the agricultural supply chain, however it is important to remember the change in skill set required to service, run and implement systems utilising technology.

Figure 3: The new Lely automated feed system being installed on the Elferink family farm, Netherlands. (source: author)

Dominique Fave, pig farmer, Brittany, France, said the improvements in technology in the agricultural sector are reducing the need for repetitive and dirty tasks, such as robotics for high pressure cleaning in his piggery, pregnancy scanning using an iPhone and automated feed rations, which have been determined by data, all of which allows a better experience for staff. Dominique believes technology and robotic adoption on farm can increase staff retention, and help to attract a new generation of employees onto the farm, however he emphasises the role in training institutions to ensure that the relevant training in new technology allows industry to develop with the advancement in technology. ‘There are less and less people willing to work on farm, but with the increase of technology, farm worker competence needs to improve’ (Fave, pers.comm., 2023).

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Promoting the research and development opportunities and the role Agtech will play in the future of the industry is vital in outlining the career potential in the sector, particularly those associated with environmental outcomes, technology and global factors affecting production. Integration of technologies such as automation, precision agriculture and robotics in the agricultural sector will allow tech savvy individuals to recognise career pathways into agriculture.

Hartnell College, a post-secondary community college located in the food producing region of Salinas Valley, California, plays an important role in agricultural education, through a range of courses they offer. Training the trainer programs, allows school teachers to upskill in agriculture and relate this to technology, that can be taught and incorporated into the classroom through practical methods. An example of this is coding and robotics, and how these can be used in an agricultural setting. State of the art facilities and equipment allow teachers to bring technology into the classroom. Richard Chapman, agricultural technology lecturer at Hartnell College, believes early exposure to agriculture and related technologies is extremely important – 'you can't dream of being anything you've never seen or heard of'. (Chapman, pers.comm., 2022).

Figure 4: Hartnell College's portable coding and robotics unit for trainee agricultural technology school teachers to use in the classroom. (source: author)

Figure 5: The Agricultural Technology training facility at Hartnell College, California, featuring computers and robotics. (source: author)

Agricultural lecturers at Hartnell college collaborate with United States Department of Agriculture (USDA) researchers on projects relating to agricultural production systems in the Salinas Valley. Real world soil sampling and analysis projects connect students both with farmers and researchers, creating a network and practical understanding of work and jobs in the agricultural industry. A popular micro credential course at the college is Ag Tech, where

students are exposed to learning about automated processing, programming, use of hydraulics, assembling robots and megatronics. Hartnell college agricultural curriculums are developed with industry engagement through independent consultants and teachers like Carrie Peterson. Carrie's work involves meeting with industry stakeholders to develop courses that will suit tomorrow's workforce requirements (Peterson, pers.comm., 2022.) Carrie's role in leadership in this space shows an example of the impact of collaboration with industry and education providers, and the requirement for facilitators to ensure these relationships are relevant and effective in delivering outcomes for the sector.

3.2 Diversity

A diverse workforce can lead to positive outcomes for businesses, such as increasing retention, improving innovation and decision making and increasing profits, which provide a great opportunity to increase the sustainability of the agriculture and agri-food sector (Toogood, 2022).

Addressing the agricultural labour shortage in Australia was the focus of a presentation given by Professor Jim Pratley in 2022. Pratley explored the need to address diversity issues within the agricultural workforce. The presentation highlighted the increase in female entrants into agricultural degrees, leading to females currently out numbering males. This has helped to double the talent pool and increase gender diversity. Pratley (2022) highlighted the need to focus on encouragement of indigenous Australians into agricultural higher education, to further build on diversity and inclusion within the sector.

Conversations through my travels indicated many young people from non-agricultural backgrounds entering the agricultural workforce felt isolated or excluded because of their lack of experience with primary production. A survey undertaken in the UK by Claire Toogood (2022) found feelings of alienation and exclusion existed for newly graduated individuals in agriculture or agri-food settings, due to a combination of non-agricultural backgrounds or being from other demographic groups that were under represented by the sector. New entrants into the sector attributed increased contact at events, farm visits and spending time in rural settings allowed interaction between individuals from a non-agricultural groups and agricultural backgrounds, to increased awareness and the removal of misunderstanding.

To accommodate the high demand of employees in a varied and changing agriculture sector, the industry needs to be welcoming of people with different backgrounds, personalities and genders. Strong mentoring programs that suit employee diversity need to incorporate industry and farming mentors to assist non-agricultural background employees' to transition into the workplace.

Digital Nest, an organisation in Salinas, California is a technology learning centre for Latnix youth, providing skills and development opportunities, resources and facilities to advance the prospects of people within their community (Donohue, pers.comm., 2022). These transferable skills can be used within their agricultural community and help to support the economic and social development of their region. Digital Nest, is a promising example of how community and industry collaboration can work to achieve positive outcomes for young people aged between 14 to 24. The organisation provides safe learning spaces for youth to gain skills in technology, marketing, design, networking, with the aim of providing career pathways within communities by providing equipment such as computers, digital printers and an electronics lab area. Digital Nest works with businesses in the community to provide field trips to allow students to see the possibilities and career opportunities in the technology space. This less traditional pathway into the workforce suits the youth in these areas, many who would not be interested in attending higher level education streams. Although, not specifically designed for agricultural

businesses, this collaboration in a regional area, allows students to contribute positively to their community, and provide job pathway opportunities within their communities through internships. This inspirational organisation is funded by a philanthropic fund. This is an example of community collaboration with customised training, where an organisation is working closely with local communities to understand their needs, offering training programs that are supporting individuals to acquire relevant skills based on their interests, while also providing opportunities for hands on experience through internships.

Figure 6: A 3D Printing workstation located at the Digital Nest, Salinas, California. (source: author)

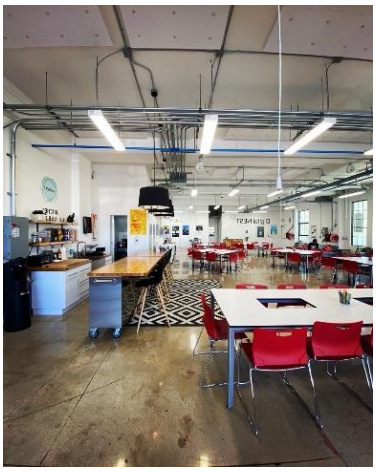

Figure 7: The Digital Nest space provide a safe learning environment for Latinex youth in Salinas, California. (source: author)

Sawaura Shoji, President of Greenleaf Co. Ltd, a Japanese farm growing and distributing fresh fruit and vegetables in Akaggihara, northwest of Toyko explained how their business encourages workforce diversity by encouraging families with small children to work in the company, by offering free on farm child care facilities on farm for employees. When our GFP group visited in August 2022, there were 20 children enrolled in the day care, allowing their parents to work on the farm and visit during their lunch break. This community feel to the organisation and the value that is placed on the importance of family and allowing all people opportunities to work, benefits the company by creating a diverse work culture and environment, commitment from workers and peace of mind for employees.

Chapter 4: Experiences and exposure

4.1 School education link

Working in agriculture can be perceived by some as working in rural, regional and remote areas of the country. While there are many opportunities in these areas, there are increasing opportunities in urban areas for agricultural professionals. Ensuring this narrative is clear, is important for the future security of agriculture and food production. A study undertaken by CQUniversity looking at '*Engaging secondary school students in the world of agricultural careers'* in 2020 highlighted the lack of understanding of students' knowledge on food production. Dr Amy Cosby, who led the research stated, "If students are not being shown an accurate vision of modern agriculture, they are unlikely to recognise that agricultural jobs can be highly skilled, well paid and possibly located outside rural areas" (Burt, M. 2023).

Australia has several initiatives aimed at attracting people into the agricultural supply chain workforce, or into studying agricultural related topics at post-secondary school level. Many of these initiatives rely on schools offering agriculture as a subject, or students being exposed to agriculture in some form, specifically during the ages of 12-16 years. While programs and curriculum aligned course work is readily available through both individual agricultural industry organisations (such as Australian Wool Innovation and Horticulture Australia and the Primary Industries Education Foundation Australia (PIEFA)), (PIEFA, 2023), there is often no formal requirement to teach using these resources. Teachers with no agricultural training or background often lack the confidence to teach agriculture to students, which is resulting in other subjects being prioritised in the teachings (Barnwall, pers.comm., 2020). The shortage of adequately trained teachers hinders suitable teaching of agriculture, whether or not it is in the curriculum (Adamo, 2023).

Agriculture taught at an Australian secondary school level has a poor reputation with students and parents (Graham, 2022). Graham, 2022, found that the biggest influences on students' reasons for joining the agricultural sector after school are determined by their agricultural background and family influence. Students from urban areas, are therefore less likely to have these backgrounds and, family influences and experiences in agricultural production. This leads to less students wanting to pursue higher agricultural education, and a reduction in the number of university graduates in agricultural degrees. Pratley (2022) discussed the need for parents to see the relevance in what is being taught at school, and the opportunities for their children.

Barker College, NSW is doing a promising job at showing not just careers in production agriculture, but also careers in the wider agribusiness sphere by focusing their teaching as a science subject. Being a college located in the metropolitan area, the focus is predominantly on teaching students about the modern science and business side of agriculture and entrepreneurship, rather than the practical aspects of production farming. This concept, developed in the mid 2000's has seen students from Barker College increase their interest in studying a range of university courses that will lead to agribusiness and commerce related agri-food sector roles, based in both city and regional areas (Graham, 2021). Through this approach, Barker College is breaking down the perceived barrier of rurality associated with roles in agriculture. While this is important for new entrants into agriculture, it also encourages new generations who may be from a farming of agricultural family, but do not wish to live rurally.

Agricultural high school colleges, such as the Western Australian Department of Education Agricultural Colleges (Narrogin, Harvey, Cunderdin, Denmark and Morawa) offer students a

more practical approach to learning, and focus of production agriculture. Programs such as these are critical to the continual development and upskilling of young people wanting to work on farm or in a more practical setting within the agricultural sector. These students often go on to work in trade roles, as agricultural technicians, and in farm roles, all critical to the growth and sustainability of the agricultural workforce.

At King Valley High School, Hanford, California, 83 percent of students attending are classified as economically disadvantaged. King Valley High School is located in a rural city, where the local economy relies on agriculture and food processing. In 2022 the school opened a new agriculture facility, designed to connect students with agricultural skills that can be used to forge careers and pathways in the sector. Courses offered as part of the agricultural faculty include mechanics, horticulture, agricultural science, animal science and floral science. The skill development offered to these students allows them to explore and see the potential of working in the agricultural industry, and the innovation. State government funding of the facilities shows a real investment into the importance of agriculture and food production, with between $200,000 and $400,000 USD funded to the school for supplies each year. At King Valley High School, more than half the students choose to take an agricultural subject or pathway (730 students each year) (Donohue, pers.comm., 2023).

Cosby (2023) highlighted the lack of understanding of school aged students, not only to the role of agriculture, but the career opportunities in agriculture. The majority of survey participants linked agriculture careers with farmers, rather than other roles. The study highlighted the importance of developing adequate education programs in Australia for school aged children, and recognised the importance exposure has on students overall understanding of agriculture (Cosby et al., 2023) A cumulative impact has been noted in the same survey, where students with increased exposure to agriculture, continue to further develop their understanding, and improve knowledge levels over time (Cosby, 2022).

Local industries are partnering with local schools in Lodi, California. This wine producing region south of Sacramento is home to Lodi Wine, which provides localised research and extension to farmers. Stephanie Bolton, Lodi Wine has been actively engaging with the local primary school to create education packs for teachers, allowing them to teach students about wine grape growing, and the industry that is important to their local economy. Simple, fun and engaging materials allow students to develop understanding of what people in their community do, which is also providing exposure to a potential future wine producer, researcher or grower.

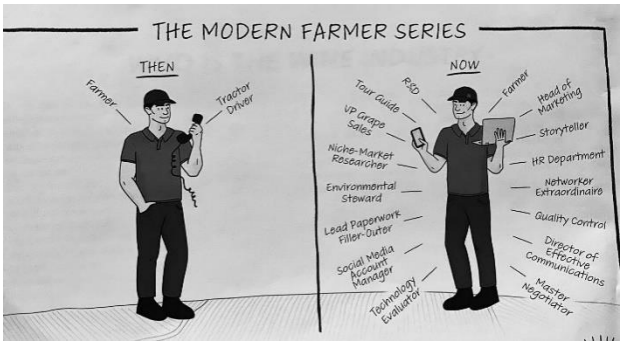

Figure 8: Primary school education material developed by Lodi Wine, to create awareness of agriculture and farming in the local area, demonstrating the skills required to be a wine grape farmer. (source: author)

Across many of the conversations I have had with people now working in agriculture, with no agricultural background (ie. no direct living family members involved in the agricultural

industry), there is often a common theme or a significant event or exposure to agriculture which made them consider studying or further pursuing a job in the sector. Rogier Scherpbier grew up in an urban environment in the Netherlands, and found after school work on an organic vegetable, cropping and beef cattle farm. Arriving at the farm with no experience or knowledge of farming, the farmer provided a nurturing learning environment where Rogier could develop skills in farming and agricultural production. Rogier found this experience rewarding and has gone on to start his own organic grain milling and cleaning business, where he also produces niche organic flour, beer, and cereals for human consumption (Scherpbier, pers.comm., 2023). From the positive experience Rogier had during his formative teenage years, he has built a business and passion for agriculture. Sharing stories like Rogier's with school students creates an important connection and awareness of opportunities to people from all backgrounds, ultimately giving them confidence in that pursuing a career is possible, successful and rewarding.

Figure 9: Rogier Scherpbier, with his milled and packaged organic flour products, Netherlands. (source: author)

Farmers, industry and agricultural businesses have the ability to work with schools to promote and encourage agricultural careers to students, by supporting excursions, workplace learning and experiences. By changing the narrative, linking agriculture with innovation, science and technology, students from all ages will see the range of skillsets required in the agricultural sector.

4.2 Attracting prospective students to study higher education agriculture

'Agriculture has the potential to be one of the most exciting and rewarding industries in the world' (Ives, 2023).

In a study undertaken by Claire Toogood, (2023) it was found that students from non-agricultural backgrounds were positively influenced to study agriculture by relevant experiences. These included visiting agricultural events and farms, spending time in rural environments, and being motivated by sustainability and helping to conserve the natural environment all contributed to positive experiences.

School and community education in agriculture are vital to be able to attract students into higher education tertiary or vocational education courses. However, tertiary and vocational

education providers need to be able to market and brand courses correctly. In Australia, university education is a common pathway for those wanting to enter the agricultural industry. Colleges and other vocational higher education options, although available in Australia have reduced over the past 20 years, making it more difficult for students to connect with industry through learning in a direct and practical way.

Organisations such as the Agricultural University Council aim to bring together Agricultural universities across the UK to work collaboratively. In 2023 the public perception of Agriculture in the UK was considered one of the lowest paid sectors for university graduates (the second lowest after creative arts). Catherine Douglas from Newcastle University believes there could be a great benefit of universities coming together to promote the scientific, high tech and exciting nature of agriculture. In collaborating, the universities will be able to share the positive prospects of a career in agriculture, not only with potential students but also their parents (Douglas, pers.comm., 2023).

Newcastle university, UK, is thinking outside the square when it comes to attracting all backgrounds into university degrees. The University has developed the 'Bitesize Uni' concept, which offers year 12 students 'taster sessions' in broad subject areas including sciences, maths, technology and agriculture. These free residential summer schools provide students the complete university experience, where the students live on campus, attend lectures, and tutorials and experience university life. In addition, Newcastle University lecturers also give a 'Beyond Biology' career talk to biology students in their third year of study. The aim is to create awareness of the links between agriculture and biology, and the job prospects in agriculture. The university has seen an increase in the uptake of biology students undertake honours projects in primary production and food production, as a direct result of the beyond biology talks, which create a larger awareness of agriculture (Parker, pers.comm., 2023).

Figure 10: Simon Parker and Kathryn Fleay at Newcastle University, UK. (source: author)

It is critical that the current agricultural and agrifood workforce create a positive narrative about the sector. The agriculture and food sectors will always be vital to Australia's economy, not just from a trade perspective, but also with respect to ongoing food security. By promoting the ongoing need for a highly skilled workforce, and highlighting the diverse roles within a sector that is rapidly adopting new technologies, prospective students can make link between agriculture, food and other job opportunities such as environment, engineering, research and logistics within an agricultural context. It is vital that promotion of careers in the agricultural sector highlight the full supply chain from paddock to plate. The redefinition of agriculture to encompass all the steps in the production of food will inform the prospective workforce of the breadth of opportunity beyond the farm gate.

4.3 Higher education course design

Students, particularly those from non-agricultural backgrounds gain knowledge and experience by practical visits and field trips outside the classroom. All agricultural and related research university and vocational education providers have opportunities to create fast and impactful links between students and industry. These links help foster recognition of opportunities, networks and industry challenges, providing an impactful appreciation of the industry.

Landex is a UK based organisation aiming to raise the standards and outcomes of universities and colleges throughout the UK. Universities and colleges pay to become a member of Landex, which provides access to leadership programs, guest speakers, coaching and support and a peer reviewed assessment of their courses and degrees. Assessing higher education providers in the agriculture, environment and agri-food sector and sharing best practices can allow for improved outcomes around teaching and learning experiences, which will benefit the industry in the long term. Landex try to utilise industry to guide higher education providers around requirements for new qualifications, focusing on skills that may be required in five to 10 years' time. Liz Lawrenson and Alex Payne, Landex highlighted the importance of university and college's engagement with employers through work placements and work experience through their reviews and involvement in Landex.

The political situation in the Netherlands around land use, the environment and farming has led universities to develop new courses and degrees in order to remain relevant and produce graduates with a well rounded understanding of agriculture and the connection with society, the environment and land use. Aeres University of Applied Sciences engages with industry representatives to continue to help and develop courses that aim to have a positive impact not only for the agricultural industry, but also make a positive impact on the wider population, through increased understanding of the links between all sectors. An example of this is a newly formed degree in agricultural real estate, which has arisen due to the current government's policies around agriculture, the environment and land use. The degree aims to provide students with an understanding of land use, policy, environment and agriculture. Graduates will have the skills to be able to work in a variety of roles, including government, environmental organisations, agricultural consultancy and land stewardship (Van de Beek, pers.comm., 2023).

Environmental schemes and policies in the UK have seen universities offering new courses that aim to fill a workforce skills shortage bridging the agricultural and environmental sectors. Countryside Management is a new degree being offered by Newcastle University. This degree is aiming to equip farm and agribusiness consultants of the future with expertise around linking farmers with environmental schemes. The new Countryside Management degree incorporates rural development, environmental and business management and agriculture and land management. The degree aims to provide agricultural and environmental links, specifically to farmers and agribusinesses, assisting farmers to improve their environmental stewardship. (Parker, pers.comm., 2023). Newcastle university is based in the city of Newcastle, and despite not being located on a farm, the university place a high importance on practical field visits throughout the course. As a result, courses are structured to heavily involve industry and farm visits.

The Royal Agricultural University, Cirencester, UK, evaluate the agricultural courses offered at university every four years. Course module names are updated and new modules are designed to attract more students into the university. Examples include using 'Soil, environment and agri-food', and feedback from students has indicated wording is particularly

important for people from a non-agricultural background, that can relate to worldly, topical subjects, rather than specific agricultural related subjects such as 'pasture production'. The university believes this is also important in attracting a diverse range of students (Cannon, pers.comm., 2023).

Harper Adams university in the UK, has recently developed a new school – Sustainable Food and Farming. Formed in 2021 the school's aim is to provide the farming sector with sustainable farming systems by collaborating with industry. The aims of the school include:

1. Encouraging new talent
2. Upskilling the current workforce
3. Research collaboration with industry – breaking new ground
4. Developing common language for policy makers, and giving a clear message from the agrifood industry around food and agricultural sustainability

The key themes of sustainability research the school are focusing on with industry include:

Table 2: Themes of the Harper Adams School of Sustainable Food and Farming. Source: Harper Adamas, 2023.

Society (People)	Economy (Profit)	Environment (Planet)
• Food quality and safety • Farmer skills • Rural social and economic conditions	• Food supply • Farmers income • Sustainable food products	• Soil health • Soil/water/air • Energy • Biodiversity • Climate change

The school is allowing a pathway for innovative ideas that link with industry to be researched. Having links to national food companies and retailers allows student involved in research to see the benefits and links to the entire agrifood supply chain (Hardie, pers.comm., 2023).

Universities offering minors in a range of subjects not traditionally linked to agriculture is common throughout the world. This connection with other interests, studies and occupations, allows students to think about opportunities outside traditionally perceived agricultural opportunities, allowing the agricultural workforce continued growth and expansion. Aeres University of Applied Sciences offer a range of minors courses, through different universities, including robotics, mental health and teaching. Ranked as the top USA university in agriculture, plant sciences, animal science, veterinary medicine and agricultural economics, UC Davis's College of Agricultural and Environmental Sciences, California, USA offer 29 majors, and 40 minors, allowing for a diverse range of career options at the completion of a degree, and there are clear pathways aligned with different degrees and subjects (Bond, pers.comm., 2022).

The rise in the use of AI in the workplace will allow for great advancement and integration of new staff into the workplace. It is essential that courses start to integrate technologies into course design.

Chapter 5: Work Experience, internships and exchange programs

In Australia, agriculture and agribusiness work experience can occur in a formal setting through university or TAFE placements or through individuals organising placements directly with farmers or agribusinesses. Time constraints while studying, the requirement to find paid employment and the ability to connect with organisations can provide barriers to work experience, when organised individually. Throughout my travels in Europe, UK, Canada and the US, I heard from past students, employers, agribusinesses, university lecturers about their thoughts around the value of an extended work experience (three months minimum), internships and exchange programs. There were a range of ways higher education institutions included work experience into the learning structure of bachelor degree in the agriculture and related sectors.

The majority of Australian universities offering bachelor's degrees in agriculture or related fields do not have a requirement for extended work placement as part of the course. Of those universities that do have work placement programmes, the lowest end of interaction is a two to four week placement that is incorporated into course work, for example the University of Western Australia (UWA). Conversely, Marcus Oldam College requires students to take a compulsory gap year in year two of their degree, in addition there is an emphasis on pre entry experience before enrolment.

5.1 Internships and work placements

The Royal Agricultural University (RAU), Cirencester, UK require agricultural science students to undertake 15 weeks compulsory work experience after completion of their second-year subjects. Industry placements occur between 18th March and 18th September each year (Cannon, pers.comm., 2023). RAU offer an alternative course structure for the same degree, where the student completes a year of compulsory work placement. Cannon (2023) commented on the benefits of this compulsory work placement had on student engagement in their final year, commenting on the increased maturity levels, and awareness of the agricultural sector.

Aeres University of Applied Sciences, Dronten, Netherlands has seen an increase in student numbers over the past five years, with the many of the 300 new students studying agricultural related courses annually coming from a non- farming or agricultural background. Many people I spoke with believed this has been driven by the strong media coverage of agriculture, climate change and communities in the Netherlands (Van de Beek. 2023). People from diverse backgrounds are wanting to contribute to positive food production stories and choose to study agribusiness courses to not only gain a stronger understanding of the sector but to equip themselves with the knowledge to drive a practical career that will make a difference to the agricultural production of the Netherlands. These courses combine theoretical and practical learning in a bachelor's degree, with on farm learning beginning in the first year first year of agricultural degrees. After successful completion of the first year at university, the students are required to undertake a ten week internship, preferably on-farm, where the college assists with making placements. Internships make up an important part of study at Aeres, with opportunities for students to continue internship placements throughout their degree and during summer breaks (Van de Beek and Hierink, pers.comm., 2023).

Higher education 'semi-private schools' in France, for those over 18 years old, place a heavy importance on internships. Across France there are around 300 students per year at each of

the eight semi private agricultural schools, and they require students to complete a total of 18 months internship over the first three years of their degree, generally in 6 month blocks. At the end of the degree, students graduate as an Agricultural Engineer (Pellegrin, pers. Comm., 2023). Internships are integrated into course structure as follows:

- Year 1 – farm internship
- Year 2 – internship abroad in an English speaking country
- Year 3 – internship with an agribusiness or agri food business
- Year 4 and 5 – no compulsory internship

Pellerin, 2023 states the importance of the French higher education structure, particularly for students from an urban area studying agriculture. Integrating into businesses and industry settings allowed Pellerin to develop confidence an understanding in the sector, allowing her to focus on her passion biology, but being able to relate that to an agricultural context.

Chloe Pellerin and Agathe Bonnes grew up in an urban environments in France, with no direct connection to agriculture or farming. It was a chance discussion for both of them with an inspirational biology teacher that allowed them the opportunity to discover the agricultural sector. Chloe highlighted the importance of having at least one mentor, or person during formative teenage years, that can challenge your thoughts but also inspire you to find your values and purpose. With their love for biology, and with the help of their biology teachers, both Chloe and Agathe sought further education at a semi private agricultural school after graduating high school. Agathe worked as an animal nutrition consultant for 12 years, before becoming an agriculture teacher at Ecole d'ingenieurs de Purpan, Toulouse, France. Agathe believes that the 18 months of compulsory internship required during the agricultural engineering degree gives students a well rounded pathway to experience a range of roles and allows them to decide the types of careers they would like to pursue after completing their course. After becoming an agricultural teacher, Chloe and her partner now own and run a small farm producing honey, sheep, organic fruit and fruit liqueurs. Chloe and Agathe believe the students are better equipped for the agricultural workforce as graduates, with more experience and from their internships and increased maturity after they graduate (Bonnes and Pellerin, pers.comm., 2023).

Harper Adams University in the UK have a requirement for all students studying at the university to complete a year of work placement as part of their degree after completing the second year of full-time university. Employers, students and university lecturers have all seen the benefits of this course structure, with Harper Adams Career Advisor and Service Manager Maria Simpson commenting on the increased maturity of the students when they return for their 4th year of study. 'There is a real shift in the way students learn when they return from their workplace year. We see them develop as people during this process.' (Simpson, pers.comm., 2023). Around 50 percent of students studying at Harper Adams return to their placement employer after graduation as a full time employee (Boot, pers.comm., 2023). This statistic shows the impact work placements can have on industry for staff attraction, and students to gain pathways into agriculture careers, while studying.

Figure 11: Kathryn Fleay at Harper Adams university with career and work placement staff, UK, 2023. (source: author)

Eurofins undertakes agriculture and horticulture field and laboratory research in plant breeding and pesticide efficacy for multinational agricultural and chemical companies. With locations world wide, recruitment of staff is of major importance. Eurofins in the UK aim to meet the labour requirements with their graduate recruitment program. Four students are employed each year as part of the graduate recruitment program, with science and agriculture students being the traditional applicants for the program. Megan Dugdale, Trials and Good Laboratory Practice (GLP) Coordinator at Eurofins, studied Biology at university and completed an internship with Eurofins. With no initial interest in working in agriculture, Megan expressed the value of the internship, and how it provided the connection with her biology studies and agriculture. Following graduation Megan joined Eurofins full time and has been with the company for eight years. Megan is now involved in the internship program, attracting students to Eurofins, and explained the benefits to both the student and business. 'The process, from interviewing to working in a variety of aspects of the business allows students to develop a strong understanding of the company, the roles and responsibilities of being in the workforce'. Following the internship year, the company can offer the student a job, paying them an incentive of $2000 AUD to commit, which they can begin after they finish their final year of studies.

Figure 12: Kathryn Fleay and Megan Dugdale, Eurofins head office, UK. (source: author)

5.2 Summer Students

Olds College and Lethbridge College, Alberta, Canada both have a 12 week summer vacation period, where students are expected to be involved in 'summer work' within the agricultural industry. Multinational companies (e.g. Bayer) and smaller private companies such as applied field research organisations (e.g. Farming Smarter) employ students from agricultural universities and colleges to undertake 'summer work'. While the primary driver of summer employment is peak seasonal labour requirement, this provides an important opportunity for students to gain practical work experience in an agricultural business, providing them with workplace ready skills. Students are commonly given a project they are responsible for, ie. a broadacre cropping field research project, which has assessments and analysis within a field experiment. This provides the students with responsibility, they are given a mentor, and have something to work towards. Students are included as a valuable part of the team, and quite often these initial work placements lead to full time job opportunities after successful graduation (Coles and Lawson, pers.comm., 2023).

Figure 13: Kathryn Fleay with the Farming Smarter staff, which includes previous 'summer students', Lethbridge, Alberta, Canada. (source: author)

Steve Maddox is a dairy farmer in Fresno, California. Each year the farm provides summer internships for students from the local university, which last 11-13 weeks. Students are able to experience all aspects of the dairy during this time, which include animal nutrition through to milk production and delivery to processing facilities. While some students are from farms, many students have never considered agriculture as a career. Ken Coles, manager of Farming Smarter, says after a summer of work, on programmes like this, the students are more interested to learn about a career in agriculture, whether the student pursues a career in agriculture, they gain a broad understanding and appreciation of an industry they can share with friends and family, providing a positive contribution to the wider consumer understanding of agriculture.

In the UK, there are many examples of work experience being built into vocational education degree courses. In 2019/20 there were over 6,000 people studying diploma degrees in the agriculture, horticulture and animal care areas in the UK, from a range of training institutions

(Toogood, pers.comm., 2023). Many of these involve one day per week on the job training combined with theory during the week. These courses provide pathways for agricultural professionals in a more practical setting throughout the diploma or degree.

Agribusinesses and farmers that employ students for work experience, must be willing to accept that on occasion, these people may have never been on a farm, in a regional or rural setting or had any interaction with people involved in agriculture. In understanding this, it is important students are encouraged throughout the experience, with positive communication and necessary feedback. Farmers and agribusiness should be encouraged by training providers to undertake this work. Industry or government incentives for employers to provide this service to students should be considered if there is poor uptake in these programs. Lack of work experience can impact students with on limited to no agricultural experience, which is exacerbated in regional areas, where access to work experience options are limited (Toogood, pers.comm., 2023).

Chapter 6. Agricultural Industry and Government Initiatives

6.1 Scholarships

In Australia, scholarships are commonly offered to students during their first or second year of university. This allows students with an interest in their area of study, an incentive to continue study, and achieve high results. Pratley, 2022, suggested that agricultural scholarships given in year 12 studies could provide an additional incentive for students in secondary school to pursue higher education in the field of agriculture. This would be an early positive experience, not only for students, but also parents, to gain an appreciation for the industry, and the value it places on securing talent or the future workforce.

The Royal Agricultural University, UK, offers undergraduate scholarships, including scholarships specifically for students that are not from an agricultural background (Cannon, pers.comm., 2023). This financial incentive removes any perceived bias, and encourages students from non-agricultural backgrounds to not only consider a career in agriculture, but to invest in their studies throughout the life of their degree.

6.2 Alternative pathways in agricultural education

Rancho Cielo is a non-profit organisation located on a 100 acre Ranch in Salinas, California. The ranch is a philanthropic venture offering education and vocational training for youth that have struggled with traditional education settings, youth that have been in the justice system and youth that have overcome societal challenges. The Salinas valley is a key vegetable and fruit growing region in California, with many of the students having family members involved with vegetable farming operations such as planting and picking. Racho Cielo allows students to remain in a familiar community setting, and are provided with training to allow them to re-enter the workforce with confidence and contribute positively to society. Rancho Cielo offers training in key soft skills including resume writing and interview preparation, in addition to streamlined training programs in mechanics, culinary and sustainable agriculture. Through collaboration with local businesses and the community, youth involved in the programs offered by Rancho Cielo are able to successfully use the skills learnt in mechanics, agriculture and food to contribute positively to society and be involved in the local agri-food industry. This program is far from the traditional vocational and higher education pathways, abut it also an extremely important and successful way to encourage people from a diverse background into agriculture, and using agriculture as a way to prevent poverty and incarceration cycles. When I visited Rancho Cielo in August 2022, there were 63 students aged between 16 and 18 and 45 students aged between 18 and 24, with a 1:4 ratio of staff to students.

Figure 14: A classroom at Rancho Cielo, showcasing electronics course work. (source: author)

Allowing students with no connection to farming or agriculture to be immersed in an environment that is unfamiliar to them, allows fast tracked learning through experiences. This is the premise behind Aeres University of Applied Sciences in Dronten's idea of specialised student housing on the university's 320 hectare farm, designed to accommodate students with no agricultural or farming connection. A competitive selection process selects 10 students each year to live in a student 'Farm House', which also comes with the responsibility of working on the farm for a year. Work includes all aspects of farm management, including poultry, piggery, dairy and arable cropping program management with the assistance of paid staff. The program works around their academic requirements. The program allows students to gain experience firsthand in the sector, undertaking a range of roles. The experience fast tracks an urban students understanding of agriculture in a setting that is typical to Dutch agriculture, allowing these students to integrate into the workplace (Van de Beek, pers.comm., 2023).

Figure 15: Aeres University of Applied Sciences' student Farm House, located behind a pasture variety demonstration being run by students. (source: author)

6.3 Industry collaboration

Career opportunities in agriculture are varied, exciting and constantly changing. Industry collaboration with training institutions allows up to date and relevant information to be shared with students, allowing them to understand the wide array of careers that look beyond what may typically be recognised as farming. Such roles include marketing and management roles in various industries, including new and emerging industries (vertical farming, exotic fruits, hemp, insects etc), agricultural technologies, (including data analytics, AI, robotics), agricultural engineering and electronics, the agri food sector, including complete supply chain management and development of food products.

The agricultural industry in Australia is extremely connected. Collaboration between training providers, farmers, private businesses and government departments to work collectively on industry relevant and local research initiatives provide students with real life examples of the impact agriculture has on society, the economy and the environment. Higher education providers undertaking research projects collaborating with industry, allow students and researchers to gain a real life experience of the problems encountered by farmers, therefore being more connected to the sector, which is vital for research impact (Dempster, pers.comm., 2023).

Industry collaboration with agricultural universities and colleges in the USA and Canada was particularly evident. By partnering with industry to test products and technologies, learnings are made by researchers and the next generation of agri-professionals. Industry partners allow knowledge to be transferred in a teaching environment that bring community members together, and allows students to develop relationships with industry. This has multiple benefits, allowing students to experience working and collaborating with industry, building an understanding of the roles within agriculture and exposure to the new innovations and technologies. Students have more confidence to utilise these tools in their future employment, when solving problems or challenges. For the companies that collaborate, by testing and demonstrating technologies in a real farm environment, and also allowing collaboration with producers, researchers and students, information flows and idea sharing can be adopted.

While visiting California in 2022, it was pleasing to see the funding the California Department of Agriculture had put into schools, colleges and universities with an agricultural focus. Carrie Peterson works to ensure that industry collaborates with education providers to utilise such funding for the benefit of both the students and industry. Carrie has been working with Western Growers Association, an organisation supporting farmers in California, and community colleges to identify skills gaps in the agricultural technology space, and assisting the development of the curriculum to ensure these skills are taught to students. Carrie works with a committee that brings together industry, education and large agricultural business personnel, to discuss new technology, educational partnerships, labour requirements to ensure solutions are tabled and relevant actions are made as recommendations for improving agricultural education (Peterson, pers.comm., 2022).

Olds College, Olds, Alberta, Canada is located on a 3,600 acre working farm ‘lab’, where livestock and crop farming and research go hand in hand with new technology. The fast paced, high tech learning environments within the college, encourage innovation, using the college farm. The Olds College Smart Farm allows students, industry and researchers to work on solutions to challenges faced in agricultural production. The current direction of the college is focusing on how to feed the world’s growing population and reducing agriculture’s

environmental footprint. The farm at the college, allows new products and technology from agricultural businesses to be tested and validated within a typical Albertan farming system, allowing students and producers to see first hand how the technology can be incorporated into farming systems, and for what benefit. The Smart Farm currently comprises of land for crop and forage production, 140 commercial cattle, stud cattle and 150 commercial ewes. The Smart Farm at Olds College supports over 50 projects centred around crop production, livestock production, environmental stewardship, cereal breeding and technology integration in collaboration with industry. Olds college have developed strong working relationships with over 148 small and medium sized enterprises (Agnew, pers.comm., 2023).

Figure 16: Cattle feeding research, collaboration between an animal nutrition company and Olds College, Alberta, 2023. (source: author)

Aeres University of Applied Sciences use industry collaboration for university research programs, such as investigating soil compaction in an arable cropping environment, by working with machinery companies and students. This example allows students to work with the latest technology, but also see the practical side of research, something that staff at the university see is impactful and relevant to students. Another example of Aeres is students working with farmers and lecturers on assignments that will directly impact on farming practices in the real world. While visiting Aeres, a project that was currently being undertaken had come from strawberry farmers. The farmers had presented the problem of insect pests and the impact this was having on their strawberry production, and the challenge of using biological insect controls, with reduced accuracy using the current methods. Students were given the assignment of finding a solution to this problem in their technical classes, specifically utilising design and 3D printers, to develop a prototype and tool to assist farmers in solving their issue. Through group work and processes, projects like this, start to emulate real world environments and allow students from a diversity of backgrounds to gain practical knowledge, critical thinking and collaboration skills (Van de Beek and Hierink, pers.comm., 2023). Other industries Aeres collaborates with include horticultural production and dairy production, specifically around teaching of new and traditional techniques, sustainability practices including demonstration and trials involving pollinator strips and cover crops.

Figure 16: The latest model tractors are leased out from local dealerships for teaching purposes at Aeres University of Applied Sciences, Dronten, Netherlands. (source: author)

Figure 17: 3D Printers are used by students to develop prototypes for solutions to farmers and agricultural businesses throughout the industry collaboration projects run at Aeres University of Applied Sciences. (source: author)

Chapter 7. Transitioning from study to the workforce

Employee expectations have changed significantly over the past 10 to 20 years, according to many of the people I met with during my travels. This is due to the number of jobs available to potential employees. For example, in Australia it is estimated that there are six agricultural professional jobs throughout the supply chain available for every university agricultural student graduate. This means graduates can choose the employer they want to work with, and the market is highly competitive.

In the UK, Toogood (2023), found that employers must provide exceptional leadership and training opportunities and consider things such as flexibility, work hours and hybrid working environments in order to be the employer of choice. Employers may need to adapt their traditional ways of employing staff to attract the generation they are employing. Ives (2023) indicated students studying higher education courses believed there were ways to encourage retention of staff in the workplace which included meeting young people's expectations of social, economic and environmental values.

Providing a supportive learning environment to graduates with recognition is outlined in Claire Toogood's report: *Effective leadership, management and development of people working in agriculture and agri-food: supporting new entrants from non-agricultural backgrounds,* as being an important factor in providing motivation for the employee to remain in a role. Recognition provides the employee positive feedback and encourages further development and commitment with the role. Recognition requires good management, excellent communication skills and individualised support. The report noted that managers and employers must acknowledge the needs of individual employees may differ if they are not from an agricultural background.

For graduates from a non agricultural background, workplaces need to consider the employee's experience and engagement from the start of employment, ensuring it is safe and supportive. Managers can assist with this by supporting informal communication, welcome questions from employees, value and develop workplace learning, focus on training and development and provide mentoring (Toogood, pers.comm., 2023).

Planning long term career progression in the agricultural and agri-food sectors is important for people throughout their careers. Helping students and young agricultural professionals to define their purpose, and understand what their values are, helps to provide a sense of direction, ignite passion into their chosen field and create systems and people around them that support their beliefs and values (Beks, pers.comm., 2023)

7.1 Agricultural businesses supporting staff from non agricultural backgrounds

In Japan, people are leaving the land in increased numbers due to the high workload that is often associated with agricultural sector employment. Nabehachi Nousen Co.Ltd produces rice, wheat and soybeans on 239ha, on leased land, a comparatively large farm in a country where the average farm size is 0.1ha. In addition to their own production, the company supply contract services to other farmers. Employing 17 full time staff and 8 part time staff, none with a background in agriculture, the company aims to upskill and value ideas and suggestions from everyone working in the business.

By providing structure and methods of learning to encourage input and contributions of everyone in the business to be heard, the Kaizen principals adopted by the company include: regular scheduled meetings throughout the week, a Kaizen meeting weekly, where all employees' ideas are shared, encouraging staff to start thinking on their own. Staff take ownership of ideas, and by sharing amongst peers in smaller groups of 3-4 people, all ideas are valued in a positive way. The manager then considers the staff ideas and can decide to implement if this fits into the business goals.

7.2 Graduate programs

Graduate programs in agriculture aim to attract recent graduates of higher education degrees to a business, to learn and develop over a one- or two-year period. When designing graduate programs and training sessions for graduates, organisations should determine the full learning, development and training portfolio they can offer within their organisation to maximise the value to people from a non agricultural background (Toogood, pers.comm., 2023). In a survey of recent agricultural graduates, Claire Toogood concluded that respondents valued informal workplace training such as demonstrations and work shadowing over formalised trainings and inductions.

7.2.1 Case Study: Management Development Services

'A growing industry needs new skills', Barden, pers.comm., 2023.

Management Development Services (MDS) provides management training for graduate students in the agriculture and agri-food sectors in the UK with a structured two-year graduate program. The program involves students working in four work placements over two years with MDS member businesses. Companies throughout the supply chain, including farmers, seed producers, food retailers, horticulture, agriculture, logistics, marketing and research businesses can become members of MDS. During the work placements, students develop a strong understanding of four businesses and roles, which can often lead to full time employment at the completion of the program. There are 62 member businesses, with training programs changing depending on industry needs.

MDS attract and develop people from all backgrounds, and unlike other graduate programs, there is no requirement for prior industry experience, allowing a diverse cohort of students applying, from a number of degrees, including arts, marketing, biology, technology, food science, agriculture and horticulture to apply. The application process is online and focuses on the applicants' interest in the agri-food industry. MDS take on 60 people each year, with two intakes.

After the successful completion of the two year program, MDS will help graduates find a job suitable to their interests within the industry. By this time, the student has experienced four very different workplaces and roles and has a stronger direction of where they see their career in the industry. The members of MDS, value the training offered by the MDS program highly, and as such, it is considered amongst the industry to fast track the employee's careers up to 5 years ahead than that of their graduating peers. After meeting with MDS and subsequently speaking with businesses, universities and organisations, it was clear that the reputation of the program was exemplary, with businesses recognising the program and sharing positive experiences they had had with graduate or employees that had graduated from the MDS program. Employers regard MDS graduates as being more mature and work ready compared to graduates that had not used that pathway. Following completion of the program, approximately 80 percent of the graduates find a job with a MDS member organisation,

showing a huge benefit to both the students and businesses across the agri-food supply chain benefiting.

The diversity of students that MDS attract is a great narrative, with only 15% of graduates in the program coming from a farming background and the majority coming from degrees in sciences and arts. Students need to commit to the two-year program, which includes the need to be flexible with relocation, with no guarantee placements will be in a location students are from or have experiences with. Despite this, the program has a 90-95 percent retention rate of students successfully completing the program after two years.

The graduate program involves skilled trainers providing guidance, mentorship and coaching, which include three trainee reviews for each six month placement, allowing fast professional development and feedback. This program could be replicated in an Australian agribusiness context, and developed correctly, could enhance the development of student graduating from Australian universities, which are often lacking course integrated work experience and internship opportunities (Barden and Waterson pers.comm. 2023).

Conclusions

Over the past decade, the agricultural sector in Australia has grappled with persistent labour and workforce challenges, including skills shortages that have impacted efficiency and productivity. These issues are not unique to Australia; they resonate globally, as countries worldwide report similar workforce skills and labour shortages.

Amidst a rapidly evolving agricultural landscape driven by technological advances, heightened environmental concerns, and shifts in logistics and infrastructure, it is clear that the industry must adapt to meet the changing demands of the agri-food supply chain and agricultural workforce. To accomplish this, a concerted effort is required from education providers, employers, and agribusinesses to attract and retain staff.

Encouraging and supporting individuals from non-agricultural backgrounds to pursue roles in agriculture is crucial to ensure the sector remains innovative, productive and efficient. Collaboration between government, educational institutions, industry stakeholders and communities is paramount in achieving this goal. By offering diverse post-secondary education options and training opportunities, agriculture can appeal to a broad range of students, illustrating the myriad roles available beyond traditional production agriculture. These roles encompass Ag tech, ag-environment, carbon management, finance, logistics, entrepreneurship, and research, underscoring the industry's diversity and potential for exciting career paths.

As Harvey (2022) aptly noted, agriculture must attract top-tier talent across the entire production system and effectively communicate its story. Industry involvement in education and public engagement is crucial to portraying agriculture as a relevant, innovative, and enticing field. It is not just about reaching those already connected to the industry, but also educating the wider public and school-aged children about the breadth of opportunities within agriculture.

Diversity and inclusivity are paramount in addressing the evolving skill requirements in the agricultural and agri-food sectors. Embracing individuals of different genders, cultures, and abilities, as highlighted by Ives (2023), is essential for future growth and adaptability.

However, the sector faces challenges in attracting and retaining staff. Short-term industry funding and project siloing hinder the development of a sustainable talent pipeline. Collaborative efforts are crucial in building staff development and retention strategies that transcend individual organizations.

As agriculture evolves to integrate with emerging industries, technologies, and environmental concerns, it opens up numerous opportunities. These opportunities must be managed carefully to provide newcomers to the sector with the necessary tools and support for success. Drawing inspiration from other industries and applying transferrable knowledge can efficiently drive change and innovation.

In summary, the agricultural sector finds itself at a crucial point, ready for expansion and progress. By championing diversity, inclusivity, collaboration, and sustained investment in workforce development, agriculture can continue to thrive, exceed expectations, and remain at the forefront of innovation in a rapidly changing world.

Recommendations

Attracting and Educating Talent:

- Emphasize the role of technology in modern agriculture to attract individuals interested in innovations such as data analytics, artificial intelligence, precision farming, and sustainability.
- Encourage collaborations between agribusinesses, farmers, and educational institutions to support agricultural education.
- Develop strategies to introduce agricultural programs into the curriculum of urban high schools, similar to Barker College's program in Australia.
- Increase funding for on-farm experiences and ensure ongoing support for these programs.
- Create incentives for post secondary students to actively engage with the industry during their studies.

Diverse Learning Pathways:

- Investigate the potential of apprenticeship degrees and encourage businesses to offer opportunities for students pursuing this pathway.
- Structure graduate programs to include mentoring, goal setting, and exposure to different aspects of the agricultural business.
- Promote engagement between businesses and schools, universities, and training providers to inspire individuals to pursue agricultural careers.

Curriculum Enhancement:

- Enhance industry involvement in agricultural courses at universities to align the curriculum with workplace needs.
- Make agricultural courses more appealing to young people by highlighting the connection between agriculture and food production.
- Incorporate a personal values understanding approach in schools and universities to help students personalise their agricultural career choices.
- Develop scholarships specifically for students from non-agricultural backgrounds to study agricultural or related courses.

Practical Collaboration:

- Foster partnerships between businesses and educational institutions to work on projects that address industry challenges and encourage collaboration.
- Emphasize the link between food production and agriculture in educational programs and outreach efforts.
- Showcase advancements in mechanization and automation during school visits and educational exposure to agriculture.
- Establish agricultural and horticultural apprenticeships to provide practical learning opportunities.

Employer Promotion and Government Support:

Advancing agricultural opportunities through higher education: empowering youth, especially those from non-agricultural backgrounds, to pursue careers in agriculture

- Promote agricultural businesses as employers of choice by marketing career pathways, offering strong business development programs, and providing flexible working arrangements.
- Advocate for increased government financial assistance to attract individuals from non-agricultural backgrounds to study and work in agriculture.
- Share success stories of individuals who have built successful careers in agriculture from non-agricultural backgrounds to inspire prospective students and consumers.

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