QUEENSLAND FARMERS' FEDERATION
Primary Producers House, Level 3, 183 North Quay, Brisbane QLD 4000
PO Box 12009 George Street, Brisbane QLD 4003
qfarmers@qff.org.au | 07 3837 4720
ABN 44 055 764 488

Final Report

To

Jobs Queensland

2018 Agriculture Future Skills and Training Needs Research

By Peter Perkins, Diana Saunders, Tristan Perez and Jim Collings

Queensland Farmers' Federation Ltd

19 June 2018

This research has been funded by Department of Employment, Small Business and Training as a Deed of Variation to the existing VET Industry Advice Organisation (VETIAO) arrangements.

TABLE OF CONTENTS

INTRODUCTION

The Queensland Farmers' Federation (QFF) acknowledges that for Queensland agriculture to have a sustainable future, it must support its most important resource: the people. QFF plays an active role in developing and implementing projects that assist Queensland's agriculture industries in attracting, training and retaining appropriately skilled workers.

This is achieved through a structured research and industry engagement program that supports the Rural Jobs and Skills Alliance (RJSA) work plan. This alliance of industry members and government provides advice to government, service providers and other organisations with respect to employment, skills, industry training and workforce planning on behalf of Queensland's agriculture industries. QFF has used the alliance members and their networks to conduct this 2018 research project for Jobs Queensland.

Due to the time constraints involved in delivering this report from request inception to reporting deadline, QFF, on behalf of agriculture, submits to Jobs Queensland that further and fuller work is required to adequately address many of the initial findings reported here.

CHAPTER 1: CURRENT WORKFORCE ISSUES

Industry issues with the supply and demand of agriculture labour and skills

The initial RJSA program began with a foundation sector survey conducted in December 2015 and January 2016. The results of the survey, which amassed a total of 993 responses, were then disaggregated to assist industries and regional participants to identify key workforce issues and how training may be used to help rural industries and agribusiness enterprises achieve more from their operations and commercial activities. The survey results were published on QFF's website and more detailed assessments of the data were ongoing throughout 2016.

Through this research and consultation processes, at the end of 2016 RJSA identified the following issues:

Regional approach to workforce planning

Workforce planning in agriculture has taken a specific industry-based approach and has been led by national commodity groups. This has resulted in individual workforce development strategies and outputs for commodities such as dairy, cotton, beef and horticulture. While commodity based approaches focus on a single commodity across multiple regions, regional approaches offer cross-industry workforce understanding for an area. Regional approaches centre on the factors affecting workforce attraction and retention for that community, which better suits agriculture because it is predominantly located in rural and regional areas where the workforce is significantly influenced by local factors.

A regional approach can create a pool of labour services for a region, thereby using skills across industries rather than creating competition between industries. Critical to its success is participation from regional industry representatives, key influencers, and local government. In Queensland, industries such as construction have adopted a more regional approach to workforce planning. This has provided various benefits as it creates community based solutions and it is this model that RJSA members will continue to explore in the future.

Future skills and upskilling

Long-term tracking of labour changes by key industries in various regions is needed to inform the development of a future labour workforce profile. The future in agriculture brings interesting opportunities and changes that will impact the work and the skills required. The CSIRO report named "Tomorrow's Digital Enabled Workforce" (Hajkowicz, et al., 2016) provided an indication of the possible impact of rapid technological development on industries and the workforce. Crowdfunding, big data analytics, robots and artificial intelligence, nutritional genomics, microgrids, GPS and sensors have been recognised as technologies most likely to transform the agriculture industries (Agrifutures, 2016). Other factors that may also change the agricultural sector in the near future are climate variability and change, competition for natural resources, changes in customer preferences, and increased regulation across many areas of agriculture supply chains.

Aging workforces and changing demographics

At a national level, the agriculture, forestry and fishing industry has the oldest age profile of any of the industry groups, with a median age of 49 compared with 40 across all industries (Department of Employment). The need for succession planning strategies to mitigate against skills and labour shortages is a clear priority for agriculture.

There is a need to work with the next generation of agricultural farmers and service providers to ensure they have the skills to be sustainable in the future. It is important that a culture of continuous improvement is supported to enable the next generation to embrace technology as part of everyday business.

VET sector issues

The VET sector must focus on building strong industry links to ensure its graduates are job-ready. RJSA continues to provide industry input to the Queensland VET Quality Framework and provide advice about training needs. RJSA works with training providers to ensure that relevant training is provided in the right areas. The Alliance will continue to work with VET providers to determine what the key issues are in delivering training to the agriculture sector and the best ways to address these issues.

The VET sector should be equipping students with skills that improve their prospects of employment across various agriculture sectors. To achieve this, strong industry links are essential. Various recommendations to strengthen the VET sector have been highlighted by previous analyses. For example, the VET programs should shift from narrow focused qualifications to streams of broader skills that apply across industries. Working towards more flexible packages and a structured progression between qualifications would be beneficial.

Seasonal labour (peak demand and labour shortages)

Seasonal workers primarily include contractors and casuals, and a supply of foreign temporary workers. Securing access to a readily available, flexible pool of local seasonal workers that can return in following seasons is important for sectors such as cotton, grains, sugarcane and horticulture. Funding for up-skilling this highly mobile workforce in cross-industry skills could improve job opportunities across industries.

RJSA has identified a need to assess the demand for casual seasonal labour based on reliable data. It is important to review current strategies and options in terms of temporary working visas and labour agreements to address community and industry concerns regarding foreign workers. There also needs to be an improvement to the framework in which the selection is made and an assessment of infrastructure to support seasonal workers, especially local accommodation and transport.

Data analysis and gaps

The need for reliable and timely data to determine the scope and size of the workforce has been mentioned in various reports. The most complete data source is provided by the Census, and between censuses data is based on the Labour Quarterly survey (which is based on a sample at a set time and doesn't allow the sector to get accurate and reliable detailed data). Neither of these sources take peak periods into consideration. Currently, the data is insufficient in providing an accurate picture of the agriculture labour force.

A recent paper by Nettle (2018) indicates that the dynamics of farm labour need to be considered. Nettle suggests that much of the farm workforce demands may exist in employment categories outside of the captured statistics. This can also relate to family members and people employed casually, as migrant workers or as contractors (Nye, 2018). Nettle mentions the following roles as important in the current farm business:

- Investors (don't work on the farm – but can inject capital for labour replacing technologies)
- Farm owners/operators and family members paid and "unpaid"
- Farm managers (salaried, often categorized separately from employees in workforce statistics)

- Share farmers (a category sitting between 'contractors' and 'employees')
- Contractors (separate business owners servicing agriculture). An important category for farm work (e.g. 80% of Australian farmers use contractors and advisors for some aspect of their farming operations and this has been noted as an increasing trend in Australia and the UK (Nye, 2018; Nettle et al., 2018)
- Employees: temporary, casual, permanent and migrant employees (e.g. working as calf-rearers; farm hands; or pasture and herd managers, etc.). This can involve work experience/youth workers through to older/semi-retired workers).

Each of these workforce categories represent different 'labour and skill pools' or segments that in combination reflect the options for designing farm systems that suit and fit the people. Each segment reflects different skill categories and the people in each category will hold different expectations requiring different management.

Supply and demand of agriculture labour and skills - Issues update May 2018

QFF assembled a special meeting of selected industry participants and specialist advisors on 3 May 2018 to review six of the special research issues identified by Jobs Queensland for this Research Report. The meeting was introduced by a special presentation from QUT Professor Tristan Perez, entitled "Skilling the Future Work Force in Digital Agriculture". The terms "digital agriculture" and "AgTech" tend to be used interchangeably and are taken to mean "the collection of digital technologies that provide the agricultural industry with the tools, data and knowledge to make more informed and timely on-farm decisions and improve productivity and sustainability" (KPMG., 2016). However, Professor Perez notes that for practical reasons, when considering the transition of the agricultural sector into the digital age, it is wise to think also of the wider supply chain impacts. He notes that, "within the technologies considered, we include robotics and smart machinery; sensors and sensor networks; probabilistic reasoning; machine learning and artificial intelligence for cognitively-matched decision support systems; autonomous systems for the automation of particular management processes; communication networks and infrastructure for data access; data sharing and data analysis; and the Internet of Things." To this, he adds the mathematical modelling of Big Data to extract information to support decisions made under uncertainty, risk, conflict and consensus that lead to robust system behaviours.

Professor Perez notes the main purpose of education and training is to develop skills within the workforce to ensure the efficiency and effectiveness of the sector in the context of productivity and competitiveness. The link then to AgTech is how it transforms jobs and whether the education and training system are flexible and responsive enough to cater for known trends and emerging technologies.

The industry discussions that followed this presentation provided further updates and insights into agricultural labour market issues and training needs. These included:

Attracting local labour

Many forest and farm industries report that attracting local labour is an ongoing issue that is spreading across regional agricultural activities and hindering expansion of opportunities. Some industries have noted they are not filling apprenticeship and traineeships positions needed to support staff turnover and technological changes. Various industries are addressing these challenges with targeted promotions to career advisors and "year 13s" initiatives. Some are using bus tours to show off and explain "local industry" activities and promote their message with social media stories.

In an associated issue, the May 2018 Federal Budget announced $4.7 million of new funding for the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) to develop data that will improve the understanding of seasonal agricultural labour needs. This will involve collecting new data on labour expenditure, the number and type of people employed on-farms, the mix of skills required by farm businesses (including seasonal and skilled workers) across different agricultural industries, as well as the challenges in recruiting and retaining employees. This analysis will help to inform employment and labour market programs to ensure rural and regional businesses can access the appropriate mix of seasonal and skilled workers to meet their workforce needs.

Data and information overload challenges

This issue covers a range of management challenges that are emerging as agriculture transitions into the digital economy and is often expressed as the problem of "data-rich, information-poor". This reflects the difficulty in identifying the information embedded in data that translates into practical decision-making. Some industries note they have under-utilised multi-purpose data that could improve production efficiency, harvest and processing scheduling and social license. Other industries argue that controlled traffic farming across different crop, production and land management systems is too complex. On top of this, the data linkages across traceability, food safety and quality assurance arrangements present an uneven feedback loop to farm managers. Some animal industries report the growing complexity of integrity systems and the emergence of blockchains and links for animal welfare and biosecurity issues.

All of this suggests a gap in training and education systems that needs addressing.

Teacher training and extension services

There is a rising demand from school teachers for more demonstrations and professional development opportunities in the AgTech space, which could stimulate more student interest in these emerging agricultural and technical support jobs. Many industries note the long-term decline in extension services has opened a gap in the market where the capacity to understand and adopt new science and innovation into farm systems is lagging and may be responsible for restricting the sector's growth.

Updating middle management and supervisory skills

A lack of sufficient training in servicing middle management requirements and for leadership and supervisory roles has been identified. Some industries are addressing this issue by developing mentoring programs to fill the demographic and remoteness challenges for new entrants and early career recruits.

Biosecurity and surveillance, sensors and drones

There are additional training issues that need addressing as technology solutions are sought to improve early detection and surveillance systems, including automation.

Some industry-specific training needs include:

- Building materials estimators and detailers
- Forest harvesting and haulage operators
- Data management for new technologies (sensors, robotics, drones, etc.)
- Data management for supply chain issues (very wide range)
- Broad quality assurance systems and data management
- Emerging biotech and biofuel opportunities require appropriately skilled operators and managers.

CHAPTER 2: EMERGING TRENDS AND DISRUPTIONS

One of the perceived issues in the workforce context globally is that we are currently educating a future workforce for jobs that do not currently exist. However, this situation is not different from those in the past. We can draw parallels with education in the late 1990s at the verge of the introduction of mobile technologies and how these changed the work landscape with new jobs and markets displaced and created. Although we cannot forecast with certainty all the different requirements that will eventuate in the future agriculture workforce, we are in a favourable position to make rational predictions based on developments and trends in industries other than agriculture.

What enables this, on the one hand, is that agriculture is currently lagging in the adoption of technology relative to other sectors of the economy such as manufacturing, finance, health, and defence; and, on the other hand, is that the agricultural sector has adapted in the past by adopting disruptive technologies: machinery through the industrial revolution; synthetic fertilisers; agri-chemicals; and new crop features through: the green revolution; precision agriculture; and advances in satellite technologies, telecommunications, and automatic motion control of machinery.

There is little doubt the next revolution in agriculture will be dominated by the adoption of digital technologies. From robotics to data analytics, and cognitively matched decision support to artificial intelligence, these technologies will augment the sector's capability and capacity for sensing, thinking and acting in order to optimise crop production whilst ensuring sustainability. Digital technologies are already at our doorstep and the disruption these will produce could be significant, not only for the practice of agriculture, but also in research and education.

The revolution is being triggered by significant global drivers which stem from intensification and sustainability, high-inefficacy in value chains, demands of protein and high energy foods in developing economies, competition for land use, population growth and habits, cost and availability of inputs, consumer concerns (about safety, pollution, and provenance), and climate change (Queensland University of Technology , Institute for Future Environments, 2018).

Digital agriculture describes the combination of deep agricultural knowledge with a set of digital technologies and processes that enable the use of information extracted from purposefully collected data to manage agricultural production systems. These production systems help optimise yield and quality, increase input-use efficiency, and ensure sustainability (CSIRO, 2018).

Within the technologies considered, we included robotics and smart machinery; sensors and sensor networks; probabilistic reasoning, machine learning, and artificial intelligence for cognitively-matched decision support systems; autonomous systems for the automation of particular management processes; communication networks and infrastructure for data access, data sharing, and data analysis; and the Internet of Things (IoT). Within the processes that underpin digital agriculture, we include mathematical modelling within the context of Big Data; data analytics for extracting information from data; decisions made under uncertainty, risk, conflict, and consensus; and optimisation of decision processes for shaping and achieving robust system behaviours.

Digital agriculture will have a direct impact on agriculture and jobs within the sector. Robotics and autonomous systems will take on many of the tasks people currently do. These technologies promise also to create new, higher value and hence higher paying jobs (Brynjolfsson & McAfee, 2016). However, this technology will also threaten to eliminate many of the tasks and jobs currently undertaken by people.

There are currently seven global drivers that are triggering changes in the agricultural sector in general (T. Perez):

- Population increase and prosperity leading to intensification of agriculture due to demands of protein and high kJ intake
- Inefficiency in value chains leading to over 50% of food wastage (farms, pack house, cold stores, shipping and transport, markets)
- Increase of competition for land use
- Unsustainable population habits towards food
- Cost and availability of inputs (chemicals, water, energy, fertiliser)
- Consumer concerns about safety, pollution, sustainability, and provenance
- Climate change.

These drivers are putting an enormous pressure on farmers in particular to optimise their operations to become more efficient and sustainable. AgTech is seen as a potential component of the solution to address efficiency and sustainability.

According to the CSIRO, in addition to those global drivers, five 'megatrends' are impacting the Australian agricultural sector:

- A hungrier world - population growth will drive global demand for food & fibre
- A bumpier ride - globalisation, climate change and environmental change will reshape the risk profile for agriculture
- A wealthier world - a new middle-income class will increase food consumption, diversify diets and eat more protein
- Choosy customers - information empowered consumers of the future will have expectations for health, provenance, sustainability and ethics
- Transformative technologies - advances in digital technology, genetic science and synthetics will change the way food and fibre products are made and transported.

CSIRO's "Rural Industry Futures" (CSIRO, 2015) report describes these megatrends as having an impact horizon for the next twenty years up until 2035, although some effects are already being seen and these include several emergent issues that represent key opportunities and challenges:

- Continued productivity gains (including labour productivity) are required to deal with competitive terms of trade and an ageing labour force in agriculture
- Australian agriculture is predominantly export-oriented, a sector with real comparative advantage and a crucial part of the economy now and in the future. This export orientation means the sector benefits from, and is reliant on, the performance of these global markets.
- Variability in returns to agriculture has increased significantly due to increased climate variability, volatile exchange rates and fluctuations in market demand. Skills and systems to effectively anticipate and manage these increasing risks are a crucial component of the future for the sector.
- The trend to fewer, larger farms continues in response to the need for improved competitiveness. While new business models are emerging, the family farm remains the most common ownership structure and it increasingly faces pressure to grow and to maintain efficiency.
- Rural industries must continually grow and diversify exports in response to structural change in emerging economies. As more people (in the Asian region especially) join the middle-income classes, there will be a stronger demand for conventional products and for a more diverse range of food and fibre products.

- Access to quality production resources (arable land, reliable water) and proximity to markets remain major factors in planning for increased production capacity.

All of these megatrends represent both challenges and opportunities for Queensland businesses. Opportunities as outlined by the Qld agriculture snapshot (2018) include:

- Increased exports of protein-rich products (e.g. beef, seafood, some crops like chickpeas)
- Exports of healthy food products
- Increased exports of a variety of horticultural products (including exotic fruits), using the advantage of Queensland's counter-seasonality to northern hemisphere producers
- Value-adding to higher quality, more convenient and better packaged products across all industries
- Increased exports deriving from increasing recognition of Queensland's clean and green record and status.

The trends that have underpinned growth in Queensland's agriculture and food sector are expected to continue into the medium-term future. These trends are dominated by opportunities generated by ongoing growth in major Asian economies, which can be summarised as:

- Increased demand for protein-rich products such as meat
- Increased demand for healthy food products, particularly benefitting meat and some horticulture and grains products
- Increased exports of a variety of horticultural products, including exotic fruits
- Value-adding to higher quality, more convenient and better packaged products across all industries
- Increased demand deriving from widening recognition of Queensland's clean and green record and status, benefitting meat, horticulture, timber and (potentially) aquaculture industries.

In short, subject to seasonal considerations, the next decade looks much like the last decade. In that time, the Queensland food and fibre industries recorded average annual growth of 4.6% in the value of production, as output volumes grew by 1.1% annually and prices received were maintained, and increased slightly, in real terms.

Trends in digital agriculture, robotics & autonomous systems

Components of digital agriculture

The three key components of our Agrifood Production System (APS) are the farming enterprise, the value chain and the enabling infrastructure (as illustrated in **Figure 1**). The APS is affected by policy, markets, climate and social aspects. Each component of the system has its own objectives. Farmers seek to minimise the use of inputs (labour, water, nutrients, herbicide and pesticide) and maximise the yield, quality and health of their produce. In the value chain, operations seek to maximise food quality, traceability of products and market impact. The infrastructure supporting food production seeks to optimise its performance in terms of communications, transport, energy and data volume, rate and availability. All three components operate in a highly uncertain environment. They must deal with uncertainties relating to, for example, crop and livestock health, market prices, national policies and legislation, workforce capabilities and the climate. To manage these uncertainties and achieve their objectives, various feedback mechanisms to gather data, gauge performance and guide decisions are used. Digital agriculture will make the use of data and information far more holistic and effective.

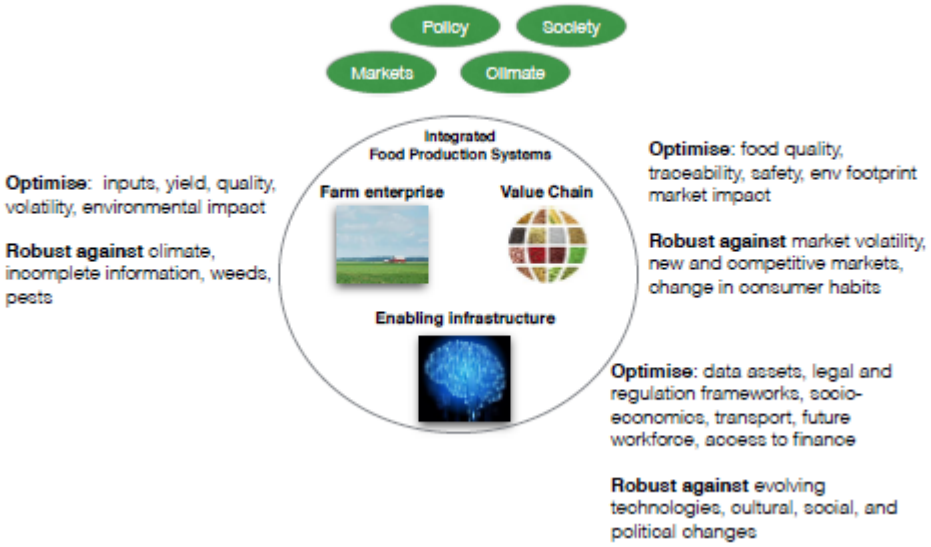


Figure 1. Components of our agricultural ecosystem

To illustrate this, let us consider a crop system in a farm. This can be described as the interaction of components such as the crop, the soil, pests and diseases. These components are affected by the system environment, which in this case refers to weather and the management strategies undertaken. If we consider a sequence of decisions relevant to in-season crop management, such as in irrigation, nutrition, or pest and diseases management, digital agriculture solutions take a particular form as depicted in **Figure 2**.

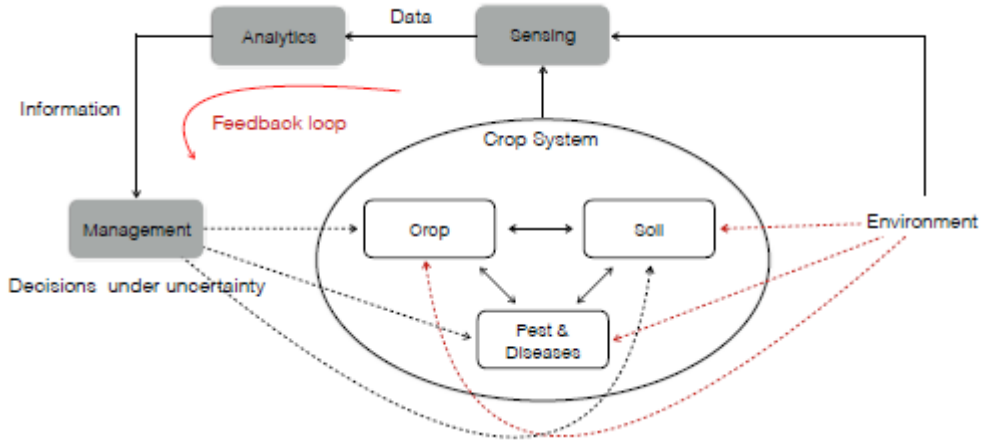


Figure 2 Components and management of a cropping system

Figure 3 shows the different components of digital agriculture.

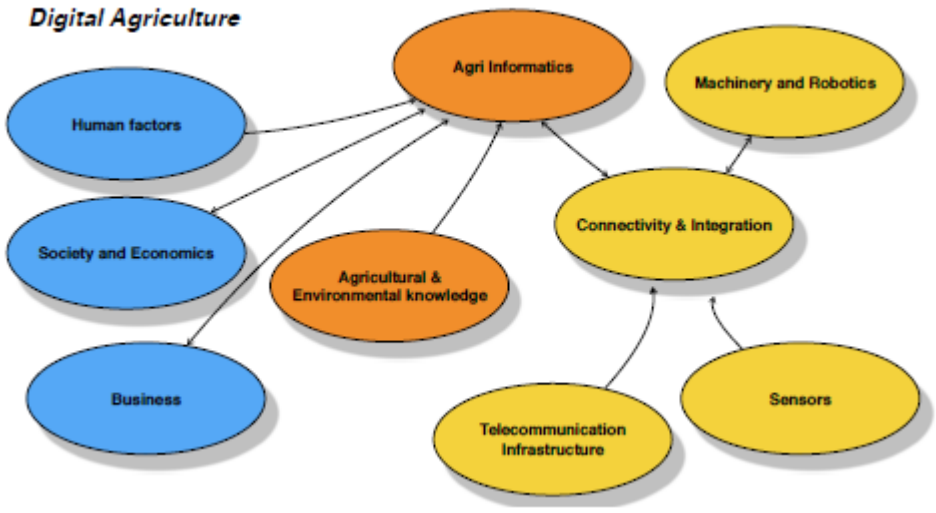


Figure 3 Components of digital agriculture

With reference to **Figure 3,** we can separate the components into three areas of focus:

- **Digital technologies**
- **Agri-informatics**
- **Enabling factors.**

Digital technologies include those that: collect data such as sensors, sensor networks, robotics, and smart machinery; implement data analytics such as mobile and cloud technologies, and the telecommunication network, the Internet of Things (IoT); and data storage devices that enable connectivity and data integration. Digital technologies can also allow the implementation of management decisions with different levels of autonomy e.g. through robotics and smart machinery.

Agri-informatics refers to the combination of data with agricultural knowledge in order to achieve three services: extracting information for management decisions through data analytics, developing decision support systems for humans, and developing optimisation strategies for autonomous management of particular processes. Agri-informatics relies on underpinning processes that include mathematical modelling within the context of Big Data; statistical inference; decisions under uncertainty, risk, conflict, and consensus; and optimisation of decision processes for shaping and achieving robust system behaviours.

Enabling factors relate to all those aspects that need be considered for the successful design, implementation and addition of agri-informatics and digital agricultural solutions in general. These include understanding of markets, business models, regulation and certification, socio economical aspects leading to the adoption of technology. Understanding the potential capabilities of the components in these three areas is what will drive the change in agricultural jobs, while knowledge of the technologies and processes involved is what will drive the requirements for education and training.

Deployment of robotics and autonomous systems in agriculture

When it comes to robotics and autonomous systems for on-farm operations, we can classify the potential take up that the robots can do in terms of:

- Robot-enabled sensing

- Robot-enabled acting

Robot-enabled sensing refers to the use of a robot as a mobile platform carrying sensors of different type. This is a problem that current technology can easily address. Indeed, both AgBot II and Harvey carry cameras and laser sensors that can collect data. Tasks in which robot-enabled sensing can be deployed include:

- Weed detection & species classification (horticulture, broadacre)
- Crop yield estimation (horticulture, broadacre)
- Crop quality and spacial distribution assessment (horticulture, broadacre)
- Soil characteristics (horticulture, broadacre)
- Flower & fruit detection and spacial distribution (horticulture)
- Pest and disease detection & monitoring (horticulture, broadacre)
- Remote and proximity sensing (horticulture, broadacre)
- Animal behaviour and health monitoring (livestock, dairy).

Robot-enabled acting refers to the use of a robot as an agent for interacting with the crop and environment. This is a more challenging task, and technology is only at the development stage.

Tasks in which robot-enabled acting can be deployed include:

- Herbicide application (horticulture, broadacre)
- Alternative weed destruction (horticulture, broadacre)
- Pest control agent application (horticulture, broadacre)
- Pollination (horticulture)
- Harvesting (horticulture)
- Pruning (horticulture)
- Soil sampling (horticulture, broadacre).

Impact of digital agriculture on farm operations

The next step for determining what future education and training will be required in the agriculture sector is to understand what the relationship will be between the workforce and digital agriculture technology. To do this we need to consider both digital technologies and agri-informatics. RJSA has identified technology will have impact within the next ten years on the following areas:

- Improved situational awareness:
    - Improved knowledge about the state of the crop, soil, pest and diseases, and business through the use of paddock-specific data. This will provide infrastructure for data generation, access and use through digital technologies such as robotics, sensor networks, remote sensing, smart machinery, and the Internet of Things.
    - Increased collection and use of spatio-temporal data to gain a better understanding of space and time behaviours of crops, soils nutrients, and pest and diseases
    - Use of information and data from the value chain
    - Use of sensing for detection of conditions conducive to the development of pest and diseases before they develop.

- Informed decision-making:
    - Adaptation of existing methods of extracting key information from data analytics in order to mitigate risks and make better decisions in agricultural production systems

- Expansion of management objectives and constraints to include not only profitability but also aspects of sustainability in decision making
- Better understanding of the nature of the different decision problems related to planning, in season, harvest and post-harvest, and business, and use of improved decision support tools
- Developments of whole-system management views. This is currently used in protected cropping to control climate, irrigation, and nutrition, and pests. With the use of data and automation, we envisage these developments will transition outside protected cropping, helping more farmers to manage the complex interactions between weather, nutrients, irrigation, pests, diseases, energy, soils and emissions in an integrated way.

- Better compliance with regulation:
  - Development of information systems (where data can be stored, accessed, queried)
  - Increase of automation in relation to data generation and capture for reporting compliance with regulations
  - Adoption of protocols for data aggregation at different scales for the benefit of the individual and the whole industry.

- Automation and autonomy:
  - Increased automation of certain processes for planning and for in-season management such as water, nutrients and pest and disease, and harvesting in the case of horticulture
  - Use of robotics as tools for both collecting data and also implementing management strategies in relation to management
  - Increased levels of autonomy (requiring less human input) in some of the automation processes as technology improves and is trusted.

CHAPTER 3: EMERGING WORKFORCE AND SKILLS ISSUES

Current and emerging occupations

Trends in agriculture-related occupations

The Agribusiness sector is an important contributor to the economy and particularly significant to driving growth in regional areas. A recent report from the National Centre for Vocational Education Research (NCVER) (Shah & Dixon, 2018) projects that employment in agriculture, forestry and fishing (under the most likely scenarios) at a national level will increase by 18 per cent due to favourable trading opportunities and the value of the Australian dollar.

There are many diverse opportunities for new entrants to be involved in the sector. Agriculture provides a variety of opportunities for a variety of skills levels. Tristan and Lee (2017) categorise people in agriculture into three different segments:

1. **Production**: this segment contains the direct employers who either own or manage farms
2. **Allied industry or support services**: these include contractors such as agronomists, managers and operators, shearers, harvesters and pesticide spraying services, agribusiness, seeds, machinery retail and service etc.
3. **Value chain**: this includes processing, distribution, retail, and wholesale. (Note that this report did not examine this segment of agriculture within the time constraint).

Figure 4 shows the top 20 occupations for employees in Queensland agriculture with crop farmers and livestock farmers being the biggest pools of contributors.

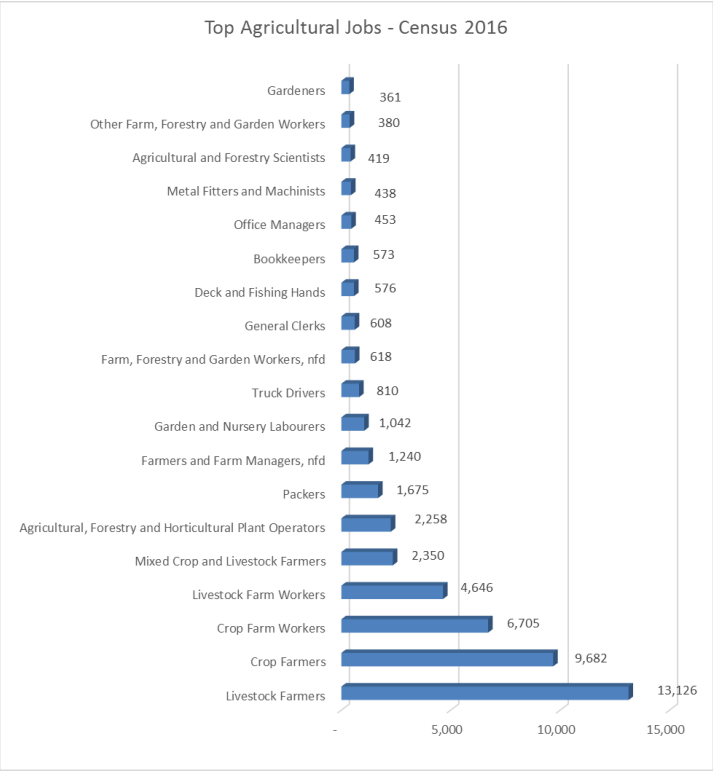


Figure 4. The 20 largest occupations in Queensland Agriculture. Source: Census 2016.

These occupations can be classified by the status of employment as an employee, owner-manager or contributing family worker. Approximately 52 per cent of the people employed in agriculture are drawn from an external pool of resources, and over 45 per cent are owner-managers and family workers.

Occupations	Employee	Owner-manager	Contributing family worker
Livestock Farmers	14%	49%	35%
Crop Farmers	23%	54%	20%
Crop Farm Workers	94%	2%	2%
Livestock Farm Workers	81%	9%	9%
Mixed Crop and Livestock Farmers	10%	60%	27%
All occupations	**52%**	**30%**	**16%**

Table 1 Status of Employment (% employment within occupation - QLD data). Source: Census 2016.

Table 2 provides a snapshot of the most agriculture-related occupations at a national level and the projected changes for the next five years by the Department of Jobs and Small Business. The data shows that most agriculture occupations will either remain the same or increase with the exception of farm managers.

This trend might be affected by the fact that 49 per cent of those employed as farm managers are aged over 55, which in itself is a unique opportunity for the next generation. It is likely that there will be a high replacement rate for this occupation.

	Employment level - May 2017 ('000)	Department of Jobs and Small Business		
		Projected employment level - May 2022 ('000)	Projected employment	
			('000)	(%)
Farmers and Farm Managers	***142.8***	***127.0***	***-15.8***	***-11.0***
Agricultural and Forestry Scientists	14.1	14.2	0.1	0.6
Agricultural Technicians	2.6	2.7	0.1	3.9
Skilled Animal and Horticultural Workers	***134.8***	***147.7***	***12.9***	***9.5***
Agricultural, Forestry and Horticultural Plant Operators	13.3	13.3	0.0	0.3
Farm, Forestry and Garden Workers	***119.1***	***124.1***	***5.0***	***4.2***

Table 2. Change in Agriculture Related Occupations (National data). Source: Department of Jobs and Small Business.

Data generated for a recent NCVER report (Shah & Dixon, 2018) forecasted the number of job openings per occupation over the forecast period of 2017 to 2024. The report found that at the national level, the job openings for farmers and farm managers could be around be 10,100 per year (80,900 total). This is due to farm managers having a much older workforce than other occupations, and therefore a higher replacement rate. However, the report warns that this rate might be over-estimated as farmers are likely to continue to work past the age of 70.

A more conservative analysis has been provided for Queensland in **Table 3**. The data shows that there is a potential increase in employment and job openings across agriculture-related occupations. This approach shows the number of job openings for farmers and farm managers in Queensland would be around 800 per year (6,100 total).

Occupations	Employment projections			Job Openings 2018-25 ('000) annual average
	2017	2025	Change %	
Farmers and Farm Managers	22.6	25.1	11%	0.8
Agricultural, Medical and Science Technicians	9.8	11.6	19%	0.4
Horticultural Trades	17.2	18.9	10%	0.5
Animal Attendants and Trainers, and Shearers	6.6	7.6	15%	0.2
Farm, Forestry and Garden Labourers	26.7	29.9	12%	0.6

Table 3. Employment Projections and Projected Job Openings in Agriculture Occupations (Queensland data). Source: NCVER and Department of Employment, Small Business and Training.

A significant number of the sector's workforce occupy roles that are specific to the sub-sectors, such as livestock and crop farmers, farm workers, shearers, agricultural and horticultural plant operators, nursery workers and gardeners. There is also a significant proportion of the workforce who are employed to undertake more general roles, such as clerical and administrative work.

The sector employs people in a range of other occupations, such as process workers, mobile plant operators, metal casting trade workers, and road and rail drivers. Professional workers such as agricultural scientists, environmental scientists and veterinarians are also significant occupations in the sector.

A recent National Farmers' Federation (NFF) survey on farm labour assessed what roles experienced labour shortages with most respondents indicating semi-skilled roles (e.g. requiring a reasonable degree of practice and experience, Certificate II) (50% of respondents). Other roles mentioned include unskilled labour roles (29.51%) and skilled roles (28.63%) e.g. requiring accreditation, a Certificate III, or significant experience.

Allied industries or support services

The shearing, cropping and agricultural support services is another sector that needs to be considered in the context of future training and education. This sector is made up of 10,424 businesses. Its services to the agricultural sector generated $5.5 billion in revenue from 2015 to 2016[1] Australia-wide.

The shearing, cropping and agricultural support services industry provides a range of services to the Agriculture subdivision, such as livestock marketing and handling, cropping, and shearing services.

The main services that this industry provides are:

1. Cropping services
2. Livestock services
3. Marketing and handing services
4. Other services, including business, management and scientist
5. Hay bailing or pressing
6. Shearing and crutching services.

The main activities of this industry include:

[1] Source: IBISWorld (2016) IBISWorld Report A0529, Shearing, Cropping and Agricultural Support Services in Australia

1. Livestock mustering and droving
2. Artificial insemination
3. Crop and fruit harvesting
4. Farm irrigation
5. Hay bailing or pressing
6. Livestock dipping
7. Shearing and crutching
8. Aerial crop planting and spreading.

As this sector is quite diverse, there is no one business that has a large market share. Typically, service providers are very small and tend to be sole operators, partnerships, or family-owned businesses.

The main contracting companies consist of an owner-operator and one or two employees. Larger companies tend to provide services that are capital-intensive with sole traders providing labour-intensive services.

Producers will continue to seek more efficient and effective ways to increase productivity and competitive advantage as market opportunities grow and competition increases. It is expected that farm sizes will increase to achieve economies of this scale, which lends to an increasing demand for support services.

Impact of digital agriculture on occupations

The effect of digitalisation on jobs has been a topic of much debate with sophisticated analysis conducted both in Australia and overseas. For example, CEDA's report estimates that 40 percent of job losses can be expected due to automatisation based on the work of Frey and Osborne (2013) (CEDA, 2015). This assumption was then challenged by the Organisation for Economic Co-operation and Development (OEDC) arguing that while 60 percent of jobs will be affected by automation, only 9 percent will actually be automated (Arntz, Gregory, & Zierahn, 2016).

Research has suggested that it is difficult to accurately predict the effect of automatisation on job roles and associated skills across industries, occupations and locations. Complexity is added to the analysis as emerging technologies continue to evolve (Bowles & Corrigan, 2017). Automation is part of the wider transformation of existing business models and how work is being designed and transformed. This research states that, "Machines may replace routine physical and cognitive tasks, but it is where machines and humans form powerful combinations that future business and employment opportunities will reside" (p. 3).

In the next section, we provide an outlook on the broader impacts robotics, and autonomous systems will have on the occupation categories. The information has been extracted from an analysis done by Perez and Lee (2017).

A. Professional roles

- **Role description**

  Professionals will usually have a tertiary education or higher qualifications and their fundamental role is often related to analysing a situation or problem and providing advice and recommendations, or to finding a solution to that problem. A person within this role will utilise data and information gathered through the use of digital technologies and agri-informatics to provide advice and recommendations.

- **Envisaged changes**

It is most likely the set of tools used by professionals to conduct their jobs will be augmented by digital-agricultural technology including knowledge management systems, data analytics (such as visualisation tools, artificial intelligence, virtual reality), and novel decision support systems.

It is envisaged that skills in data analysis and the selection and use of interactive decision support systems and artificial intelligence tools will be increasingly required.

The number of jobs in professional roles is expected to increase as the sector becomes more data-rich and data-driven.

B. Para-professional roles

- **Role description**

Para-professionals typically support the role of a professional with specific mechanistic tasks such as data collection and exploratory data analysis. For example, an agricultural technician may conduct investigations in the field about crop health to provide an agricultural scientist with data for analysis.

- **Envisaged changes**

Digital technologies including robotic systems have the potential to disrupt these jobs. A robot carrying sensors and with connectivity to a knowledge management system will have the ability to not only collect plant, weather, and soil related data, but also to categorise, organise, analyse and generate reports.

Potentially many of the key tasks of workers within this category may be conducted by robots. However, robots are still not good at manipulating and interacting with the environment. In this instance, these roles may change quite significantly which will require some consideration as to how people would be re-tasked.

C. Skilled-trade roles

- **Role description**

The roles within the skills-trade workforce are quite extensive and varied. Consequently, determining the breadth and depth the impact digital technology will have on this sector of the workforce presents a significant challenge.

Generally, people working within this sector of the workforce gain their qualifications through some sort of certification and experience as they tend to be in a position where they are operating machinery, handling chemicals or require some sort of licence or registration to perform their roles.

- **Envisaged changes**

One of the top 20 occupations in agriculture (see **Figure 4**) is Agricultural, Forestry and Horticultural plant operators). This is probably the area in which robots initially will have the greatest impact. This is already occurring as tractors operating on farms now are semi-autonomous or autonomous (albeit supervised).

Plant equipment and operations are used to perform tasks such as transport, field preparation, weed control, fertilising and irrigation. All of these tasks may ultimately be performed by robots. This will in turn significantly impact on workers currently performing these roles.

Robots may be developed to a point where they can perform certain tasks with animals. However, it is unlikely that robots will replace people where direct interaction with animals is required. Some skilled-trade roles also provide maintenance to machinery and farm equipment. As the use of digital technologies in farms increases, maintenance requirements will be relate to electronics, connectivity, deployment and the set-up of sensing devices.

These roles can also expand into monitoring robotics systems. At this stage, we envisage personnel responsible for the supervision of robotic operations and for loading and moving the robots from paddock to paddock.

C. Semi-skilled roles

- **Role description**

Again, the tasks performed by people in a semi-skilled role are extensive and varied. In general, a person in this role performs a variety of manual, animal-and-crop-raising tasks on a farm.

This could include mustering, feeding and watering livestock and animals, cleaning sheds, stables and pens, and picking, cutting, or collecting fruit and vegetables to harvest crop. It could also include other tasks that require signicant manual effort and experience in building and maintaining farm infrastructure such as sheds, fences, bores or irrigation.

- **Envisaged changes**

It is probable that robots may develop to a point where they can perform these tasks. However, this is not likely in the near future. Manual tasks such as these present the greatest challenges to robotics. We therefore envisage people to continue to perform many of these tasks into the future.

Tasks that will be impacted, certainly by the first generation of robots, will be in the area of pest control, weeding, and to a lesser extent pruning, picking and harvesting. In this regard, robots will be of major benefit as the agricultural sector suffers from productivity issues due to a shortage in workers. However, it will have a major impact on people who currently work in the area of fruit and vegetable picking or harvesting crops. This also extends to remote-area infrastructure such as seasonal accommodation and food services.

D. Researchers

- **Role description**

Researchers usually have high degrees at the level of Masters or Doctorate. They conduct both blue sky and applied research that supports the agricultural sector in areas such as agronomy, business, technology, sociology, biology, environmental science, management, data analysis, decision science, robotics and automation.

- **Envisaged changes**

The availability of Big Data will transform some of the research methods currently used. In particular, many aspects of modelling will shift from first principles relying on historical data for forecasting of seasons to more data-driven models supported by larger data availability rates and the use of statistical tools, dynamical system theory tools, machine learning, and artificial intelligence.

The availability of Big Data will not only change research methods in traditional disciplines associated with agriculture, but will also bring new researchers in disciplines related to data

science, statistics, mathematics, decision science, dynamical system theory, control systems, operations research, robotics and autonomous systems.

Occupational changes - What does this mean for agriculture?

Predicting the agriculture jobs of the future is difficult to do due to the rate of change in agriculture work (Pratley, 2017). Many of the jobs have changed or been created with new jobs now in place that were not there a decade ago.

The changes in the environment and consolidation of farming operations means dealing with the needs of larger business. These changes have increased demand for farm managers, specialists and technical advisors. There has subsequently been an increase demand for university graduates in the service industries reflecting new skills (Pratley, 2017).

There is a growing professionalisation of roles to support the changing nature of modern farming businesses. Expectations on what is required of those who wish to enter agriculture and maintain their employment has shifted towards higher-skills and specialisation.

The state's agricultural workforce is undergoing a sizable shift in required roles. Technological change will increase the demand for more professional and technical jobs in our sector. Predicted future skill needs include those of other occupations not traditionally associated with agriculture including engineers, data analysts and business support services. Therefore, we need to attract new and different talent into the sector with these required skills.

An example of changing roles is present in the forest and timber sector, which has seen sawmills up-take new technology. Jobs in the sector are rapidly changing towards high tech jobs rather than the labour intensive kind. As a result, the roles in forestry have changed dramatically. But this has not been enough to motivate new entrants to the industry.

It is important to note that while a lot of the potential technology can have an impact, some of the technology is not ready to be adopted commercially. So there is a need to sustain current practices until disruption occurs. The industry needs to keep attracting people to current roles that might change in the future.

Agriculture has traditionally been able to cater for unskilled labour. There are likely to be many farm activities that will continue to require unskilled labour e.g. most logistics, livestock movement and machinery operations still require pools of unskilled workers. It is unlikely that new technology will perform all tasks that unskilled labour has performed. Therefore, agriculture will still require a mix of skill in its pool of resources (Korff., 2017).

A report commissioned by the European Parliament (Scientific Foresight Unit, 2016) on the effect of precision agriculture and the future of farming in Europe, suggests that new business models will emerge as a result of new technologies as well as professional profiles such as:

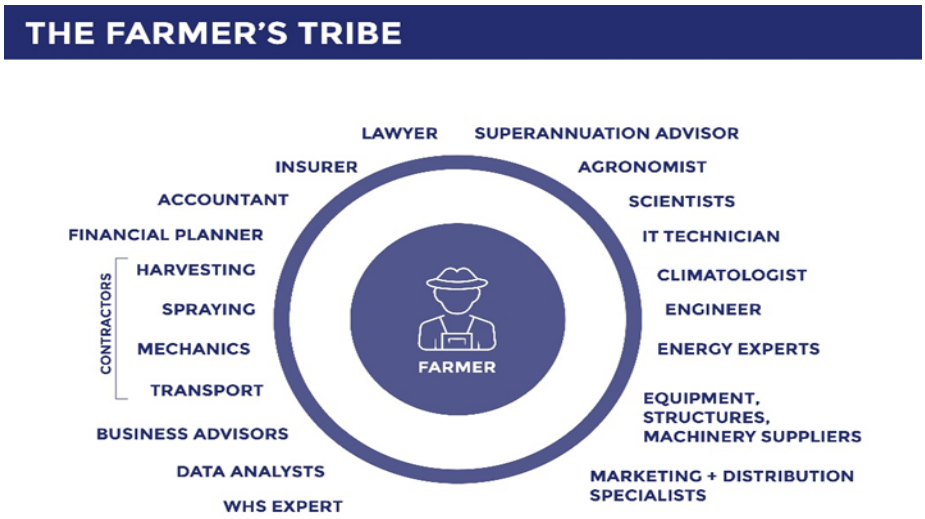
- The Geo-Engineer to specialise in carbon sequestration, alongside a food production business
- The Energy Farmer to specialise in renewable energy production and management for the local area
- The Web Farm Host to give a constant, positive commentary to the outside world, explaining what is going on and often giving virtual tours to school children
- The Animal Therapist to act as a welfare manager for farm animals making sure consumers buying meat or dairy products from the farm can access information about animal wellbeing

- The Pharmer to use biotechnology expertise to grow and harvest plants that have been genetically engineered with foreign DNA to make them produce medicine
- The Insect Farmer to farm large quantities of insects for use as natural predators to control the new species of insect that spread in farming areas because of climate change.

While technological capability in the workforce is increasingly needed in agriculture, there will still be requirements for qualified agronomists, soil experts, livestock and other specialists. These professionals need to build their problem-solving capabilities and systems of thinking so that integration with new technologies is managed. ICT will need to become part of the process in many of the agriculture occupations (Pratley, 2017).

Pratley (2017) also mentions that in addition to these roles, there will be a growth in specialist ICT companies and businesses that service technologies. Occupation in the service sector will tend to grow including marketing, value-adding process, packing, logistics, distribution, fencing, harvesting, spraying, picking, farm business advising, data analysis and others. New career paths are also available in the environment sector, land management in conservation, climate change, irrigation and water management, and biosecurity (Burrow, 2017). The farm is made up of a tribe of support occupations as shown in the image below. The involvement of these contractors is likely to increase.

The agribusiness sector is recruiting a new generation of technologically savvy graduates as the sector provides more modernised and diverse career pathways for young generations (Australian Academy of Science, 2017). According to the Australian Council of Deans, enrolments in universities have increased in recent years, and the number of online advertisements for off-farm work has also increased (Burrow, 2017).



In a recent report around the impact of automation on future work, it is stated that some job roles might present opportunities to transition to areas of predicted high-growth (Bowles & Corrigan, 2017). Some of these will highly beneficial for agriculture sector such as:

- Agribusiness farmers with IT and mechatronic skill sets
- Advanced science, engineering and technology professionals
- Specialist logisticians and supply chain managers
- Business development and financial managers
- Business services/consultants
- Specialist machine operators and technicians (advanced manufacturing workers).

Emerging workforce challenges

The importance of ensuring the sector has the required workforce and skills for the future has been acknowledged by Food Innovation Australia (FIAL)'s Sector Competitiveness Plan for the Food and Agribusiness Growth Centre (Food Innovation Australia Limited (FIAL), 2016). This plan acknowledges that to achieve its vision that "by 2025, the industry is working together to grow the share of Australian food in the global market place", and to achieve its objectives of "access to new markets" and " to increase the productivity and/or competitiveness of the industry," one of the required inputs is that " industry players need to have the confidence and capacity to use their knowledge, resources, skilled workforce and associated capabilities to develop innovative, cost-effective and differential offerings that meet the wants and needs of Australian markets and consumers".

The Decadal Plan for Australian Agricultural Sciences 2017-26 (Australian Academy of Science, 2017) also mentions that "the capacity to deliver the agricultural science agenda involves a whole-of-education supply chain approach. It starts with capturing the minds of children and ends with qualified practitioners to create and implement innovation". Opportunities need to be created for students to align their own expectations with the expectations emerging in the ever-changing rural and related industries.

The recent Queensland Agriculture and Food Research, Development and Extension 10 Year Road Map (Department of Agriculture and Fisheries, 2018) recognises the importance of Agriculture to the Queensland economy and for the growth of regional jobs. To achieve the desired growth, the report stated that the capability and skills challenge for agriculture and for Research, development and extension is whether the pipelines are in place to deliver the researchers, extension officers and other experts that will needed by the sector in 10 years' time. There is a real need to document RD&E skills and capabilities and identify gaps. There is also a need to promote career opportunities at all levels.

Agriculture is extremely diverse and a great contributor to regional economies. The sector is predicted to increase its value of production which might bring new employment opportunities. For agriculture, having the appropriately skilled workers will be important to achieving the expected growth. Some of the emerging workforce challenges are explained below.

Our sector has the highest share of employed persons who are above retirement age, and its labour workers are aging. About 23 per cent of the sector's workforce is likely to retire over the next five years (Skills Impact, 2018). Upcoming retirements are likely to bring significant job vacancies across the sector, requiring efforts from employers to refill these skills.

Improved succession planning tools are required to support the transition of the farming sector. The need for new business structures to support a new generation of farmers is also a key challenge. This involves supporting industry education and extension programs to provide the tools and advice needed to adopt more efficient and effective business structures.

The sector is likely to find a tightening of labour supply, particularly for skilled farm managers. Agriculture needs quality leaders and appropriately skilled workforce to adopt innovation. Producers with general, technical and business educations may be more willing and better at adopting innovation. To encourage uptake of new technologies and products, producers require an understanding of the background principles, and the gains and risks involved.

Overall, it is expected that innovation and technological change will increase the number of professional and technical jobs in our industries. The agriculture sector recognises the need to embrace the use of technology and the opportunities for advancement that these innovations offer. We know the sector will be highly influenced in the coming years by disruptive technologies that may increase efficiency,

productivity and profitability. Improving the capability to use technologies, robotics and automatisation more efficiently is a challenge that can bring production benefits for all industries.

Increased process automation has the potential to increase labour efficiency (Heath, 2018). The impact of digital technologies on labour efficiency is likely to affect routine tasks with a high degree of predictability and a need for high accuracy. In a sector where labour costs are a significant cost for agriculture, labour efficiency and improved workplace health and safety are of great potential value for agriculture businesses.

The potential growth of the sector's demand for labour will be driven by increasing the demand of products from emerging markets that will drive export markets. The potential shrink in available workforce could put pressures on the sector to find workers. Therefore, measures to address these potential labour shortages will be needed.

Successfully attracting future generations will require the sector to improve its narrative about the benefits of working in agriculture. Agriculture offers one of the most diverse opportunities for new entrants. There are a great variety of jobs and careers paths and they are changing rapidly (Heath, 2017; Burrow, 2017). However, developing effective long-term career pathways is a significant challenge, as the job roles and demands change (Korff., 2017).

The sector needs to inform younger generations about new and exciting job opportunities and careers. More support for initiatives that work with schools and in the training sector to create awareness of the importance of agriculture, and its possible careers is needed.

An increasing challenge will be attracting and retaining an appropriate mix of skilled workers in rural towns (Korff., 2017). Large rural towns are sustaining their populations, while populations in smaller towns are decreasing. The availability of people in remote regions will likely decrease in the near future (KPMG, 2018). However, rural communities that provide telecommunications, health, education and childcare services are likely to contribute to attracting skilled people to the sector.

Competition with other industries for skilled labour in regional areas will potentially have an impact, particularly in mining areas. Agriculture has the largest fluctuations in employment in any sector which has resulted in negative perceptions about the sector among potential workers. In a competitive market, agricultural employers are unable to raise wages.

In relation to low-skill work, overseas workers will always have an important role to play in the sector. The demand for labour at peak times is more appealling to overseas workers than Australians. Migration policies in Australia will need to help the sector and not make it harder for farmers to access workers (KPMG, 2018).

A recent survey by NFF on labour issues found that the most common labour concerns a farm will need to address in the next 12 months are employment costs, the shortfall in labour supply, and red tape and administrative burdens.

To date our interactions with industries have reported the following emerging workforce challenges:

- Attraction of young people to agriculture through the VET system. Young people are currently encouraged into university rather than using traineeships and apprenticeships via the VET system.
- Attraction of well-trained agricultural teachers and trainers
- Increased competition with other industries for skilled labour. This is particularly the case in regional areas where mining has started to come back. Agriculture does not seem to get enough

credit for the contribution it makes to local economies thus limiting the support it gets through programs and funding.

- Identifying future industry leaders and investing in building their capabilities
- Providing quality education that meets the evolving needs of the sector
- Increased need for skilled middle managers with a combination of technical skills, business skills, and people management skills
- Transitioning the industry to evolving technological roles
- Identifying and promoting agriculture career pathways: Promoting the future driven agriculture careers
- Increase need for technical and highly specialised skill sets such as entomology
- Skilling and upskilling specialist contractors, extension and advisors
- Support succession planning initiatives to ensure the future generation of the sector
- Establishing a solution to the employment of seasonal workers to address potential shortages that is cost efficient and meets the standards required.

Emerging skills needed

Skills needed in response to emerging trends

The capacity of an economy to innovate relies on its stock of human capital - the skills, knowledge and expertise embedded in its workforce. Innovation has been linked to educational attainment (OECD, 2015). The education level of producers is directly related to productivity growth and influences their disposition towards the adoption of new technologies and practices. Encouraging a more professional and capable sector will provide the capacity for it to be more responsive and forward-thinking to take advantages of the market opportunities available.

An innovation culture must be supported by the education sector continuously updating its programs to ensure training packages are relevant for the needs of the sector. Agriculture always has and will continue to embrace new technology that requires a significant level of skills and expertise in the production and research workforce. This means appropriate training and education for the future workforce is a priority. Fostering skills and addressing skill gaps will provide an important boost to innovation.

Advances in agriculture including wearable devices, natural interfaces and smart machines are opening the door to new opportunities. Tools such as crowd-funding, big data analytics, artificial intelligence, nutritional genomics, micro-grids, GPS and sensors are likely to be increasingly adopted throughout agriculture. There is a great ability to collect temporal and spatial information about the status of soil, water, crops, water, animals and pasture, but this is of little value unless it can be integrated to assist making improved decisions within farm operations (Trindall, Rainbow, & Leonard, 2018).

A whole-of-agriculture-sector digital agriculture project "Accelerating Precision Agriculture to Decision Agriculture (P2D)" has analysed what needs to happen for Australian producers to capture value from their data. The report's key recommendations to address this issue include "[providing] education and capacity building to increase digital literacy in the agricultural sector". A digital skills and capability gap was identified across the value chain. Big data solutions will provide very little value if the industry doesn't have the skills and expertise required. The P2D project calls for a structured approach for the sector to build data and data science expertise (Skinner, 2018).

Adoption of new technologies across agriculture will require learning new skills, particularly technological skills, environmental skills and managerial skills (Heath, 2017). To uptake the available opportunities, farm managers need a combination of skills in decision making, analysis of data, marketing, while also being aware of the potential of technology. They will need to be technologically literate and capable, familiar

with e-commerce and social media, have advanced managerial skills, be familiar with modern production techniques and be able to deal with complex environmental issues (Australian Farm Institute, 2017).

It is expected that growers with good general, technical and business education will be more willing and better at adapting and integrating innovation within their farm operations, leading to production efficiencies. Business decisions are less likely to be made solely by managerial instincts and more likely to be backed by data-driven insights.

The workforce needs job-specific skills to support higher efficiency targets, innovation, automation and digitalisation (Skills Impact, 2018). Agricultural businesses are looking for workers that have experience, skills sets and demonstrated capabilities rather than focusing on full qualifications. Training needs to promote re-skilling and continuous learning in the workplace with a preference for micro-credentialing and stackable credentials that may over time lead to a completing a full qualification for individual workers. Workplaces also need to provide workers with access to the skills and knowledge when they are required.

Adopting lifelong learning strategies will be important because the ever-changing landscape requires stakeholders to be up-to-date with the latest knowledge and flexible to any change required, including the lead-times necessary to implement appropriate responses.

To be more relevant to industry requirements and to support the current workforce to update their knowledge constantly, new skill sets should be identified and supported with a higher priority. Adopting flexible course structures that allow students to train in areas that might not be conventional agricultural subjects but of significant value to their future career in agriculture should be encouraged e.g. combining courses of agriculture and engineering.

In scoping the skills needs for Australian agriculture, horticulture and conservation and land management industries, Skills Impact states that the right mix of high-level skills will allow industries to capture technological advances (Skills Impact, 2018). This will include a range of skills in Science Technology Engineering and Mathematics (STEM), compliance, and leadership areas.

Priority skills identified by Skills Impact (Skills Impact, 2018) for the next four years include:

- Conservation and Land Management updates to address new practices
- Production nursery skills and integrated pest management (IPM), soils and irrigation
- Landscape qualifications: there is a need for clear pathways to landscape construction or landscape design roles. Key skills are missing in ecology and there is a growing need for skills during the design and construction phases of work.
- Rooftop and vertical gardening
- Sports turf skills update: update of skills to include regulation and technology improvements
- Carbon farming skills sets
- Permaculture review
- Protected horticulture
- Irrigation technology, design and processes
- Agriculture skills in data and analysis
- Biosecurity skill sets
- Agribusiness innovation and farm gate value adding
- Compliance and Regulation and Medicinal Crops.

Impact of digital agriculture on skills

Bowles (2017; Bowles M. , 2017) argues that two different skills sets are required: skills to develop automation; and those skills to apply automation. Research has indicated common requirements from any industry are those competencies that prepare the industry for automation and that enable the individual to move and transfer skills across jobs in an occupational stream.

The research mentions that the areas of technological development and ongoing competency across the sector include cyber security, mobile technologies, the Internet of Things, data analysis, cognitive computing, machine learning, sensors, GPS, augmented reality and virtual reality, and nano and biotechnologies. (Bowles M. , 2017).

An analysis of the impact of digital agriculture on skills (Perez & Lee, 2017) proposes the following skills needed in agriculture:

A. Up-skilling the professional component of the workforce to be able to continue performing the roles in an industry that is deploying digital technologies and becoming data-rich. This will require skills in:
   - Data management - to be able to access and combine data from different sources
   - Data analytics - to be able to select, use, develop, and assess data analytics and statistical tools to extract and analyse information and gain situational awareness in relation to management and decision problems
   - Decision analysis and support - to be able to identify different types of decision problems, adopt logical and coherent frameworks to engage with and support decision makers, explain the rationale behind a proposed decision and its associated management strategies to decision makers and auditors, and adapt and use interactive software tools for decision support.

B. Transitioning the para-professional component of the workforce to be able to make use of digital technology to deliver support to the professionals. This will require skills in:
   - Use of computer equipment in the field to capture data related to particular tasks
   - Plan operations and deploy robotic systems for data collection and then the implementation of actions for crop management.

C. Up-skilling the skilled-trade component of the workforce to be able to install and maintain digital technology. This will require skills in:
   - Mechatronics trade
   - Operation of robotic equipment.

D. Up-skilling researchers to be able to adapt to research in data-rich environments. This will require skills in:
   - Development of data-driven models based on system identification models based on system identification techniques
   - Big Data analytics
   - Sequential data analytics driven by increased rate of data availability
   - System theory, sampled-system theories, spatiotemporal system theories
   - Development of robotics technology
   - Development and application of probabilistic reasoning, machine learning, and artificial intelligence.

Industry consultation responses

Our interactions with industries have reported a need for the following skills to equip our current workforce:

- Use of sensor, robotics, spatial and other technology e.g. use of drones for forestry mapping and fire surveillance. Estimating and harvesting and haulage.
- Digital skills and technology, greater use of drones and skilled agronomists that can effectively interpret data and help farmers make decisions
- Increased need for computer programming ICT skills
- Product innovation, marketing, e-commerce, negotiation and contract management
- Export and negotiations skills for new markets
- Increased used of traceability technologies
- Data collation and management is an area where all industries saw benefits in order to better interpret data to inform decision-making
- Increased need for business management skills as well as the ability to analyse data to make decisions
- Increased need for specialist skills to drive the sector forward such as biotechnologist, genetic specialist, food technicians, soil conservation, entomologists and others
- Increased ability of advisors and extension sector to act as knowledge and innovation brokers. Advisors will need to provide up-to-date advice based on up-to-date knowledge. Advisors with precision agriculture skills will be required in particular.
- Succession planning and use of improved business structures
- Leadership skills for upcoming generations: since there is a new generation of farmers there is a need to build their skills to drive the future of agriculture.

Strategies to address emerging challenges

The sector has identified the following strategies to address its emerging needs:

- The NFF has suggested the introduction of a dedicated agricultural visa designed to support people coming to Australia for employment in Agriculture (KPMG, 2018). The visa will provide legitimate incentive for international labour hire where domestic shortages exist.
- Implementing successful planning models to encourage new participants to replace aging population of farmers and farm managers
- Increasing the attractiveness of rural communities. Ensure that by 2030 all regions in Australia have access to the best levels of communications, health, education and childcare services.
- Find innovative solutions for attracting and retaining workers e.g. some producers might coordinate with others to address seasonality in demand and provide more attractive, stable terms of employment.
- Develop an integrated and collective approach for agriculture to promote the vast number and types of job available across Queensland - clarify job requirements and career paths available, and give job seekers, students, teachers, guidance counsellors, and employees an organised point of information. This task is currently undertaken by the Primary Industries Education Foundation (PIEFA).
- Improve human resources management: support the skills and tools available to agricultural employers, managers and supervisors to manage their staff effectively and to implement workforce planning strategies that will support their business including creating professional development plans that provide the opportunity for employees to target their training.

- Align training resources with workforce needs: support a closer alignment between training and educational programs along with current and future requirements of industries.
- Assessment of the disruption (technology, skills, process, and analysis) environment in agriculture would be beneficial for strategic planning. This will place the sector in a position to manage and plan for the training needs into the future. The sector needs data that accurately predicts where new jobs might be created, the impact of current roles, the socio-economic benefits automatisation has to Australian agriculture, as well as an indication of skills required.

CHAPTER 4: AGRICULTURE FUTURE SKILLS AND TRAINING NEEDS – EMPLOYER INTERVIEWS

Introduction

QFF acknowledges that the agriculture sector is extremely diverse and a major contributor to regional economies and the Queensland economy overall. Many agriculture industries are confident of their future and are planning expansion over the next several years which may also bring new employment opportunities. This growth potential is creating optimism to expand market opportunities, create new jobs and embrace new technologies – and having an appropriately skilled workforce will be key to realising this potential.

The agricultural workforce has changed considerably over previous decades, as technological improvements have changed labour requirements, with today's industries offering a broad range of opportunities and career paths that are increasingly non-traditional in nature. The rapid rate of technological development across the sector is forecast to continue affecting the skill requirements of its future workforce.

The Rural Jobs and Skills Alliance (RJSA) is a collaborative initiative that represents organisations across agriculture industries to provide a united voice for Queensland agriculture that assists in attracting, training and retaining appropriately skilled agricultural workers, both now and in the future. QFF is using Alliance members and their networks to conduct this 2018 research for Jobs Queensland.

Supply and demand of agriculture labour and skills – Issues update May 2018

As noted in Chapter 1, QFF convened a special meeting of selected industry participants and specialist advisors on 3 May 2018, to review six of the special research issues identified by Jobs Queensland for this Research Report. To further validate those findings, QFF undertook interviews with key industry employers (defined as operating with at least three employees, including the owner) across a range of industries.

The restricted time window available for this research limited the number and range of people who could be contacted in the period between May and June. For instance, grain, cotton, cane and some horticultural producers are currently busy harvesting and planting winter crops.

The selected employers were initially contacted and provided with **The Future Skills and Training Needs for Queensland Agriculture** project outline and consent form, plus an invitation to participate in an online survey. The results of the survey are tabulated at the end of this chapter. The remainder of this report summarises the responses to the structured employer interviews we were able to conduct.

While the number of completed responses amounted to 22, the quality and representativeness of them is an important indicator of future challenges across rural industries. For example, the beef industry responses represent more than 30 stations, accounting for 10 million hectares across inland Queensland, more than 650,000 head of annual cattle turnoff, and more than 1,200 employees, most of whom are in permanent positions. The horticulture businesses we spoke to all trade inter-state and supply to major supermarkets and some span geographically diverse regions to ensure all-year cropping. They also include exporters and some of them operate packing sheds and processing facilities. Respondents in horticulture had a combined gross turnover (FY16/17) well above $150M and employed approximately 400 permanent staff and 1300 casuals between them. QFF also spoke to a sample of cotton growers and sugarcane growers; the participants in these two industries included managers of large operations across regions, as well as industry champions that hold various leadership positions.

Although limited in number, the results are still rich with insights as to current and emerging trends in the various industries under the umbrella of agriculture.

In summary, QFF undertook various interactions to complete the project including:

- 21 surveys and 22 one-to-one interviews with industry representatives including employers from various industries in the agriculture sector such as grazing, horticulture, sugarcane, cotton
- Roundtable discussions with selected industry representative bodies and specialist advisors (3 May)
- Roundtable discussion with the forestry and timber industry representatives (16 May)
- One to one discussions with technology experts and industry representatives
- Attendance and participation in the AFI (Australian Farmers Institute) Digital Farmers conference (13-14 June).

The following analysis combines the responses of all interactions completed to date.

Current local labour and skills issues

A consensus of respondents indicated that it was a challenge to fill vacant positions that required a degree of experience and skill (including those carrying additional responsibilities, such as supervisory roles or leading hands). Although the responses vary across regions and industries, there is agreement that many agricultural industries are finding it difficult to attract qualified workers in regional areas, and that this is a rising concern due to advances in technology.

Industries varied in their skills requirements based on the workforce they need. Three main segments of their workforces were identified: the unskilled mostly seasonal workforce that most industries use, the skilled and technical roles, and managerial positions. The composition of the workforce varies depending on the industry or commodity and the size of its operations. The use of contractors also varies across industries and sizes of operations, however most of the businesses recorded use contractors for specific skills and jobs.

Many in agriculture use the "word of mouth" method and social media networks to advise their followers of upcoming positions. This is reportedly working well, with the notable exception of abattoir workers which remain hard to fill due to the physicality of key jobs. However, a number of respondents noted that the use of social media is becoming a 'two-edged sword' because many young recruits are more easily lured away by instant notifications of potentially more attractive jobs in their preferred location where they can work with their friends. Many participants also indicated that it is important for organisations to show they provide fair and good conditions in their social media posts. By giving their employees a good experience, some respondents have been able to build a reputation of good employers. In these cases, social media has been a vehicle to share good stories and to help attract seasonal workers.

Access to good, reliable, capable workers with the 'right attitude' in the 'guest' or casual workforce was highlighted as being a critical factor and a substantial risk to the future sustainability of businesses in the horticulture industry. Respondents indicated they were almost entirely reliant on backpackers and holiday-makers as their principal source of casual, unskilled labour to plant and harvest their crops. Whilst the supply of these workers is usually dependable (especially in those regions with strong tourism attractions and good transport infrastructure), everyone interviewed noted that in recent times there had been a slight but noticeable drop-off in the availability of a casual workforce.

It is worth noting that due to the nature of the work itself, which is often repetitive manual labour performed in prevailingly hot conditions, and despite the opportunity to earn decent money, many backpackers are being attracted to other sectors during their visa stay (such as hospitality). Businesses report that a decade or so ago it was relatively easy to source unskilled labour from the local workforce. Due to a range of factors including a demographic population shift from inland to the coast, it is increasingly difficult to find willing workers locally. A majority of horticultural businesses indicated that they felt their industry was rapidly approaching a critical "tipping point" where their access to, and reliance on, unskilled manual labour (particularly at peak harvest time) was a significant risk to their overall ability to operate.

In the sugar, cotton and forestry and timber industries, most respondents have experienced issues recruiting skilled workforce. In the sugar industry for example, they expressed issues in trying to recruit seasonal workers with the level of skills that are currently needed. In most regions harvesting drivers, haul-out operators and planting staff with the right skills and attitude are hard to find. Some respondents also had difficulties recruiting farm managers and supervisors. According to a top senior manager, "It was difficult to find top-end commercial agriculture people and difficult to find good machinery operators that have GPS ability". In some instances, this has meant certain businesses haven't had all the resources needed to start the season.

The reasons for these labour shortages are many including competition with other industries, mainly mining, for skilled workers. The level of skills required at all levels is changing across industries, and it is increasingly difficult to find appropriately skilled workforces. Regarding machinery operators, for instance, companies have invested in expensive equipment with new technology and aren't willing to accept the risk of having unskilled workers operate their machinery.

In the sugar and cotton industries, new harvesting, planting and haul-out equipment for instance can be expensive and there is a limited pool of people that can fully operate the machinery and fully engage with the technology. Businesses have invested in expensive machinery such as round bale cotton pickers and irrigation systems that require less but more specialised labour. Casuals are also employed to fill seasonal tasks, but they often require training and supervision to reduce the risk of damage to machinery.

Most respondents across industries also indicated their use of more contractors for more specialised tasks such as agronomy, mustering, and IT. Large businesses prefer to keep their skills in-house, especially if those skills are used most of the year, while smaller businesses rely on contractors to provide specialised skills. Cotton, in particular, relies on private advisors. The required level of skills for these advisors is increasing as technology, regulation and management practices change. Improving the level of digital skills across the sector, not just for farmers and farm staff, but for specialists also was cited as a need across industries.

The timber and forestry industry advised shortages in various roles and locations in Queensland. In particular, they expressed an increased need for wood machinists, estimators, frame and truss detailers, and saw millers. The workers required to fulfil these roles are expected to have a high level of skills. One respondent said: "Sawmills are becoming more high tech rather than labour intensive, so there is a need for more technical skills". The increased regulatory requirements imposed in the industry have also added an extra complexity to the jobs performed particularly by contractors. Employees and contractors are now required to have a mix of skills and a combination of knowledge of forestry, technology, and environmental codes and regulations.

The nursery industry expressed a gap in recruiting good, reliable staff in roles across the business from nursery hands to head senior managers. The industry advised a decline in available plant specialists as the current cohort of people coming out of the VET system have little knowledge of plant propagation

techniques. The aging workforce was a concern in industries such as sugar, nurseries and forestry. The average age of these workers is much higher than in other industries. As a result, strategies must be established to replace the workforce that is retiring and increase the uptake of succession planning solutions. In the sugar industry, it is expected that there will be an increase of corporatisation and amalgamation of business. Therefore, the composition of the workforce is changing, with farm managers requiring a different skill set to manage larger operations.

The composition of farm manager duties is becoming more complex and varied. Farms have to deal with a changing landscape caused by legislation, new technology and work practices that require farmers to have a combination of managerial, technological and environmental skills. Interviews with farm managers have shown that a higher level of education and professionalism is needed in this occupation.

The aging workforce is also affecting the availability of specialist advisors in areas such as soil conservation, entomology, plant breeding, biosecurity, and professional extension. There is a perception that this issue was caused by the closing down of agricultural colleges and changes to university programs in agricultural related areas. Mentoring programs have been put in place across the sector to ameliorate the issue, led by industry organisations, Research Development Corporations (RDC), and government. It will take significant time and effort to upskill the workforce with much-needed skills.

In horticulture, ongoing access to labour, the cost of labour and the complexities of the associated paperwork was cited as a major factor in the decision of one business to begin a transition from high-input, intense production (strawberries) to low-input production (macadamias).

Regional remoteness is a barrier to recruitment, especially for businesses expanding the diversity of their farming operations geographically into other regions. Experienced workers with the maturity to undertake the roles required are usually in their mid-30s and are a parent of a family. However, it is particularly difficult for families to relocate to these remote areas. As expressed by a respondent, 'Small country towns: nobody wants to move to them and local talent pool is very small'. This is an issue, particularly when recruiters are looking for workers with higher skill levels. Towns need to be able to provide transport, education, internet connection and other main services to attract skilled workers.

A few of the larger horticultural, cotton and sugar businesses we spoke to have developed their own Graduate Programs to attract young people to their industries with very successful outcomes recorded for their region. Most industries highly value the connections with universities offering career pathways related to agriculture. Connections with the University of Queensland, James Cook University, and the University of New England were frequently mentioned in the survey responses.

However, there is an almost universal concern about the long-term trend of the declining number of young people with an interest and experience in farming and what will happen when the mining sector has its next upturn. Many employers point to their limited capacity to use contractors for any shortfalls that will occur, especially in new entrant and semi-skilled positions.

One strategy that many businesses are adopting is the facilitation of good relationships with local trainers to make the annual cycle of up-skilling and short courses appealing to their workforce. This way, local communities are aware of their good workforce practices.

Respondents also expressed that there is a training response gap developing as training providers and the VET sector in general are lagging in their response to the training requirements of advancing technology and knowledge. To address this situation, non-accredited training is largely being conducted in-house so it is specific to individual operational requirements (e.g. equipment manufacturers/software developers).

Most large organisations are conducting their own training, and in many cases, they are using freely available training provided by reputable experts and advisors. For example, respondents from the sugar and cotton industries indicated their representative bodies and Research Development Corporation provide free and available training that is highly relevant for their business. There are many training opportunities; the issue for businesses is to find the time to dedicate to training.

Although there are many organisations that provide training, they are also likely to prefer people that already have basic technical knowledge and some hands-on experience. As expressed by a respondent, "We provide a lot of update training to maintain compliance but do not train from scratch due to the overall cost and the likely flightiness of the worker".

One of the biggest issues affecting agriculture is the need to raise the sector's profile to better promote the diversity of exciting career opportunities and career pathways that are available, and to attract more talented professionals. This was a concern raised by most people interviewed. In timber and forestry, the perception of the industry is an important issue. They have promoted traineeships and traineeships vacancies for youth but struggle to attract candidates to fill these positions.

Some respondents are trying to address the problem by actively promoting the sector in schools. They participate in the Gener8 program, Aginspirations, and talk to students about careers in agriculture. Industry involvement in the School to Industry Partnership Program (SIPP) and initiatives such as Aginspirations and Agcareers are seen as a valuable way to promote agriculture to schools and future generations. Most respondents agree that increasing the efforts in making people aware of the importance of agriculture and the careers is highly important.

Emerging industry disruptions

Most respondents commonly noted several sources of continuing disruption, namely: technology disruption; input-costs of operations (energy, labour and water ranking highest); climate variability; telecommunications connectivity (internet access & speed, LWANs on-farm); changes in government policy; continual increased compliance and regulatory regimes (Reef regulations, and others); consumer perceptions of farming techniques, forest practices and animal welfare (social license); soil conservation, water quality and ecosystems (sustainability and environment); availability of farm land; commodity prices; market competition (domestic and international); access to export markets (especially China); and consumer food preference trends that may reduce demand for traditional agriculture outputs and products (e.g. artificial protein).

The industries have already identified these and are attempting pro-active responses, but up-skilling workers or contactors to meet changes in farm practices is a constant challenge (e.g. Controlled traffic field works and precision planting).

This issue of data analytics and 'information over-load' is emerging as an important management challenge that many respondents have mentioned in slightly different forms. This reflects the difficulty in identifying knowledge embedded in data that does not translate easily for practical decision making. Some industries have under-utilised multi-purpose data that could be used for production efficiency, harvest and processing scheduling and social license. Others note the complexity of controlled traffic farming across different crop, production and land management systems. Still others note of data linkages across traceability, food safety and quality assurance arrangements and the uneven feedback-loop to farm managers and contractors. Certain animal industries report the growing complexity of integrity systems and the emergence of blockchains and links for animal welfare and biosecurity issues.

Associated with these data challenges, many respondents noted that they need to keep their managers and supervisors on a constant learning curve so that they are equipped to help workers learn and master new technologies in their production processes and businesses.

Data ownership and management was an issue mentioned by respondents (mainly from the sugar industry) who would like to better understand the system and be able to use the data more efficiently for the management of their farms and for the improvement of the value chain. Most respondents indicated they would be more likely to be adopters of technology than developers. There is an increasing reliance on researchers, technology providers and advisors to make sense of the data that is collected. Although they are likely to produce more data as they adopt technology, they rely on technology providers to provide decisions systems and tools to help them make better decisions.

The adoption of technologies and improved practices is far more likely to improve if there is a perceived economic benefit attached. Most respondents agreed they will be looking to innovate as long as technologies and innovations presented improve their business, and are reliable, affordable and cost effective. A majority of them make an effort to keep informed about new technologies and possibilities for their businesses.

In the future, precision farming will become the norm, with many of the respondents already implementing some of the technology. Precision farming is increasing efficiency at every level of the agricultural process and is therefore enabling the sector to get more produce out of their land in a way that is sustainable and environmentally friendly. This kind of increase in production in some industries is simply impossible without technology.

Advances in new varieties and new practices are likely to be adopted if they make sense and are easy to implement. The agri-tech sector is perceived as having a powerful role to play in the development of Australia's agriculture.

Other business disruptions that respondents identified include managing for extreme weather events, export market opportunities and the managing of complex supply chain contracts and risks. In the sugar industry, the viability of farms is at risk due to the low sugar price forecast for the next years. It is likely that some sugar farms will be repurposed into to larger farms or more diversified farms.

New market opportunities in agriculture will need farmers to think about how they can create value added products that meet the needs of today's consumers. To take advantage of these market opportunities, agricultural entrepreneurs will need support from industries and government alike.

Emerging workplace challenges

Respondents identified the changing role of managers as leaders and teachers of technologies to their work groups as a new challenge, in addition to the well-documented issue of the ageing managerial demographic. Many claimed this to be the key to new productivity gains as managers master new modes of working and reporting and pass this on to their subordinate workers. One respondent mentioned, 'Management would gather training and continually up-skill, then change business systems, then it affects everybody'.

Industries have identified there is a training gap in servicing middle management requirements and leadership and supervisory roles. Some industries are addressing this by developing mentoring programs for new entrants and early career recruits to fill the demographic gaps.

Aside from the impact on managers, the new technologies in remote monitoring (of water and biomass for instance) and animal and meat performance analytics are the next big things to be mastered. Drone

technology and satellite imagery and big-data analysis are also emerging challenges. Training to up-skill staff for these technical advances will be difficult because the technologies are often advancing ahead of the trainers.

While it is acknowledged this small sample of employers surveryed are industry leaders, when asked to rate the degree to which they and their workers are informed on emerging technologies the answers were in the top 8 to 10 range. However, some pointed out that planning a five-year timelime was probably 'too far out' to be practical for their businesses and that their decision planning was often limited to the next 18 months to two years. Some respondents argue that, although the management team was highly aware of the upcoming technology, the level of awareness across staff varied depending on the role. Supervisors and middle managers are expected to be aware of technology improvements, while operators and lower skilled positions are only expected to be able to use current technology.

Most respondents agreed that encouraging a more professional and capable sector will result in positive market opportunities. However, changes need to happen across the education and training sector to be more responsive to the needs of the sector.

When asked if they expect the total number of workers to increase, decrease or stay the same, the respondents differed in their responses. Some of the respondents expect the number of employees to stay the same because even though technology will represent more efficiencies in labour, their businesses are likely to expand and therefore the requirements for labour force would stay at similar levels. Most respondents agreed that technology will provide the ability to improve productivity with the same number of staff members.

However, they also agreed that technology is likely to impact the composition of their workforce and the skills required. In particular, middle management roles (upskill for tech and commercial) and high end machinery operators (tech upgrade) would be affected. There will be a greater need for skilled staff to operate equipment, fix the machines when they break and know-how to troubleshoot the machine when required.

The ability of workers to integrate and respond to advances in technology is increasingly a priority. Respondents agreed that there is constant need to continuously invest in up-skilling their workers. Some have approached the challenge by adopting a 'train the trainer' approach. They invest in supervisors to acquire the skills though training from a reliable source, mainly technology providers, and then they become the trainers in their business.

Changes in the market will also have an impact on the labour force. Food technologists, quality control specialists and other product specialists will need to be able to provide products that add value and address customer's needs.

Other skills mentioned that would be increasingly important are: weather interpretation and risk management; high use of electronic data capture and remote variable rate control; and safety and sustainability. Management in agriculture will increasingly require knowledge of technology, regulation, markets, and the ability to lead and manage staff. Most respondents indicated that management will be required to be more tech-savvy, more business-savvy and more aware of the changes and opportunities in their environment.

Most respondents also indicated they are likely to increase their use of contractors across the sector for more specialised tasks such as agronomy and IT. It is likely that the providers of technology and agtech industries will require more employees with the skills to develop technologies that producers need. There is also a requirement for advisors to be able to up-skill and use technology to provide advice to

farmers. Advisors will also be expected to help the agtech sector to 'design technology with the farmer' to ensure uptake and relevance of technology. They will be required to be the knowledge brokers and innovation coachers for industry. It is likely that the need for advisors in the use of particular technologies, and new practices is likely to increase.

Demographic factors and regional variations

The 'thin market' issue in the training delivery arena was often mentioned by respondents in various formats. Likewise, a number of respondents mentioned that government-funded employment and skilling programs are often too diffused and spread too thin to be of any value to even the bigger enterprises ($20 million + annual turnover).

There are several training issues that need addressing as technology solutions are sought to improve early detection and surveillance systems (including automation).

Through this survey, we sought specific information on what government workforce programs respondents used to hire workers in the past 12 months. Respondents have used a variety of programs encouraging diversity in the workforce over the years, but they are not in much use at present, with the noted exception of visa programs for overseas workers. These migration programs are currently under national review with a focus on a possible dedicated migration solution with visa arrangements that are specific to meeting labour shortages in agricultural industries and integrate into a robust and flexible Fair Work systems.

There was a lack of awareness among respondents of the available initiatives provided by government to skill or recruit workers. With the exception of horticulture, just a few of the other industries have used initiatives such as Skilling Queenslanders for Work, Back to work, and other incentives supported by Job Actives. There is a perception that the programs are complex and time-consuming. Most companies were interested in finding solutions for their business, but the solutions needed to be flexible, easy to implement, and attract the right type of workers for their business.

The horticulture industry, however, uses these programs actively, in particular, temporary foreign workers, and seasonal workers. Most respondents in this category had some experience with programs that support the employment of foreign workers.

In less labour intensive industries like sugar, there was limited knowledge of the programs available to access these groups. Currently, they advertise their positions through normal channels and do not target specific groups.

Respondents were very open to encouraging diversity in the workplace. A few have put a lot of effort in doing so by increasing the participation of women in the workplace. Most agriculture businesses are willing to try any of the programs as long as they provide appropriately skilled workforces and are not too onerous and complex to engage in.

A few respondents that had experience with some of the programs expressed their concerns in the level of paperwork and processing. Some also had bad experiences with past efforts to employ the long-term employed. In a few instances, they tried to employ this cohort but had very limited success.

One of the respondents from the horticulture industry stated that: "Better support is needed for the employer for them to apply programs, both training and employment initiatives. For example; the Seasonal Worker Programme requires a lengthy administration process".

Survey Responses

To compliment the information gathered through the interviews, participants were asked to complete a small survey. Twenty-one people completed the survey.

The first question asked participants to rate what extent the following workforce issues affect their industries (see Table 4 for responses). Most of the respondents agreed that a significant issue for their industries is attracting young workers (19 out of 21). The respondents also agreed that there is a shortage of skilled workers which is having a negative impact on the sector (17 out of 21) as well as the ability to retain this workforce (16 of 21). Regarding skills, most respondents agreed there was a need to improve the capabilities of their workers (16 of 21), and that employees with new technology skills (17 out of 20) and management skills (15 out of 20) were needed.

Other workforce issues mentioned included: the cost of training due to remoteness; the physical demands imposed in some positions are a disincentive; job seeker sources can be difficult to find; and young people lack experience.

	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE OR DISAGREE	AGREE	STRONGLY AGREE	DON'T KNOW	TOTAL
A shortage of qualified/skilled workers is having a major negative impact on the industry	0.00% 0	9.52% 2	9.52% 2	52.38% 11	28.57% 6	0.00% 0	21
The difficulty retaining qualified/skilled workers is having a major negative impact on the industry	0.00% 0	9.52% 2	14.29% 3	42.86% 9	33.33% 7	0.00% 0	21
There is an urgent need to replace retiring managers/operators and focus on succession planning in the industry.	0.00% 0	0.00% 0	55.00% 11	30.00% 6	15.00% 3	0.00% 0	20
A main issue for the industry is difficulty in attracting young workers	0.00% 0	0.00% 0	9.52% 2	33.33% 7	57.14% 12	0.00% 0	21
A main issue is the need for new/improved management skills of employers	0.00% 0	9.52% 2	19.05% 4	52.38% 11	19.05% 4	0.00% 0	21
A main issue is the need for new skills such as technology skills	0.00% 0	0.00% 0	15.00% 3	55.00% 11	30.00% 6	0.00% 0	20
A main issue with employees is a lack of essential skills like English literacy	0.00% 0	33.33% 7	52.38% 11	14.29% 3	0.00% 0	0.00% 0	21
A main issue is the education not meeting the needs of my sector	0.00% 0	0.00% 0	61.90% 13	28.57% 6	4.76% 1	4.76% 1	21
A main issue if the need to improve the skills of workers	0.00% 0	4.76% 1	14.29% 3	57.14% 12	19.05% 4	4.76% 1	21

Table 4 Responses to agriculture workforce issues

The second question asked which top four activities would help respondents most to address HR issues affecting operations in the agriculture industries. The top responses are shown in Table 5 below. The top activities mentioned were: increasing marketing efforts to show what agriculture has to offer to its workers; increasing access to training programs, and broadening mentoring, apprenticeship and internship programs. The responses show that industries are interested in attracting new entrants and need to provide training that includes practical experience. Other responses mentioned that the pool of local workers is getting smaller, so the sector needs to get creative in recruiting efforts and getting good trainers to remote locations.

ANSWER CHOICES		RESPONSES	
Increase marketing efforts around what the agricultural industry offers to workers (1)		61.90%	13
Increase access to training programs (e.g., online learning; workshops) (4)		61.90%	13
Broaden mentoring / apprenticeship and internship programs (2)		52.38%	11
Promote professionalism in the sector (e.g., worker proficiency, standards and certification) (6)		42.86%	9
Improved human resource management (HRM) skills and practices for employers. (10)		42.86%	9
Improve support for partnership and collaboration among agricultural industry workers, training institutions, associations and businesses (8)		38.10%	8
Alter subsidies/ incentives (related to income) (5)		33.33%	7
Hire additional unskilled entry-level workers (9)		23.81%	5
Other (please specify) (11)	Responses	19.05%	4
Increase support for broader skills training (e.g., project management, marketing, communications, IT skills and financials, etc.) (3)		14.29%	3
Improve work-life balance of workers (e.g., flexible work arrangements) (7)		9.52%	2

Table 5. Activities that would help addressing the HR issues

The third question asked respondents what roles in agriculture have experienced labour shortages. Table 6 shows the responses that indicate that more than half of the respondents have experienced shortages in the roles of supervisory personnel (who are not farm managers), skilled roles (those requiring accreditation or significant experience) and semi-skilled roles (requiring a reasonable degree of practice or experience, certificate II). Most respondents indicated labour shortages. Only one of the respondents stated that they did not have any labour shortages.

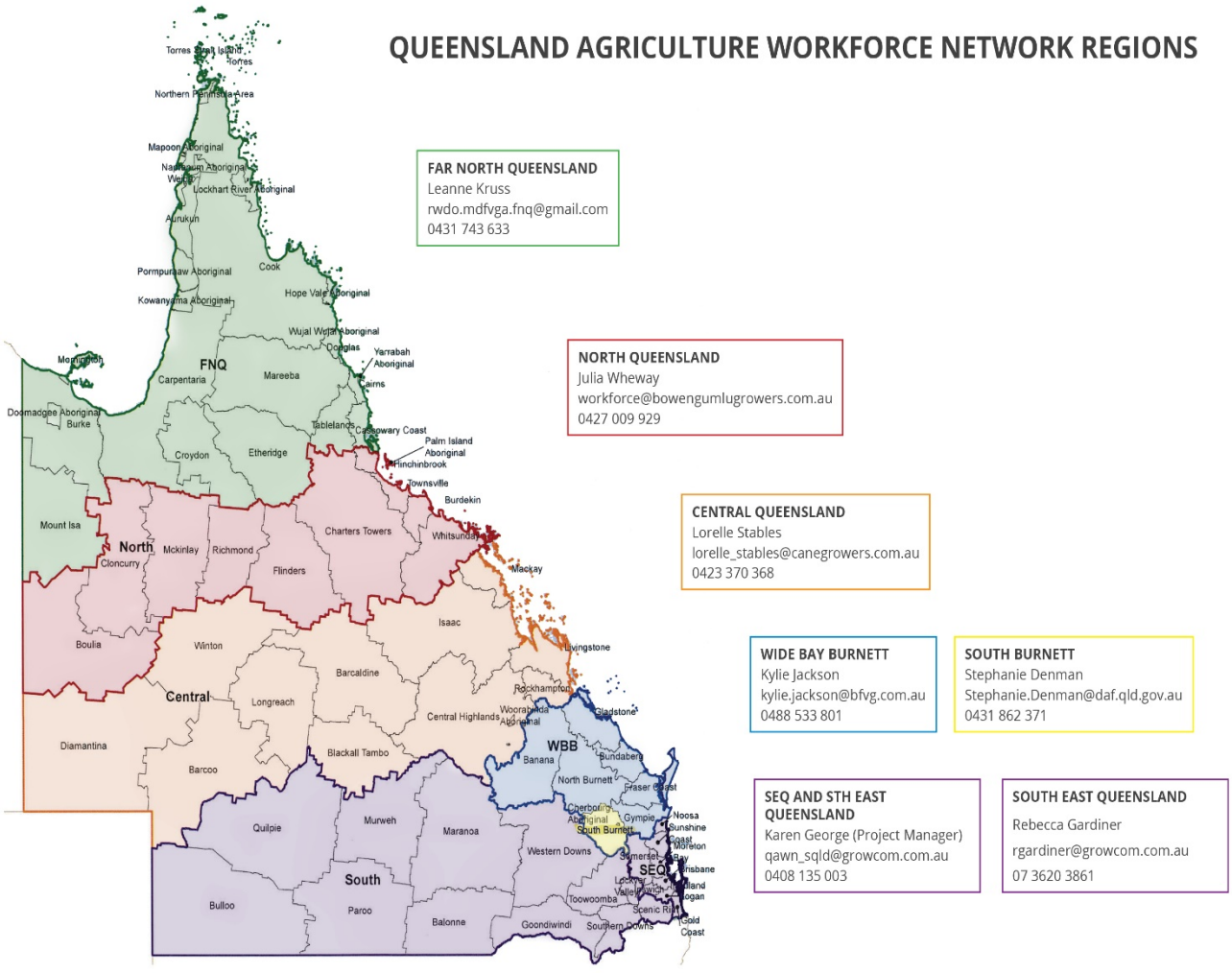
ANSWER CHOICES		RESPONSES	
Supervisory personnel (who are not farm managers).		55.56%	10
Skilled roles (e.g. requiring accreditation, a certificate III, or significant experience).		55.56%	10
Semi-skilled roles (e.g. requiring a reasonable degree of practice and experience, certificate II).		55.56%	10
Farm managers.		33.33%	6
Unskilled labour roles (e.g. requiring little more than a brief introduction to the work).		22.22%	4
Technical roles (e.g. requiring a university degree, or certificate IV and above).		16.67%	3
The farm does not experience any labour shortages.		5.56%	1
Other (please specify)	Responses	0.00%	0

Table 6 Labour shortages experienced

CHAPTER 5: REGIONAL ANALYSIS - QUEENSLAND AGRICULTURE WORKFORCE (QAWN) REPORTS

The following regional analysis is provided by the Queensland Agricultural Workforce Network (QAWN). The information provided is based on anecdotal evidence from the network gathered through their interactions with industry.

QAWN is an industry-led rural jobs initiative funded by the Queensland Government. It consists of six agriculture workforce officers based with agriculture industry organisations to help address agriculture's labour and skill needs. The map below shows the regional division across Queensland.



QAWN REGION - Central

Emerging challenges and disruptions

The main disruptions to impact agriculture in Central Queensland over the next five years may be:

- Climate change resulting in increasing droughts and cyclones. This is particularly an issue in regions such as the Central West where drought conditions continue at present and stock numbers are low.
- Emerging environmental regulation of industries located in reef catchments
- Cost of power and water. This is an ongoing issue for all industries in the region. For example, the prices for both energy and water for the sugar industry are due to rise in the next few years, and this on top of a declining price will affect their margins.
- Digital disruption: uptake of technology offers possibilities for productivity gains and cost savings. However, the cost of adopting these technologies can be high and a barrier to their uptake.

Emerging workforce, skills issues and recommendations

Emerging industries in biofuels, biopharmaceuticals and aquaculture can offer new possibilities of work in agriculture over the next three to five years.

Central Queensland workforces have expressed that Cane BMP and other Best Management Practices (BMPs) in the cotton and horticulture industry are challenges to training. Farmers require the right skills and understanding to comply with BMP practices to remain competitive and sustainable. This training needs to be flexible and industry relevant, perhaps through greater funding of skill sets. Current Ag colleges offer courses but graduates have complained that they are not coming out with actual hands-on training. The establishment of a regional Ag training facility in Mackay or the Whitsundays where practical experience is provided would greatly benefit farmers in the region. This facility could consider partnership with already available research facilities.

The ability to train seasonal workers to uptake tasks such as haul-out driving and shearing is a significant challenge in Central Queensland. These workers move on each season and therefore new people have to be trained on an annual basis.

Excellent training in various formats is being delivered through reef funding to sectors such as grazing and sugar by NRM groups and industry groups. However, areas such as Central West don't get access to the same training resources. Without the Industry Skills Fund, there isn't much space for agriculture to apply for funding for training.

There needs to be more funding to support skill sets and to support employers to up-skill their current workers.

Queensland VET training system

The Queensland VET training system needs to be more pro-active in order to assist the agriculture industry in Central Queensland. The system needs to be more flexible, less time consuming, and increase the ability of agriculture workers to do Recognised Prior Learning (RPL). The training has to be designed with the people, not just for the people. This requires closer connections with industry bodies to ensure the training is relevant and meets the requirements of farmers.

Issues affecting the supply and demand of labour and skills

Retaining appropriately skilled workers is an issue, particularly in remote areas such as the Central West, where it is difficult to attract skilled or seasonal workers.

The seasonality of the work is a huge barrier in retaining a skilled workforce. The lack of appropriate training facilities in some areas to conduct practical hands-on application of learning is also a barrier. Current facilities in some areas of the Central West are not meeting the standards expected by the industry.

There lacks a committed and willing local workforce to undertake jobs in agriculture, coupled with a high turnover in these jobs. This has been experienced in the meat works in Mackay i.e. they have gone through 150 employees since February with an estimated induction cost of $2500 per employee. In one week, they had 75 unemployed people come through their doors and only 2 lasted the week. Competition from competing industries such as mining and more recently solar farms is also a factor.

Barriers to recruiting and training

There is a perceived remoteness on behalf of workers for some areas in Central Queensland. The government needs to better promote the lifestyle benefits of living in regional areas. This would help to promote the new and emerging work opportunities that are available. Another priority should be to ensure workers have their basic needs covered including transport infrastructure, and access to education and health providers.

Agriculture industries particularly in the Central West are competing against mining and other industries (including solar farms which are a big poacher of skilled and unskilled workers) for new workers. There is also a lack of haul-out drivers. The trend has been for them to train, do their jobs for the season and then leave in order to get employment elsewhere. Most of them find work in competing industries such as mining. These industries normally pay higher wages and offer full time employment so they are more attractive.

When it comes to training, the most common issue for workers is the cost. For example, forklift courses are being delivered at a price that is almost double what others are offering. Farmers are also too constrained by time to undertake proper training. More flexible delivery methods are needed to fill the needs of the industry.

Current strategies to address challenges

Industry is providing its own training to meet its needs, as is the case with haul-out driving. In many cases, industry bodies are not using the VET sector to deliver training as it is too complicated and out of touch. Informal training is provided by a range of industry organisations and growers are seeking training through NRMs and grower groups.

The government program that has received the greatest traction in the region is the Seasonal Worker Programme. This programme helps farming businesses locate a reliable workforce that are happy to come back to work and meet the needs of the industry. Even when there are locals to perform the jobs, they don't often want to do the work because of the casual nature, the hard work in hot conditions etc. Therefore, the Seasonal Worker Programme is very important to growers to fill the gap. Employers

in the region are known to favour employees from the Seasonal Worker Programme and Back to Work Program, as well as youthful workers.

In the Central West, the dominant RTO service providers known to work closely with industry include Queensland Agricultural Training Colleges (QATC), TAFE and Central Queensland University (CQU), while very few agriculture organisations have confidence in Job Actives.

Uptake of incentives and initiatives

The industry does engage with the Skilling Queenslanders for Work program and finds it useful. Recently CANEGROWERS ran a Haul-out course and ten out of ten individual participants found gainful employment. Unfortunately, these ten employees will likely move on to other industries after the season.

However, there is a concern that the timeline of the Skilling Queenslanders for Work program doesn't address those that are currently in other jobs who want to come to agriculture. The timeliness for the program needs to be more flexible to meet the seasonal needs of the industry; otherwise other programs need to be put in place.

Current programs under the Skilling Queenslanders for Work funding only apply to unemployed people and do not help students at-risk. The program should consider working with schools to identify at-risk individuals to prevent unemployment for this cohort.

QAWN REGION - FNQ

Emerging challenges and disruptions

The Northern Australian Agricultural Industry is a booming sector facing huge change and progression in today's "green" world. With growing populations and the need for innovative ways to make the most of productivity, scale-ability and resources, there are endless labour opportunities on the horizon.

Technology is transforming the entire supply chain into a high-tech, highly data driven industry with decisions being made based on real gathering and processing of data, ultimately delivering substantial increases in productivity yields and adding value to businesses.

As a result, developing a good framework in ag-tech foundations (both Vocational and Tertiary), and proper facilitation to teach young generations new skills is essential. It is important for industry to create employment and training partnerships and establish and expand industry specific workforce planning for reasons of long term sustainability, productivity, capacity and capability building. In Far North Queensland, it is particularly vital that the industry retains interested local students that are unable to travel south to continue their studies.

QAWN FNQ has developed a three-to-five-year strategic plan for agriculture in this region (our biggest economic industry for the region) to future proof sustainable workforces. There is an absolute need for our growing innovative agricultural region to develop new pathways to keep agriculture digitally advanced and sustainable. The strategic plan includes a strategy to build middle to high-skilled job positions, which at present are difficult to fulfil or retain due to study pathways not being available in the north.

Emerging workforce and skills issues

QAWN FNQ has collaborated with local industries to develop an up-skilling plan to determine industries' priorities for action.

The term up-skilling here covers the breadth and diversity of occupations and careers associated with technical transformations to industry including:

- Leadership/Management
- Production (on farm and beyond farm gate)
- Processing (on farm and beyond farm gate)
- Natural Resource Management (water, catchments and regions)
- Marketing, Content Marketing and Brand recognition
- Research, Development and Extension
- Governance and Policy.

Our workforce of the future needs a complement of diverse, new and evolving skills that will help enable: the interpretation of vast amounts of data; operation of emerging and advanced technologies; adaption of changing farm practices; the disciplined adoption of food safety; understanding consumer markets; and the implementation of IPM (integrated pest management).

At present, the northern agricultural industry has reported widespread shortages of skills in the following areas:

- Supervisors
- Middle managers and supervisors
- Farm operations managers
- Agronomists
- Irrigation specialists
- Experienced machine operators
- Service personnel
- People with higher level technical skills.

There are a series of strategic actions required to ensure work in agriculture is properly promoted over the next three to five years:

1. Engage in an industry-wide promotional campaign
2. Articulate and promote the diversity of pathways and training in agriculture into the future
3. Investigate funding for workforce development and planning in agriculture, especially in technological transformations and future skills needs
4. Improve co-ordination of training and skills development through partnerships between industry, stakeholders and government.

Queensland VET training system

The Queensland VET training system needs to listen more closely to industry voices and make decisions for a statewide and regional strategy based on market intelligence via QAWN. Funding for purposeful skill sets that link to full courses should be made a priority.

With the Farm Business Management Skill Set (AHCSS00030), farmers who are just starting out or wanting to take their business to the next level have an opportunity to strengthen their management skills with funding from the Queensland Government. The training aims to enhance practical business skills and covers business planning, budgeting, risk management and succession planning.

Another great example of a skill sets program is the federally-funded P-TECH program through Tec-NQ's senior school in Townsville. QAWN FNQ and QAWN NQ are representing the needs of industry in this program. Tech-NQ is interested in offering a qualification that encompasses basic electrical skills, electronics, engineering and hydraulics (proposed) skills to enable people to perform the installation, maintenance and repair of various forms of agricultural equipment and technology.

The aim of P-TECH is to offer industry supported educational pathways commencing in senior school and concluding with a diploma or associate degree outcome. James Cook University (JCU) is proposing the development of a Diploma of Applied Technologies to suit this outcome.

Issues affecting the supply and demand of labour and skills

The industry's most valuable asset is its workforce and the northern agricultural sector is confronted by a number of workforce challenges. These include:

- An ageing workforce
- Competition for labour and skills from the higher-paying mining and construction sectors
- A poorly marketed industry sector in terms of employment opportunities
- A workforce with management staff with often lower levels of qualifications
- An increasingly sophisticated, highly technical workplace requiring a more highly-skilled and educated workforce
- Demands from the marketplace for higher quality and lower prices.

Additionally, since most companies are located in regional and rural areas, attracting people to live and work outside urban centres is often difficult.

Barriers to recruiting and training

QAWN FNQ has a huge focus around retention. Often businesses can recruit and source staff, however turnover is frequent due to their location and required positions. People from the southeast with higher-education qualifications are being sourced due to the fact that no tertiary agricultural degrees are offered locally. Other barriers include difficult summer weather for work, natural disasters, distance from family, and a lack of public transport services.

There will always be a need for seasonal labour and QAWN is filling these positions with the backpacker industry and the SWP, however the industry is moving away from less non-skilled positions towards more highly skilled positions in permanent positions. There is a growing struggle to fill these positions if we do not begin to develop appropriate training in this region.

QAWN propose the following degrees be offered in Far North Queensland:

- Degree in agriculture (with a core focus on modern agriculture needs, agronomy, plant and animal science)
- Degree in mechanical engineering (focusing on robotics, future automation of paddock and packing sheds, and all other engineering aspects and technology)

- Degree in Technology (IoT and the whole technology side towards agriculture, mapping, gis, satellite services, apps, drones etc.).

These proposed degrees should have exit points for different qualifications. For example, should a student complete one year, they will receive a Diploma level qualification, two years and they will get an advanced diploma. QAWN is helping develop this into a reality. Information about the proposed degrees and the promotion of careers in FNQ agriculture to change negative perceptions are core industry needs.

Current strategies to address challenges

New and increased developments in the Seasonal Worker Programme are helping this region. Transport problems are rectified by providing vehicles and licensing within the SQFW program of soft skills. Migrant workers are also housed and local councils are vigilant that housing options are readily available, especially in peak seasons.

In Far North Queensland, very few RTO service providers work closely with industry. There has been a push towards servicing heavily funded certificates rather than specific industry needs.

TAFE does have a Workforce Planning skillset which QAWN promotes, however it is generic and needs to be modified to meet specific agriculture needs.

When it comes to hiring skilled workers, incentives and initiates make no difference to the minds of employers who base their decision on work ethics. If by chance the worker falls into a category with an incentive, then that is just a bonus.

For a more permanent position, in most cases the right person is sought by industry who will connect with QAWN to see what available incentives are out there. For more casual and seasonal positions, this approach is not taken.

As a general consensus amongst the community, the industry would like to think they would employ local Australians, however they will always choose the best option that increases their productivity levels, work performance and safety with the least amount of hassle or paperwork. Therefore, most options addressed above are not explored due to the effort required.

Due to QAWN, there is an increased uptake of the SWP for a more stable low-skilled workforce. Evidence shows business productivity for the first three years increases after employing seasonal workers. It is believed this program will be the main source of low skilled workers in the next five years across the region, especially as confidence is improving with the new labour hire regulations. The north has the added bonus of the tourist capital of Cairns on its doorstep, and a constant supply of backpackers seeking their 2nd year visa. Industry can access these low skilled workers easily and enjoy the flexibility of having them exactly when needed for harvest. A combination of SWP and backpackers are the best low-skilled choices for providing productivity increases for local businesses.

Uptake of incentives and initiatives

The agriculture industry in Far North Queensland engages in a range of incentives, primarily the Back to Work program and SWP. The up-take of these programs has generally been driven, facilitated and instigated by QAWN FNQ. Very few workers would utilise these programs without the help of QAWN.

Business engagement in training often depends on the size of the business. Most corporate farms are vigilant with training due to the very high presence of Workplace Health and Safety (WHS) officers and WHS workshops in the north. However, some smaller family owned farms are missing out.

QAWN works with BMP Coordinators to update the mapping of skills needed and match them to current units of competency, skill sets and full qualifications. The idea is that when a skills gap is identified through the BMP process, the farmer will be given the option to contact the QAWN officer in their region to find out:

- What accredited units of competency / skill sets / full qualifications would be of benefit
- What registered training organisation (RTO) can deliver the training
- What funding is available to subsidise the training or what the fee for service cost is.

In addition, if it is identified that there are a number of people who have the same skills gap in a particular region then QAWN works with an RTO to deliver a group training session.

To date, discussions have been held with the grazing, sugar and production horticulture BMP coordinators.

QAWN REGION - North Queensland.

Emerging trends and disruptions

The main challenges affecting the agricultural sector in North Queensland are external factors including the regulation of various industry functions e.g. awards and wages, industrial relations, food security, water security and biosecurity, environmental legislation regarding the reef including waste management, market access and emerging technology.

The region is impacted on a yearly basis by weather events ranging from severe tropical cyclones, flooding and winds which can all have damaging effects on the crops and soils. Transport and logistic challenges affect north Queensland with better road and rail access required (especially during severe weather events) to transport domestic produce to the main markets in Brisbane, Sydney and Melbourne as well as port access for the growing export market.

Emerging workforce and skills issues

Competition from other industries for skilled workers will continue to be a challenge for the industry in north Queensland in the next three to five years. There is a shortage of workers with a range of machinery operation skills in all the agricultural sectors in north Queensland, including cane haul-out drivers, and tractor and spray rig operators. Farm Managers with experience in managing and supervising staff are also at a shortage.

Recently there have been cases where skilled and unskilled workers, both Australian locals and backpackers alike, have been attracted to roles for the construction of solar farms in North Queensland. A farm north of Ayr has had difficulty in recruiting its usual level of backpackers via a contractor due to workers choosing higher paid work on solar farms.

Opportunities exist in North Queensland in the area of emerging technologies and new roles are being created due to a greater uptake in automated processes on-farm. QAWN is working on a pilot P-TECH project with Tech-NQ in Townsville to develop a program that will provide workers with skills for the future in conjunction with training for traditional trades.

To up-skill their employees, agriculture employers need direct subsidies for training costs. This could be applied as a stipulation as part of the existing Back to Work program, that a certain percentage of the $10,000 or $20,000 is spent on training. Previous experience with the Federal Government's Industry Skills Fund has shown that providing businesses with direct access to required training has led to better outcomes than training dollars being attached to the employee or RTO. Agriculture employers should be able to up-skill their existing workers and choose a recruitment strategy for the remaining skills gaps. A strategy similar to the Industry Skills Fund, but for primary producers, could provide better retention of skills in the industry.

Recommend strategy for seasonal workforce needs

It has been shown through the huge uptake of backpacker workers during peak seasons that employers are willing to employ workers from a broad range of backgrounds and countries in order to get their product to market. Local industry is working to manage these seasonal workers more effectively.

A pilot program could be developed in the region to provide structure to the working holiday visa. An agriculture-specific visa has been mentioned and this could be developed and expanded to include a process to pre-recruit workers from certain countries. There could be two streams of employment available: unskilled (pickers and packers) and skilled worker positions (machinery operators, supervisors, technical). These positions could be filled to meet the gaps during peak periods. The 88-days to receive a second-year visa could be applied to this program to attract workers.

A program such as this would attract target groups of people looking for an overseas experience as well as workers looking for practical agricultural experience to supplement their careers in their own country. This program would be especially useful for university students to gain practical experience.

This concept is being trialed in Bowen in 2019 via a program QAWN is developing with the Japanese Agricultural Exchange Council. Under this program, Japanese agricultural graduates will travel to Australia on working holiday visas and undertake a one-month English language program with TAFE Queensland, followed by 10 months of practical experience on farms in the Bowen region. Reciprocal arrangements for Australian workers to go to Japan are available and will also benefit growers by generating relationships with the Japanese market.

Queensland VET training system

More direct industry engagement is required from RTOs to understand the skills needed in the agriculture sector. There needs to be greater flexibility and access to required training.

Issues affecting the supply and demand of labour and skills

Competition from industries offering year-round permanent employment options is a challenge across the sector. Skilled workers are hard to find as they are employed in other industries, recently solar farms and mining. While it's relatively easy to get backpackers to fill seasonal roles in Bowen, it's more difficult for the farms in Gumlu and Burdekin to attract workers since they need transport options to get from their hostels to farms.

Transport is a major issue in this region as there are no buses linking Bowen, Ayr, Gumlu, Townsville, Airlie Beach and Proserpine. Local residents are more likely to choose work that is closer to where they live. The Tourism industry in Airlie Beach also takes a lot of the local workforce including backpackers.

The image of the industry amongst locals is not optimal and there are many misconceptions on the roles available. Agricultural work is seen as seasonal and only offers picker and packer positions. Awareness campaigns are required to educate people on positive career opportunities.

As a result of these factors, there is a lack of machinery operators, managers, specialists in the region. To address these skill gaps, industry has turned to VET and in-house training, and informal accredited and non-accredited training.

Uptake of incentives and initiatives

Employment via the Seasonal Worker Program has been successful for some businesses and is being pushed more in 2018.

It has been hard to encourage the industry to utilise other initiatives, which are there to assist them to employ a sustainable workforce. Some employers have started to use the Back to Work program after many one-on-one conversations. However, most employers are content to employ workers casually depending on their workforce needs. This is mainly due to the daily variations of work on-farms due to environmental factors and crop conditions.

The incentives in place have been geared towards long term-employment, with exception to the Seasonal Work incentives Trail (SWIT), which does not fit with the industry's seasonal nature. There is a lack of understanding about the benefits of the SWIT program amongst all stakeholders and feedback has been given to government on how this program could better benefit the industry.

Employers in North Queensland have shown to favour Temporary Foreign Workers with the visa class 418. They have also engaged seasonal workers from the SWP, Aboriginal and Torres Strait Islanders and mature aged workers at least 55 years and older. Employers were less likely to employ the long term unemployed, youth, skilled migrants, refugees or people with disabilities.

When it comes to government initiatives, farmers in the area are most likely to engage with the Seasonal Worker Programme. Unfortunately, there is not a Harvest Labour office in the region which means local jobs are not advertised on the Harvest Labour website and locals do not see available positions.

Recommendations

North Queensland requires better education about the staff roles available in the agriculture industry. There also needs to be pre-employment programs and work ethics training sessions with a specific agricultural focus. Financial incentives and training dollars need to be attached to these programs for employers to up-skill their workers.

QAWN REGION - South Queensland and southeast Queensland

Emerging challenges and disruptions

The main challenges facing agriculture in southern Queensland in the next five years may include:

- Adjustments to management decisions due to tree clearing legislation, particularly with regard to Mulga lands
- An increasing population of native wild life due to increased water points and redirection of kangaroos due to cluster fencing, along with increased numbers of wild dogs and pigs

- Higher demand for the traceability of products and continued pressure by large supermarket chains to provide quality assured traceable produce from a holistic view point. Already, organisations such as Growcom are delivering programs to meet industry needs. Disruption to current management systems is occurring through supply chain management systems which provide efficient solutions to traceability.
- The continued development of feedlots and other intensive production systems where water is available and populations are low. Intensive systems such as poultry are moving to lesser populated areas such as the Darling Downs.
- The increasing development of robotic assistance and improved efficiencies through the development of GIS and similar technologies
- Farm debt which remains high, the lack of water and changes to water accessibility and affordability
- Family farms being amalgamated and purchased by Australian and foreign companies.

Emerging workforce and skills issues

Over the next three to five years, the continual ageing population of family farm ownership and management will demand further assistance to carry-out operational tasks. There is continued competition with the resource sector to attract and sustain employees and a difficulty in attracting Australians to work in agriculture.

Family businesses are finding it more and more difficult to spread their own skills and resources across the workforce and are working unsustainable long work hours to make up for low staff.

There is movement towards seeking government funding to manage natural ecosystems across rural regions and for payment to be made to land managers to manage natural ecosystems. All the while, there continues to be rural and regional population declines and lower numbers of Australian job applicants.

Experienced rural operators are moving to larger company-owned rural enterprises. As a result, there are challenges facing the industry in finding expert assistance to operate and maintain technologically enhanced systems. Many systems are developed in other countries and the knowledge for repairs and maintenance is not within Australia. The challenge facing education and training is a lack of understanding and a shortage of trainers.

The low level of jobs in natural resource management limits the availability of trained employees to manage the state's natural resources. The non-continuous funding structure for natural resource management and agriculture extension services has resulted in low attractiveness for people entering this field of work.

Recommendations

Current and future opportunities in agriculture need to be marketed with specific targeting towards job seekers and students. Education and training facilities need to be implemented to up-skill rural professionals to educate their fellow staff. Increased government services should also be rolled out in rural and regional areas with more incentives for employees and their families to remain local to provide much-needed services to their communities.

Improved internet and mobile connectivity in rural areas is imperative to allow businesses to operate and communicate effectively.

Queensland VET training system

The Queensland VET training system could inject financial support into businesses to combat the lack of training opportunities. The lack of service to remote areas is caused by restrictions from RTOs, for example, TAFE QLD requires a 'classroom' size number of students in order for them to provide training.

Funding could be provided to rural peoples to obtain their Cert IV in training and the qualified people could then mentor their students and market vocational education opportunities to the wider community.

Issues affecting the supply and demand of labour and skills

It is difficult to attract Australian workers to undertake seasonal work because agriculture is not promoted or deemed to be a good career choice. Schools often consider it as a ''fall back'' for students who are underperforming in the class room. Students have little understanding of future job opportunities in the agriculture sector and their view points are limited.

The agriculture sector has not been well represented by government and statisticians do not capture the broad range of jobs associated with agricultural industries, often limiting their data to jobs on family farms and not including the broad range of service industries which exist to service agriculture.

Businesses often source specialist skills from other countries because Australia does not train or educate in the areas needed. Skilled visa employees dominate in intensive production systems which require specialist knowledge.

The administration required to employ staff is onerous and government requirements are constantly changing. Farm owners continue to have difficulty keeping up with understanding and complying with requirements. This contributes to businesses preferring to use labour hire providers.

Another issue affecting industry jobs in south-east Queensland is that Job Actives rarely place people in agriculture, preferring to place people in other industries such as hospitality. This could be because of their lack of understanding of agricultural work, perceived high risk for workplace injury and barriers such as distance to workplace, lack of transport and perceived high-risk work areas.

Programs available through the Department of Jobs and Small Business are also not applied equitably. Job Actives lacks the application of programs such as the National Work Experience Program, Youth Jobs Path and SWIT.

Barriers to recruiting and training

Current barriers that prevent agricultural business in south and south-east Queensland from recruiting and retaining workers include:

- Lack of interest by local job seekers to work in agriculture
- Lack of transport
- Lack of accommodation
- Lack of qualified workers for higher skilled positions
- Lack of youth remaining in rural and remote areas
- Competition from the resource sector

- Dependency on Centrelink of unemployed people, including youth. Pathways are provided to access Centrelink services but a lack of pathways are provided to gain work experience and training
- Agriculture is discouraged as a career path
- Business owners are not skilled in effective induction programs and there is lack of education and training for employers and managers in the area of human resource management.

Within south and southeast Queensland, there are skills gaps in agriculture relating to middle management training, HR training and the application of technology and problem solving.

Current strategies to address challenges

Allowing skilled workers from other countries to work in agriculture has helped address the shortage of farm workers. The South Pacific SWP has shown to work for many farm businesses as well the Transition to Work program.

Skilling Queenslanders for Work has had some success, although it would be improved if all cohorts were able to apply their skills learnt through training on private properties as well as community owned land.

QATC are working in grazing areas to deliver Farm Business Management Skill Sets and TAFE are working in amenity horticulture. Private RTOs have recently been delivering shorter course qualifications and working specifically with individual industries, such as the poultry industry.

Although ultimately positive, the SWP is not without challenges. It is only suitable for a multiple of positions - those being daily farmhands and pickers and packers.

Uptake of incentives and initiatives

Employers in this region are more likely to employ from a wide range of backgrounds and marginalised groups than other regions in Queensland. Businesses in these areas have employed Temporary Foreign Workers, Skilled Migrants, youth workers, seasonal workers, Aboriginal and Torres Strait Islanders and mature aged workers. Employers are starting to embrace the employment of refugees and people with disabilities, although these numbers remain low. The long term unemployed are the least likely to find employment in south and southeast Queensland.

The Harvest Labour Service has been very successful in Stanthorpe and a similar service is needed in the Lockyer Valley and other seasonal work areas. The SWP has gained momentum in 2018 and is highly-valued amongst some farm businesses.

More recommendations

Job Actives needs to be educated on SWIT and the benefits of the Youth Jobs Path program to promote these incentives to local communities.

In order to encourage better engagement in agriculture programs, there needs to be an equal benefit to job seekers. For e.g. the National Work Experience program only gives job seekers $20, whereas the Youth Path Internship gives $200. This is very unfair to job seekers, especially in a group situation.

QAWN REGION - Wide Bay Burnett, Gladstone & Bundaberg

Emerging challenges and disruptions

There are a number of potential challenges that may impact these regions in the coming years. Indicators hint at the following:

- Automation and technology - Farm owners are reluctant to allow an unskilled worker to operate equipment or machinery that is expensive in nature and potentially temperamental in application without the appropriate training. Training providers in these regions do not have notable opportunities to provide the appropriate training.
- Transference of farming operations from small crops to tree crops. Market trends, pest & disease incursions (predominately in the Bundaberg region) has many producers re-evaluating their farming operations to a more manageable and profitable commodity such as avocados & macadamias. These crops are less labour intensive and can often be managed, harvested and transported with a team of less than 15 in peak seasons.
- Further casualisation of positions - Seasonality of crops, market demand and weather constraints all contribute to shorter terms of employment. Employers in these regions tend to rely on a casual workforce where there is limited obligation on the employer to guarantee work as a contingency for periods where there will be no or limited work available.
- Changes in VISA guidelines.

Emerging workforce and skills issues

In considering school leavers, there is still much work to be implemented to develop work-ready employees. Local state schools in the Bundaberg region have recently implemented a voluntary Work Experience program for Year 10 Students, however there is a lack of support to continue with part time or casual employment for these students.

Work-ready programs across the region including the Federal Government's Youth Path training lack the deliverance of tangible real work skills such as being able to discern workplace bullying.

At present, the culture of the RTOs in these regions shows a reluctance to tailor programs specifically to business needs. This problem also lies with reluctance of the industry to communicate its specific needs to the training providers. There is additionally a need to contextualise training to align with emerging technology.

The advancement of technology provides a foreseeable gap in the future for much-needed training for the Bundaberg region. For the emerging workforce and industry to benefit, it is envisioned that RTO partnerships will be facilitated, endorsed and rewarded so that there can be a more rounded approach to training. Training for year 10 and 12 students needs to be improved so graduates are ready for the workforce. This emerging workforce must have transferable skills with entry level skills that can be applied across multiple sectors in the industry.

Queensland VET training system

As mentioned above, it would be advantageous if there is a 'reward' incentive for RTOs to partner with fellow RTOs to provide a broader range of skill developments for industry stakeholders. The acknowledgement of the value of skills sets and short courses for local industry workers would also help.

Issues affecting the supply and demand of labour and skills

There are limited reports of industry having issues in finding transient workers to meet the seasonal nature of the work. However, some producers have reported an increased desire to employ a local workforce to support community and regional opportunities.

The problem with current government support programs is that they are driven predominately by outcomes, rather than sustainable and ongoing employment. Traditionally, there has been a higher incentive for placing a jobseeker with high levels of disadvantage rather than placing a quality worker in the right role.

Farmer feedback has also proven that the worker's willingness and ability to attend work is a bigger issue than their skills and qualifications. This is partly being caused by limited transport options since employees' start and finish times do not correlate with available timetables.

Barriers to recruiting and training

There seems to be a blanket attitude in respect to bad unemployment rates in the region. There is a perceived lack of willing and able workers. Other barriers include: unavailable transport options, including a lack of relevant licenses and vehicles; limited practical skills and knowledge bases; the seasonal nature of employment; and workers' inability to commit to full time work.

Current strategies to address challenges

A limited number of local workforces in the region offer facilitated opportunities for its workers who show interest in being trained in alternative areas of the business, thus providing them with a more certain career pathway.

There are also instances of successful traineeships and apprenticeships being facilitated in heavy machinery and automotive trades.

Uptake of incentives and initiatives

Generally speaking, agricultural employers in the Wide Bay Burnett, Gladstone & Bundaberg primarily employ Temporary Foreign Workers with the visa class 418, skilled migrants and seasonal workers.

Regarding the Skilling Queenslanders for Work program, the traineeship stream of funding would be a perfect platform for candidates to complete the broader skills sets and participate in paid employment work experience for up to 26 weeks of placement. Unfortunately, the guidelines for this program do not allow for paid work placements. Government needs to work closely with industry organisations to allow flexibility in the guidelines of programs such as these to meet the needs of local businesses and the communities they serve.

BIBLIOGRAPHY

Agrifutures. (2016). *Cross-Industry Innovation Scan.* Retrieved from http://www.agrifutures.com.au/wp-content/uploads/publications/16-046.pdf

AgriFutures Australia; QUT IFE. (2018). *Horizon Scan Final Report: Detecting opportunities and challenges for Australian rural industries.* Retrieved from http://www.agrifutures.com.au/wp-content/uploads/publications/18-009.pdf

Arntz, M., Gregory, T., & Zierahn, U. (2016). The Risk of Automation for Jobs in OECD Countries. A Comparative Analysis. *OECD Social, Employment and Migration Working Papers*.

Australian Academy of Science. (2017). *Grow, Make, Prosper. The Decadal Plan for Australian Agricultural Sciences 2017-26.* Australian Academy of Science.

Australian Farm Institute. (2017). *Farm Policy Journal.* Surry Hills NSW, Australia: Australian Farm Institute.

Autor, D. (2015). Why are there still so many jobs? The history and future of workplace automation. *Journal of Economic Perspectives, 29*(3), 3-30.

Bowles, M. (2017). *Automation: Implications for training packages and national vocational education and training system in Australia.* Deakin Co.

Bowles, M., & Corrigan, F. (2017). *Automation Skills.* Skills Impact.

Brynjolfsson, E., & McAfee, A. (2016). *The Second Machine Age.* W. W. Norton & Company.

Burrow, T. (2017). Agribusiness is a Cornestone of Australia's Future Prosperity. *Farm Policy Journal, 14*(1), 29-35.

CEDA. (2015). *Australia's future workforce.* Canberra: Comittee for Economic Developemnt of Australia.

Collins, J., Krivokapic-Skoko, B., & Monani, D. (2016). *Attraction and retention of new immigrants in regional and rural Austrlain.* Canberra: Agrifutures.

Collins, J., Krivokapic-Skoko, B., & Monani, D. (2017). New Immigrants Critical to Australian Agriculture. *Farm Policy Journal, 14*(1), 37-49.

CSIRO. (2015). *Rural Industry Futures: Megatrends impacting Australian agriculture over the coming twenty years.* Retrieved from http://www.agrifutures.com.au/wp-content/uploads/publications/15-092.pdf

CSIRO. (2018). *Digital Agriculture: what's all the fuss about?* Retrieved from https://blog.csiro.au/digital-agriculture-whats-all-the-fuss-about/

Department of Agriculture and Fisheries. (2018). *Queensland Agriculture and Food Research, Development and Extension- 10 year Roadmap and Extension.* Retrieved from https://publications.qld.gov.au/dataset/qld-agriculture-and-food-research-development-and-extension-roadmap/resource/5ab53e3a-b245-4271-aefc-774fcc560765

Department of Agriculture and Fisheries. (2018). *Queensland Agriculture and Food Research, Development and Extension: 10 year Roadmap and Action Plan.* Advance Queensland.

Food Innovation Australia Limited (FIAL). (2016). *Sector Competitiveness Plan: Food and Agribusiness Growth Centre.* Werrebie, Victoria: FIAL.

Frey, C. B., & Osborne, M. A. (2013). The future of employment: How susceptible are jobs to computerisation?

Hajkowicz, S., Reeson, A., Rudd, L., Bratanova, A., Hodgers, L., Mason, C., & Boughen, N. (2016). *Tomorrow's Digital Enabled Workforce: Megatrends and scenarios for jobs and employment in Australia over the coming twenty years.* CSIRO.

Heath, R. (2017). The Changing Agricultural Workforce. *Farm Policy Journal, 14*(1), 1-8.

Heath, R. (2018). An Analysis of the Potential of Digital /agriculture for the Australian Economy. *Farm Policy Journal*, 9-24.

Korff., D. (2017). The Changing Agricultural Workforce- How Can it be Sustained and Developed? *Farm Policy Journal, 14*(1), 11-17.

KPMG. (2018). *Growing agriculture into a $100 billion industry .* National Farmers Federation.

KPMG. (2016). *Power growth - realising the potential for agtech in australia.*

National Farmers Federation (NFF), KPMG. (2018). *Talking 2030 - growing agriculture into a $100 billion industry.* Retrieved from https://assets.kpmg.com/content/dam/kpmg/au/pdf/2018/talking-2030-growing-australian-agriculture.pdf

Netttle, R. (2018). International trends in farm labour demand and availability (and what if means for farmers, advisers, industry and government). *Internatioal Agricultural Workforce Conference.* Cork, Ireland.

Nye, C. (2018). *The 'blind spot' of agricultural research: Labour flexibility, composition and worker availability in the South West of England.* Cahiers Agricultures. 27. 35002. 10.1051/cagri/2018018.

OECD. (2015). *Innovation, Agricultural Productivity and Sustainability in Australia.*

Perez, T., & Lee, G. (2017). *Skilling the Future Workforce in Digital Agriculture.* Brisbane: Under Review.

Pratley, J. (2017). The Technology Paradigm Driving Agricultural Workforce Change. *Farm Policy Journal, 14*(1), 19-27.

Queensland Department of Agriculture and Fisheries. (2018). *Queensland Agriculture Snapshot.* Retrieved from https://www.daf.qld.gov.au/__data/assets/pdf_file/0007/1383928/State-of-Agriculture-Report.pdf

Queensland University of Technology , Institute for Future Environments. (2018). Horizon Scan Final Report: Detecting opportunities and challenges for Australian rural industries. Agrifutures Australia.

Scientific Foresight Unit. (2016). *Precision Agriculture and the Future of Farming in Europe.* Brussels: European Parliament Research Services. Retrieved from http://www.europarl.europa.eu/RegData/etudes/STUD/2016/581892/EPRS_STU(2016)581892_EN.pdf

Shah, C., & Dixon, J. (2018). *Future job openings for new entrants by industry and occupation.* NCVER.

Skills Impact. (2018). *IRC Skill Forecast and Proposed Schedule of Work 2018-21.* Skills Impact.

Skinner, A. (2018). Big Data Maturity in Australian Agricultural Industries. *Farm Policy Journal, 15*(1), 61-68.

Trindall, J., Rainbow, R., & Leonard, E. (2018). Enabling Digital Agriculture. *Farm Policy Journal, 15*(1), 1-6.