MISSION FOOD FOR LIFE

AgriFood Supply Chain Resilience

Leveraging digital and data to enhance the resilience of Australia’s AgriFood sector

July 2020
We acknowledge the in-kind support of the project stakeholders.

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The findings in this report have been formed on the above basis and completed between 20 May 2020 and 15 July 2020.

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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>AANZFTA</td>
<td>ASEAN-Australia-New Zealand Free Trade Agreement</td>
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<tr>
<td>ACCC</td>
<td>The Australian Consumer and Competition Commission</td>
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<td>AgriFood</td>
<td>Operations involved in the production, movement and supply of food.</td>
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<td>AI</td>
<td>Artificial Intelligence</td>
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<td>APVMA</td>
<td>Australian Pesticides and Veterinary Medicines Authority</td>
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<td>ASEAN</td>
<td>Association of Southeast Asian Nations</td>
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<td>BOM</td>
<td>Bureau of Meteorology</td>
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<td>Codex</td>
<td>Codex Alimentarius</td>
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<td>CRM</td>
<td>Customer Relationship Management</td>
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<td>DAWA</td>
<td>Department of Agriculture, Water and the Environment</td>
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<td>EDI</td>
<td>Electronic Data Interchange</td>
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<td>eNVD</td>
<td>Electronic National Vendor Declaration</td>
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<td>EU</td>
<td>European Union</td>
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<td>IoT</td>
<td>Internet of Things</td>
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<td>FTA</td>
<td>Free Trade Agreement</td>
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<td>FMD</td>
<td>Foot and Mouth Disease</td>
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<td>FSP</td>
<td>Food Safety Plan</td>
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<td>GDP</td>
<td>Gross Domestic Product</td>
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<td>GM</td>
<td>Genetically Modified</td>
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<td>kmt</td>
<td>Thousand Metric Tonne</td>
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<td>ML</td>
<td>Machine Learning</td>
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<td>MLA</td>
<td>Meat &amp; Livestock Australia</td>
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<tr>
<td>mmt</td>
<td>Million Metric Tonne</td>
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<td>MRL</td>
<td>Maximum Residue Limit</td>
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<td>NTM</td>
<td>Non-Tariff Measure</td>
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<td>RD&amp;E</td>
<td>Research Development and Extension</td>
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<td>ROI</td>
<td>Return on Investment</td>
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<tr>
<td>RFID</td>
<td>Remote Frequency Identification system</td>
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<td>SWT</td>
<td>Shipped Weight</td>
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<td>T</td>
<td>Trillion</td>
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<td>VRT</td>
<td>Variable Rate Technology</td>
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<td>WUE</td>
<td>Water Use Efficiency</td>
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Drought. Fire. Flood. Pandemic. Geopolitical barriers. A lot has been thrown at the Australian AgriFood industry in the last 12 months. What we initially thought was an unfortunate conflation of events, we now realise is the new normal of constant 'shock-upon-shock'. Are we ready for it?

The pandemic has been a wake-up call for businesses whose digital transformation strategies have been idling. Supply chains have been pulled and strained in ways we have never experienced before. Those with the capacity to respond quickly via digital solutions and build new data-driven business models have had the upper hand.

As a sector, AgriFood has not been idling, but it has been in a lower gear when it comes to digital transformation. Other major industries systematically use data to anticipate, innovate and grow value. They have built resilience through their use of data and digital technologies.

Modern food supply chains will never look the same again, but there is an exciting opportunity for them to emerge stronger than ever. Now is the time to accelerate digital transformation of AgriFood and to build new data-driven solutions that will help it to REBOUND quickly, REINVENT business models and build RESILIENCE.

The other key ingredient is trust. Supply chains connected with data thrive on trust. Without it, data will not be shared and the benefits of predictive decision making will be lost. Food Agility takes very seriously its role as a trusted, independent broker and co-investor within the AgriFood innovation system. It’s our job to help bridge the gap between different actors in the supply chain and to create an environment where people are willing to collaborate and share data to benefit the broader industry.

This report is a launchpad, rather than a culmination. It is an important first step in understanding the challenges, identifying where the opportunities are and prioritising them for action. It is also the first project in Mission Food for Life, a $10 million Food Agility CRC initiative to build data-driven resilience in our food supply chains.

It is our conviction that research and development to unlock data-driven resilience can deliver significant returns-on-investment for our sector. Mission Food for Life is a call to action for AgriFood and AgTech partners who share our vision and want to show leadership in tackling what is one of the greatest challenges of our time: how to keep food on the table in a crisis and beyond; how to produce and deliver... food for life.

We invite you to join the Mission.
The Australian AgriFood sector has demonstrated significant resilience in the face of adversity for decades. Whether we’re faced with drought, bushfires, flood – or as in recent times a global health pandemic – we’ve been able to focus on recovery and rebuild to establish a new way of operating.

In more recent times as we’ve continued to operate in a rapidly changing and more unprecedented environment, it has become evident that we need to better prepare the sector and specifically the capacity of our AgriFood supply chains to withstand the successive impacts of shocks.

To enable and enhance the resilience of our AgriFood supply chains, we must fast-track the identification of core weaknesses to develop and invest in mitigation strategies that reduce the stresses that these weaknesses impose upon our supply chains, and enhance their capacity to withstand future shocks. The AgriFood sector needs to invest more, and more strategically, particularly in the area of digital prediction and enablement tools.

Connecting the physical, biological and digital worlds together will enable the AgriFood supply chain to make better, faster decisions, automate processes, reduce cost and enable the prediction of future events. Insights from trusted real-time data will help the sector to more nimbly respond to what the market wants, be more efficient in production, reduce wastage, increase yield and show our customers how safe and sustainable our food is.

This report highlights that further investment in harnessing digital innovation is required if we are to see a step-change in the resilience of the AgriFood sector. We have the capacity to leverage cross-sector collaboration and technology capability that will deliver for a broader set of supply chain actors and a larger aggregate of industries. Agriculture technology (AgTech), the Internet of Things (IoT), blockchain, Artificial Intelligence (AI), satellite imagery, genetic modification and gene editing will all play a key part in enhancing the underlying resilience of our AgriFood supply chains.

Investment is required across the public and private sector, along with a coordinated approach to the adoption of new data and digital interventions. Along with Food Agility, KPMG Australia look forward to continuing to build on our work in the AgriFood sector with governments, researchers and industry to progress the agenda.

They say ‘Adversity is the Mother of Invention’ and as with any major historical period of rapid change, the current times herald a new frontier for the Australian AgriFood sector.
The topic of resilience in the AgriFood sector has become increasingly important in recent years as supply chains across the globe look to respond to the pressures of a rapidly growing population, increased climate variability and resource scarcity.

At the same time, digital and data disruption is creating new and diverse opportunities to transform operations throughout the supply chain. Dietary habits are shifting, and consumers are wanting to know more about the origins and sustainability of their food, adding increasing pressure on supply chains to become more transparent and accountable.

Not only do we need to produce more food to feed the world’s population, but need to do so in a context of constant disruption and volatility. Out of necessity, supply chains have become leaner and more efficient, designed to be as competitive as possible. Without robust mitigation strategies in place, supply chains and entire markets can be severely impacted in the event of a shock.

In the past 12 months alone, Australia has endured a number of shocks in the form of catastrophic bushfires, drought, floods, and is currently navigating its way through the global COVID-19 pandemic. The compounding effects of these shocks have meant supply chains of all forms are experiencing heightened volatility and vulnerability as they adapt to their ‘new normal’ way of operating. Operating in the ‘new normal’ requires investment in resilience across our AgriFood supply chains, with an appreciation that supply chains are only as strong as their weakest link. Organisations need to constantly re-assess resilience within their own operations and assets, but they need to do so with consideration of the broader context of their end-to-end value chain.

Future resilience will be underpinned by the adoption of digital and data-driven technologies including the likes of artificial intelligence and machine learning, Internet of Things (IoT) and blockchain technologies. These technologies have the capacity to better manage and mitigate the impacts of production and demand volatility, increased climate variability, rising costs of inputs and market access compliance. Technology can provide organisations with the insights they need (real-time, predictive and over time, cognitive) to enable greater oversight of supply chains when shocks occur, leading to proactive and informed decision making. Resilient supply chains of tomorrow will use these tools to become dynamic and tightly integrated ecosystems where data sharing is encouraged and incentivised.

As a collective AgriFood industry, now is the time to invest in the required research and infrastructure to support digital and data adoption, ensuring stable production and consistent flow of food supply in future shock scenarios. More resilient AgriFood supply chains will underpin our GDP growth ambitions and drive more sustainable industries for the long-term.

Purpose of this report

This report seeks to identify and assess the underlying stresses within six significant Australian AgriFood supply chains and the amplified impact that these stresses have on supply chain resilience when shocks occur. By understanding when, where and how stresses occur, mitigation strategies for industry investment can be identified with the goal of reducing the risks and vulnerabilities which arise in shock scenarios.

The report maps strategic digital and data R&D investment opportunities that are clustered around core to transformative ROI potential for each sector. Key themes emerging across sectors highlight the potential to integrate solutions and target cross-sector opportunities to enhance synergies, accelerate realisation of the benefits and increase whole of industry impact.
Key findings

1. Strong potential for cross-sector collaboration

This report has identified the wide variety of challenges faced by AgriFood supply chains across Australia and the impact that shock events incur on individual businesses and the industry at large. While some sectors are dealing with specific challenges inherent in their supply chains, many of the challenges identified are experienced to some extent across all sectors. Climate variability, labour and skills shortages, environmental sustainability, shifting consumer preferences and global competition are challenges all sectors are facing and will continue to face in the years ahead. This gives rise to a number of cross-sector investment opportunities and the potential for industry collaboration.

2. Resilience to date has been incremental and reactive

From boutique wine operations in South Australia to expansive cattle stations in Northern Queensland, resiliency structures within the Australian AgriFood sector have been traditionally built in an incremental and reactive fashion as Australia periodically responds to bushfires, floods and droughts. Resilience to these shocks has in some ways become ‘business as usual’ as industries develop frameworks and mechanisms focused on rapid aid and recovery to normal operating conditions. A reactive rather than proactive mindset means the industry risks complacency and is more vulnerable when unpredictable and unprecedented shock events occur. Additionally, as experienced in the last 12-months in particular, a compound effect of shocks such as drought, bushfires and now COVID-19 has meant the industry has not had the time to adequately recover from one shock before the incursion of another. This compound effect has significantly eroded the resilience of our supply chains and a more proactive approach is now required.

3. COVID-19 will be a game changer for the sector

The sheer scale and impact of the COVID-19 pandemic and subsequent economic crisis is unlike any other the AgriFood sector has faced. Businesses of all sizes and maturities have been impacted by the havoc the pandemic has created, and many have been insufficiently equipped to deal with its impacts. Our biggest supermarkets have been inundated with unprecedented panic buying and have been unable to provide accurate demand forecasts to suppliers, impacting supply chains back to production. Entire sectors such as the rock lobster sector in Western Australia have been cut off from key markets overnight, bringing it to a grinding halt. We know of the devastating effects that COVID-19 has inflicted so far, but the greater concern is the unforeseeable aftershocks that will continue for years to come.

4. A fundamental shift in mindset is needed

In the aftermath of COVID-19, AgriFood supply chains will require a fundamental shift in mindset in order to survive and thrive in what will become the ‘new normal’ operating environment. Greater collaboration and digital adoption will be essential in driving agile and adaptive supply chain capacity with the ability to pivot and transform in times of shock. Supply chains will need to collaborate to develop and implement new tools and technologies which allow for real-time, predictive and even cognitive decision making to mitigate the risks which arise in future shock scenarios. The AgriFood sector’s ability to respond to the next significant shock will be defined by its use of post-disruptive learnings in the development of sustainable supply chains underpinned by digital and data.
12 key themes for enhancing supply chain resilience

The future mitigation strategies outlined across the six sectors in this report have surfaced 12 key themes for enhancing supply chain resilience:

1. A digitally capable workforce
2. Accelerating on-farm digital adoption
3. Developing new business planning and financial tools
4. Enhancing infrastructure and transport regulation
5. Enhancing our sustainability and natural capital
6. Implementing digital platforms and solutions
7. Embedding interoperable data systems
8. Utilising innovative packaging and labelling
9. Improving market access
10. Implementing digital platforms and solutions
11. Embedding interoperable data systems

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A key focus area for collaboration surrounds the collection, analysis and use of data to inform real-time and predictive decision making across supply chains. Whether in business planning, supply chain forecasting or sustainability, the ability to adopt new systems and platforms to capture and use data effectively will be critical in the future resilience of supply chains. Moving to paperless systems, particularly in transport and distribution, will be essential in driving efficiencies and preparing supply chains for future shock events like COVID-19 where access to physical assets is constrained.

The establishment of data standards and governance frameworks in addition to supporting awareness building will help improve trust and promote a culture of collaboration where data sharing is encouraged and incentivised. Moving away from siloed technology implementations towards interoperable platforms will be critical in achieving objectives relating to traceability and sustainability in the sector.

Digital and data adoption will itself give rise to new cyber and privacy challenges, creating new vulnerabilities in supply chains. The industry would be prudent to work together and invest in measures to mitigate these risks and review these measures on an ongoing basis as the technology landscape evolves.
Introduction

Purpose

The purpose of Mission Food for Life: AgriFood Supply Chain Resilience is to identify and assess the underlying stresses that impact Australia’s AgriFood supply chains when shocks occur, specifically as they relate to building AgriFood supply chain resilience. By understanding when, where and how stresses occur, mitigation strategies for industry investment can be identified, with the goal of reducing the risks and vulnerabilities which arise in shock scenarios.

This study is designed to:

1. Reach deep into multiple commodity supply chains (Red Meat, Grains, Horticulture, Dairy, Wine, Seafood);
2. Address domestic and export markets; and
3. Respond to five high risk foreseeable shocks: One Health, Drought, Natural Disaster, Geopolitical, and Technology.

Sectors in scope

The following six AgriFood sector supply chains have been analysed as part of this study:

- **Grains** (cereal, oilseeds and pulses)
- **Horticulture** (fruit, nuts and vegetables)
- **Dairy** (fresh milk and value-added products)
- **Red meat** (beef and lamb)
- **Seafood** (focus on high value products – rock lobster, premium tuna species, salmon and abalone)
- **Wine** (various geographies and wine types).

These sectors have been selected in part due to their contribution to Gross Value of Production (GVP) and export value, but also to allow for a diversified conversation which considers bulk commodities, high value export markets and value-added products. The sectors examined also bring to bear a range of geographical footprints and consideration of small, medium and multi-national businesses with wide ranging supply chain structures and processes in place.

Challenges and opportunities relating to the future resilience of these sectors are examined in the following chapters.

Resilience through a digital lens

The opportunities presented by digital and data in Australia’s AgriFood system are significant and diverse, with the potential to make AgriFood supply chains more globally competitive and sustainable. Recognising these opportunities, Food Agility aims to create new digital technologies, approaches and services for the benefit of the sector. KPMG’s Food and Agribusiness and Digital Delta teams are leaders in the Australian AgriFood supply chain and technology markets, with specialists who understand the latest market trends and how emerging technologies can be used to create competitive advantages across the sector. This combined expertise provides the opportunity to view AgriFood resilience through a digital lens, identifying opportunities to leverage digital and data to harness new value in the sector.
The opportunity for a digital AgriFood supply chain

Estimated potential increase in annual gross value of production (GVP) through unconstrained digital agriculture

-$20.3 billion
25% increase on 2014-15 levels


Digital trends shaping supply chains

- **Automation and labour savings**: $7.4 billion
- **Genetic gains through objective data**: $2.9 billion
- **Tailoring inputs to need**: $2.3 billion
- **Market access and biosecurity**: $1 billion


41% of the agricultural workforce will be impacted in the future by automating and augmenting technologies

1 in 3 new jobs in Agriculture, Forestry and Fishing will be tech related over the next 10 years


**Surveys of supply chain, risk management and industry executives show:**

- **41%** do not utilise tracking tools to enable real-time reporting
- **13%** have complete visibility into the end-to-end supply chain
- **29%** said there is no process at their company to aggregate risks from across the business
- **27%** believe there is ‘likely to almost certain’ risks with the prices of raw materials

### Defining ‘resilience’

The definition of resilience applied for the purposes of this study borrows from the 2018 adaptive definition of AgriFood resilience developed by Stone and Rahimafard (2018).

“The collective ability of AgriFood supply chain stakeholders to ensure acceptable, sufficient and stable food supplies, at the required times and locations, via accurate anticipation of disruptions and the use of strategies which delay impact, aid rapid recovery and allow cumulative learning post-disruption.”

This definition of AgriFood resilience is adaptive because it includes the ability to adapt in line with changing operating environments as well as to prioritise availability, access, suitability and stability of food supply. It prioritises food security rather than individual organisation competitiveness, and highlights the importance of post-disruption learnings in the development of sustainable supply chains (Stone and Rahimafard, 2018).

This definition also supports the notion that in the aftermath of shocks, supply chain actors are required to transform their operations to thrive in a ‘new normal’, rather than fall back into traditional ways of operating. Preparedness and proactive measures among individual supply chain actors, and on a collaborative basis, are essential in ensuring resilience at a whole of supply chain level.

The following approach has been taken across each of the six sectors to understand key resilience factors and identify opportunities for collaboration.

<table>
<thead>
<tr>
<th>Supply chain structures</th>
<th>Identifying the critical features, actors, information flows, stock, and movement of materials across the supply chain as a baseline for analysis.</th>
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<tbody>
<tr>
<td>Underlying stresses</td>
<td>Identifying the underlying stresses inherent in the sector which increase the vulnerability of the supply chain and the actors within it. ‘Stresses are long-term trends or pressures that undermine the stability of a supply chain and increase vulnerabilities within it.’</td>
</tr>
<tr>
<td>Shock scenarios</td>
<td>Assessing how shock scenarios impact on the commodity’s supply chain and exacerbate existing stresses, as well as the risks and vulnerabilities which arise as a consequence of a shock. The five shocks examined across each of the six sectors in this study include:</td>
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</table>
|                         | One Health  
Relating to human, animal or plant health and biosecurity.  
Drought  
The unpredictable and sudden impacts which arise due to the ongoing and cumulative effects of drought.  
Natural disaster  
The consequences of bushfires, floods and severe storms.  
Geopolitical  
The relations between international political actors and interests including factors such as trade, regulation and policy.  
Technology  
Relates to technology failures, service outages and cyber attacks, and other risks which arise through the use of digital and data systems. |
| Current mitigation strategies | Analysing the current technologies, frameworks, tools, and other mitigation measures that are being used by industry to build resilience and reduce the impact of shock events. |
| Future mitigation strategies | Identifying innovative mitigation strategies which could be invested in to build resilience and address current gaps across sectors. These strategies can act as the catalyst for future projects and working groups to build resilience in sector-specific focus areas, as well as projects which reach across multiple sectors. |
The Food Agility Ambition Matrix for data-driven resilience

AgriFood has low levels of digital adoption in general compared to most other sectors – this is a whole of sector R&D challenge. The AgriFood sector must progress digital adoption in order to build resilience through investment in digital and data advancement. The Food Agility Ambition Matrix (below) prioritises resilience investment into three horizons (core resilience, enhanced resilience and transformative resilience) to strategically manage investment in resilience. The rationale for prioritisation of mitigation strategies is outlined in each of the following sector chapters.

Where to play

Adaptive business models that reconfigure supply chains with predictive insight

Leverage digital and data to enable supply chain alignment to adjacent market entry

Enhance supply chain connectivity and end-to-end digital adoption

ROI: Exponential
TRANSFORMATIVE RESILIENCE
Breakthrough innovation which allows business to pivot in times of shock.

ROI: Driving growth
ENHANCED RESILIENCE
Building enhanced redundancies through the adoption of new methods and technologies.

ROI: Incremental
CORE RESILIENCE
Adoption of known methods to mitigate underlying stresses which are exposed in times of shock.

How to win
Invest in new tools
Create new platforms and build connectivity
Create products to meet future needs

Cross-sector opportunities

Each mitigation strategy has been categorised as either ‘sector-specific’ or ‘cross-sector’ throughout the sector chapters, and summarised in the Summary of findings. Sector-specific strategies are projects that have been developed in a fit for purpose way to respond to a specific sector challenge (e.g. a national livestock identification system for the red meat sector). While some of these strategies could be extended into other sectors, focusing on one sector from the outset can provide quick wins and learnings for others to follow. Cross-sector opportunities, however, highlight areas for collaboration across sectors to enhance synergies, accelerate benefits realisation and increase whole of industry impact (e.g. workforce digital training tools, AgTech commercialisation). These categories are not definitive and should be explored further as Food Agility and partners take these initiatives forward.
Introduction

The Australian grains industry is a leading contributor to the Australian economy, representing 23 per cent of Australia’s agricultural production from an average of 45 mmt per annum (ABARES, 2019). The largest product is wheat, accounting for approximately 25 mmt of this production. Approximately 70 per cent of Australian grain is exported, predominantly to markets in Asia and the Middle East (AEGIC, 2020). Production is forecast to grow to 5.65 mmt per annum by 2030, with growing domestic demand to consume a considerable portion of this increased volume (AEGIC, 2020).

Following complete deregulation of the wheat industry in 2008, there has been an expansion of both domestic and international industry participants. Competition in accumulation, freight, marketing and processing of grain has provided alternative channels to domestic and export markets. The industry’s ability to maintain the highest quality channels to market in this competitive environment is critical to support market access. The year-on-year variability in the volume of grain to be handled provides considerable constraints when seeking to improve efficiency and flexibility of the bulk handling system.

On-farm productivity is driven by continually improving practices including increased automation, targeted formulation and application of inputs and advancements in breeding technology. The scale of farming operations required to withstand the inherent risks in grain production are resulting in increased farm sizes. Productivity growth has slowed in part due to climate variability (Behind Australian Grain, 2019).

The industry has experienced increased environmental accountability highlighted by the regulation of canola sold into the European Union (EU) for biofuel production. In recent times, discussion around the use of glyphosate in agriculture has created concern for the industry as the grain production system is heavily reliant on this input.

In addition to increasing domestic demand, the grains industry has an opportunity to benefit from the growth in consumption of plant-based proteins and whole grains as part of a more sustainable food system (EAT-Lancet, 2019). Further, key export markets in the ASEAN region have and will continue to see a considerable increase in the consumption of protein as standards of living and incomes rise.

Illustrative grains supply chain product flow

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Source: ABARES. Note: employment includes grain, sheep and beef farming.
### Trends

- Increasing domestic consumption of grain for both livestock feed and food.
- Growing prevalence of plant-based diets.
- Dietary transition to increased consumption of protein and Western staples in Asian markets.
- Increasing automation in production, logistics and processing.
- Ageing infrastructure including digital.
- Increasing understanding of health benefits of (whole) grains.
- Increasing global competition in key export markets including the Black Sea and South America.
- Increasing consumer expectations with respect to environmental impact, food safety and social impact of food production.

### Challenges

- Increasing global competition with yield and efficiency upside.
- Aligning supply chain infrastructure with highly variable production.
- Reducing the cost of production and the balance of the supply chain.
- Access to capital.
- Farm consolidation, succession and the impact on regional communities.
- Measuring world leading environmental performance (water use efficiency and chemical use).
- Biosecurity incursions and increased pest resistance.
- Adapting to climate variability.
- Efficient collection and use of data.
- Accessing and retaining skilled labour.
- Maintaining and improving workforce wellbeing.
- Understanding and anticipating consumer demand.

### Opportunities

- Improved sharing of information across the supply chain (production, logistics and market intelligence).
- Making a positive contribution to climate change (carbon sequestration, reduced use of fossil fuels and supply of alternate protein sources).
- Enhancing and leveraging environmental and social sustainability credentials for high value markets.
- Engaging with educational institutions to improve the agricultural curriculum, encourage study in the likes of agronomy, food science and nutrition.
- Diversifying into higher quality (and value) markets.
- Exploration of new income sources (ecosystem services).
- Increasing supply chain efficiencies.
- Improving the allocation of capital with respect to supply chain infrastructure.
- Contributing to healthy diets through plant-based proteins and whole grains.
- Supplying growing domestic and export markets for feed grain.
Priority stresses

Key stresses undermining the stability of the grains supply chain include:

⚠️ Production variability

The grains sector’s inherently wide range of annual production applies constant pressure on all supply chain participants to efficiently grow, store, handle, transport, process and market grain. Consistency of production enables investment in the maintenance of existing channels to market and diversification into new ones. The primary driver of this stress is climate variability, with the most pronounced example being drought, as has been seen recently in eastern growing regions. Underutilised infrastructure or logistics capabilities increases the cost per tonne of grain that is delivered to domestic and import markets. Research, development and extension (RD&E) and ever improving production practices seek to maximise production and limit variance for the benefit of the entire supply chain.

⚠️ International competition

The ever increasing production and logistical capabilities of international grain growing regions such as the Black Sea and South America place pressure on the competitiveness of Australian grains in key export markets. These (relatively) immature production systems have capacity for greater yield and supply chain efficiency. While not immune from climate variability they have the scale, soil nutrient profiles and improving supply chains that will see them continue to grow as a threat to our ambitions to sell grains into Asian markets. These competitors are also favoured by low labour costs, devalued currencies and subsidised production costs. The Australian grains industry’s ability to maintain supply to key export markets is particularly strained when market dynamics such as drought result in higher domestic prices.

⚠️ Efficiency of data use

Data is collected at all stages of the grain supply chain (e.g. weather, soil and crop health, chemical residue, protein, storage conditions, freight movements and market conditions). The variable extent to which supply chain participants use this data to mitigate risk in production and supply chain interactions (e.g. storage, roads, rail and ports) can place stress on the industry through inefficiencies. The need for efficient data collection and use is increasing to support and certify specific supply chain requirements for market access (e.g. environmental and safety), interact with consumers to inform areas where the industry can achieve its best return on investment and enable predictive planning capabilities.

⚠️ Optimisation of infrastructure

The primary role of the bulk handling system is to efficiently transport grain while maintaining quality. The alignment of storage and logistics to flex with variable production is a constant challenge, acknowledging that differing production zones are typically geared to specific markets (e.g. food or feed, domestic or international). Grain storage and handling infrastructure is regularly stressed to accommodate varying levels of production and specifications. The increased prevalence of on-farm storage impacts the industry in a number of ways including increased choice and risk mitigation for growers; and opportunities for direct relationships with markets (e.g. processors and export). While providing many benefits, on-farm storage can complicate the management of quality, efficiency and stock forecasting visibility. The optimal use of key road, rail and port infrastructure is also a key stress, exacerbated by the increased domestic movement of grain. This complex ecosystem also places strain on energy requirements, particularly at times of peak activity such as sowing and harvest.

⚠️ Consumer preferences

Understanding and anticipating evolving consumer expectations that impact both consumption (e.g. plant-based diets, whole grain benefits and animal protein markets) and how grains must be grown to manage pests and disease, and subsequently be handled throughout the supply chain (e.g. food safety and sustainability requirements). This creates a challenge for the supply chain to align with these preferences while maintaining competitiveness. The most commonly used indicator of consumer preference is price, and an increased understanding of markets that value high quality, safe and sustainably produced Australian grains is crucial to delivering a greater return on investment for the industry. Improved insight as to the specifications required by markets will inform opportunities for supply chain optimisation. Notwithstanding its considerable export focus, the grains industry must also continue to manage domestic perceptions of its operations including both land and chemical use.
Impact of shocks

Identified below are the shock scenarios which can inflict the greatest impact on the grains supply chain, exacerbating existing stresses and giving rise to new risks and vulnerabilities.

**One Health**

A biosecurity breach at any point in the supply chain can create considerable challenges for the grains industry including delays in the importation of fertiliser and chemicals, reduced quantity and/or quality of grain produced, rejected deliveries to bulk handlers, increased storage and handling costs, and in its worst case scenario rejection of cargos delivered to export markets (with ongoing market access implications). Biosecurity risk is amplified in times of drought where greater volumes of grain are moved between regions, states and in rare cases, imported. The use of quality infrastructure that can treat inputs and grain in line with market requirements (e.g. maximum residue limits and phytosanitary) is crucial to maintaining Australia’s reputation for producing and delivering clean and safe grains.

From a food production perspective, the grains processing sector has identified vulnerabilities through COVID-19, not with regard to access to grains but in relation to the sourcing of supplementary ingredients and packaging.

**Drought**

The ability of the grains supply chain to handle the flow-on implications of drought can provide undesirable shocks. As we have seen recently with the East Coast Drought, increased requirements for animal feed grain support higher domestic prices and re-direct grain from export into domestic markets. This change in product flow places pressure on the efficiency of road, rail and port infrastructure, creating bottlenecks that impede the timely supply of grain. With Australia’s domestic grain consumption forecast to increase considerably out to 2030 and beyond, the supply chain’s ability to flex between exportable surplus and local demand is key to its resilience (AEGIC, 2020). Prolonged dry conditions can impact soil health and environmental performance (topsoil erosion). From a workforce perspective, drought impacts the capacity of grains supply chain participants to maintain employees, with subsequent impacts for regional towns. New employees and contractors require re-skilling with associated impacts for the efficiency of supply chain functions.

**Natural Disasters**

The increasing occurrence of severe weather events has the potential to damage crops (e.g. frost and hail), road and rail infrastructure (e.g. flood and fire), and digital connectivity (e.g. towers and sensors). These scenarios contribute to production variability (damaged or downgraded production and quality), the critical mass required to underpin the viability of storage and handling infrastructure. In extreme cases the potential for high impact events such as earthquakes (e.g. Newcastle and Meckering) have the capacity to disrupt supply chains at the most inopportune times (e.g. harvest and export).

The capacity of the industry to plan for these highly variable scenarios (relative to likelihood of occurrence), overlaid with differing market forces (e.g. drought) can support key areas of vulnerability by developing contingency plans including alternate sources of grain for domestic or export markets impacted by geographical supply shortages.

**Geopolitical**

The grains industry has well established channels of governance and advocacy to identify the potential imposition of trade barriers (e.g. barley tariffs and China, chickpea tariffs and India or canola regulation and the EU). The impact of such measures can be sudden if the sector has not established contingency plans to mitigate the potential loss of market access or reduced competitiveness that can result. These strategies include flexibility at a production level and the diversification of markets for grains at high risk of geopolitical impacts. Geopolitical shocks can impact the use of plant breeding technology that mitigates the stress of production variability (e.g. genetically modified or GM and gene editing), with visibility of future market access constraints crucial to enabling the long RD&E lead times and significant investment that must occur before production. The industry’s inability to rapidly adopt new technology impacts the resilience of production and subsequently the balance of the supply chain.

**Technology**

Efficiencies in the grains supply chain can be unlocked through the use and sharing of data to mitigate risk on-farm and integrate key logistical and marketing functions. The need for digital platforms will also be driven by expectations of transparency around environmental performance (e.g. water, chemical and fossil fuel use). Currently, the industry is not significantly exposed to technological shocks including cyber attacks, however the increased use of data for harvest planning, trading platforms, national production and automation required to extract supply chain efficiencies will merit investment in appropriate data governance and security.
Resilience heat map

The primary stresses impacting the grains industry are mapped across the supply chain below, with the impact of each stress on the respective supply chain nodes colour coded as per the scale shown. Shocks can be seen overlayed on the heat map, indicating where supply chain nodes can be hardest hit during shock events and the flow-on effects up and down the supply chain.

Key stresses regarding the management of food safety considerations and pests and disease are an ever-present focus of the industry with existing mitigation strategies in place – these can of course be enhanced by further application of digital solutions. Ultimately, the collective stresses identified are interrelated and impact two key areas – the sector’s competitiveness and the conditions under which it can continue to access key markets.

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<th>Impact of stress</th>
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### Supply Chain

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Key areas to strengthen resilience

1. Minimising production variability to support the efficacy and profitability of the entire supply chain.
2. Measuring and improving environmental performance to support market access and underpin social licence.
3. Understanding consumer preferences to inform grains grown and supply chain features.
4. Optimising infrastructure to support diversity of markets and align with future demand patterns.
5. Enabling greater use of data to inform agile supply chains, real-time and predictive analysis.
**Key export market**

**Indonesia**

### Market context

- AUD $2.7 billion of Australian AgriFood products are imported per annum into Indonesia. Approximately 4.2 mmt of Australian wheat imported per annum with AUD $1.2 billion per annum value of exports for Australia. These volumes have been impacted in recent years by poor Australian seasons and increased competition (AEGIC, 2020).
- World’s fourth most populous country (263 million, 2017 > 295 million+ by 2030), fastest growing economy in the G20 behind China (AEGIC, 2020).
- Increasing urbanisation and per capita incomes. Increased per capita consumption of bread and other baked goods, grain-fed meat.
- Healthier dietary choices following increased affluence including increasing market for wholegrain (1 mmt, 10 per cent of bread market worth $350 million per annum by 2030).
- Increasing adoption of technology as evidenced by more than 220 million mobile user accounts (AEGIC, 2020).
- Grains sold in bulk into flour mills for noodles (primary market), breads (secondary market and higher value). Australian wheat is well suited to noodles, growth in bread and pastry markets primarily served by Canadian and USA wheat (traditionally higher in protein).
- Sold in bulk into feed grain sectors, supported by the ratification of the Indonesia-Australia Comprehensive Economic Partnership Agreement (IA-CEPA), identifying a quota of 500 kmt for feed tonnes into Indonesia to be grown by 5 per cent per annum (Grain Growers Limited, 2020).
- Drought: balancing investment in domestic and export supply chains to continually improve efficiency of supply into Indonesia, maintaining growth of grades required to meet market expectations, ensuring consistency of supply when domestic pricing favours feed grain markets.
- One Health: loss of market access through biosecurity or food safety breaches. Increasing focus on food safety following COVID-19.
- Natural Disaster: loss of production of key grades supporting Indonesian customers impacted by frost or severe weather events in specific growing regions (e.g. Western Australia).

### Key vulnerabilities

- Competition from emerging production areas including Black Sea origin and existing competition from North American high protein wheat.
- Managing Australia’s variable growing conditions to produce the requisite quality of grain for existing noodle and higher value baking market segments.
- Educating Indonesian customers and consumers on the functional properties of Australian wheat, encouraging adoption of Australian varieties suited to rapid dough baking methods (AEGIC, 2019).
- Drought: balancing investment in domestic and export supply chains to continually improve efficiency of supply into Indonesia, maintaining growth of grades required to meet market expectations, ensuring consistency of supply when domestic pricing favours feed grain markets.
- One Health: loss of market access through biosecurity or food safety breaches. Increasing focus on food safety following COVID-19.
- Natural Disaster: loss of production of key grades supporting Indonesian customers impacted by frost or severe weather events in specific growing regions (e.g. Western Australia).

### Key considerations

- Australian grain is comparatively clean and low in contamination compared to our competitors which bodes well for this market.
- Australia must continue to breed wheat varieties that meet the protein and functional requirements of specific bread and baked goods.
- Target sectors that can utilise Australia’s readily grown lower to mid protein wheats.
- Continued focus on supply chain efficiency to support competitive pricing into Indonesia. Australia’s proximity alone does not provide a silver bullet to address international competition.
Current mitigation strategies

Overview

The geographical breadth of grains production coupled with the variability of domestic and global markets means that the application of solutions to mitigate risk and build resilience are equally as varied and nuanced. To navigate the inherent stresses and acute shocks, each node within the supply chain needs to play its part to share the load of risk mitigation. The ability of the grains industry to integrate its supply chain and collectively pivot to implement contingency plans will determine its success in the face of dynamic domestic and export markets.

Current approaches

- **Management of soil fertility and moisture** to enhance yield and quality.
- **Increased size of farms** to achieve economies of scale.
- **On-farm storage** to manage operational and commercial risks.
- **Geographical diversity of growing regions** to minimise exposure to poor growing or market conditions.
- **Plant breeding technology** to maximise resilience of grains to heat stress, pest and disease resistance, and to improve functional traits.
- **Precision agriculture** through tailored nutrients for crops, use of technology and data collected through ground-truthing, equipment, satellite and IoT.
- **Vertical integration of logistics and trade** to maximise supply chain efficiencies.
- **Chain of responsibility reporting** to identify biosecurity breaches and responsibility for corrective action.
- **Engagement with key markets** to identify desired functional traits and educate consumers on associated uses and benefits.

Learnings from the resource sector

The scale and logistical challenges of Australia’s resource sectors (e.g., coal, iron ore and natural gas) provide an opportunity to adapt learnings for grains. These sectors produce bulk products that require considerable infrastructure, agility to contend with variable quality, are subject to global competition, automate to improve safety and reduce costs and, (even more so than grains) are subject to increasing scrutiny with respect to sustainability (Austrade, 2018).

As with grains, resource sectors have challenges with respect to stock visibility, monitoring of product condition, variable specifications, complex contractual structures, automation, equipment maintenance, rolling stock management, ship slot booking, and berth sizes when looking to increase efficiency.

While the production of grains is more contingent on weather, natural disasters and geopolitical shocks also impact the resilience of resource supply chains.

Delmia Quintiq is an example of a software company providing supply chain optimisation solutions from basic decision support through to automated and predictive supply chain planning. Companies such as Delmia Quintiq have worked in the resources sector and increasingly with agriculture to develop optimised decision making systems. These intelligent systems map basic rules (e.g., product quality, MRLs, axle loads, rail speeds, handling rates and stock levels) through to more detailed considerations (e.g., ethical sourcing, currency, port congestion and futures markets). By understanding sector specific parameters any number of scenarios can be simulated to identify opportunities for optimisation. This enables the development of contingency plans to mitigate the shocks contemplated in this report in grains and other sectors.

As with any sector, increased integration of data provides challenges with respect to the treatment of commercial and private information. Supported by third party services providers, the resources sector has developed governance structures for the sharing of data between government and commercial parties, detailing who takes responsibility for the management of such information (government, industry, commercial entity, port authority etc.). These challenges aside, the key benefit of this approach is first and foremost the creation of a framework in which Australia’s grains industry can remain competitive and resilient on a global scale, with prosperity of individual businesses to flow from that baseline.
The following mitigation strategies have been identified as potential measures to improve the resilience of the grains supply chain. These strategies can act as the catalyst for future projects and working groups to build resilience in sector-specific focus areas, as well as projects which reach across multiple sectors.

1. **Supply chain integration**
   Improved real-time and predictive capabilities for stresses and shocks hinge on production forecasting and scenario planning to identify best value and contingency plans. How does the industry better respond to ‘what ifs’ including market access, oil price shocks, sustainability certification, pest incursions and production shortages?

2. **Digitised engagement**
   Both within the supply chain between growers, logistics and traders, as well as with customers to enhance their respective experiences. Measuring performance of respective tasks to establish baselines and track the performance of enhanced product and service offerings is critical.

3. **Sustainability credentials**
   Understanding ROI for sustainability (environmental, economic and social). What markets value these credentials for market access? What markets will require these credentials for market access? How can the grains industry collaborate with other sectors to enhance the measurement of sustainability (e.g. metrics)?

4. **Digital workforce capabilities**
   Alignment of education pathways with the requirements of a digitised workforce, technical capabilities, workforce planning initiatives, improved business skills, financial planning including succession to build the resilience of all supply chain participants.

5. **Market diversification**
   Pursuit of higher value markets, leveraging sustainability credentials and product quality, supported by aligned value chain participants. Market diversification brings complexity but also enhances the durability of the supply chain to withstand shocks.

6. **Infrastructure optimisation**
   Improved rail capabilities including speed restrictions, capacity, scheduling, allocation of storage, port access flexibility. Increasing the agility of infrastructure to mitigate variability of grains (e.g. handling and storage of suitable non-grain bulk products).

7. **Measuring environmental performance**
   Measuring WUE, input use, carbon sequestration, carbon emissions throughout the entire supply chain, to both promote improvement and leverage for specific markets. A key focus of continuous improvement is the identification of new ways to increase productivity while reducing environmental impact (e.g. reduction or alternatives to glyphosate, high carbon cost of nitrogen impacts on soil biodiversity).

8. **Natural capital development**
   Further development of the awareness of environmental ecosystem services and establishment of markets to increase biodiversity, improve productivity and diversify on-farm income.

9. **Plant breeding RD&E**
   Continued RD&E into plant breeding technology to increase pest, disease and climate resistance, increase protein and improve functional traits through GM and gene editing.

10. **Environmental advocacy**
    Continued advocacy for the functional and environmental credentials of Australian grains, engaging with markets to simplify and unify market access requirements; and support market acceptance of new technologies that will enable greater resilience in the grains supply chain (e.g. gene editing).

11. **Data governance framework**
    Development of a data governance framework and principles to define what and how the industry measures key data (biosecurity, environmental, logistics, consumer behaviour, market access), align industry-wide efforts to support broader sustainability and geopolitical advocacy. Consideration of how this data is stored and shared is also critical to mitigate the risks of technological shocks (e.g. cyber attacks).
The capacity of grains supply chain participants to invest in resilience varies year-on-year and by location.

Operations with larger geographical footprints are inherently well placed to both trial and implement new measures. Truly transformative resilience requires a clear understanding of the domestic and export markets that will drive greatest and most consistent value for the industry, potentially requiring significant changes to what and how grains are grown, and the way in which they are delivered to the market. Given its stewardship of such a considerable portion of the Australian landmass and its key contribution to livestock production, the grains industry has the opportunity to drive improved resilience not only with respect to its own supply chain, but throughout Australian agriculture.

Core resilience
Irrespective of improvements to the balance of the supply chain, the resilience of the grains supply chain will hinge on the development of varieties that can survive and thrive in Australia’s variable climate. Continued research into heat, frost and disease resistant crops will support the production system. Existing technology including GM and gene editing are regularly being advanced and their ability to be utilised is dependent on acceptance by the market. The need to continue advocacy efforts to educate and engage with markets around the use of technology such as this and the industry’s sustainability credentials can mitigate the risks presented by geopolitical uncertainty. Establishing a consistent framework for the management of data will enable transformative supply chain integration.

Enhanced resilience
The location and scale of grains production dictates the need for considerable storage and handling infrastructure. The sector’s capacity to maximise the efficiency of this infrastructure and improve the experience of supply chain participants will improve resilience. Leading logistics providers are obtaining and analysing data to reduce downtime and maintain the quality of grains moving throughout the system. From an environmental perspective, reducing the use of chemicals and water while maintaining the resilience of the production system will underpin market access. Measuring this performance through the valuing of natural capital can diversify incomes and improve productivity. Ensuring the continued pursuit of diversified markets supports all supply chain participants when shocks occur.

Transformative resilience
Enhancing the agility of a supply chain for a sector as large, complex and variable as grains is a challenge. The sheer volume of production and market variables means that greater integration between supply chain participants can enable significant gains and share the load of risk mitigation. The sector has significant environmental credentials that can benefit both the environment and related sectors – identifying how the industry can best leverage and improve these credentials will guide its prioritisation and pursuit of high value markets.
The horticulture sector in Australia (excluding nursery) generates $10 billion in gross value each year, producing over 6.7 mmt of fruits, vegetables, and nuts and employing over 70,000 people (ABARES, 2020). Approximately 50 per cent of Australia’s fresh fruit and vegetables are produced by 13 companies (Fresh Produce, 2019). The sector produces over 70 varieties of fruit, vegetables and nuts (Hort Innovation, 2019).

Australian horticultural products are typically produced for the domestic market (fresh or processed) with just over 10 per cent of total volume exported. Fresh exports delivered $3.3 billion value in FY18-19 (45 per cent fruits, 34 per cent nuts, remaining vegetables and other horticulture), benefiting from Free Trade Agreements (FTAs) signed with China, Japan and South Korea, with exports growing 65 per cent by value in the past five years (ABARES, 2019). China is the largest export market, valued at $868 million for FY19 (ABARES, 2019). Table grapes, citrus, cherries and nuts are the primary categories exported to China.

The sector benefits from counter-seasonal harvesting periods to other major exporting nations. The greatest import competition is at the food processor level, with fresh produce imports providing Australian consumers with out-of-season supply.

Horticulture is grown all around Australia, with different climatic conditions and seasonality including temperature and rainfall determining where and what types of crops are grown. Maximum shelf-life, pest and disease management, and protection of perishable products are key for fresh produce quality, safety, pricing and market access. Appearance and shelf-life act as key quality and food safety measures at retail and consumer level.

Illustrative horticulture supply chain product flow
**Trends**
- Growing global population.
- Increased focus on healthy eating, plant-based diets, organics, convenience and provenance.
- Increasing international market access enabled by free trade agreements and reduced non-tariff barriers.
- Increasing domestic consumer acceptance of ‘ugly’ produce, and pricing being directly linked to available supply.
- Increasing desire to buy Australian (for domestic and international consumers).
- Increasing import competition for processed foods.
- Increasing protocols, inspections and assurance requirements related to food safety, quality and biosecurity.
- Increasing climate variability impacting temperatures and rainfall.

**Challenges**
- Access to labour (seasonal labour, middle management and technical specialists).
- Adapting to climate variability (production methods, crop type and plant breeding).
- Access to sufficient water.
- Perishability of fresh food.
- Cost and effort for compliance and regulation.
- Urbanisation removing farms from city fringes.
- Organic food waste resulting from ‘out-of-spec’ produce, weather events, inability to access labour for harvest, food safety issues, and/or pest and disease outbreaks.
- Reliant on paper-based records.
- Protecting quality of produce from farm to plate, with multiple stakeholders involved.
- Aligning value chain with consumer/market expectations.
- Connected data and insights loops in the value chain to enable traceability, compliance, market insights, and sustainability.
- Cost and utilisation of infrastructure and equipment.
- International market access.
- Price sensitivity of produce impacted by supply/demand, and foreign exchange rates.

**Opportunities**
- Improve labour attraction and retention.
- Shift from paper to digital recording.
- Integrated data and digital solutions from production across the supply chain.
- Increase consumer education (health, ‘out-of-spec’, support Australian farmers).
- Focus on higher value produce and value-added products.
- Sustainability: R&D of resilient crops, pest and disease and weed management, measurement of environmental impacts.
- Review of climate impact and market demand on what crop should be grown and how.
- Increase use of indoor controlled growing environments.
- Improve export market access compliance with simple one-stop-shop digital hub.
- Connected data and alignment of retailer and state government operational requirements for faster and easier market access.
- Digital auditing and self-certification.
- Use of big data and Artificial Intelligence (AI) to inform business and supply chain decisions.
- Focus on improving grower financial literacy.
- Circular economy models to maximise value from organic waste, and utilisation of equipment and infrastructure.
Priority stresses

Key stresses undermining the stability of the horticulture supply chain include:

- **Access to labour**
  Australian horticulture (specifically fruit and vegetables) relies heavily on seasonal labour for peak periods of harvesting. Travellers utilising the Seasonal Worker Programme and working holiday makers constitute a significant proportion of the workforce. The sector struggles to attract ‘middle management’ and technical skillsets due to the regional location of the work, competition with other industries and the nature of the work. There is also a lack of training and education opportunities to drive interest in the sector and develop a skilled talent pool. Inability to access skilled labour impacts production output, quality, and profitability, with flow-on effects through the supply chain. Reliance on a short-term and transient workforce increases training periods and costs, workplace health and safety risk, and requires higher infrastructure costs to house travelling employees.

- **Food safety**
  Listeria, salmonella, E. coli, and other contamination (e.g. needles in strawberries) all create food safety risks, negatively impacting market access and consumer demand with estimated market recovery of 1-3 years. A ripple effect results when growers respond by switching to a different crop, increasing demand for different inputs (e.g. seeds) and driving down retail prices due to increased supply of the different crop. Food safety is heavily regulated and essential for market access, however, the food safety trail and audit process is typically paper-based and time consuming. Conversely, the sector benefits from short feedback loops as fresh produce moves with urgency from farm to retailer/market enabling food safety issues to be identified quickly. Consumers also typically do not buy fresh produce that “looks bad”, acting as a preventative measure to food safety issues, however resulting in increased waste at the retail node.

- **Business planning and literacy**
  The horticulture sector has varying levels of financial literacy and business sophistication. More sophisticated businesses place greater emphasis on data collection and analysis, resulting in a better indication of the next six months to five years. However, other growers expose themselves to risks by not capturing and understanding key metrics, seeing it as too hard, preferring to not know, or not wanting to pivot from the way they have always operated.

- **Climate variability**
  Climatic conditions are the key determinant of where and when Australian horticulture is grown. This enables geographic disbursement and seasonal variation in the timing and types of fruits, nuts, and vegetables grown throughout Australia. Climate variability impacts the input products and services (irrigated water versus rainfall, chemicals, pollination services and infrastructure) required by growers and can lead to unpredictable quality of produce and organic waste. Farm gate prices, quality and quantity are all impacted with flow-on supply chain impacts, including to the retail price. The prevalence of pests and diseases can also increase with higher temperatures.

- **Pests and disease**
  Australia has strict biosecurity protocols because domestic and exotic pests and diseases are a threat to the horticultural sector. The Queensland fruit fly is the most significant pest to the sector causing an estimated $300 million loss in domestic and international markets each year (APBCRC, 2019). Varroa mite pests are also a big biosecurity risk for the sector. Growers, input providers and government are highly focused on biosecurity management. Outbreaks can destroy crops on a farm/regionally (impacting supply and prices), increase costs associated with incursion management and result in market access restrictions or bans (domestic or international). Maintenance of ‘pest free areas’ is critical for continued export market outcomes and value growth in this channel. A growing desire from consumers for ‘organic’ and ‘chemical free’ produce will likely require a greater focus on integrated pest management and controlled growing environments (protected cropping).

- **Retaining and growing market access**
  Strict rules apply for both domestic and international market access. Food safety and quality assurance, product labelling, packaging and biosecurity are all factors impacting market access that must be considered through the entire supply chain. Phytosanitary factors impact market access, although different requirements apply for different crops and markets. Tariffs also impact the competitiveness of Australian produce in international markets. The sector, particularly fruits and nuts, has benefited from FTAs signed with China, Japan and South Korea, with total exports growing 65 per cent by value in the past five years (ABARES, 2019).
Impact of shocks

Identified below are the shock scenarios which can inflict the greatest impact on the horticulture supply chain, exacerbating existing stresses and giving rise to new risks and vulnerabilities.

One Health

A biosecurity incursion or a health pandemic such as COVID-19 can further exacerbate the stresses of market access, pest and disease management, food safety management, labour supply, business planning and financial literacy. Stakeholder consultations noted the sophistication of farm business management impacts the resilience to this shock.

Food safety and pest and disease-free produce is paramount for retaining and growing market access and consumer demand. Biosecurity issues are often linked to small market and community gardens in metropolitan areas with lower sophistication in management processes. Climate variability (rising temperatures) is also impacting the risk of pest and disease outbreaks, creating a more suitable temperature for the fruit fly. Recent years have seen fruit fly outbreaks in Tasmania, a state with historically no fruit fly. Market access enabled through Pest Free Area (PFA) status can be revoked without significant biosecurity investment and action.

COVID-19 has identified that in times of health pandemics, travel restrictions and quarantine periods impact the ability to access international workforces to meet the needs of peak periods (harvest). Health events can also impact consumption behaviour and produce demand with a shift towards eating at home and away from food service, impacting demand for exported produce destined for these channels (Nielsen, 2020).

The sector is threatened by sabotage at the farm, packhouse or at a retailer through the introduction of foreign material causing food safety recalls. As recently as late 2018, the sector experienced this when needles were found in strawberries from three Queensland-based strawberry brands causing a food safety scare and the mass dumping of harvested strawberries from Queensland (Brisbane Times, 2020).

Drought

Horticultural production is heavily reliant on reliable and affordable access to water. During times of drought, growers have greater reliance on purchasing irrigated water to achieve production volume and quality of produce. The added expense drives up farmgate prices, and in the event that irrigated water is not accessible or affordable, a grower may lose a season (or more) of production. Nuts are an irrigated crop, with water management a particularly key business activity for growers.

Higher farmgate prices, reduced quality and quantity can negatively impact consumer demand and market access. The whole of the supply chain and value chain is impacted in times of drought with reduced RD&E levies paid by growers, reduced farm equity, impacts on regional towns, and greater reliance on government funding and support. Drought also impacts the presence of bees for pollination and can impact yield and quality of produce such as almonds, apples, avocados, blueberries and cucumbers.

Geopolitical

Although 90 per cent of Australian horticulture is domestically consumed, approximately $3b in export market value is at risk during times of market access closure and increased trade barriers. This may result in flooding markets with produce, driving down retail prices and increasing organic waste. Changes in tariff (financial) and non-tariff (phytosanitary requirements, labelling requirements) barriers impact the competitiveness of Australian exports and ability to access markets. Strict pest and disease management is a significant factor in maintaining and growing market access. Diversified growers with more sophisticated business planning and financial literacy are better placed to manage the shock of market access disruptions. Changes to visa arrangements would further strain the sector’s ability to access labour for peak periods of harvest. This may result in the inability to harvest, leading to reduced supply and increased retail prices.

Technology

Despite low technology adoption across the sector, cyber attacks pose an increasing threat for processors, transport and logistics providers, and retailers. Any event relating to hacking of supply chain data would further exacerbate challenges of transparency and data sharing and erode consumer confidence. A cyber attack on track and trace systems applied to higher value export categories such as cherries could impact food trust and assurance.

Natural Disasters

The geographic diversification of horticulture supports the overall resilience of the sector against this shock with the impact of events such as drought, storms, floods and fires often localised to a region or a single farm. Although, it is noted that organic waste at a farm or regional level often results from natural disaster.
The heat map below plots the various stresses inherent in the horticulture supply chain. The relative impact of each stress on each supply chain node is colour coded as per the scale shown. Shocks can be seen overlayed on the heat map, indicating where supply chain nodes can be hardest hit during shock events and the flow-on effects up and down the supply chain.

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- **Access to labour**
- **Climate variability**
- **Food safety**
- **Pests and disease**
- **Infrastructure, equipment and connectivity**
- **Environmental impact**
- **Market access**
  - Consumer demand
  - Access to technology
  - Import competition
  - Urbanisation
- **Business planning and literacy**
  - Business planning and literacy
- **Significant stresses**

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**Key areas to strengthen resilience**

1. Improving reliable access to labour – the right skills at the right time.

2. Improving supply chain collaboration and sharing of data and insights. This includes consumer insights to influence production quality and quantity and crops grown.

3. Improving business and financial management and planning capabilities.

4. Measuring and improving environmental performance to support market access, social licence, and access to financing (impact funding and natural capital finance solutions).

5. Digitising and introducing self-auditing for food safety and biosecurity compliance.

6. Improving crop and market diversification.

7. Optimising infrastructure and equipment – irrigation and dams, workforce accommodation, cold chain storage and logistics, farm equipment.

8. Improving understanding of climate variability on suitable crop types.

9. Measuring and improving the productivity of water and land.

10. Ongoing education and focus on pest and disease prevention, management, and recovery.
Key export market

China

Market context

The Chinese market is characterised by:
- A rising middle class;
- Growing urban population;
- Desire for healthier lifestyles;
- Increased focus on food safety, quality and provenance;
- Growing use of online platforms; and
- Cultural celebrations – fruit as a traditional gift (Austrade, 2019; McKinsey & Company, 2020)

Horticultural product exports to China were worth $868 million in FY18-19, a 50 per cent increase on the prior year, resulting from a significant boost in the value of Australian fruit and nut exports to China (ABARES, 2019).

Key exports:
- Cherries (#1 export market)
- Table grapes (#1 export market)
- Citrus (#1 export market)
- Summerfruits (#1 export market)
- Almonds (#1 export market)
- Macadamias (#1 export market)
- Pecans (#1 export market)
- Pistachios (#1 export market) (Hort Innovation, 2019)

Key channels include:
- Retail including supermarkets, hypermarkets and convenience stores;
- Food service through hotels and restaurants; and
- E-commerce such as JD.com and Tmall.com (owned by Alibaba).

Key vulnerabilities

- Health shocks impact access to air freight and in-market cold chain logistics, chemical farm inputs, farm labour for harvest, and compliance with biosecurity/phytosanitary requirements for market access.
- Health events (i.e. COVID-19) also impact consumption behaviour and demand with consumers eating at home more often, rather than food service (a leading channel for exported produce).
- Drought and natural disasters both impact the quality and quantity of produce available for the Chinese market.
- Tariffs and non-tariff barriers impact price competitiveness of Australian produce (a market ban would stop Australian produce from entering the Chinese market). Changes to seasonal labour visa arrangements impact access to farm labour for harvest.
- Farm sabotage – impact on a grower/region/crop type and the quality and quantity of produce available.

Key considerations

- China–Australia Free Trade Agreement.
- Regional sales channels.
- Improving cold chain logistics in-market.
- Growing use of online platforms.
- Provenance and trust in ‘Taste Australia’ brand.
- Food safety and biosecurity compliance are essential.
- Food fraud is a risk.
- Importance of packaging for customer demographic and/or occasion.
Current mitigation strategies

Current approaches

- Farms are often on city fringes and near major roads/routes to be closer to market, with chilled/climate controlled storage and transport essential to protecting the quality and safety of produce.
- Focus on plant breeding for climate resilience and new higher yielding and higher value varietals.
- Strict biosecurity policy, legislation and regulation by State, Territory and Federal Governments. Biosecurity information is available to all grower types and sizes, including for exporting products in the MiCOR system.
- Physical inspections for food safety, quality assurance and phytosanitary certificates. Stakeholders noted this is time consuming and often paper-based.
- Market access research, analysis and engagement to understand consumer demand and opportunities.
- Sharing of grower stories, connection with trusted service providers and translation of content into multiple languages supports adoption of new practices and solutions. For example, one stakeholder noted improved adoption as a result of regional education workshops with local grower panels, and recognition that English may be a second language through translation of educational documents.
- Emergence of protected cropping to reduce exposure to climate variability and pest and disease. The infrastructure cost is high and stakeholder consultations revealed there is limited understanding of high value crops proven for the growing environment.
- There are technologies available to the sector such as sensors, robotics, variable rate technology, and farm and business management platforms. Cold chain logistics, GPS and temperature monitoring also exist. However stakeholder consultations noted the buying process can be difficult with limited understanding of ROI and access to skilled labour to support the technology.
- Commercial and government online labour recruitment platforms exist. Stakeholder consultations noted the focus of these platforms is typically on attracting backpackers or workers on visas, and unemployed Australians who are not necessarily seeking a horticulture career.
- Online training – State Governments are funding in-demand TAFE courses primarily focused on skillling unemployed residents. Digital Farm WHS courses also exist through private providers (Victorian Government, 2020; Queensland Government, 2020; TAFE, 2019).

Case study

WorkReadyU Program (Dallas County, USA)

Attracting and retaining a local workforce to the Australian horticultural industry is a challenge whether it be to fulfil seasonal harvest needs, or to perform higher skilled roles such as farm management.

In Dallas County, USA, seven independently accredited colleges are collaborating to deliver microcredentials and digital training tools that build a local talent pool for the region’s workforce needs across multiple industries. Three years ago, the colleges established the WorkReadyU program to address skills gaps, provide career and learning pathways for the residents of Dallas County, and provide employers with access to work-ready talent.

The program recognises the need to support ‘adult-learners’ with flexible training and upskilling and to help businesses attract and retain employees. Based on the region’s employment needs, skills training is available in manufacturing, technology, health care, education and more. WorkReadyU also provides access to technical skills training, hands on training, ‘soft skills’ training such as leadership courses, and the ability to improve English skills. On completion of courses, students receive microcredentials or certificates. These can be completed as a one-off course, or as part of a career pathway.

The WorkReadyU program is available to residents of Dallas County who are over 16 years of age, with no bachelors or advanced degree, who have valid photo ID. The program is available regardless of employment status – looking for work, or looking to up-skill. Businesses are consulted in the development of the programs to ensure that the training programs are aligned with high-demand careers and jobs.

Grant funding is used to enable students to access courses and services from WorkReadyU at no cost.

WorkReadyU delivers courses online or in person at local college campuses, for example. The website and WorkReadyU Mobile App connect users with course information, enrolment forms, a ‘career navigator’ and importantly with current job postings within the region. Resources are available in English and Spanish.
Future mitigation strategies

The following mitigation strategies have been identified as potential measures to improve the resilience of the horticulture supply chain.

1. **Online training tools and micro credentials**
   With a focus on in-demand jobs/talent gaps for a region or sector, leverage existing or develop new online training tools and micro credentials to build and retain a local talent pool and support on-boarding of seasonal labour.

2. **Digital food safety auditing and tools**
   Integrated digital system for faster, more accurate, and more cost efficient quality assurance, food safety and biosecurity data flow and inspections.

3. **Traceability solutions**
   Identify existing commercial solutions or develop new low cost traceability solutions to address food fraud and food safety issues.

4. **Decision support tools**
   Improve business literacy and planning with farm management and insights tools – leverage IoT sensors and AgTech to inform decision making. A focus on the interoperability and integration of these tools is important to improve functionality and user insights.

5. **Scenario planning tools**
   Greater insight and transparency on the ripple effect of changes in inputs and processes at a farm level, regional level, national level, crop level and across the supply chain. Scenarios such as the change in crop grown on access to water, cold chain storage and logistics, and upward/downward pressure on market pricing would be of interest.

6. **Supply chain predictive analytics**
   Enable greater use of data to inform agile supply chains, real-time and predictive analysis. This would include digitisation of on-farm records and transport documentation to improve reporting accuracy and efficiency, and enable improved planning, decision making, and resource utilisation.

7. **Measuring resource efficiency**
   Collect data and measure productivity of water and land – for example, the litres of water required per kilogram of fresh produce, yield and quality per hectare. This would promote a focus on using resources better to feed more people.

8. **ROI tools and case studies**
   Develop an ROI calculator and grower case studies for digital solutions (IoT/AgTech) to assist in the buying and technology adoption process, stimulating adoption rates.

9. **Automation solutions**
   Identify existing commercial solutions or develop new affordable automation solutions to reduce reliance on manual labour at harvest, packaging and processing phases.

10. **Market diversification**
    Conduct alternative export market scoping to reduce exposure to changes in China market access and improve substitutes in times of shock.

11. **Digital compliance tools/apps**
    Develop simple digital tools/apps with guidance, checklists and insights to support market awareness, understanding of access and simplified compliance steps.

12. **Alternative farming methods**
    Explore commercial opportunities for alternate farming methods such as protected cropping and urban farms. Research higher margin/niche crops that can be grown in this environment, technologies that can improve input management (VRT, smart irrigation, pollination) climate/temperature management, forecasting of output, and reduce reliance on labour through automation/robotics.

13. **New financial products**
    Research opportunities for new insurance and financial products to support growers in times of stress and shock and in their recovery (e.g. multi-peril insurance, sustainable finance solutions, and ESG investment trends).

14. **Crop research**
    Review the types of crops that should be produced in a region based on changes in climate (temperature, rainfall, etc) and market preferences ('free-from'/organic, carbon emissions/kms to market).
The horticultural sector is typically characterised as a low adopter of technology.

With that in mind, a focus on cultural change strategies is essential to improve adoption and engagement with technologies, digital solutions, tools, processes, and insights. Education of supply chain participants on data standards, privacy, and security is also required to improve data collection and collaboration through the supply chain.

**Core resilience**

1. 4. 8. 11

The integration of existing digital tools and platforms for labour attraction, development and retention will help to grow the available talent pools in regions and the work-ready pool for peak periods. This can also reduce training costs and liability risks for growers. Improved understanding of market opportunities supported by simple digital tools and checklists will help demystify market access requirements. Simple ROI calculators for technology can encourage confidence in adoption of solutions available to the sector. Business management and financial literacy can be improved through existing farm management and finance tools. Training and support in using these tools will be important to improve adoption.

**Enhanced resilience**

2. 3. 6. 7. 10. 13

To drive enhanced resilience for the sector, there is a need to improve the quantity and quality of data captured, and to showcase the insights and value (i.e. time/cost savings, improved productivity) that can be delivered from big data and information sharing, including for market diversification. This could include digital auditing and compliance tools, scalable traceability solutions, and real-time insights on the path to market and produce quality. Collecting data and measuring the productivity of water and land will help to set a benchmark for the crop segments and varieties, and provide an ongoing indicator of performance. New insurance and financial products can reduce the ‘bounce-back’ period in times of shock and also reward desired environmental and social behaviours.

**Transformative resilience**

5. 9. 12. 14

Addressing climate variability and exposure to drought and weather events is important for the sector’s resilience. The challenge is that the urgency for the sector to invest in environmental resilience can fade when the weather changes (‘it rains’). High-tech indoor farming for higher margin crops can reduce the stresses of climate variability, labour supply, and pest and disease management. Predictive tools and scenario planning with a farm, regional, crop, and supply chain lens would support improved decision making and appreciation of the ‘ripple effect’ to others in the sector.
Introduction

Dairy is Australia’s fourth largest rural industry, producing 8,795 million litres of milk and $4.4 billion of farm gate production in 2018-19. Australia is currently the world’s fourth largest dairy exporter with a six per cent share of global trade in dairy products (Dairy Australia, 2019). Dairy exports were valued at $3.4Bb in 2017-18 (DAWE, 2019). The majority of milk production in Australia is processed into cheese (38 per cent), followed by drinking milk (28 per cent), and skim milk powder or butter (21 per cent). Most farms are concentrated in Australia’s Southeast due to the favourable climate for seasonal pasture-based production systems, however production is also spread across New South Wales, Queensland and Western Australia.

The dairy industry has seen particular difficulty over the ten years preceding 2020 due to factors including climatic conditions and unsustainable pricing mechanisms. Despite this hardship, a large proportion of dairy farms remain family farms. This places particular emphasis on succession planning to maintain the industry’s longevity.

Due to the perishable nature of dairy, the industry’s supply chain is uniquely interdependent, with short lead times and changes at any point having knock on effects across the supply chain. For this reason, dairy production is typically concentrated close to urban centres, which makes the supply chain increasingly vulnerable to the threat of urbanisation. Dairy exhibits high levels of supply chain integration and significant infrastructure (particularly cold chain) for product collection, storage and retail.

Dairy is regarded a progressive industry in relation to technology, research and sustainability. The industry has been a leader in exploring the use of certain precision agricultural technologies, developing efficient production methods as well as conducting research and development to improve herd genetics and breeding techniques. Dairy was one of the first agricultural sectors to drive its own sustainability agenda by developing the Australian Dairy Sustainability Framework, with industry targets to improve its environmental impact and accountability across animal and human welfare.
**Trends**

- Increase in farm and processor size through consolidation, with many small players historically driven out of the industry, however there has also been an emergence of smaller, value-add farms.
- Australian fresh milk consumption has been steadily increasing in all categories, notably whole milk as well as modified milk types and high value products like yoghurt (Dairy Australia, 2020).
- Majority of production in Northern and Western dairy regions (NSW, WA, QLD) goes to fresh milk, while Southern and South-Eastern regions are processed for cheese, butter, high value exports.
- 38 per cent of Australian milk is processed for cheese, 28 per cent is used for drinking milk, and yoghurt is a large growth area (Dairy Australia, 2019).
- Driven by demand for high quality heifers in China, the dairy live cattle export industry is now valued at more than $200 million.
- Development of breeding values and use of selective genetics and artificial insemination to drive genetic gain and improve herd performance.
- The dairy industry has been an early adopter of automated technologies such as automatic cup removers, slower uptake of fully automated robotic dairies.

**Challenges**

- Uncertainty around price and poor returns in recent years has contributed to production’s decrease to a 20-year low in 2018-19.
- Since deregulation, Australian farmgate milk prices have remained highly susceptible to volatile global milk commodity prices, as well as import competition (Dairy Australia, 2019).
- Uncertainty and/or increases in farm input costs (e.g. fertiliser, grain, water, electricity) at a higher rate than farm output (milk) price.
- Unfavourable seasonal conditions and climate volatility have impacted production and increased reliance on fodder.
- Increasing consumption of non-dairy milk and other alternatives. Plant milk now accounts for ~7 per cent of all milk consumed in Australia (Inside FMCG, 2019).

**Opportunities**

- Continued investment in herd and plant genetics, breeding and pathways to adoption for more resilient livestock and feedbase (pasture/fodder) in current and future environments.
- Large capacity for digital and data-enabled traceability solutions to assure product quality.
- For farmers who have overcome the recent challenges and remained profitable, market outlook is good. Lower milk supply and excess manufacturing capacity creates strong prices as processors look to retain limited milk supply.
- Further research and investment in agricultural technologies to automate processes in both production and processing.
- Capitalise on broadening consumer trends domestically and globally, including lactose-free and other product modifications or value-add that offer high value industrial opportunities.
Priority stresses

Key stresses undermining the stability of the dairy supply chain include:

- **Animal welfare**: Key animal welfare issues in dairy production relate to bobby calves, cow-calf separation, infections such as mastitis, controversial breeding techniques, or other stress-inducing practices. Poor animal handling and treatment practices can decrease productivity and quality of outputs through increased stress to animals, as well as damage the industry's social licence. Rising input costs and fundamental profitability pressure, exacerbated by the costs of compliance with increasing animal welfare regulations, can create pressure on farmers to choose between animal welfare and profitability. Live dairy exporters face high animal welfare stress given a lack of visibility and control over animals in transit and animal welfare practices in the cattle’s destination country.

- **Volatility in global commodity prices**: Australian dairy’s reliance on export markets means that milk prices have long been highly susceptible to fluctuations in global milk commodity prices. This has contributed to unfavourable Australian price step-downs in recent years. This susceptibility is due in part to the removal of market distorting industry policies, progressive deregulation and increased global trade. With around 36 per cent of annual milk production exported, no significant tariff barriers to commercial imports, and a sizeable component of domestic consumption in some categories based on imports, global dairy prices have a direct impact on Australian dairy company and farmgate returns.

- **Market access and global competition**: As one of the most commoditised agricultural sectors worldwide and heavily reliant on export revenue streams, market access is a significant stress underpinning dairy’s ability to compete in the global dairy market. Over-exposure to global dairy prices, a de-regulated industry and distinctively high input costs create substantial export risk. Increasing production in low input-cost countries such as Argentina. As reflected in stakeholder engagement, the industry’s over-reliance on exports to China also worsens the stress of global competition for Australia.

- **Cold chain traceability**: Maintaining precise cold chain conditions that support the traceability of products across the dairy supply chain is a constant stress underpinning the storage, transport and logistics, processing and distribution of dairy products. Threats to cold chain stability have the capacity to substantially disrupt product movement, resulting in food safety breaches, damage to reputation and final returns across the supply chain. Cold chain complexity makes traceability increasingly challenging, heightened by uncertainty in data sharing. Sufficient record keeping, Cleaning in Place (CIP) systems and other sterilisation protocols, and product recall plans are critical to managing cold chain stresses.

- **Environmental degradation**: The environmental impact of the dairy industry has been a high risk stress for decades. Run-off issues, waste management, greenhouse gas emissions from cattle and fodder production, and degradation of land from intensive pasture management can all threaten the industry’s longevity. Dairy contributes to a notable proportion of Australia’s agricultural GHG emissions with farm inputs and production identified as significant risk areas (Dairy SA, 2017). Dependency on water is also an issue given the large amount needed for milk production and processing. This reliance not only creates a negative perception of dairy’s environmental impact, but increasingly limited water availability and rising costs also pose a risk/stress.

- **Rising input costs**: The rising costs of water, fuel, energy, and other inputs are putting pressure on already tight margins across the dairy supply chain, most notably for farmers. Continuation of upward cost trends would see farmers incurring over $900,000 of input costs each year by 2030, an increase of 32 per cent on 2018 costs (ANZ, 2020). Further, farmers are frequently encouraged through payment models to move to non-seasonal production systems. This increases costs and risk, especially when water and fodder/grain costs can be variable and high (ACCC, 2019). As reflected in consultation with processors, rising fuel and energy costs are an issue particularly in storage, transport and processing of milk. These costs are ultimately passed back to consumers through higher retail prices.
Impact of shocks

Identified below are the shock scenarios which can inflict the greatest impact on the dairy supply chain, exacerbating existing stresses and giving rise to new risks and vulnerabilities.

**One Health**

The occurrence of a biosecurity threat or animal infection, for instance Foot and Mouth Disease, poses serious risks to dairy inputs and production. Australia estimates that a small FMD outbreak, controlled in three months, could cost the industry around $7.1 billion (DAWE, 2020). Animal stress will impact production and increase an animal’s vulnerability to further disease, and impact the industry’s social licence. A pandemic such as COVID-19 creates risk in access to labour and jeopardises exports, causing immediate damage to product flows, consumption models, and profits. In these situations, exporters face challenges in limited shipping reefer availability, container capacity and input import delays, as indicated in consultation.

Contamination of final dairy products via animal or human infections or pathogens is also a large risk for food safety and traceability. Dairy in particular is highly vulnerable to food safety issues given product perishability, short lead times, and high degree of supply chain interconnectedness. Breach of cold chain conditions due to One Health threats can result in product recalls, compromising profitability and reputation.

**Drought**

As a product of underlying climate variability, drought creates risk in the dairy industry by increasing reliance on water (in particular regarding stock water, as well as processing) and fodder production. This aggravates existing industry challenges relating to environmental degradation by increasing emissions and further depleting natural resources. The weakening of farm balance sheets in recent years has impeded farmers’ ability to borrow capital during drought to accommodate increased input costs. Drought also compromises animal welfare, given that an increase in average ambient air temperatures increases the chance of heat-induced complications in cattle, including damage to fertility, appetite and likelihood of mastitis, risking productivity (Dairyproducer.ca, 2020).

**Geopolitical**

A sudden halt to the dairy industry’s ability to export caused by geopolitical volatility creates the largest immediate risks in processing, wholesale, and market distribution. With 36 per cent of dairy products exported, a threat to market access can ignite an oversupply of products and force processors to decrease prices and shift product mix into lower-return products. For example, recent volatility in market access due to COVID-19 has seen processors experience increase demand for low-value, extended shelf-life products such as milk powders, with a decline in demand from global food service and industrial markets. Tariffs limiting product flows can expose supply chain actors even further to global competition and volatile price fluctuations, as well as cost of imported inputs.

**Natural Disasters**

Natural disasters pose risks to animal welfare, as well as giving rise to input cost and profitability pressures. Bushfire is particularly threatening to dairy’s cold chain operations and traceability efforts, with the potential to block or destroy certain transport and distribution routes, increasing lead times and compromising visibility over product flows. This difficulty of this situation was recounted in consultation with both processors and producers. The catastrophic 2019-20 bushfires resulted in the loss of approximately 150,000 dairy cows and 800,000 litres of milk which were dumped due to inaccessible roads and power outages (ANZ, 2020). Flood also creates high risk by damaging pasture area, decreasing mobility of stock, disrupting product flows, and importantly, damaging fodder production. Mould growth on water-damaged fodder reserves such as hay or silage reduces its nutritive value and palatability, jeopardising productivity and bottom lines (Agriculture Victoria, 2020).

**Technology**

A cyber attack has the potential to increase the industry’s vulnerability to track and trace, location, temperature or biohazard stresses as well as volatile global commodity prices, given exports may be threatened if sufficient data guaranteeing the food safety of products cannot be provided. Cyber threats, for example the recent attack on Lion milk’s order fulfilment system, can significantly undermine credibility, cause severe disruptions to supply chain flows and damage overall productivity and profitability.
Resilience heat map

The heat map below plots the various stresses inherent in the dairy supply chain. The relative impact of each stress on each supply chain node is colour coded as per the scale shown. Shocks can be seen overlayed on the heat map, indicating where supply chain nodes can be hardest hit during shock events and the flow-on effects up and down the supply chain. Given both dairy production and processing are typically highly concentrated in certain geographic regions, some areas are more vulnerable to targeted shocks such as natural disaster or drought. More broadly, many day to day stresses impact the supply chain regardless of location or size of production, for example animal welfare, climate variability, or rising input costs.

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- **Animal welfare**
- **Environmental degradation**
- **Fundamental profitability pressure**
- **Urbanisation**
- **Optimising infrastructure**
- **Consumer preferences**
- **Volatility in global dairy commodity prices**
- **Climate variability**
- **Access to labour**
- **Rising input costs**
- **Cold chain traceability**
- **Fundamental market structure**
- **Use of data**
- **Regulation**
- **Market access and global competition**

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**Key areas to strengthen resilience**

1. Reducing and stabilising cost of inputs to improve resilience toward changing climatic conditions and responsiveness to fluctuating market demand.
2. Measuring and improving environmental performance to better manage climate variability and reduce environmental degradation.
3. Understanding evolving consumer preferences and combatting consumer misperceptions of animal welfare, environmental impact and dairy nutritional value.
4. Improving herd genetics to produce more resilient livestock with reduced environmental impact and enhanced animal welfare.
5. Leveraging greater use of data to enhance cold chain productivity and traceability, ensuring food safety, and product quality and stability.
Singapore

Market context

- Singapore is the Australian dairy market’s fourth largest export market by value in 2018-19, exporting 67 thousand tonnes of dairy product worth USD$118.9 million (Dairy Australia, 2020). Singapore is ranked as the most food secure country in the world (Global Food Security Index, 2020).
- Top products measured by value that make up the majority of Australia’s dairy exports to Singapore are milk and cream ($55 million), cheese and curd ($36 million), buttermilk, yoghurt, kefir ($22 million), and butter and other fats and oils derived from milk ($18 million) (Trading Economics, 2020).
- Singapore is a vital re-export hub facilitated by liberal market access regulations, importing about 90 per cent of its food from over 160 countries, with a volume of external trade 3.5 times its annual GDP (The Diplomat, 2015).
- Packing and processing factories form key links to regional supply chains, with the country relying on bulk import of intermediate goods to be manufactured and re-exported, primarily to China and other Asian nations.
- One of three supermarket chains that dominate Singapore’s grocery retail sector is Dairy Farm International, which accommodates dairy exports catering to mid-range to high-end consumers (Austrade, 2020).
- Singapore is dependent on exports for food service sectors targeted at tourists and nutritionally-minded expats.

Key vulnerabilities

- The supply of dairy exports to Singapore is constantly underpinned by the risk of competition and market flooding due to the country’s liberal trading nature. In the event of a shock in the Australian market that decreases supply and increases price, Singaporean importers have many other alternative suppliers.
- Slower lead times and decreased production capacity due to COVID-19 shocks have increased the price of Australian dairy products in Singapore. As a result of the virus, Singapore’s trade in April 2020 dropped 12.8 per cent, with Australian dairy imports decreasing due to limited port availability.
- Biosecurity is a key concern for Singapore, having experienced the largest recorded outbreak of Hand, Foot and Mouth Disease in 2000.
- As a net food importing nation, Singapore is particularly susceptible to geopolitical disruptions in its trading partners. Trade wars between USA and China has decreased China’s demand for Singaporean finished goods, therefore decreasing demand for Australian dairy manufacturing inputs.
- Increase in export prices due to drought can cause Singapore to seek dairy supply elsewhere.
- Recent Australian bushfires caused an estimated 0.6 per cent drop in dairy exports, pushing prices up around 3 per cent (Hoard’s Dairyman, 2020)

Key considerations

- Excellent logistics, infrastructure and trading ecosystems, facilitating efficient dairy trade.
- Singapore’s strategic location within Southeast Asia is highly valuable due to growth in demand for dairy from the region in recent years, underpinned by rising middle class incomes and health prioritisation.
- Singapore re-exports are valuable in spreading product quality awareness and strengthening ‘Brand Australia’ leading to increased demand from other markets.
Current mitigation strategies

As an industry that has faced numerous challenges since its inception, the dairy industry has been a pioneer in the implementation of comprehensive strategies to take ownership of its issues and increase its preparedness for disruption. The pursuit of increased resilience is essential to protect the industry’s longevity, export market positioning, and social licence to operate.

Current approaches

• Celebrating dairy marketing campaigns and labour attraction programs
  For example Dairy Australia’s Cows Create Careers, strengthening social licence to operate.

• National livestock Identification System (NLIS)
  Obligatory identification system, provides lifetime traceability and enables more efficient herd testing.

• Precision livestock farming technologies
  Automated milking and feeding systems, RFID systems, heat detection, fixed cluster and platform spraying systems, etc.

• Breeding and herd genetics
  Research into lowering heat increment in cows to improve overall feed conversion and reduce methane emissions.

• Live data loggers
  Tracking temperature and other controls across the supply chain.

• New Mandatory Code of Conduct 2019
  Helping to balance market power between dairy farmers and processors.

• Industry Sustainability Framework
  Maintains transparency around goals to improve environmental and animal performance.

Case study

Lewis Road Creamery

Lewis Road Creamery (LRC) is a boutique New Zealand dairy company, one of the country’s fastest growing dairy brands most famous for its chocolate milk. Upon the release of its chocolate milk in 2014, LRC faced abrupt nationwide demand far greater than production and distribution capacity, resulting in debilitating supply chain shortfalls. This rapid growth quickly highlighted the limited nature of LRC’s existing data systems, which were incapable of handling the sudden doubling of orders, increasing between 300 and 400 daily. LRC’s data management system required extensive manual data entry, with high margin for error and flow-on effects such as over or under-charging, dispatching incorrect quantities, or sending the wrong product. The situation was exacerbated by short product shelf-life and a geographically widespread distribution network.

In response to this challenge, LRC implemented a new, highly sophisticated Enterprise Resource Planning (ERP) system which leverages strategic logic to automate the receiving, processing, dispatching and payment of orders. The major advantage of the new system was its ability to integrate with customer data systems via Flow Software for Electronic Data Interchange (EDI), enabling more streamlined transactions, cost-effective data sharing, and improved data accuracy.

LRC ensures traceability and product quality through its ERP and EDI systems by identifying the source and lead time for each individual product before dispatch, ensuring they are dated correctly in order to arrive in-store with maximum shelf-life remaining. Automated information flows across the LRC value chain enhances flexibility, for example automatic product stacking when low supply is detected. This capability enables agile supply chains, rapidly responding to changing business circumstances and strengthening reliability with customers (Flow Software, 2020).

This type of progressive data integration demonstrated by LRC increases supply chain resilience by decreasing vulnerability against cold chain threats, responding rapidly to evolving consumer demands, decreasing reliance on labour and enabling more responsive supply chains that cater to the growing complexity of processors’ distribution models.
The following mitigation strategies have been identified as potential measures to improve the resilience of the dairy supply chain. These strategies can act as the catalyst for future projects and working groups to build resilience in sector specific focus areas, as well as projects which reach across multiple sectors.

### Future mitigation strategies

<table>
<thead>
<tr>
<th>1</th>
<th>Digitisation of paper records</th>
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<tr>
<td>The digitisation of contracts, compliance, audits and other paper trails through the adoption of technologies such as blockchain can streamline and automate administrative and physical processes across the supply chain decreases dependency on often unreliable paper trails. For example, regulatory technology is being used by Dairy Food Safety Technology to digitise food safety audit and compliance mechanisms for manufacturers by more responsively identifying risks (DFSV, 2020).</td>
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<tr>
<th>2</th>
<th>Supply chain predictive analytics</th>
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<tr>
<td>Explore the possibility to increase implementation of machine learning algorithms which can identify trends and predict likely outcomes. These can be leveraged by supply chain parties to improve preparedness and forecasting in shock events. In processing, predictive maintenance can be used to detect when equipment is about to malfunction, and adjusting production accordingly.</td>
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<tr>
<th>3</th>
<th>Energy efficiencies for processors and producers</th>
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<tbody>
<tr>
<td>Analyse the opportunities to increase energy efficiency such as variable rate energy mechanisms and biogas plants to offset energy costs. In processing, variable rate energy can be achieved through an enhanced understanding of fluctuating energy consumption in plants. Other potential energy solutions include micro-grids in concentrated production areas and biogas plants. Also assess the appetite for investment in biogas plants to generate electrical power as well as energy micro-grids in concentrated dairy producing regions.</td>
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<th>4</th>
<th>Value-added innovation</th>
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<tr>
<td>Pending sufficient milk supply, increased investment and innovation in value-added products can diversify the industry’s value proposition to maintain prices and demand when disruption occurs, in particular for regions such as Queensland or Western Australia where the majority of production’s processing into primarily fresh milk creates higher vulnerability to shocks.</td>
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<th>5</th>
<th>Reciprocal data mechanisms</th>
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<tr>
<td>In addressing challenges in the dairy industry around lack of compatibility of data between supply chain actors, exploration of data mechanisms that streamline process validation would substantially improve efficiency. For example, producers could enter their use of certain antibiotics into a centralised data repository which automatically notifies processors and other downstream actors. These mechanisms would then enable greater implementation of machine learning and other solutions. Such data could then be used to streamline reporting against industry targets such as those in the Dairy Sustainability Framework.</td>
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<th>6</th>
<th>Leveraging big data learnings</th>
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<tr>
<td>Centralise on-farm data in a private cloud to create joint analysis and interrogation opportunities. With the appropriate data privacy and standards in place, aggregated data sets create the opportunity for shared learnings across the sector that can enhance on-farm and processing decision making.</td>
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<th>7</th>
<th>Real-time payments</th>
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<tr>
<td>Encourage adoption of blockchain-enabled real-time payments leveraging electronic certifications, which could potentially cut out costly third party product testers, decreasing costs for processors. As reflected in stakeholder engagement, real-time payments will also enable producers to be paid earlier.</td>
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<th>8</th>
<th>Cross-state transport regulations</th>
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<tr>
<td>Explore possibility to advocate for alignment in road regulations across state borders, to decrease complexity of product distribution through standardised travel rules and rates.</td>
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<tr>
<th>9</th>
<th>AgTech adoption and commercialisation</th>
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<tbody>
<tr>
<td>Explore possibility for further production and commercialisation of AgTech, particularly around producers’ appetite for adoption. Emphasise strengthening pasture management through hyper spectral imaging and satellite data.</td>
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There is significant capacity for investment in the dairy supply chain to increase resilience and protect the industry as it moves into a new digital era, underpinned by growing uncertainty and disruption.

The sector’s demonstrated history of incrementally and strategically automating operations, implementing technology, and engaging in innovative research all attest to the notion that the industry is ready for this change. While mitigation strategies to maintain core resilience will be required to address inherent stresses, investing in those that will facilitate the development of enhanced and transformative resilience will be critical in ensuring the industry’s longevity.

Core resilience

The sector as a whole would be well-placed to implement digitisation of paper records in production, manufacturing and markets. Increased investment in the transitioning of producers to more value-added production, thereby mitigating risk through a diversified product offering, will also contribute to core resilience. Finally, more standardised cross-state road infrastructure regulations will strengthen the supply chain’s ability to rapidly adjust to increasing demand through more efficient distribution models.

Enhanced resilience

Enhanced resilience can be achieved through the continual adoption of Industry 4.0 technologies. From a processor perspective, this will involve the automation of processes through machine learning to enhance inventory management and product flows. Leveraging insights from aggregated datasets can unlock key efficiency and profitability opportunities through shared learnings. The execution of certain AgTech commercialisation opportunities, particularly around improved pasture management, has significant opportunity to enhance the industry’s resilience. Further, investment in variable rate energy consumption mechanisms and alternative energy sources such as biogas plants will benefit all supply chain participants and improve sustainability.

Transformative resilience

The seamless integration of data and digital processes across the dairy supply chain through reciprocal data mechanisms to enable standardised digital reporting will transform industry resilience by standardising software and reporting methods across the supply chain. Further, predictive analytics and blockchain-enabled real-time payments will transform the industry’s ability to manage traceability and enable highly agile supply chains capable of seamlessly adapting to sudden changes in product flows. This type of technology could fundamentally revolutionise the way dairy farms are managed, creating new levels of on-farm efficiency that enable distinctive preparedness for potential disruptions.
The Australian red meat (beef and lamb) industry is a significant contributor to Australia’s Gross Domestic Product (GDP), contributing $18.5 billion in value in 2017-18 or approximately 1.5 per cent of total GDP. In 2019, Australia produced 2.32 million tonnes of beef and 730,000 tonnes of sheepmeat with approximately 74 per cent of total red meat production occurring in the eastern states (MLA, 2019). The sector directly employs 172,000 workers, and supports an additional 232,000 workers.

Australia exports red meat to over 100 countries. USA, China and Japan are key markets for beef, while the USA, Middle East and China are key markets for sheepmeat exports. A sound national traceability system underpins Australia’s reputation as a global leader in these markets, producing high quality, safe and nutritious red meat.

The Australian red meat industry is geographically diverse, operating across a range of climatic regions. Australia’s northern region is most suitable for grazing cattle on large pastoral properties, favourable for the live export market and commodity marketed beef. Southern Australia’s grazing businesses target premium markets with higher costs of production, predominantly for the chilled and frozen markets. Grain-fed operations support the overall supply chain as an alternate market for graziers and support sales through consistently high quality products.

Continual growth in global demand for animal proteins is a favourable trend for the Australian red meat sector, supported by a growing Asian middle class and resulting in a global annual increase in demand for beef (1 per cent) and lamb (2 per cent) (MLA, 2019).

In recent years, Australian red meat has competed domestically against increasing demand for other animal proteins including chicken and pork, as well as consumer demand for alternative proteins such as plant-based products driven in part by the uptake of flexitarian, vegetarian and vegan diets.

Increased community interest in the impact of red meat production on the environment, animal welfare and diet have heightened the focus on the sustainability in the industry. Supported by the development of the Beef Sustainability Framework, the industry has looked to take a proactive stance on these issues.
**Trends**

- Global red meat consumption is increasing year on year (Beef at 1 per cent, Sheep meat at 2 per cent) (MLA, 2019).
- Decreasing red meat domestic consumption per person.
- Increasing domestic retail price for red meat.
- Domestic per capita consumption remains higher than the global average; Beef (3x) and sheepmeat (5x) (MLA, 2019).
- Growing middle class, particularly in Asia where Australian red meat is favoured.
- Increasing community expectations and scrutiny of livestock practices and their impact on production.
- High quality, quality assured and safe products with traceability are in demand, reflecting a growth in the ‘paddock to plate’ global narrative.
- Increasing market opportunities for Australian lamb.

**Challenges**

- Increasing global competition (with lower cost of production).
- Target to achieve carbon neutrality in the sector by 2030 (MLA, 2020).
- Ageing farmer demographic.
- Decreasing national herd and flock.
- Increasing domestic livestock prices to be the highest priced livestock globally.
- Digital uptake and overall understanding of agricultural technologies.
- Business knowledge and planning for increased stresses and subsequent shocks.
- Biosecurity outbreaks and costs of minimising potential effects.
- Increasing community pressure and expectations regarding environmental and welfare impacts of red meat production.
- Increasing seasonal variability influencing input requirements and prices.
- The industry faces challenges with increasing complexity of its supply chains (geographically dispersed, fragmented sectors and the embedded culture).

**Opportunities**

- Collaboration across the value chain (sharing information for mutual benefit – production, supply chain and consumer facing participants).
- Increasing digital uptake and collaboration to improve data-driven decision making and supply chain efficiency, traceability and visibility.
- Emerging enhanced production methods and models that are understandable and relatable to communities.
- Strengthen social licence to operate by working towards Carbon Neutrality 2030 (CN30) goal for red meat production, lot feeding and processing (MLA, 2020).
- Emergence of diversified income streams through carbon sequestration projects and carbon markets.
- Maintain ‘high value and premium’ products to avoid competing with ‘commoditised red meat’ in international markets.
- Diversified capital streams and models to support business growth and entry.
- Stronger recognition of quality assurance programs across the supply chain and stronger in-market partnerships.
## Priority stresses

Key stresses undermining the stability of the red meat supply chain include:

### Environmental sustainability

Climate variability and natural resource depletion pressure the performance and sustainability of the sector as a whole. Increasing rainfall volatility has a direct impact on land management and overall degradation. Increasingly, scrutiny of vegetation laws are restricting the operations of producers, particularly in northern Australia. The red meat sector contributes 10 per cent of Australia’s total Green House Gases (GHG) emissions, however the sustainability metrics required to improve this figure are not clearly aligned nor encompass the entirety of the supply chain.

### Consumer preferences

Domestically, a continual decline in red meat consumption in favour of ‘alternative proteins’ including animal and plant-based is indicative of shifting consumer preferences. These preferences are driven through health and environmental concerns, as well as increasing retail costs. For key export markets, red meat is seeing strong growth with demand from consumers aligning to a preference for natural, healthy and nutritious red meat.

### Technology (utilisation of information)

Technology utilisation, particularly for documentation and information transfer remains low across the entire red meat supply chain. Significant delays and costs can be incurred as the supply chain is reliant on duplication and transfer of information with the physical product. Low levels of information flowing back down the supply chain mean businesses including production are less optimised and less prepared for adverse scenarios.

### Public sentiment

The industry’s social licence to operate continues to face scrutiny. In particular, concerns remain over animal welfare, environmental and human health impacts, as well as the use of antibiotics and hormonal growth promotants within the ‘live nodes’ of the supply chain. An independent report released by the MLA in 2019 indicated the red meat industry could lose up to $3.2b by 2030 if it does not meet changing consumer attitudes to animal welfare (MLA, 2019). The industry’s leading bodies and businesses will remain pivotal to maintaining and enhancing community trust.

### Regulatory and compliance impacts

Regulatory and compliance costs across the supply chain and across markets both domestically and globally are significant. Costs incurred by supply chain stakeholders for the domestic market stem from environmental legislation, animal welfare and rising health standards. Compliance and affiliated costs for export can vary dependant on the country of destination. Producers can incur regulatory costs of up to 10-15 per cent of annual turnover. Varying state and local based regulations for livestock management and transport of product can create duplication and reduce operational efficiency.

### Pests and disease

The impacts of a pest and disease outbreak could have widespread implications for the industry. For this reason, significant investment across the supply chain supports Australian biosecurity standards in the sector and agriculture more broadly. Fragmented biosecurity laws, however, can create ambiguous rulings and confusion.
Impact of shocks

Identified below are the shock scenarios which can inflict the greatest impact on the red meat supply chain, exacerbating existing stresses and giving rise to new risks and vulnerabilities.

**One Health**

A health shock can occur at multiple nodes within the red meat supply chain. On one hand these impacts can be localised and manageable, while on the other, they can result in severe restrictions and management protocols that can inhibit the entire red meat supply chain. In both minor and moderate cases of biosecurity incursions, for example a Foot and Mouth Disease (FMD) outbreak, local or state based intervention will be required to manage the impacts, severely impeding production and product flows. Other health implications such as the ongoing COVID-19 pandemic have extensive implications on the red meat industry. These impacts can be localised to individual processors or extend to the entirety of the supply chain, resulting in shifting consumer demand, limited access to information and increasing compliance burden.

**Drought**

Drought is a prevalent and active threat across Australia. The effects of drought can remain localised to certain geographic regions, or can be catastrophic and widespread. The millennium drought, as well as the more recent drought experienced up until 2020, have both caused widespread, significant impacts to the red meat supply chain. A lack of business planning, understanding of available information and utilisation of resources perpetuates the effects of drought, with volatility remaining for a substantial period of time. Increasing competition for breeding animals and the slowing of genetic advancement during drought reduces the future resilience of the red meat industry.

**Natural Disasters**

Natural disasters have significant and immediate impacts on the entire supply chain. Unlike drought which tends to experience steady decline, giving businesses the ability to adapt, the intense nature and often far reaching impacts of flood and fire in particular create immediate, unanticipated shock effects within the supply chain. The North Queensland floods in early 2019, for example, led to the loss of more than $800m worth of livestock at very little notice (AgForce, 2019). The 2020 bushfires across the eastern states of Australia reduced access to livestock markets, damaged infrastructure, decimated livestock feed sources (grains, hay, and grasses) and increased input costs with disruptions flowing through to processors and exporters. This can increase the ongoing effects of environmental degradation, pests and disease, and the health and wellbeing of stakeholders across the supply chain.

**Geopolitical**

Reliance on and consolidation of key markets such as China and the USA, particularly for premium Australian export products, increases Australia’s susceptibility to geopolitical shocks. As a net exporter of red meat, the risks associated with geopolitical shocks for the Australian industry translate to a less resilient supply chain that lacks diversification across all players. For premium export products and live export livestock markets geopolitical risks are significant, often leading to increased regulatory and compliance costs.

The 2011 live export ban on Australian cattle to Indonesia, for example, caused an immediate cease in trade based on the decision made by the Australian Government declaring Indonesian animal welfare standards as unacceptable. Implications across the supply chain were severe and invoked significant economic consequences (AFI, 2013). The flow-on effects of this decision led to increased levels of ‘inventory’ on-farm, reduced relationships in-market and created ongoing ambiguity in the live export industry. Further, in 2019, non-conformance to legislated paperwork resulted in the delayed suspension in exports of six Australian abattoirs’ products to China, causing significant damage to industry profitability.

**Technology**

Relatively low levels of digitisation across the red meat supply chain decreases technology risks, yet cyber risks remain a key threat for processors, transporters and exporters. As the industry transitions and enhances the level of digitisation across the supply chain, moving to paperless systems, the impacts of a potential technology shock increase dramatically. Prudent investment in cyber strategy and security now will hold the industry in good stead for the future.
Resilience heat map

The heat map below plots the various stresses inherent in the red meat supply chain. The relative impact of each stress on each supply chain node is colour coded as per the scale shown. The stresses found to have the most critical impact on the resilience of the red meat supply chain were compliance and regulation, technology, public sentiment, non-parity costs of operation, consumer preferences, pests and disease and environmental sustainability. The overlayed shocks on the heat map indicate supply chain nodes most impacted by a shock event and the flow-on effects up and down the supply chain.

### Impact of stress

- **Very High**
- **High**
- **Moderate**
- **Low**
- **Very Low**

### Shocks

- One Health
- Drought
- Geopolitical
- Natural Disasters
- Technology

### Supply Chain

<table>
<thead>
<tr>
<th>Impact of stress</th>
<th>Shocks</th>
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<tbody>
<tr>
<td>Inputs</td>
<td>Production</td>
</tr>
<tr>
<td>Increased volatility in rainfall</td>
<td>![Impact Level]</td>
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<tr>
<td>Health and wellbeing</td>
<td>![Impact Level]</td>
</tr>
<tr>
<td><strong>Regulatory and compliance impacts</strong></td>
<td>![Impact Level]</td>
</tr>
<tr>
<td>Reduction in breeding numbers</td>
<td>![Impact Level]</td>
</tr>
<tr>
<td>Premium product vs commodity markets</td>
<td>![Impact Level]</td>
</tr>
<tr>
<td><strong>Technology (utilisation of information)</strong></td>
<td>![Impact Level]</td>
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<tr>
<td><strong>Public sentiment</strong></td>
<td>![Impact Level]</td>
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<tr>
<td>Market access</td>
<td>![Impact Level]</td>
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<tr>
<td><strong>Non-parity costs of operation</strong></td>
<td>![Impact Level]</td>
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<tr>
<td>Business literacy</td>
<td>![Impact Level]</td>
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<tr>
<td>Animal welfare</td>
<td>![Impact Level]</td>
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<tr>
<td><strong>Consumer preferences</strong></td>
<td>![Impact Level]</td>
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<tr>
<td><strong>Pests and disease</strong></td>
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<tr>
<td>Access to labour</td>
<td>![Impact Level]</td>
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<tr>
<td><strong>Environmental sustainability</strong></td>
<td>![Impact Level]</td>
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<tr>
<td><strong>Significant stresses</strong></td>
<td>![Impact Level]</td>
</tr>
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</table>
### Key areas to strengthen resilience

1. Increase the flow of information from markets and retail back down the supply chain to support processors and producers optimise planning and decision making.

2. Improve access to information and training to enable better business decisions and proactive preparation for shock scenarios.

3. Increase public engagement and provide balanced views to address public concerns relating to red meat production and health.

4. Reduce costs of production and increase the competitiveness of both domestic and export products.

5. Improve compliance outcomes by streamlining processes to reduce the time and cost associated with these activities.
Key export market

**USA**

### Market context

- USA is the second largest export market for Australian beef and the largest market for lamb.
- USA has 5 per cent of the world’s population with more than 20 per cent of the world’s total income.
- In 2019, total Australian beef exports to USA were 259,149 tonnes, with a value of $1.9b. Sheepmeat exports were 79,257 tonnes, with a value of $936.5m.
- Despite a beef quota volume of 433,214 tonnes, seasonal impacts have prevented Australian exports from nearing this export quantity in recent years.
- Manufactured beef (mince, burger patties) represent 61 per cent of total exports to the USA.
- More than two-thirds of exports are to food service and quick service restaurants (QSR), with retail food service serving as a key sector for trim products.

### Key vulnerabilities

- Conscious consumers are reducing their red meat intake and looking at alternative animal and plant proteins.
- Increasing domestic supply of red meat is resulting in cheaper red meat in-market.
- Strong competition in the grass-fed beef category from New Zealand.
- Managing Australia’s variable growing season and maintaining grass-fed products at the level that is demanded year-round by the USA.
- Geopolitical pressures and the ongoing USA-China Trade war creates uncertainty for trade relations.
- Transhipment hubs and lack of access to information during human health pandemics can lead to significant risks with reliance on people in-market.
- USA processing facilities saw a fall of 30 per cent in cattle slaughter between March and April 2020 during COVID-19.
- Drought is correlated with significantly lower volumes of exports (DAWE, 2020).

### Key considerations

- Maintain strong trade relationships and growth opportunities for Australian red meat.
- Grass-fed products are the key Australian red meat export product for the USA and managing pasture availability on-farm has flow-on impacts on overall trade volumes.
- Australia is strongly positioned with ‘natural and healthy’ red meat products.
- Investment in premium and value-add products to cater for the increasingly choosy consumer.
Current mitigation strategies

Access to information and ease of data interpretation is critical for a resilient red meat supply chain. Actionable and measurable insights provide the industry with the ability to manage variances. For exporters and customers, clear information flows are required for enhanced business decision making. For producers, maintaining awareness of events across the supply chain can assist with guiding better management decisions.

Current approaches

- **Livestock Data Link (LDL)** – LDL is an online application that improves the sharing of information across the supply chain.
- **SME branded exporters choose markets** – SME exporters and brands are mitigating risks by targeting exports to lower value, yet more reliable markets such as the USA and Middle East. China’s complex structure and potential risk is still a deterrent for smaller exporters.
- **National Livestock Identification System (NLIS)** – National individual and mob-based database/traceability system, with Victoria as the only state utilising the system for both individual sheep and cattle.
- **Improved processing technology** – Improvements in processing technology such as Dual X-Ray imaging at line speed and hook tracking provides improved yields and efficiencies within the processing node.
- **Market diversification** – Diversified markets and strong relations have supported the ability to pivot and maintain export volumes during COVID-19 and recent geopolitical volatility.
- **Red Meat Sustainability Framework** – Provides industry with the ability to measure and track performance annually over a number of indicators.
- **Product differentiation** – Strong Australian brand reputation and individual exporter branding in international markets.
- **Increasing access to livestock finance** and micro-financier accreditation.
- **Improving genetics** and advancements in breeding technology.
- **Quality assurance programs** – targeted both to the producer and specialised towards the consumer.

Case study

OBE Organic

OBE Organic (OBE) is an Australian beef brand exporting products to the Middle East, USA and Asia, excluding China. Purchasing directly from organic farmers, the business sells premium beef into the global market.

Maintaining visibility of the supply chain to enable timely decision making is key for OBE to mitigate risk exposure. Limited access to information to support livestock purchasing decisions, logistics planning and market conditions has been difficult to achieve. During COVID-19, the business could not access its regular air freight channels, pivoting to sea freight with subsequent delays, unloads and reduced visibility over its products.

To mitigate this uncertainty during COVID-19, BSM Global provided a digital solution that allowed OBE to maintain control of the information throughout its supply chain. The creation of bespoke, digital work flows provided greater visibility of the supply chain including digitised communications, document transfers, management of contracts, and creation of automated alerts based on parameters provided by OBE. This enabled OBE to pivot as required from pre-booking right through to receipt of payment.

The technology was able to interpret and provide insights via reports to the OBE management team meaning OBE was now in control of the information relating to their cargo. They knew the situation at each supply chain touch point and could provide updates to customers in real-time.

By integrating customer receivables, flagging delays, and high risk ports, the business was able to proactively manage its decision making from livestock purchasing through to processing.
### Future mitigation strategies

The following mitigation strategies have been identified as potential measures to improve the resilience of the red meat supply chain. These strategies can act as the catalyst for future projects and working groups to build resilience in sector-specific focus areas, as well as projects which reach across multiple sectors.

1. **Data governance framework**  
   Developing an accessible data governance framework for the end-to-end value chain to support data sharing and data integration opportunities.

2. **Improved utilisation of NDVI mapping**  
   Supporting the adoption and better utilisation of NDVI-driven tools by producers to inform decision making.

3. **Customer and market research**  
   Undertaking targeted research to understand what specific feedback from customers and other market insights is most beneficial for producers and other supply chain actors, in supporting a demand-driven supply chain.

4. **National individual animal tracking**  
   Advocacy for further roll-out of Electronic Identification Device (EID) tracking to sheep beyond Victoria to all other states. This will allow for national individual traceability and improved overall analysis across the supply chain.

5. **Digitising paper records**  
   Moving to paperless documentation and transactions in transport and logistics will provide stakeholders with improved product visibility and accuracy, supporting the better flow of goods across the supply chain.

6. **Cyber risk mitigation**  
   Undertake research to understand future cyber risks facing the sector to develop mitigation strategies which can ensure greater digital adoption does not have unintended negative consequences.

7. **Improved coordination of innovation pipeline**  
   Advance the coordination of cross-sector and cross-supply chain startups to link RDCs, universities and private organisations to advance industry innovation and implementation.

8. **Streamline product flows**  
   Analyse the opportunities to streamline product flows through strategic stock management for independent optimisation tailored for either downstream (demand) or upstream (supply) to maximise high value products.

9. **New pricing models**  
   Red meat remains a luxury product with price sensitive consumers. Explore pricing that is indicative of the quality and standard influenced by production practices and demand. Pricing grids should reflect market expectations for premium products or discounts.

10. **Value-added innovation**  
    Continued market analysis to identify diversification opportunities that align with stakeholder goals of maximising growth. Identify options available for industry value-add prior to export, as well as balance considerations regarding utilisation and production capacity with product shelf-life.

11. **Supply chain optimisation metrics**  
    Developing optimisation metrics at various nodes of the supply chain is important in developing an overall understanding of performance. Identify the potential levels for value-add production, and whether this is being measured via throughput or dollars per unit.

12. **Smart packaging solutions**  
    Research and development into tamper proof and tamper evident packaging to help identify market breaches and extend shelf life.

13. **AgTech commercialisation**  
    Provide the opportunity for further production testing of new AgTech. Increase the number of providers active in trials to reflect a commercial-ready and advanced AgTech ecosystem.
The red meat industry is incredibly resilient and innovative, with strong prospects in both domestic and export markets.

There is no singular solution that will create a more resilient supply chain, however, through partnership between private enterprises, industry and government, the red meat industry can become more adaptable to the increasing stresses across the supply chain.

### Mapping Return on Investment (ROI)

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#### Where to play

- **Adaptive business models that reconfigure supply chains with predictive insight**
- **Leverage digital and data to enable supply chain alignment to adjacent market entry**
- **Enhance supply chain connectivity and end-to-end digital adoption**

| Sector-specific initiative | Cross-sector opportunity |

**Core resilience**

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Data governance is core to providing consistent and useable information throughout the supply chain. A standard set of principles will ensure a smooth transition to a level of information capture that is standardised to capitalise on opportunities. National individual animal tracking can support biosecurity objectives while assisting operations management. Focusing on the utilisation of existing information that is readily available to support feedback loops up and down the supply chain. Identifying opportunities to increase value-add strategies works collaboratively with the decoupling of the product to maximise volume and revenue growth.

**Enhanced resilience**

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Key to supporting industry resilience will be various digital programs alongside a cyber strategy that protects an increasingly digitised supply chain. The digitisation of the transport and logistics nodes with paperless transactions will support improved efficiency, visibility and decision making. Digital logistics would provide the opportunity for digital coordination of arrivals, packaging and various supply chain processes. This enhanced visibility of processes will enable opportunities for automated calibration of transport decisions that leverage digital and data right through markets and into retail.

**Transformative resilience**

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Trialling and implementation of smart packaging has the capacity to revolutionise the red meat industry’s ability to transform resilience by improving environmental performance, traceability management, and overall supply chain efficiency. Another input to this efficiency will be the optimisation of supply chain metrics as well as commercialisation of new precision AgTech opportunities. These strategies will transform resilience by enabling the industry’s seamless adaptation to a rapidly changing technological environment. The development of optimisation metrics at each node of the supply chain will assist with the identification for value-add strategies and overall will enhance supply chain resilience.
**Introduction**

The Australian seafood and fisheries industry is a major contributor to the wider Australian economy, valued at $3.18 billion in 2017-18 across both wild-catch and managed fisheries, which employ over 17,000 people (ABARES, 2020). With value-adding and manufactured seafood activities included in the estimate, the seafood industry in total was worth $5.3 billion in the same year (ABARES, 2020). Domestic consumption of seafood is steady, and largely fuelled by imports, which make up 65 per cent of consumed seafood in Australia (ABARES, 2020). However, exports have also grown significantly by 10 per cent in the year to July 2018, reaching $1.58 billion in value and driven by Asian demand in high value premium products such as rock lobster and salmon (ABARES, 2020).

The industry in Australia is diverse given the various climatic regions and ecosystems across the nation’s oceans and waterways. Fish, crustaceans and molluscs are major categories that contain large industries such as Salmonids ($855 million), Rock Lobster ($713 million) and Prawns ($361 million) (ABARES, 2020), and each of which contain constituent wild-catch and managed aquaculture segments of production. Tasmania ($1.07 billion), Western Australia ($634 million) and South Australia ($470 million) represent 68 per cent of gross production value in 2018 (ABARES, 2020) – further reflecting the diversity of the sector.

Alongside the hundreds of species fished in Australia and different processing, the industry is spread across Australia’s vast coastline, varies between wild capture and managed aquaculture operations, and includes ocean, river and estuary fishing. Furthermore, there are both larger corporate players in the sector, and smaller, family-owned operations. These range of factors come into play across each seafood category, and drive challenges relating to achieving ‘whole-of-seafood’ outcomes and strategies.
### Trends

- Generally stable domestic consumption, between 12kg and 16kg per person annually.
- Changing consumption patterns in domestic and export markets.
- Increasingly strict food safety, biosecurity and resource management regulations.

### Challenges

- Adjusting to regulation around sustainability of fishing practices, including quotas and fishing regions.
- Exchange rate fluctuations and competitiveness of Australian products.
- Disease in fish stocks affecting availability and supply, including recently in salmon, oysters and prawns.
- Import competition from low cost production in Asian aquaculture farms, particularly for prawns and finfish.
- Over-reliance on certain export markets for industry returns and growth.
- Access to air freight and competition from other export commodities.
- Supply chain integrity and quality maintenance, including counterfeit and cold chain availability.
- Competition from other proteins, including beef, poultry, lamb and pork.
- Increasing incidences of illegal, unreported or unregulated (IUU) fishing (DAWE, 2020).

### Opportunities

- Technological advances are driving the potential for on-shore aquaculture facilities, which enable greater control of fish stocks, growth and quality.
- New market access through Free Trade Agreements with Indonesia and other markets offers potential for export growth.
- Developing traceability through supply chains to improve quality and integrity of end product.
- Freshness and safety of seafood products are reported as the most important factors in consumer purchasing decisions – both areas in which Australian produce is renowned.
- Improved extension of R&D and community engagement to enhance sector reputation and social licence.
Priority stresses

Key stresses undermining the stability of the seafood supply chain include:

**Weather and climate change**
- Particularly for wild catch fisheries which rely on specific ocean conditions to access fishing zones each day, weather can impact producers’ ability to harvest and thus sell product on any given day, which impacts supply at retail and related logistics as well as the fisher’s revenues. Longer term climatic change is also causing changes to usual fishing grounds/locations and species breeding in certain waters, influencing operational decisions made by fishers.

**Pests and disease**
- Disease in fisheries, particularly in wild catch, are hard to monitor and control. The industry has been affected by multiple incidents over recent years, including White Spot in prawns, with impacts dependent upon location, prominence in the fish stock, and has implications at retail for food safety. Disease events can have existential impacts for local seafood sectors.

**Cold chain and freight space availability**
- Many live and fresh fish products require cold chain capabilities, which are in limited supply across Australia and especially in export markets, particularly in the hot summer months. The supply chain faces issues in transporting product from port to onward logistics, and competes with other fresh agricultural products. This lack of availability constrains supply (and thus returns), and can result in sub-optimal product quality.

**Labour supply, wellbeing and succession**
- The average age in Australian fishing was indicated by stakeholders to be mid to late 50s – the production and processing sector is struggling to access skilled, youthful labour to continue operations into the future. There are also challenges associated to the seasonal nature of fishing, and the significant impact on lifestyle that a career in fishing entails.

**Market access**
- Consumer trends are consistently changing in export markets, and stakeholder interviews suggested that Australian fisheries face seasonal challenges with managing demand across locations and meeting these various preferences. There is also a significant reliance on continued market access and ongoing protocol negotiations, and changes at customs/borders have significant impact on ability to sell product abroad, which is a major revenue source for the sector. 65 per cent of seafood consumed in Australia is imported. With no country of origin labelling required, and mass-produced farmed products able to access the Australian market, Australian fisheries struggle to compete on price and face significant barriers in the market.

**Sustainability and social licence**
- Consultations suggested that the sector suffers from poor public perception of its management of the natural environment, despite various efforts across industry. High profile examples tarnish the entire sector, and fishers face reputational challenges in being accepted by the communities that they operate within. This can flow through to overall demand for seafood products if consumers have certain preconceptions.
Impact of shocks

Identified below are the shock scenarios which can inflict the greatest impact on the seafood supply chain, exacerbating existing stresses and giving rise to new risks and vulnerabilities.

One Health

One Health shocks have a significant impact the daily stresses in seafood, largely for similar reasons to geopolitics in the influence they have on export trade. Major human or animal biosecurity incidents will often result in sudden market closure or disruption, which stakeholders indicated exacerbates daily export market maintenance and protection from import competition in a significant way. Freight and logistics routes may be closed, which compounds the issue of already limited cold chain availability. One Health shocks were also shown by interviewed stakeholders to have a large impact on physical processes in the seafood supply chain. If the labour force becomes ill, fishing, processing and logistics nodes may be understaffed and unable to operate. Government and RDCs are also affected by these shocks, due to sudden need for regulatory/policy action and new research into solutions for biosecurity challenges respectively.

Drought

Drought has a low level of impact upon the sector and stresses in its day to day work. The area in which it may cause greatest impact is in exacerbating perceptions of sustainability and social acceptance of the sector, which challenges fisheries day to day. Drought increases wider societal awareness of related challenges in water use, environmental damage and other sentiments. This could translate into greater public scrutiny of the seafood industry. Further, stakeholders noted that drought and water availability in estuaries and river waterways can impact the nutrient cycle that returns to the ocean, and thus fish growth, which influences outcomes for producers. Drought has few other noticeable impacts upon the seafood supply chain however, and when it does occur the reputational elements will be limited to those that operate brands and are consumer facing, such as retailers.

Natural Disasters

Natural disasters represent significant shocks that exacerbate stresses relating to the physical process of catching fish – thus mostly impact at the producer end of the supply chain and have flow-through impacts on retail supply and logistics. Large storms beyond day to day weather conditions can severely limit harvest on a particular day, as well as opening the door to import competition and new onshore techniques of fishing which challenge the existing sector. There are also limited, geographically specific impacts on logistics and transport of product that were identified by interviewed stakeholders, as well as on-shore infrastructure such as processing facilities.

Geopolitical

Geopolitical shocks have a major bearing on day to day stresses in the seafood supply chain, given seafood is largely an export-oriented industry (though the extent to this varies per category). Over-reliance on export by a number of industries means that market access closures can significantly impact both production and processing due to the relation to price, returns and demand, and logistics as trade routes are reduced. Additionally, geopolitical movements can exacerbate impacts on government stakeholders, due to sudden pressure applied to diplomacy and regaining trade access. Stakeholder consults revealed that geopolitics also in a number of instances affects supply chain oversight, access to labour if migration channels and visas are limited, and likelihood of market closure relating to pests and disease.

Technology

Technological shocks such as data theft and cyber attacks have very isolated impacts upon the stresses to the seafood supply chain. The industry is largely limited on technology use and widespread data capture, thus stakeholders considered the industry to be relatively sheltered from related shocks. However, the isolated area in which the shock does have a significant impact is upon the supply chain oversight stress, for businesses involved in brand/sales (processors), logistics businesses and retailers. Any event relating to hacking of supply chain data would further exacerbate challenges of transparency in seafood supply and could erode consumer confidence in integrity of logistics. Track and trace technology is currently limited in certain categories, impacting on food assurance.
Resilience heat map

The heat map below plots the various stresses which stakeholders identified as having the greatest impact upon the seafood supply chain. The relative impact of each stress on each supply chain node is colour coded as per the scale shown. The stresses found to have the most critical impact on the resilience of the seafood supply chain were weather and climate change, cold chain and freight space availability, sustainability and social licence, market access, labour, and pests and disease.

There are a number of day to day stresses that impact the seafood supply chain under standard business conditions, and shocks that exacerbate their impacts. The seafood industry is highly differentiated across geography, species, and wild or managed operations – meaning these aspects have varying degrees of scale and influence across the sector. Broadly, stresses and shocks that affect the physical harvest of seafood products, and their ongoing logistics/distribution, were considered by interviewed stakeholders to have the most pronounced and consistent impacts on the sector.

<table>
<thead>
<tr>
<th>Impact of stress</th>
<th>Shocks</th>
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<tbody>
<tr>
<td>Very High</td>
<td>One Health</td>
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<tr>
<td>High</td>
<td>Drought</td>
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<tr>
<td>Moderate</td>
<td>Geopolitical</td>
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<tr>
<td>Low</td>
<td>Natural Disasters</td>
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<tr>
<td>Very Low</td>
<td>Technology</td>
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<tr>
<th>Supply Chain</th>
<th>Inputs</th>
<th>Production</th>
<th>Processing &amp; Storage</th>
<th>Transport</th>
<th>Markets &amp; Retail</th>
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<tr>
<td>Weather and climate change</td>
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<td>Quota regulations</td>
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<td>Cold chain and freight space availability</td>
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<td>Sustainability and social licence</td>
<td><img src="#" alt="Moderate" /></td>
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<td>Import competition</td>
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<td><img src="#" alt="Low" /></td>
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<tr>
<td>Market access</td>
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<td><img src="#" alt="Low" /></td>
<td><img src="#" alt="Very Low" /></td>
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<tr>
<td>Biological developments in fish rearing and infrastructure</td>
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<td><img src="#" alt="Low" /></td>
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<tr>
<td>Pests and disease</td>
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<td>Labour supply, wellbeing and succession</td>
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<table>
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<th>Value Chain</th>
<th>Capital/Risk</th>
<th>Government &amp; Regulators</th>
<th>Research/Entrepreneurs</th>
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**Key areas to strengthen resilience**

1. Impacts on demand when Geopolitical or One Health events close or disrupt markets.
2. Security/certainty of supply to meet variable demand, and reducing impact caused by weather/natural events or disease incidents.
3. Improved supply chain oversight and cold chain logistics availability.
4. Reducing costs of production and enhancing competitiveness.
5. Improving social acceptance, sustainability and ‘people’ factors – telling the story of Australian seafood.
Key export market

Japan

Market context

- Japan was Australia’s largest export market for seafood until 2005, when trade pivoted towards China and Southeast Asia (FRDC, 2020). However, Japan still purchases significant volumes of Australian seafood each year, worth $239 million in 2019 which was Australian seafood’s second largest export destination (FRDC, 2020).
- Per capita consumption of seafood in Japan is significant, as a major part of the Japanese diet – this sits at 27kg annually per person (Austrade, 2020).
- Australia operates in a niche market in Japan – supplying at the premium end of the market. Categories such as salmon and tuna have experienced 40 per cent growth in consumer demand in the past four decades (Austrade, 2020).
- Australian Bluefin Tuna experiences particularly high demand in the food service sector for sushi, and Tasmanian salmon achieves higher price points than import competitors. The former category represented 57.45 per cent of seafood exports to Japan in 2019 (FRDC, 2020).

Key vulnerabilities

- Market access and regulation – Japan has a strict regulatory regime around food imports, inbound logistics, and food safety. Exporters will need to comply with the Food Sanitation Law, Japan Agricultural Standards, labelling and liability laws as well as quotas in certain categories, which include cod, mackerel, scallops, and squid (Austrade, 2020).
- Natural disasters in Japan – Japan faces extremes in weather, with pronounced typhoon seasons and frequent earthquakes. Though the country is well-equipped in terms of infrastructure, earthquake-proof buildings and such, these events can cause sudden disruptions to supply chains and logistics. Similarly, human disease events are coupled with other biological shocks such as nuclear disaster (per Fukushima in 2011), which drove similar large-scale supply chain disruptions.
- Limited supply chain routes and oversight – compared to connectivity to other Asian countries, there are fewer direct routes to the Japanese market, with a limited number of airlines (Qantas, Jetstar and Japan Airlines) flying directly. Logistical options are somewhat limited.
- Ways of doing business – managing business relationships in Japan is significantly different to those conducted in Australia. Japanese society and business is relationship-driven, and centres around the concept of ‘face’ and hierarchy.

Key considerations

- The seafood sector’s engagement with Japan is highly category dependent – it is a high potential market for premium seafood products and fresh/live goods, however there is also greater emphasis on quality of supply chain and logistics for these products.
- Limited freight capacity to Japan via air is likely to result in higher costs for exporters – weighing up whether this cost is reflected by higher value due to the premium nature of Australian seafood products is an important consideration.
- Due to the strong consumption of seafood in Japan, there is also large competition from the Japanese domestic market and other international suppliers. Australian producers must differentiate their product and engage strategically with importers, as well as establishing market presence.
Current mitigation strategies

The industry adopts a number of mitigation strategies to reduce the impact of associated shocks and stresses, as identified in stakeholder consultation. However, it should be noted that there are significant variances between how these are adopted across the various sectors within seafood species (i.e. salmon, lobster, tuna), catch types (i.e. wild catch, aquaculture), geographies/locations, and particularly on the size of each business.

Improving adoption of the below strategies is mainly dependent upon the ability to share these strategies across broader industry, and ensuring they are relevant to the diverse groups across the seafood sector.

Current approaches

- **Monitoring developments across export markets** by purchasing and analysing data relating to consumer trends and in some industries, actively diversifying export locations. This reduces risk of over-exposure, as well as improving returns for fishers by accessing the highest value markets.
- **Short-term weather forecasting** to make decisions on daily fishing schedules, logistics and locations – allowing for business and quota planning to make demand-supply estimates.
- **Established accreditation schemes** to establish guidelines for logistics handling and processing, and encourage higher standards, aiming to improve quality of product through supply chain integrity and food safety.
- **Traceability solutions**, mostly focusing upon temperature control, allowing for greater assurance of product quality and authenticity, which can drive increased demand and returns for fishers.
- **Exchange rate hedging** to obtain greater profits on export sales.
- **Community schemes and goodwill gestures** to assist with social acceptance in local communities and improve the brand image of Australian seafood.
- **Incorporating automated processing machinery** into factory operations and logistics, including for filleting, tinning and packaging. This improves efficiency, which has implications to the bottom line of fishers, and can reduce reliance on skilled human labour.
- **Concerted efforts to develop vaccines** by partnering with scientific organisations such as CSIRO – reducing supply-side risks caused by disease and providing additional food safety assurance.
- **Online quota management**, making it easier for businesses to track volume captures to make business decisions across the season.
- **Carbon offsetting** to reduce environmental impact, in recognition of the importance of the ecosystem.

Austral Fisheries

Austral Fisheries operates across the Southern Ocean, North Australia and the Timor Reef, predominantly fishing for Prawns and Toothfish. Producing premium products, there has been growing emphasis on traceability and sustainability within the supply chain to prevent counterfeit and to connect to consumers, which has led Austral to adopt the ‘OpenSC’ traceability platform and ‘Source Certain’ provenance system.

Working closely with NGOs and the private sector, Austral’s customers can now scan a QR code on each Toothfish carton, receiving information from embedded RFID tags on where and when it was caught, logistical processes along the supply chain, and information regarding how the business catches sustainably. In the process of also being rolled-out to prawns, the Open SC platform, which utilises blockchain technology, allows Austral to tell the story of its brand and give consumers a rich understanding of the product journey. Increased transparency builds trust with customers and reinforces the premium, sustainable attributes of Austral’s seafood.

This is coupled with the Source Certain system, which helps Austral to protect products against fraud in export markets by using trace element detection. Cross-checking against expected chemical compositions, the technology indicates whether or not a product was sourced from the location it claims to be from – therefore picking up if a product has been switched or replaced. Again, this enables Austral to provide food safety and quality assurance to its global customers.
Future mitigation strategies

The following mitigation strategies have been identified as potential measures to improve the resilience of the seafood supply chain.

1. **Supply chain predictive analytics**
   Integrating weather forecasting, geopolitical information, trade protocol data and freight/logistics schedules amongst other data points, would allow businesses to make predictive decisions based upon impacts of shock events. Incorporation of consumer sales and preference metrics could also enhance demand-driven decision making. The system could also suggest real-time mitigation strategies and the cost/benefits of each strategy in relative terms – making seafood businesses more responsive to change.

2. **Mandatory country of origin labelling**
   Mandatory country of origin labelling can help Australian seafood to compete more successfully in the domestic market. Often unable to compete on price, this would enable clearer brand stories to be told to Australian consumers about the local sourcing of the product, and allow for differentiation of Australian seafood goods.

3. **Online auctions for transactions**
   Some wholesale businesses have started to use online auctions during COVID-19, however there is an opportunity to make this more widespread. Doing so would form more consistent market prices that reduce fluctuations, whilst also forming a dataset on sales volume and value metrics that can be linked into quota limits. When analysed, this dataset could lead to more sustainable and efficient management of fisheries and business planning for seafood businesses.

4. **Chartered flights for export**
   The Federal Government’s $110 million International Freight Assistance Mechanism (IFAM) during COVID-19 has helped exporting businesses to access air cargo capacity with specific charter flights, in a time when passenger planes that are usually relied upon are not available. These dedicated services were seen as successful in discussions with industry at improving capacity and easing access to foreign markets, and continuation of this scheme or provision during future shock events is seen as being helpful to industry.

5. **Consolidation of shipments**
   More efficient data-driven consolidation of shipments across seafood providers could help to lower costs and maximise freight space. For many smaller seafood exporters unable to fill a whole freight container, combining their shipment with another producer would represent more efficient use of space. Integrated datasets regarding volume for shipment, aggregated at an industry level and shared with freight forwards or coordinators, would enable this process to be automated and either business to make financial savings – improving bottom line returns.

6. **Single source of truth for export regulation**
   Further development and completion of the Manual of Importing Country Requirements (MICO) for seafood products would be an important step in ensuring a central database against which supply chain stakeholders can ensure they are harvesting, processing and shipping seafood according to export market requirements. A central and comprehensive database acting as a single source of truth would improve compliance around export regulation – reducing likelihood of product degradation if non-compliant products are held up at customs.

7. **Selective fish breeding**
   Selective breeding can mitigate against different ocean temperatures and conditions, and achieve greater control over the growth of each fish. Selecting favourable attributes can improve resilience of fish against changing environmental conditions and help producers to achieve a more consistent product size/type. Currently used in some major seafood sectors such as salmon and tuna, driving widespread adoption of similar techniques could improve resilience to changing oceans and consistency of supply for fishers.

8. **Automation solutions**
   Remote and automated feed and processes of managed aquaculture facilities, including cameras/robotics for monitoring, helps industry to reduce need to physically go out onto the water, and to tailor processes to specific locations/fisheries. This can help to reduce the influence of physical weather conditions and challenges associated with access to labour – enhancing reliability of supply and thus returns.

9. **Digitising paper records**
   Shifting towards digital certification and documentation throughout the supply chain would improve compliance to regulations, especially in export markets where seafood products are often held up at customs due to errors on paper forms (reducing freshness and quality of product). Supply chain stakeholders including government would need to work together to adopt a shared system, which would drive improved accuracy and oversight of the supply chain – supporting existing traceability efforts.
Growing supply chain resilience in the seafood sector will rely on utilising and extending existing resources, forming incremental improvement initiatives, and driving transformative developments.

Increased use of data and technological advancements underpin the sector’s future mitigation strategies and investment needs, alongside programs of work that address ‘people’ factors and improve business planning capabilities across the industry.

Where to play

**Adaptive business models that reconfigure supply chains with predictive insight**

**Leverage digital and data to enable supply chain alignment to adjacent market entry**

**Enhance supply chain connectivity and end-to-end digital adoption**

**CORE RESILIENCE**

**Enhanced resilience**

Several of the larger players in the sector are adopting new best practice resilience strategies, however wider use across the industry would drive significant improvements to overall risk mitigation. Technology-driven strategies such as online auctioning would offer greater certainty of supply and returns, and industry would work together across logistics and processing for collaborative gains in freight and in-market engagement, sharing information and forming collective strategies.

**Transformative resilience**

Game changing developments in seafood would see the full supply chain, from production through to consumer, driven by data. Integrated data points would shape decisions made around when, what and where to fish, how to most efficiently transport that product, and then incorporate sales insights. Shared across stakeholders in the supply chain, these systems would help to improve strategic business planning in the long-term, as well as responsiveness to short-term stresses or shocks.

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**Mapping Return on Investment (ROI)**

Expansion of existing resources/initiatives such as the MicOR database and IFAM scheme would support both regulatory compliance and physical movement of goods respectively. Mandatory country of origin labelling would significantly drive the marketing capabilities of the Australian seafood brand. Expanding on these government-led programs, including promotion of digital certifications/documentation to increase regulatory compliance, has the potential to support whole-of-industry with improved market outcomes. Furthermore, driving improved extension of automated machinery and processes in fisheries to a wider range of businesses would assist with lowering costs of production across the sector.
The Australian wine industry is Australia’s fifth largest agricultural export industry, contributing over $45.5 billion to the Australian economy each year and supporting over 163,790 direct and indirect jobs (Gillespie Economics, 2019). The sector is heavily export dependent, with 60 per cent of production exported to 119 nations worldwide, predominantly mainland China, United States, United Kingdom, Canada and Hong Kong.

Strong growth in the value of Australia’s wine grape crush make the Australian wine industry one of the most competitive in the world, with value of exports growing at an average of over 11 per cent per annum between 2015 and 2019.

The wine industry’s reliance on international demand, fluctuations in the AUD, issues of market access, changing consumer perceptions and geopolitical challenges all impact heavily on the industry’s competitiveness. Misalignment between domestic and international demand and supply has characterised the Australian wine industry and caused over and under valuation of grapes.

Extreme climatic volatility in Australia is placing geographic pressure on grape growers and winemakers and competition over finite resources (land, water) from higher value commodities. Climatic variability impacts yield and grape quality and considerable production variability.

Extreme weather events are also becoming more common. These shocks devastate production, critical infrastructure, employment, workplace welfare, local communities and can damage Australia’s reputation as ‘clean, green’ producers of sustainable food and wine.

With greater international travel, trade and on-farm visitation, pests and disease are a growing stress for the wine industry.

Despite higher costs for inputs, on-farm productivity is driven by continually improving practices including increased automation and adoption of technology. However, an ageing winegrower demographic means digital literacy in the industry is relatively low.

The ability of growers to access digital solutions is further complicated by inadequate telecommunications (internet) infrastructure in many major growing regions.

Long-term planning is required to prepare for and mitigate against climate change, production variability, infrastructure stress, geopolitical movements and the increasing likelihood of natural and technological shocks. Addressing these challenges will require collaboration across states, with RDCs, educational institutions, other agricultural sectors and between different actors within the supply chain.
**Trends**

- Changing consumer preferences: Increasing demand for sustainably (locally) produced, non-alcoholic and non-traditional varietals of wine.
- Increasing global competition (over supply) in major wine growing markets.
- Increased regulation across supply chain – market access (export protocols), biosecurity, food safety, chemical use, water use and labour.
- Consolidation of retailers and producers – growth of alcohol superstores and producer aggregation.
- Increasing prices for inputs (energy, water, labour and land) squeezing farm gate margins.
- Increasing competition for finite resources (land, water) in moderate regions from higher value commodities e.g. almonds and olives.
- Ageing grower population – lack of digital literacy, record keeping, automation.
- Protection of Intellectual Property (IP) between states, RDCs, companies and a lack of industry and geographic collaboration.
- Increasing global competition from markets with significant yield and supply chain efficiency upside.
- Market access issues, trade wars and over-reliance on China as an export market.
- Reducing costs of production: balancing competing priorities of sustainability and profit.
- Farm consolidation, succession, lack of business planning, inadequate data management.
- Adapting to climate variability including higher temperatures and access to affordable water.
- Biosecurity incursions and increased disease and pest resistance; market access as a consequence of chemical use.
- Lack of internet, communications and weather monitoring infrastructure.
- Aligning supply with demand for grapes and wine.
- Maintaining perceptions of Australia as a ‘clean, green, sustainable’ supplier.
- Wider adoption of technology to maximise efficiency and yield, record keeping, data management.
- Focus on supply and marketing of high value, premium and niche products including non-alcoholic wines to untapped markets.
- Utilise digital solutions to integrate supply chain and smooth out friction across supply nodes.
- Predictive analysis to inform strategic decision making.
- Greater industry cohesion and collaboration to reduce $/unit costs.
- Development of direct to consumer (online and social media) distribution models.
- Improve communication between producers and end markets using apps, blockchain and QR codes.
- Continue to develop climate resistant, functional grape varietals and speed up approval processes for new varieties and chemicals.
- Research into detection of smoke taint, heat and water stress.

**Challenges**

- Increasing global competition from markets with significant yield and supply chain efficiency upside.
- Market access issues, trade wars and over-reliance on China as an export market.
- Reducing costs of production: balancing competing priorities of sustainability and profit.
- Farm consolidation, succession, lack of business planning, inadequate data management.
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- Maintaining perceptions of Australia as a ‘clean, green, sustainable’ supplier.

**Opportunities**

- Wider adoption of technology to maximise efficiency and yield, record keeping, data management.
- Focus on supply and marketing of high value, premium and niche products including non-alcoholic wines to untapped markets.
- Utilise digital solutions to integrate supply chain and smooth out friction across supply nodes.
- Predictive analysis to inform strategic decision making.
- Greater industry cohesion and collaboration to reduce $/unit costs.
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- Continue to develop climate resistant, functional grape varietals and speed up approval processes for new varieties and chemicals.
- Research into detection of smoke taint, heat and water stress.
**Priority stresses**

Key stresses undermining the stability of the wine supply chain include:

**Climate variability**

Unpredictability, extreme events and linear warming all lead to production variability (yield and quality), and compromise the industry’s ability to meet international demand and capture market share. Shifts in quantity, distribution and seasonality of rainfall are making some traditional grape-growing regions unviable, yield predictions harder and pushing up the value of finite resources (water and land) in moderate regions. Warmer temperatures lead to prematurity in grape production (6-23 days earlier depending on region) and increase costs of production, including water requirement and chemical fertilisers.

**International competition**

With 60 per cent of Australia’s wine production exported, movements in the Australian dollar and international supply have an extreme impact on the industry’s competitiveness. International over supply puts downward pressure on global wine prices. International competitors may be less susceptible to climate change, enjoy closer proximity to export markets, cheaper access to inputs (labour, water and land) and benefit from government subsidisation.

**Market access**

Market access is a growing concern for Australian wine producers as protectionist policies including both Non-Tariff Measures (NTMs) and Tariff Measures (TMs) increase in the wake of COVID-19. NTMs such as import regulations or unexpected changes in MRLs can unexpectedly impede market access, causing cash flow losses across the supply chain and significant wastage. Ensuring international perceptions remain in favour of Australia as a ‘clean, green and sustainable’ producer of wine, particularly in the wake of natural shocks (bushfires and droughts) will be critical to maintaining market access.

**Consumer preferences**

Growing demand for sustainably produced and packaged, non-alcoholic and non-traditional wine varietals e.g. malbec, Roussanne/Viognie must be planned for as production changes require long-term strategic design (Wine Australia, 2018). Greater regulation in production (pest and disease management, sustainability, water use), processing (food safety, packaging, labour) create additional costs for wine producers and mean actors across the supply chain must balance meeting these preferences whilst maintaining competitiveness.

Further, the wine industry has long struggled with a mismatch between production and demand for grapes and wine, leading to wastage, inefficiencies and price deflation for grapes. This either reduces cash flow for growers or inflates the purchase price for wine processors. The disproportionate production of three varieties, chardonnay (23 per cent), shiraz (27 per cent) and cabernet sauvignon (14 per cent), as a result of over-planting in the 1990s should be seen as a risk to the wine industry given rapidly changing consumer preferences and the time it takes to plant and mature new varieties (Anderson, 2015).

**Pests and disease**

The last 15 years has seen a major increase in disease and pest outbreaks as international travel, imports and on-farm visitation (wine tourism) have grown significantly. Chemical resistance is also growing. Pest and disease incursions can compromise market access, particularly if the chemicals used to control them are restricted in export markets. Industry consolidation has increased the number of ‘super’ processing facilities which import higher volumes of grapes across regional and state boundaries; and specialisation has led to more contract vineyard management, raising the risk of cross-regional and cross-vineyard contamination.
Impact of shocks

Identified below are the shock scenarios which can inflict the greatest impact on the wine supply chain, exacerbating existing stresses and giving rise to new risks and vulnerabilities.

**One Health**

Biosecurity shocks affect the productivity, sustainability and competitiveness of the wine industry, particularly because of the amplified impact they have on cost of inputs, market access (regulation, logistics and consumer demand), access to labour and workplace health and safety. Between 2013 and 2020, biosecurity incidents post border increased 65 per cent, driven by skyrocketing global trade and tourism (Vine Health, 2018). Lack of industry collaboration, Business Continuity Planning (BCP) and on-farm biosecurity protections exacerbate the impact of One Health shocks. Other challenges include disruptions to freight and logistics with movement of goods halted or stopped, increased scrutiny from trading partners during market access negotiations with the need to substantiate area freedom status, falling consumer demand and an increasing desire from authorities for individual growers to manage their own biosecurity risks.

**Drought**

Droughts depress grape yields and quality, cause prematurity in grape production and reduce the amount of wine available for export, which affects Australia’s international competitiveness, market share and reputation. Droughts increase the cost of production, as more fertiliser, water and labour are required and complicate processing by producing smaller, shrunken berries with higher sugar (alcohol) content. Less cash flow prohibits on-farm capital investment and damage water and soil quality, both of which have long-term production implications for the industry. Competition for finite resources (water, land and labor) grows and significant pressure is felt on transport and logistics and labour as employees flow to high growth industries and regions. Droughts place considerable strain on workplace mental health and wellbeing as well as regional towns as business activity (discretionary income) falls.

**Natural Disasters**

Extreme weather events, including bushfire and floods can severely disrupt production, supply, and wine tourism and market access. Most recently, bushfires exposed key stresses within the supply chain, including inadequate digital, road and rail infrastructure, technology deficits (early identification of smoke taint and heat stress), consumer perception and access to labour. Smoke taint, loss of vineyards and tourism from the 2019-20 bushfires are estimated to have cost the Australian wine industry close to $100 million (Wine Titles, 2020). With an expected 30 per cent of the nation’s crush down, a shortage of wines in 12-18 months time may be experienced. Challenges to international perception of ‘Brand Australia’ as a result of national disasters may affect international competitiveness and compromise Australian market share. Delivery delays or cessations to key markets as a result of these shocks can further erode perceptions of trust and reliability.

**Geopolitical**

As a consequence of the wine industry’s reliance on export demand, geopolitical shocks, particularly to key export markets like China and the US, significantly impact the competitiveness of the industry. Increased regulation or interruptions to trade flows as a result of geopolitical movements complicate production, reduce cash flow and compromise market access. Disruptions to freight and logistics and price volatility cause uncertainty and can result in excess domestic inventory, supply chain inefficiency and price collapses. Further, if VISA conditions or import regulations change, grape growers and processors may have limited access to migrant labour and chemical inputs, which affects both the cost and ease of production.

**Technology**

Some elements of the wine supply chain are highly automated, particularly freight, logistics and distribution. As such, there are particular vulnerabilities which make the industry more susceptible to shocks. Counterfeiting, fraud and misuse of data by supply chain participants and/or competitors compromises the competitiveness of the industry, reduces consumer trust and perceptions of reliability and authenticity. Challenges of fraud and counterfeiting are made worse by a lack of visibility over export markets and technological adoption and a lack of collaboration between actors within the wine supply chain.
## Resilience heat map

The heat map below plots the various stresses which currently weaken the wine supply chain. The relative impact of each stress on each supply chain node is colour coded as per the scale shown. Shocks can be seen overlayed on the heat map, indicating where supply chain nodes can be hardest hit during shock events and the flow-on effects up and down the supply chain.

### Impact of stress
- Very High
- High
- Moderate
- Low
- Very Low

### Shocks
- One Health
- Drought
- Geopolitical
- Natural Disasters
- Technology

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<th>Supply Chain</th>
<th>Inputs</th>
<th>Production</th>
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### Key areas to strengthen resilience

1. Responding to climate variability with better weather and rainfall predictions, grape varietals and water efficiency, and technology adoption.

2. Limiting production variability and aligning supply to demand (domestic and international).

3. Improving record keeping, data analysis and software adoption on-farm and throughout the supply chain.

4. Optimising infrastructure to support supply chain and industry specifically telecommunications/internet.

5. Enabling greater use of data to inform agile supply chains and allow for real-time data mapping and predictive analysis.

6. Planning for and aligning with changing consumer preferences to inform grape varietals planted and production and supply techniques i.e. through inventory and blending in the short-term versus new varietals in the long-term.

7. Fostering greater industry cohesion and communication across borders and supply chain nodes.

8. Preparing for natural disasters with better communication and contingency planning.

9. Proactively working to engage with major export partners and smooth out fluctuations in perceptions of ‘Brand Australia’. 

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Key export market

**China**

**Market context**

- China is Australia’s largest wine export market by value ($1.28 billion or 40 per cent of total export value, 2019) and the second largest by volume after the US (Wine Australia, 2019). China is the world’s most populous country (AUD1.4 billion in 2020) with nominal GDP of $14.14 trillion (10 per cent average growth annually) (World Bank, 2019).
- The China-Australia Free Trade Agreement (ChAFTA), Australia’s ‘clean and green’ image and a growing Chinese middle class (>30 per cent in 2018) has boosted demand for premium bottled wine (1/3 of all sales) and lifted the average value of wine shipped to $10 per litre FOB (above the global average of AUD $6.64) (Austrade, 2019).
- Two thirds of wine in China is purchased on premise and online sales channels (including social media e.g. WeChat and YesMyWine) are growing in popularity among sophisticated wine consumers, especially for well known brands (Austrade, 2019). Consumers in northern China prefer full bodied and higher alcohol content wines, while lighter wines are preferred in southern and coastal regions. Red varieties continue to dominate both sales and exports (96 per cent of exports) (Austrade, 2019).

**Key vulnerabilities**

- Technology: counterfeiting, fraud and data breaches are common in China (estimated at 50 per cent of some products) (SMH, 2019). These may impact Australian supply, cash flow and Chinese trust in brand ‘Australia’. Lack of market oversight makes controlling product movements and avoiding fraud difficult.
- Market access: recent implementation of tariff and non-tariff measures signal that access to Chinese markets is not guaranteed. China has strict import regulations on almost all products, which can deter new entrants to the market and complicate distribution. Region-specific regulations can complicate distribution and augment cost of doing business.
- One Health: biosecurity or food safety breaches can disrupt freight and logistics, market access and result in greater regulation i.e. exports to China fell 90 per cent in the first three months of 2020, largely as a result of large-scale logistics issues in airfreight and shipping (Wine Australia, 2019).
- Geopolitical: successful trade relationships requires adherence to respective business etiquette e.g. in China, emphasis is placed on trust, openness, relationships and mutual contacts.
- Natural Disasters: inability of Australia to meet demand and inconsistency of quality may impact Australia’s trade reputation. China is also susceptible to natural disasters, notably earthquakes and floods which can disrupt markets, freight and logistics and consumer demand.

**Key considerations**

- Greater data mapping is required to assess demand and anticipate consumption of alternative varieties, non-alcoholic wines and region-specific trends.
- Over-reliance on the Chinese export market is risky, continued market access requires development of one-on-one diplomatic relationships with key local distributors and adherence to local customs/rules.
- Opportunity to develop online sales channels to verify origin and authenticity supported by better data, adoption of inventory and supply chain technology.
- Continued focus on supply chain efficiency to support competitive pricing into China from other premium exporting markets.

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Current mitigation strategies

Overview
The wine industry is proactive in implementing mitigation strategies to reduce the impact of shocks. However, the degree to which these are adopted depends in large part on scale, cash flow and the impact of recent shocks on operations, including bushfires and drought. However, there are considerable improvements which would further strengthen the resilience of the wine supply chain, including supply chain automation and data mapping, enhanced digital infrastructure, industry collaboration and further research to identify mitigating actions for climate change, smoke taint and heat/water stress and biosecurity incursions.

Current approaches
• **Adoption of water efficient technology** and climate resilient practices e.g. site-specific drip irrigation, climate specific varietals, moisture sensors, on-farm water storage.
• **Production efficient precision technology** including multi-spectral and thermal infrared (drone) cameras and technology, satellite, IoT, drones, big data and machine learning for data collection.
• **Plant breeding technology** including GM and gene editing (hybrid varieties) to improve resilience of grapes to higher temperatures, disease and pests and to achieve functional traits and maximise yield.
• **Emergency/contingency planning** and chain of responsibility reporting for biosecurity breaches and better on-farm management of threats and outbreaks.
• **Research** into smoke contamination, heat and water stress, consumer preferences, demand/supply mapping, suitable genetic variations, geographical suitability and adoption of Sustainable Wine Growing Initiative.
• **Vertical integration of logistics and trade** to maximise supply chain efficiency including direct-to-consumer (digital) distribution models.
• **Protecting relationships with key existing markets** to smooth out fluctuations in demand and market access requirements and developing alternative export markets.
• **Development of technology solutions** to combat fraud and counterfeiting including geomapping, blockchain and utilisation of the Wine Label Intellectual Property Directory.

Case study
**Grosset Wines**
Grosset wines is a certified organic vineyard and winery in Auburn, Clare Valley, South Australia. As producers of premium wine, Jeffrey Grosset is increasingly challenged by the production of counterfeit wine in key export markets as well as false claims, misrepresentations and the consequent inability of consumers to effectively verify genuine wine products. These shocks lead to cash flow losses across the industry, a loss of consumer trust (reputational brand damage) and undermine business confidence and ability to successfully operate in foreign markets.

In 2019, Jeffrey Grosset and David Travers (from the Clare Valley Wine & Grape Association) won a grant to develop and trial an innovative solution to address the emergence of ‘fake wine’, misrepresentations and false claims. The solution combines emerging QR code technology in a wine bottle’s screw cap linked to a consumer friendly blockchain ledger, to confirm the wine’s authenticity, integrity and provenance (using a smart phone). The QR code records the vineyard, variety, time picked and weight and fulfils the demands of Wine Australia’s’ Label Integrity Program.

The platform will ensure the provenance of grapes, authenticity of winemaking and the integrity of the final bottle, making wine fraud virtually impossible. The developers see the platform eventually supporting a complete range of services to the wine industry; an end-to-end management of the entire production process: from growers, wineries, distributors, regulators, service providers, wholesalers and the research community. If successful, this technology will have a profound impact on Australia’s ability to safely export into our key export markets, including China.
The following mitigation strategies have been identified as potential measures to improve the resilience of the wine supply chain. These strategies can act as the catalyst for future projects and working groups to build resilience in sector specific focus areas, as well as projects which reach across multiple sectors.

1. **Business continuity planning (BCP)**
   Both individuals and the broader industry need to develop business continuity plans to enable better management and response to shocks, including alternative markets and transportation routes. The industry needs better education and extension of emergency (contingency) plans and to develop a national log of winegrowers to ensure ease of contact when shocks occur. National grapevine planning is required to ensure staggered plant maturity and diversity of grapes to meet future demand.

2. **Supply chain integration**
   Adoption of analytics tools and real-time data mapping (climate, domestic and international production, consumption and price data) will allow predictive monitoring and forecasting, enable strategic decision making and better align supply with demand. End-to-end supply chain optimisation and capacity planning will improve resilience and the ability of supply chain nodes to cope with over supply, achieve premiums and avoid down-selling. The industry requires a coordinated approach to supply segmentation based on grape quality and output.

3. **Anti-counterfeiting solutions**
   The industry needs to fast-track research, development and implementation of anti-counterfeit technology solutions including blockchain and QR coding, track and trace and smart packaging. This will improve the reliability of Australian brand and protect the income and reputation of actors along the supply chain.

4. **Climate-related R&D**
   Research into early detection and impact of smoke contamination, heat and water stress will enable identification of go/no-go points to reduce resource inefficiency. The industry needs to fast-track research and approval of climate resilient and functional varietals including GM and gene editing. Ascertain geographic suitability of grape varietals to climates; educates consumers to foster acceptance of new non-traditional varietals to ensure there is demand for diverse Australian wine products. Invest in digital infrastructure (telecommunications and internet) and micro-climate weather monitoring to enable accurate planning and decision making and ensure winemakers can utilise the technology solutions available.

5. **Advocacy and market diversification**
   Australia needs to develop trade ties and close relationships with diverse markets and proactively manage perception of Australian wine, especially after reputation as ‘clean and green’ supplier compromised by association of natural disasters with bad environmental management. Australia needs to smooth out fluctuations in market access (including MRL requirements) and grow Australia’s reputation as a supplier of premium wine, not just commercial.

6. **Collaboration and IP sharing**
   Sharing of intellectual property including vineyard maps, satellite imagery and grower databases between states to improve emergency responses and communication, overcome data confidentiality issues and improve industry-wide water conservation and use, technology and adoption, and infrastructure optimisation.

7. **Digitised engagement**
   Utilisation of apps and smart packaging to connect consumers with producers and improve traceability and relationship between consumers and producers. Adoption of on-farm computer-based data management and record keeping; improve digital literacy and succession planning.

8. **Measuring environmental performance**
   Measurement and accreditation of environmental and sustainability performance building on the Sustainable Wine Growing Initiative; enhance natural capital and accurate measurement of inputs, production and supply chain impacts; greater understanding of ROI in sustainable practices and technology; better awareness and adoption of on-farm biosecurity practices and genuine reduction in use of chemicals by changing management of land and water.

9. **New insurance products**
   Development of products that provides greater insurance to farmers against risk of natural disaster and shocks i.e. multi-peril crop insurance to counteract seasonal weather events and derisk operations, and improve confidence across the sector.
COVID-19 and the recent bushfires exposed key vulnerabilities in the wine supply chain and highlighted areas of investment that would provide immediate and long-term benefit to the wine industry.

However, achieving genuine resilience will require significant cross-border and cross-sector collaboration and investment in enabling infrastructure and more ground-up, outcome-based research to inform decision making. The capacity of individual businesses to adopt resilience strategies will depend on cash flow, economies of scale and the degree to which they were impacted by recent shocks.

**Where to play**

Adaptive business models that reconfigure supply chains with predictive insight

Leverage digital and data to enable supply chain alignment to adjacent market entry

Enhance supply chain connectivity and end-to-end digital adoption

**Core resilience**

1. The industry needs to fast-track research into early detection of smoke contamination, heat and water stress to identify go/no-go points. Development of trade relationships with diverse export markets will allow directional agility when a shock hits. Securing ‘Brand Australia’ as a trustworthy, sustainable supplier of premium and commercial wines will also smooth out fluctuations in demand. The industry should better leverage and improve its sustainability credentials and reporting including the Sustainable Wine Growing Initiative to ensure environmental data is captured, benefited from and communicated to consumers.

**Enhanced resilience**

3. There is significant headway to be made in integrating the wine supply chain, utilising technology solutions to smooth out the flow of data and physical goods, increase efficiency and better withstand shocks. Collaboration across the supply chain and across regions will increase infrastructure and labour efficiency, particularly by aligning logistics and service providers. Collaboration across states and supply chain actors will smooth out intellectual property issues and better enable emergency responses i.e. sharing of state grower maps and data bases, satellite imagery matched against ownership and biosecurity data. Emergency and contingency plans need to be better communicated to growers and supply chain actors.

5. There is significant headway to be made in integrating the wine supply chain, utilising technology solutions to smooth out the flow of data and physical goods, increase efficiency and better withstand shocks. Collaboration across the supply chain and across regions will increase infrastructure and labour efficiency, particularly by aligning logistics and service providers. Collaboration across states and supply chain actors will smooth out intellectual property issues and better enable emergency responses i.e. sharing of state grower maps and data bases, satellite imagery matched against ownership and biosecurity data. Emergency and contingency plans need to be better communicated to growers and supply chain actors.

8. The wine industry has the opportunity to enable transformative resilience vis-à-vis widespread use of data across the supply chain to inform decision making supported by large scale investment in digital infrastructure. Utilising predictive insight and data analysis of consumption and production trends to drive long-term strategic decision making and better align demand with supply will improve the resilience of the entire sector. To build resilience, the wine industry needs to fast-track preparation for climate change, including research into (and advance approval of) climate-resistant and functional grape varietals (including GM and gene editing).
The future mitigation strategies outlined across the six sectors in this report have surfaced 12 key themes for enhancing supply chain resilience. The tables on the following pages categorise each strategy by theme, highlighting opportunities for cross-sector collaboration and investment across horizons. Targeting cross-sector opportunities with a collaborative mindset can enhance synergies, accelerate benefits realisation and increase whole of industry impact.

Key takeaways

1. A key focus area for collaboration surrounds the collection, analysis and use of data to inform real-time and predictive decision making across supply chains. Whether in business planning, supply chain forecasting or sustainability, the ability to adopt new systems and platforms to capture and use data effectively will be critical in the future resilience of supply chains. Moving to paperless systems, particularly in transport and distribution, will be essential in driving efficiencies and preparing supply chains for future shock events like COVID-19 where access to physical assets is constrained.

2. The establishment of data standards and governance frameworks in addition to supporting awareness building will help improve trust and promote a culture of collaboration where data sharing is encouraged and incentivised. Moving away from siloed technology implementations towards interoperable platforms will be critical in achieving objectives relating to traceability and sustainability in the sector.

3. Digital and data adoption will itself give rise to new cyber and privacy challenges, creating new vulnerabilities in supply chains. The industry would be prudent to work together and invest in measures to mitigate these risks and review these measures on an ongoing basis as the technology landscape evolves.

4. In addition to data and digital interventions, improvements in critical road and rail infrastructure and consistencies in cross-border transport regulation will improve product flows and provide greater resilience in future shocks where transport routes are compromised.
The 12 key themes for enhancing resilience


Note: Similar strategies may vary in horizon due to the differing maturities and baseline adoption across sectors, meaning what is ‘enhanced’ in one sector may be ‘transformative’ in another.

### 1. A digitally capable workforce

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<thead>
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<tr>
<td>H1</td>
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### 2. Accelerating on-farm digital adoption

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<td>Automation solutions</td>
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<td>Decision support tools</td>
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<td>AgTech adoption and commercialisation</td>
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### 3. Developing new business planning and financial tools

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### 4. Enhancing crop resilience and biosecurity

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# 5. Enhancing sustainability and natural capital

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# 6. Implementing digital platforms and solutions

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# 7. Embedding interoperable data systems

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# 8. Optimising supply chains

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## 9. Enhancing infrastructure and transport regulation

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## 10. Utilising innovative packaging and labelling

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## 11. Improving market access

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## 12. Developing new value propositions

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Food Agility CRC is inviting AgriFood and technology companies to co-invest in R&D (generating 3:1 leverage) to deliver a suite of projects over the next three years. Mission Food for Life will deliver new data-driven tools and capabilities to build supply chains that can rebound, reinvent and be resilient.

- **Validate**
- **Co-design**
- **Capability**
- **Invest**
- **Test & learn**
- **Scale for Impact**

Food Agility's model for deliberate innovation, Research Agility, draws on agile, design-led and lean start-up methods to deliver maximum impact for industry. Research Agility puts end users at the centre of everything we do, continuously testing and refining with industry to deliver timely, scalable R&D outcomes that make a difference.

To join the Mission contact Mara Bun at mara.bun@foodagility.com.
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