North Queensland Market and Agricultural Supply Chain Study

Final Report

May 2019

townsville enterprise

KPMG

Premise

AEC OUTCOME DRIVEN

The authors acknowledge the financial support of the Cooperative Research Centre for Developing Northern Australia and the support of its investment partners: the Western Australian, Northern Territory and Queensland Governments.

We also acknowledge the financial support and in-kind support of the project participants.

Principal partners: Townsville Enterprise Limited (TEL), Cooperative Research Centre for Developing Northern Australia (CRCNA) and North Queensland Regional Organisation of Councils (NQROC)

Local Government partners: Burdekin Shire Council, Charters Towers Regional Council, Hinchinbrook Shire Council, Townsville City Council, Palm Island Shire Council

Stakeholder contributors: Commonwealth Scientific and Industrial Research Organisation (CSIRO), Queensland Department of Agriculture and Fisheries (DAF), Department of State Development (DSD), James Cook University (JCU), Meat & Livestock Australia (MLA), Port of Townsville, Townsville Airport, Trade and Investment Queensland (TIQ), Wilmar Sugar

---

Inherent limitations

This report has been prepared as outlined in the Executive Summary and Scope. The services provided in connection with this engagement comprise an advisory engagement, which is not subject to assurance or other standards issued by the Australian Auditing and Assurance Standards Board and, consequently no opinions or conclusions intended to convey assurance have been expressed.

KPMG does not make any representation or warranty as to the accuracy, completeness, reasonableness, or reliability of the information included (whether directly or by reference) in the report, statements, representations and documentation provided by Townsville Enterprise Limited's (TEL) management and stakeholders consulted as part of the process, and/or the achievement or reasonableness of any plans, projections, forecasts, management targets, prospects or returns described (whether express or implied) in the report. There will usually be differences between forecast or projected and actual results, because events and circumstances frequently do not occur as expected or predicted, and those differences may be material. Additionally, KPMG does not make any confirmation or assessment of the commercial merits, technical feasibility or compliance with any applicable legislation or regulation of the North Queensland Market and Agricultural Supply Chain Study.

KPMG have indicated within this report the sources of the information provided. We have not sought to independently verify those sources unless otherwise noted within the report.

KPMG is under no obligation in any circumstance to update this report, in either oral or written form, for events occurring after the report has been issued in final form.

The findings in this report have been formed on the above basis.

Third party reliance

This report is solely for the purpose set out in the Executive Summary and Scope for TEL's information, and is not to be used for any other purpose or distributed to any other party without KPMG's prior written consent.

This report has been prepared at the request of TEL in accordance with the terms of KPMG's contract dated 16 May 2018. Other than our responsibility to TEL, neither KPMG nor any member or employee of KPMG undertakes responsibility arising in any way from reliance placed by a third party on this report. Any reliance placed is that party's sole responsibility.

Contents

Abbreviations

Abbreviation	Definition
AA	Avocados Australia
ABARES	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
AMEIS	Australian Meat Export Inspection System
AMI	Andrews Meat Industries
AQIS	Australian Quarantine Inspection Service
AUD	Australian Dollars
CoOL	Country-of-Origin Labelling
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CQU	Central Queensland University
DAF	Department of Agriculture and Fisheries (Queensland)
DAWR	Department of Agriculture and Water Resources (Federal)
DFAT	Department of Foreign Affairs and Trade
ESCAS	Exporter Supply Chain Assurance System
EU	European Union
EXDOC	Australian Government (DAWR) Export Document Source System
FAO	The Food and Agriculture Organization of the United Nations
FOB	Free on board
FRDC	Fisheries Research and Development Corporation
FTAs	Free Trade Agreements
FTE	Full Time Equivalent
GDP	Gross Domestic Product
GM	Genetically Modified or Genetically Modified Organism
HACCP	Hazard Analysis and Critical Control Point
HIA	Horticulture Innovation Australia

Abbreviation	Definition
HS	Harmonised System (Global goods classification system)
IMAS	Institute of Marine and Antarctic Studies
ITC	International Trade Centre
JAEPA	Japan-Australia Economic Partnership Agreement
JCU	James Cook University
LGAs	Local Government Areas
MFDS	Ministry of Food and Drug Safety (Korea)
MLA	Meat and Livestock Australia
MNCs	Multi-National Corporations (MNCs)
MPI	Market Potential Index
MT	Mega Tonnes
NQMASCS	North Queensland Market and Agricultural Supply Chain Study
NQROC	North Queensland Regional Organisation of Councils
p.a.	per annum
p.c.	per capita
QIP	Quarantine Inspection Permit
QLD	Queensland
RMP	Risk Management Process
SPS	Sanitary and Phytosanitary
TEL	Townsville Enterprise Limited
TIQ	Trade and Investment Queensland
UAE	United Arab Emirates
USD	US Dollars

Executive summary

The increase in the volume and value of global food consumption is a major megatrend that is set to confront this generation. Global, national and regional policy makers should consider these trends as part of their forward planning. Growing international market concern associated with food security and supply has contributed to mounting interest in North Queensland products across key markets including South East Asia, China and the Middle East.

Townsville Enterprise Limited (TEL), the North Queensland Regional Organisation of Councils (NQROC), Cooperative Research Centre for Developing Northern Australia (CRCNA) and industry stakeholders have come together to fund the North Queensland Agricultural Market and Supply Chain Study (NQAMSCS) and establish evidence-based recommendations that will assist in harnessing export opportunities and support the long-term agricultural development objectives of the region. The study has adopted a 'demand led' approach to the qualification of priority markets and products, existing supply chain opportunities and constraints, industry capacity to supply, sector collaboration and future investment considerations.

The NQAMSCS has been undertaken so that North Queensland's primary producers, industry peak bodies, stakeholders, investors and the government are in a better position to further consider the appropriate allocation of finite resources and the formulation of supportive policy settings that take into consideration the sectors long-term growth and sustainability.

The study found that there is $3 billion in unmet global market demand across ten of Australia's leading agricultural export destinations. The top ten markets identified with the greatest opportunity include:

Korea	**China**	**Japan**	**Indonesia**	**Singapore**
UAE	**Malaysia**	**Hong Kong**	**Thailand**	**India**

The study analysed five priority products that provide the greatest product, market, and supply chain opportunity for the North Queensland region in scope. In addition to this, the study also identified unmet demand in many other categories that are relevant to the study region. The five priority products were:

Beef	**Avocado**	**Macadamia**	**On-shore aquaculture** (tropical rock lobster)	**Soybean**

Transitioning land use and strategic efforts to embrace the five priority products was estimated to result in a positive NPV of up to $271.1 million and generating approximately 2,000+ new jobs within the region. Noting that intensification of food and fibre production in the region must be undertaken in a manner that improves soil and water health and reduces the risk of nutrient loss. And that secondly, proposed growth strategies include the adoption of digital and new technologies.

Adoption and implementation of the study's recommendations still require further development. Some of the priority product's supply chain infrastructure was observed to be underdeveloped or inefficient. Building value in these constrained supply chains will be critical to ensuring the region can meet anticipated global

food demand. These specifically include:

- Transitioning the beef industry to a higher value-add sector, such as targeting boxed beef markets, requires additional infrastructure investment and planning to facilitate processing and export capability.
- Utilising existing sugarcane land and fallow cropping systems to improve soil health and improve total farm output, through the rotation of soybean and other crops.
- Developing a new farm systems group to drive collaborative effort in research and development.
- Intensifying the production of fresh food supported by improved cold chain logistics and better use of shared services for biosecurity, customs and quarantine.
- Leveraging the Port of Townsville and Townsville Airport as key hubs for driving new export growth based on the study's identified priority markets and products.

Additionally, targeted investment attraction, matching customers to producers, and linking customers needs to suitable land, water and supply chain assets is key.

The NQAMSCS has produced a holistic 'developmental road map' that seeks to define the key products, target markets and critical enablers that will support the region's response to growing export market demand. More work is required to contemplate the development of value-added food processing in the region and several case studies of successful value-adding have been considered. Continued momentum and effective implementation of the strategies identified will be key, with further consideration given to how we build cross-supply chain cooperation and identify the geographical location of specific key enabling infrastructure that supports industry's capacity to ensure continuity of supply across the priority products.

KPMG, AEC and Premise were pleased to support TEL, NQROC, the CRCNA and project participants in delivering this forward-thinking study and applaud the region for its proactive stance of securing the future of the industry and capturing new growth and value for the region. KPMG is looking forward to future opportunities to work with North Queensland stakeholders and TEL to drive the implementation of the recommendations here-in and realise future export opportunities for the region.

Summary, recommendations and action plans

Background

Global megatrends

All Australian food producing regions are benefiting to some extent from volume and value growth in the Australian and key world markets. Global megatrends of an increasing and ageing population, growing middle class and increased protein consumption are increasing expenditure on food to deliver opportunities for farmers and processing companies. Consequently the agricultural sector is a constant source of investor activity, policy development and innovation.

On the downside, the agricultural sector in Australia has many remnant market structures that are commodity rather than customer-focused, have increasing climate volatility, are under-capitalised and have low or volatile returns.

Smart industries, governments and companies are carefully considering future opportunities and challenges in the emerging digital world so they can invest and set policies that will maximise the opportunity to grow volume and value in Australia and abroad.

Industry growth statistics and megatrends (NFF, 2018)

- 9.7 billion expected global population by 2050.
- Projected 54 per cent rise in food demand by 2050.
- Australian agricultural output volumes projected to rise by at least 50 per cent by 2050.
- Total value of Australia's agricultural production for 2018-19 forecast to be $60 billion.
- Agriculture, forestry and fishing represents 2.4 per cent of Australia's GDP (whole agricultural supply chain represents 12 per cent).
- Australia invests $3.3 billion in rural R&D (76th globally for innovation efficiency).
- Agricultural exports forecast to total $47 billion for 2018-19 (78 per cent of agricultural production by value).
- Australia's top export markets are China, Japan, the EU, USA, Korea and Indonesia.
- Recent trade deals executed with China, Japan, Korea and Indonesia, with more to be implemented.

New market opportunities are being identified and North Queensland's agricultural supply chains must adapt to capitalise on this potential

Representing five key agricultural production regions, Townsville Enterprise Limited (TEL) wants to position the North Queensland region with the right policies, services and infrastructure to maximise the industry's chances of success in future markets.

Market forces are already influencing investment on-farm and in the supply chain in North Queensland. Traditional sectors like beef and sugarcane are already changing farming systems and other sectors such as nuts, vegetables, fruits and seafood are seeing investment growth.

In this study KPMG found that in many cases more can be done to provide the infrastructure and services that will fundamentally underpin future sector growth. New investments in water assets, road, rail, ports, skills and education, processing capacity, farming systems research, new enterprises and market development will come from both multi-level government and private enterprise.

Dependent on the product and export market, the in-scope region has access to both the Port of Townsville and Townsville Airport to provide competitive access to priority markets. Advancements in containerised freight and supply chain efficiencies can be harnessed by the Port of Townsville to complement diversified agricultural production, supported by the Townsville Airport and the re-opening of international services to priority export markets.

TEL rightly sought a demand/market-centric approach to ensure that future strategies match the region's production strengths with in-market customer needs. For example, the beef sector is already contemplating the value that lies in the Chinese retail market compared to the traditional grinding beef markets. The sugarcane sector is well-advanced in contemplating nutrient management and changes in consumption trends. Emerging sectors need to match plantings growth with demand and be careful not to over-supply markets.

Working backwards from market-demand (identifying priority countries and products), the focus of this study was regional, with an analysis of physical assets (soils and water) and a high-level assessment of current and future supply chains. A deep-dive into future state scenarios gave the study a focus on industry potential, but also indicated the required supporting infrastructure and services that are needed (amongst other recommendations) to support sector growth. The priority products of beef, cropping (soybean), avocado, macadamia and on-shore aquaculture, had the strongest growth into key markets, however can be taken to be good proxies for other key commodities.

Key facts and figures for the in-scope region (TEL, 2019)

- Regional centres: Townsville, Charters Towers, Ayr (Burdekin), Palm Island and Ingham (Hinchinbrook).
- Employment: 103,546 people (3,642 in agriculture, forestry and fishing industries).
- $16 billion in GRP ($1 billion in agriculture including livestock, cropping, horticulture and aquaculture).
- Regional exports estimated at $8.3 billion ($544 million in agriculture, forestry and fishing industries).
- Large areas under existing agricultural production, with vast capacity to intensify or diversify production.
- Potential irrigation of an additional 100,000ha of land (under the Hells Gate Dam project).
- International air routes under negotiation to increase access to important growth markets.
- The expansion of the Port of Townsville can be leveraged as a complementary export node to Townsville Airport.

TEL and the North Queensland Regional Organisation of Councils (NQROC) engaged KPMG, AEC and Premise to undertake the North Queensland Agricultural and Market Supply Chain Study (NQMASCS). The study was specifically undertaken to identify and investigate new and innovative products and markets which will deliver a sustainable future for the North Queensland economy.

KPMG, AEC and Premise recognise, alongside TEL, the enormous opportunity the region has for supplying the growing food and fibre demands of overseas nations given its proximity to high demand markets. This includes examining agricultural enterprises that are outside of the typically relied upon sugarcane, beef production and horticulture (minimal products only) industries.

Study purpose

The purpose of the NQMASCS was to deliver a report that will emphasise the need for timely action and investment in the region's agriculture, production, infrastructure and export sectors to meet existing and future international market demands.

Specifically this includes the identification and assessment of a variety of high demand, high yielding products with growth potential in both volume and value in the market. It also examined how supply chains will need to be developed to facilitate the movement of product to the market.

Having a clear plan will allow TEL and NQROC to pursue supportive and purposeful policy, overcome market access barriers, align with federal government needs to be significantly forward thinking and garner multi-industry support to ensure that the region continues to develop and thrive.

The report ultimately emphasises how agricultural development and Australia's clean, green food producer status can be a catalyst for generating future growth in the region and maximising return on investment.

What did we do in this study?

- Scanned key export markets to identify ten priority markets of greatest export potential.
- Ranked those markets with reference to consumer trends, demography, agricultural production (current and forecast) and agricultural imports.
- Conducted a demand-driven-analysis of high-value products, shortlisting five.
- Assessed the capability of land in the in-scope region to produce shortlisted products.
- Completed a supply chain constraint and infrastructure gap analysis.
- Performed a cost benefit analysis of five future production scenarios.
- Provided recommendations and an action plan for the region's agricultural sector.

Scope

TEL engaged KPMG, AEC and Premise to specifically:

- Undertake a market-centric review to identify the agricultural products with the greatest potential to generate economic returns to North Queensland.
- Assess the current capacity of the North Queensland agricultural sector to develop a plan to optimise the region's capacity to supply to international markets.
- Complete a detailed analysis that identifies opportunities to enhance efficiencies across North Queensland's agricultural supply chain.
- Align with the specific Cooperative Research Centre for Developing Northern Australia (CRCNA) focus areas, research priorities and investment themes.

Market demand and opportunity

Prioritised market opportunities

Typically trade and market discussions have focused on China. In this study however, we aimed to consider more of the key emerging markets, understand their baseline demand and match this to specific products produced (or possible for production) in the North Queensland study area.

A market-assessment matrix was used to contemplate the attractiveness of markets based on population (including growth), reliance on imported food and fibre, proximately to the North Queensland region, logistics maturity, market accessibility requirements, market potential, risk factors, trading partner status (including free-trade status), current import and export volumes information, current domestic production capabilities, GDP (including growth forecast), income per capita and inflation. For further detail regarding the market prioritisation criteria refer to Appendix A: Market assessment.

Whilst the priority countries are as expected, the specific point of note is their order of priority. This serves as a reminder that key South East Asian and Middle Eastern markets have attractive characteristics including large populations, reliance on imports, favourable free trade agreements (FTAs), high disposable incomes and reliable business environments. China is rightly a priority for growth, but is not and should not be the sole focus for North Queensland. For example, Korea ranked number one in the matrix with a population of 51 million people and a recent FTA with Australia to improve trade and forecast average disposable income of US$52,745 per person by 2023. The trade hubs of Singapore and Hong Kong also remain important in the region.

It is also important to note, that while many priority markets examined have favourable trade or economic partnership agreements, that the more detailed protocols for entry are limiting to future expansion of exports to market and will be a key consideration in the supply chain analysis later in this report.

Table 1 provides an overview of the priority markets identified for North Queensland exporters. For each market, a list of priority products has been identified that further refine the export opportunity within each priority market. For detailed market profiles, see Appendix A: Market assessment.

Global megatrends that include an ageing population, growing middle class, and increased protein consumption are creating a market with increased expenditure on food. This offers farmers and processing companies generous opportunities for growth. Consequently the agricultural sector is a constant source of investor activity, policy development and innovation.

To maximise the opportunity to grow volume and value in North Queensland's agriculture industry and in particular in the identified growth markets, study partners Townsville Enterprise Limited (TEL), seeks to arm the region with the right policies, services and infrastructure to fuel success. Using a demand-centric approach, TEL's aim is to ensure future strategies are aligned with the region's production strengths and with in-market customer needs.

This study was a joint collaboration that looked at the North Queensland region and covers five key local government areas (LGAs) across a variety of land types that already generate $1 billion in agricultural value, including contribution from livestock, cropping, horticulture and aquaculture industries.

Working backwards from market-demand (identifying priority countries and products), the focus of this study was regional, with an analysis of physical assets (soils and water) and a high-level assessment of current and future supply chains. A deep-dive into future state scenarios gave the study a focus on industry potential, but also indicated the required supporting infrastructure and services that are needed (amongst other recommendations) to support sector growth.

Demand for agri-food products exists across the usual key markets, including South East Asia, China and the Middle East, with ten countries each ranked (in this study) according to their demography, economy, food demand, and security. The findings remind us that China is not the only market of interest, and that – based on the study selection criteria – markets such as Korea, Singapore and the United Arab Emirates (UAE) are also significant.

The top ten markets identified with the greatest opportunity include:

Korea	China	Japan	Indonesia	Singapore
				
UAE	**Malaysia**	**Hong Kong**	**Thailand**	**India**
				

The focus of the study was to analyse five priority products that provide the greatest product, market, and supply chain opportunity for the North Queensland region in scope. The five priority products were:

Beef	Avocado	Macadamia	On-shore aquaculture (tropical rock lobster)	Soybean
				

We identified nearly $3 billion in unmet global market demand for these five Australian products. Not to say there were no unmet demands in other categories relevant to the study region, simply that these were prioritised as the top five.

Transitioning land use – by intensifying or diversifying agricultural systems – to include the priority products was estimated to provide a positive impact of between $26.5 and $271.1 million NPV. Additionally, it would generate numerous employment opportunities. It is noted that any intensification of food production in the region must be undertaken in a manner that improves soil and river health, and that reduces risks of nutrient loss.

We found a strong case to support the transition of the beef sector to a higher value-added sector in the boxed beef market. This is supported by additional fodder and grain production, feedlot planning, and infrastructure along with new processing, and export capability.

New sectors such as macadamia and avocado are proxies for how the North Queensland region attracts new industries of a substantial nature. This commences with a customer-focused approach, linking back to farm production investment. There are a range of recommendations and issues with new sectors, including provision of farm equipment and expertise, handling and processing infrastructure, and need for expert advice. The extent of these are not insurmountable to overcome. For example, the on-shore aquaculture sector for species such as tropical rock lobster represents a competitive advantage for the region and suitable production locations are available.

The sugarcane industry is the largest in the region and will remain central to output and employment. The aim of this study was to examine complimentary industries that could utilise existing cane growing land and fallow systems to improve soil health and total farm output through crop rotation. Soybean and other cash crops can achieve this however supply chains are undeveloped and more needs to be done to support new sectors to a level of critical mass.

This report recommends the creation of a new farming system group structure, modelled off the highly successful Birchip Cropping Group, to drive a collaborative effort in farming systems research and development including on-farm adoption and supply chain design.

The Port of Townsville and Townsville Airport will be central in the consideration of the export growth of existing sectors like beef and sugarcane but also new sectors such as seafood, fresh fruit and vegetables, prepared meals and other value added/retail packed products. Additional storage and handling in bulk grains and cold supply chain infrastructure needs to be considered early as part of further market sounding and key priority market customer attraction.

Targeted investment attraction, matching customer to producer through targeted close loop marketing supply chains is a preferred approach compared to more generic trade missions. Linking customer needs back to suitable land, water and supply chain assets is key. This could include the development of intensive fresh food production that links into Townsville Airport, cold chain management, and the provision of shared assets such as x-ray or irradiation services.

A number of recommendations have been made to drive the development of the agricultural supply chain in North Queensland and these can be grouped into four key themes:

- Trade and market access
- Production
- Supply chain improvements and optimisation
- Collaboration and innovation.

There are a number of considerations and next steps that need to be undertaken to achieve this, including further research, full commercial feasibilities and further stakeholder engagement. More work is required to contemplate the development of value-added food processing in the region, however several case studies of successful value-added products have been included in the report to further highlight the opportunity.

It is also acknowledged that a number of key infrastructure projects have been announced following the completion of this study. The announcement of funding for the Hells Gates Dam business case and construction of the Big Rocks Weir will need to be contemplated in future analysis and will only serve to bolster the recommendations and scope of agricultural diversification identified in this study.

KPMG, AEC and Premise were pleased to support TEL, the CRCNA and project participants in delivering this forward-thinking study, and applaud the region for its proactive stance of securing the future of the industry and capturing new growth and value for the region. KPMG is looking forward to future opportunities to work with North Queensland and TEL to drive implementations of the recommendations herein and realise the future potential export opportunities.

Table 1: Overview of priority markets

Ranking	Potential market	Key insights	Detailed market profile
1	**Korea**	Korea represents an existing mature export destination for Australian products such as beef. The region should seek to diversify its export offerings with premium produce and finished goods. Korea's appetite for ready-made, processed foods needs to be supported by facilities in the region capable of supplying directly to the end user.	Page: 58
2	**China**	The Chinese market represents a large scale opportunity where the North Queensland region can position itself to export high-volume and high-value products direct to market. The existing FTA and protocols in place will enable future growth. With average income expected to continue increasing in the next decade, North Queensland is well placed to supply premium Australian products to meet the expectations of Chinese quality-conscious consumers.	Page: 60
3	**Japan**	As a net importer with high purchasing power, Japan is an attractive market that will demand a range of products produced in the North Queensland region as raw materials and finished good form, i.e. pre-packaged ready to eat meals. Japanese consumers are willing to pay a premium for Australian produce, for example, soybean produced for tofu finished goods products are in high demand and producers can command a premium price for the raw material non-GM variety.	Page: 62

Ranking	Potential market	Key insights	Detailed market profile
4	**Indonesia**	Food security is high on the Indonesian Government's agenda, especially access to protein (beef) which means the region is well placed to meet that demand. As average incomes increase, consumer demand for protein will continue to rise and be enabled by better infrastructure, such as access to refrigeration for imported processed beef. The Townsville export facilities will require suitable infrastructure to export this product direct to market, such as cold storage for pre-packaged beef products.	Page: 64
5	**Singapore**	Singapore is a net importer with low food security and heavy reliance on imports. As such, given the diverse production base (beef, horticulture, aquaculture), the North Queensland region is well placed to increase exports utilising the existing FTA and established trade relationships. Singapore operates as a regional re-export hub that results in greater import volumes and provides an opportunity for the North Queensland region to export higher volumes consistently with access to secondary markets. High GDP and per capita income in Singapore represents an opportunity to market premium produce directly from the region and command a premium price.	Page: 66
6	**UAE**	High average incomes and presence of expatriates in the UAE create demand for products from North Queensland such as meat, nuts, citrus and stone fruit, as well as pre-packed ready-to-eat meals that have been processed prior to export. The lack of suitable agricultural production area in the UAE encourages strong import demand and long term supply security for North Queensland producers.	Page: 68
7	**Malaysia**	Malaysian consumer's appetite for high quality, healthy fresh food as well as pre-prepared meals positions the region well to supply the market with fresh fruit and vegetables. The FTA in place will enable future export growth but investment must be made to develop export partnerships with local enterprise.	Page: 70
8	**Hong Kong**	With no, or very limited, agricultural production, Hong Kong is well suited as a long term export market with a propensity to consume high-value fresh produce. Like Singapore, Hong Kong acts as a regional re-export hub to neighbouring countries that results in greater import volumes and provides an opportunity for the North Queensland region to export higher volumes consistently. As a protocol-free and re-export market, there is strong demand for high-value and volume products from the North Queensland region to supply the well-established market.	Page: 72
9	**Thailand**	In line with the Thai Government's desire to manufacture processed and prepared food products, the Townsville region can supply raw materials across all agri-food types. High-value Australian produce would be supplied to meet only the niche upper class urban market that consume a variety of quality 'clean and green' produce.	Page: 75
10	**India**	The large economy and population size of the Indian market presents a significant opportunity for rapid and sustained future export growth. With consumers increasingly influenced by Western consumption trends, demand potential for Australian agricultural products will continue to grow. Despite the lack of a FTA in place, this market should still be a focus for producers in the North Queensland region to target in the future because the level of demand is so significant in comparison to other export markets.	Page: 77

Source: KPMG analysis.

Product identification and assessment

Prioritised product opportunities

Given the demand-led nature of the study, we examined unmet demand in the top ten countries identified in the market scan. A list of more than 30 products were considered as part of this study representing the potential product export opportunity for the region. While most of this list has the potential for export growth opportunity, the analysis conducted as part of this report prioritised the identified products into five key product opportunities (see Appendix B: Product Assessment for a detailed analysis of each product).

The focus of the study was to provide high priority products for deeper analysis that provided the greatest product, market and supply chain opportunity. The five products prioritised were (see Table 2):

1) Beef (intensification)
2) Avocado
3) Macadamia
4) On-shore aquaculture (tropical rock lobster)
5) Soybean

These products can inherently be taken as proxies for other like products, and have potential to value-add and/or retail pack into consumer-ready products at a later date. Case studies of value-add/retail pack businesses have been included in further detail to highlight the future market development opportunities.

Table 2: Overview of five priority products identified

Product	Key insights	Detailed product profile reference
Beef	– Large scale existing beef production in the North Queensland region already exists with a concentration of the industry in Charters Towers, making Charters Towers the most suited to production intensification and supply chain development to support export. – Significant demand from priority export markets for beef and beef products: Korea, Singapore, China, UAE, Japan, Malaysia, Hong Kong, Thailand and Indonesia. The highest priority markets are Vietnam, greater China (including Hong Kong) and Malaysia. – The study identified significant unmet demand for Australian beef products of approximately $2.5 billion. Given the scale of beef production in the region (approximately $375 million p.a.) and the changing production trends in the sector, it was considered important to further examine an intensification of beef production as a key scenario. – Value-add opportunities exist, such as boxed beef, processed ready-to-eat packaged meals, and provide significant margin for food processors. – Accordingly, supply chain development of both the commodity and value added products should be investigated. The Townsville region requires supply chain and infrastructure to export the product to consumers in <24-48 hours.	Page 83

Product	Key insights	Detailed product profile reference
Avocado	– Production of avocado does not currently occur at scale in the study region with viable growing conditions identified in the Burdekin, Palm Island and Hinchinbrook LGA's. – Existing demand from Malaysia, Singapore and Hong Kong is expected to increase in line with current export volumes, this is largely due to a shifting demographic with consumer preferences for the food. Non-tariff barriers are being reduced in countries like Japan with its recent Hass avocado announcement. – The risk of adverse weather events can be mitigated through production practices and avocado trees can recover well from damage due to the rigorous pruning cycles they undertake. – Finished good potential to produce premium Australian made avocado pulp, smoothies or baby food does exist, however demand is equally as strong for the raw commodity itself. – Development of the supply chain for both raw and processed avocado should be investigated to meet growing demand for this product and further diversify agricultural production in the study region. – Production at scale is required to underpin investment in sea (controlled atmosphere containers) and air freight (commercial or dedicated freight services), supported by the development of markets for products suited to both or either method of transport.	Page 93
Macadamia	– No large scale production currently occurs in the North Queensland region, however viable growing conditions exist in the study region LGA's such as Burdekin, Palm Island and Hinchinbrook. – Existing demand is very high from countries such as Korea and China as these already have well-established markets for macadamia. – Demand for husked and de-husked macadamia is high, however there is also demand for value-added products (e.g. processing the nut into snack food items, such as chocolate and other confectionary). – New production undertaken to capitalise upon demand in export markets would require careful grower management to mitigate impact of cyclones, such as reduction of tree height. – Development of the supply chain for both raw and processed macadamia should be investigated to meet growing demand for this product and further diversify agricultural production in the study region.	Page 102
On-shore aquaculture (tropical rock lobster)	– On-shore aquaculture is well suited to the North Queensland region with access to coastal water, suitable climate conditions and land availability. Additionally, establishing on-shore facilities is not overly land intensive, and thus could be conducted in the Townsville LGA (where more broad, large scale production of agricultural commodities cannot occur). – Existing on-shore aquaculture operations in the region produce fish and smaller crustacean products, but demand for live lobster,	Page 110

Product	Key insights	Detailed product profile reference
	particularly in Asian countries, presents an opportunity to expand into other seafood. – Significant global demand for lobster comes from Asian markets, particularly those with growing wealth such as Thailand, China and Korea, and those who consume lobster as an 'occasion food'. – Advances in tropical rock lobster production technology will facilitate on-shore commercial operations, and collaboration with research institutes and industry bodies will be required. – Development of the supply chain for both live and frozen tropical rock lobster should be investigated to meet growing demand for this product and further diversify agricultural production in the study region. – Consideration must be given to limitations of water quality regulations when commencing or expanding on-shore aquaculture production.	
Soybean	– Production of non-GM soybean is viable in the North Queensland region, with soybean well suited to growing in rotation with sugarcane. – There is existing small-scale production in the North Queensland region however there is scope to expand by using soybean as a rotation crop in sugarcane production systems, or by cultivating additional land available in LGA's such as Charters Towers, Hinchinbrook and Burdekin. – Demand is driven from Asian markets that traditionally consume high volumes of soy in their diets. Particularly China, Japan, Indonesia and India. While these countries don't have high imports of soybean from Australia currently (instead they look to source from the Americas), there is a lot of potential for Australia to capture a niche market given only non-GM soybean is grown in Australia. – Soybean production can also support the development of new sectors in the study region through the provision of feed products (intensive livestock and aquaculture). – There are significant value-adding opportunities in the soy product market as soybean can be transformed into tofu, soy meal and noodles. – Development of the supply chain for both bulk and processed soybean to domestic and export markets should be investigated to meet growing demand for this product and further diversify agricultural production in the study region.	Page 119

Source: KPMG.

Product considerations and limitation

It should be noted that it is well acknowledged that sugarcane production is by far one of the strongest production sectors in the region, intrinsic to North Queensland. Although the sugar industry was not included in the five priority products, and consequently is not modelled extensively in the future state scenarios, the focus of this review was to look at how sugar production could be maintained or diversified while total returns from farms wouldn't be reduced, and in fact may improve through rotational cropping

farming systems. This could include soybean or other cash crops on fallow rotation which could break the mono-culture system and improve soil health.

Whilst the five selected priority products have been highlighted, the list shouldn't be seen to be exhaustive of other high-value products that could be produced and exported. The above list provides the best indication based on the market and demand data. Where products are similar to each other, their suitability for production and the requisite supply chain recommendations are likely to be synonymous. For example, avocado will have similar recommendations as for other horticultural tree crops suitable in the North Queensland region (e.g. mangoes). Or similarly, while tropical rock lobster is the most suitable on-shore aquaculture product other aquaculture species are also going to be viable (e.g. fish species and other crustaceans).

Additionally, the frequency of cyclone and weather events in the region (on average every ten years or so) were regularly raised as a risk factor that prevented investment in some growth sectors including permanent plantings and indoor agriculture. In some instances farm businesses are considering approaches that can mitigate against cyclone risk e.g. in greenhouse construction. More work needs to be done on investigating the potential of intensive, indoor style production systems.

Supply chain capacity and constraint analysis

Following the identification of five priority products, further analysis of the region's capacity to produce each was performed. Supply chain constraints and gaps were identified, together with opportunities to leverage the inherent strengths of the in-scope region and its existing industries.

Five industry production scenarios were developed to provide insight into future industry growth opportunities, including continuation of the region's current production mix. The process for developing the scenarios included a thorough assessment of each priority product against the following criteria:

- Mapping of land capability and suitability.
- Review of on-farm production methods.
- Review of existing supply chains and identification of gaps/constraints to support new and expanded production.
- Identification of opportunities for value-adding.
- Irrigation requirements and availability.
- Review of potential market constraints that may limit the scale of expanded production.

While the outputs of this report focus on the region as a whole, Appendix C: Scenario analysis Appendix C: Scenario provides a detailed analysis including land assessment, product opportunity and production capability for each LGA within the study region.

Key enablers

The following are key enablers identified in the study region that will allow the region to implement recommendations of this study which relate to natural resources and existing infrastructure. This list is not exhaustive, but indicative of the significant enablers required to underpin any regional transition, supply chain optimisation, collective effort coordination and improved overall region productivity.

Table 3: Key enabler overview

Key enabler	Overview
Water availability	High rainfall events are regular and increased water storage will de-risk the region further and support high-value farm systems in the key areas for growth including intensive beef, soybean and permanent plantings.
Utilising cooperatives	Cooperatives provide a basis for the accumulation of key grower requirements including expertise (research) and inputs, and the marketing of outputs. An examination of the potential to establish critical mass soybean, nuts and fruit industries in a manner that enhances the production of sugarcane and improves soil health and grower return should be explored. Further examination of the storage and handling requirements for the potential new sectors, and how these can integrate with existing assets or service providers must be conducted. This will include the ways that production assets such as seeders or harvesters can be shared, how advisory skills and know-how can be attracted to the region, and how production can be pooled for collective processing and/or marketing.
Townsville Port	It is acknowledged that the significant recent investment announcements for major upgrades to the Port of Townsville and the plans proposed by port operators to improve the competitiveness of services from the Port will provide significant support for agricultural exports from the region. The development of food export logistics services that includes sea freight should engage with the Port at an early stage so that transport, on-port infrastructure and shipping can be contemplated in design of the supply chain. The Port of Townsville remains the focal point for export pending the establishment of relationships with markets and consumers for high-value perishable products requiring air freight capabilities in the future.

Key enabler	Overview
Townsville Airport	There are two key factors recommended for the future development of Townsville Airport as a food export hub. Firstly, continue to focus on the developing commercial flights to key international destinations such as Singapore, Hong Kong and mainland China so that these flights can be leveraged with fresh food freight complementary to these passenger services. Secondly, work with TEL to engage with potential customers in key export markets (as outlined in this study) to attract the customer-led demand that can support investment in production and processing in the region. This will likely take the form of fresh value-added food as outlined in this report i.e. fresh retail meat, seafood, high-value fresh fruits and vegetables. TEL could lead consideration of food precinct areas that include indoor agriculture e.g. greenhouses, food processing/packaging, shared services such as cold store warehousing, biosecurity services such as phytosanitary irradiation, digital services and potentially export clearance/freight forwarding services. Air freight exports via passenger flights will provide supplementary direct export opportunities to the Port of Townsville until production output is at a scale sufficient for direct cargo air freight.

Source: KPMG.

The in-scope region's capacity and capability for agricultural production

The land in the region was classified according to its capability to produce agricultural products. Following this, limitations with respect to crop and management options were considered to identify prospective areas for production. Finally, consideration was given to the important issues of access to water and labour to define prospective areas for production of specific products within each LGA.

Section snapshot

What? Assessment of land in the in-scope region for agricultural production capacity and capability.

How? Review of publicly available data to classify land types, water availability and labour status.

Key insights:

- The region has the capacity and capability to produce products for high demand markets.
- Strengths: favourable climate, proximity to Asia, available labour, regional sea port and airport infrastructure.
- Challenges: extreme weather events, export market access (air freight), high transport costs, climate change, supply chain limitations.
- Opportunities: expansion of irrigation, export of high-value products, improvement of supply chain infrastructure, use of renewable energy and utilisation of regional labour sources both seasonal and permanent.

A detailed assessment of the land, including further production considerations such as water and labour has been performed in Appendix C: Scenario analysis.

Supply chain constraint and infrastructure gap analysis

The study reviewed supply chains of varying complexity and capability for each of the five products. The current state of the supply chain for each priority product was mapped to set a baseline for the analysis of constraints and infrastructure gaps. A future state was then developed for each product to highlight existing impediments to production and opportunities for investment in the supply chain. Key constraints included production expertise, processing capabilities and air freight access to priority markets. Infrastructure gaps such as storage (e.g. grain, cold and processed goods), processing facilities (e.g. abattoirs, HPP) and water storage were identified.

Table *4* contains an overview of the current and future state of the assessed priority products and the key enablers required to produce and supply to potential export markets.

Table 4: Overview of findings

Priority product	Current state	Future state	Key enablers
Beef	Large scale production, live export dominant, limited value-add	Increased grain storage, intensive production and regional processing facilities producing high-value cuts, boxed beef	Increased finishing capabilities Water storage and new irrigation regions Expansion of cropping sector
Avocado	Limited production, limited processing capability	Processing facilities producing high-value, processed products	Agronomy, research and extension services Processing facilities
Macadamia	Limited production	Processing facilities producing high-value, processed products	Agronomy, research and extension services Processing facilities
On-shore aquaculture	Limited production	Processing facilities, producing high-value, processed products and live exports	Engagement with regional universities Cold chain storage
Soybean	Limited production, local consumption	Rotational and dedicated cropping areas, grain storage and processing facilities to produce high-value, processed products containerised exports and animal feed	Water storage and new irrigation regions Storage and handling facilities

Source: KPMG.

A detailed current and future state analysis on each product has been performed, refer to page 151 of the Appendix, for supply chain maps, gap analysis and infrastructure investment recommendations.

Production scenario development and financial analysis

To ensure producers are fully informed on the potential new export market opportunities, this study undertook baseline scenario development and corresponding financial analysis as it relates to each priority product from an on-farm production perspective. This section outlined the indicative production and potential financial returns outcomes to assist producers in determining any enterprise transition. The financial analysis performed is based on the scenarios developed, and individual farm enterprise financial modelling should be conducted to factor farm business specific considerations as they relate to the priority products.

Refer to Scenario development on page 181 for the complete analysis performed.

Scenario development

The following scenarios were based on publically available benchmark data, to allow the consideration of incentives and barriers to change from the existing production of the in-scope region.

1 **Business as usual (BAU)**

The BAU scenario entails a continuation of current production trends with the industry's dominant crops of sugarcane and low intensity beef cattle production supported by small areas of annual horticulture. No significant growth is projected under the BAU scenario, however the agricultural sector remains a significant employer and driver of economic activity in the region, both on-farm and through the supply chain. The BAU scenario is designed to act as a benchmark against which results for other scenarios can be compared.

2 **Beef cattle intensification (land use change of 17,637ha extensive grazing to feedlotting)**

This scenario focuses on regional opportunities for intensification of North Queensland's beef cattle sector through the establishment of intensified production systems including feedlotting and potentially irrigated pasture. The scenario includes increased capacity of approximately 190,000 head turnoff per annum (36,000 head on feed at any one time). This level of production is considered viable to support increased regional meat processing capacity (DAF, 2014). This intensive production will largely occur on existing low intensity beef cattle areas, resulting in a loss of current activity.

3 **Fallow cropping (land use change of 36,000ha to rotational soybean in a fallow system)**

This scenario focuses on the potential development of 20 per cent of existing sugarcane lands (based on a one in five year fallow) across the key Hinchinbrook and Burdekin production areas to a rotation of soybean (and potential other grain/pulse options) to create diversified income for growers and establish a new industry. The new production will not impact upon existing sugarcane production, and in many cases will improve cane yields as a result of improved soil nitrogen provided by legume crops, and the transition away from monoculture sugarcane production.

4 **Diversification of current land use (change 36,000ha of current land use to rotational grains and pulses and 4,000ha extensive grazing to perennial horticulture)**

This scenario focuses on the potential transition of 20 per cent of existing sugarcane lands across the key Hinchinbrook and Burdekin production areas to alternative cropping options, including extended fallow incorporating soybean (and potential other grain/pulse options) and the expansion of perennial horticultural production (avocado, macadamia) where land is suitable, and irrigation is available. Key aspects of this scenario include a focus on a transition of existing production lands (within the base case) to new cropping options rather than the development of greenfield sites. Therefore, production is not a net increase as it will replace irrigated sugarcane in the Burdekin and dryland cropping in Hinchinbrook.

5 **Expansion of land based aquaculture (land use change of +500ha on-shore aquaculture)**

This scenario focuses on the expansion of on-shore aquaculture, with 500ha of high-value aquaculture ponds developed across the region. The expansion of aquaculture operations is not projected to substantially impact existing agricultural production.

Financial analysis

Financial returns for each of the priority crop options were contrasted against current dryland and irrigated sugarcane production over 15 and 30 year periods. Financial outcomes were assessed in terms of net present value (NPV) at a modest 7 per cent real discount rate and internal rate of return (IRR).

Key findings of the analysis include:

- Incorporating rotational fallow crops such as soybean provide modestly increased grower returns under dryland and irrigated production.
- Transitioning from sugarcane completely in favour of a grain/pulse rotation improves returns under dryland cropping and irrigation. However, the increase in NPV needs to be weighed against the relative reliability of sugarcane production (particularly in the absence of irrigation).
- Transitioning to avocado production presents a strong potential return on investment, however macadamia provide a negative return due to the high upfront capital cost and long turnaround time for investment. The changing market supply dynamic, particularly for avocado, with strong increases in supply and some large producers projecting grower prices to fall from $9 to $4.50 to per kilogram experienced in recent years (Delroy in ABC, 2018) means the relative returns between the two crop options will change over time.
- Feedlotting of beef cattle is modelled to provide an internal rate of return (IRR) of approximately 14 per cent over 15 years.

Cost-benefit analysis results

The cost benefit assessment (CBA) considered the net economic costs and benefits associated with the future scenarios to the in-scope region between the financial years ending 30 June 2020 and 30 June 2049. Specifically, the following costs and benefits associated with each scenario were assessed:

- Capital costs to support new production both on-farm and identified supply chain infrastructure.
- Opportunity costs of transitioning from existing production (i.e. lost beef cattle, sugarcane and milling revenues).
- Operating margins/value gained associated with new farm and value-added production.

The CBA modelling at the real discount rate of seven per cent produced the following results:

- Intensification of beef cattle scenario – NPV of $26.5 million, benefit cost ratio (BCR) of 104, and IRR of 9.9 per cent.
- Fallow cropping scenario – NPV of $134.1 million, BCR of 4.20, and IRR of 39.6 per cent.
- Diversification of sugarcane scenario – NPV of $271.1 million, BCR of 1.25, and IRR of 14.1 per cent.
- Expansion of aquaculture scenario – NPV of $244.9 million, BCR of 2.83, and IRR of 16.6 per cent.

The CBA identified that, at a 7 per cent discount rate, the four scenarios would be deemed economically desirable (benefits outweigh costs) (see Table 5). The fallow cropping, diversification of sugarcane, and expansion of aquaculture scenarios are estimated to be preferable to business as usual at discount rates between 4 per cent and 10 per cent, while the intensification of beef cattle scenario returns a negative NPV at a 10 per cent discount rate.

Table 5: Cost benefit analysis results

Real discount rate	PV costs ($M)	PV benefits ($M)	NPV ($M)	BCR
Intensification of beef cattle				
4 per cent	$1,031.3	$1,105.2	$73.9	1.07
7 per cent	$726.3	$752.9	$26.5	1.04
10 per cent	$541.5	$540.4	-$1.1	1.00
Fallow cropping				
4 per cent	$48.8	$258.5	$209.7	5.30
7 per cent	$42.0	$176.1	$134.1	4.20
10 per cent	$37.2	$126.4	$89.2	3.39
Diversification of sugarcane				
4 per cent	$1,563.8	$2,126.4	$562.6	1.36
7 per cent	$1,106.4	$1,377.6	$271.1	1.25
10 per cent	$827.1	$939.1	$112.0	1.14
Expansion of on-shore aquaculture				
4 per cent	$319.4	$747.3	$427.9	2.34
7 per cent	$295.3	$540.2	$244.9	1.83
10 per cent	$279.9	$412.3	$132.3	1.47

Source: AEC.

Recommendations, actions and next steps

The review of export markets identified key characteristics of priority markets to be in demand for high-value products, increasing capacity to pay and dependency on imported products. The assessment of priority products focuses on unmet demand in priority markets, identifying beef, avocado, macadamia, on-shore aquaculture and soybean for the purpose of this study. Land in the region was then assessed for its capacity to produce the priority products, identifying specific areas with suitable agronomic, site conditions, access to labour and water required to support production.

Recommendations and actions

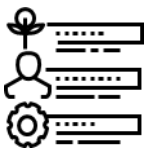
The report's key findings inform recommendations for the improvement of the region's agricultural supply chain. Four key themes are identified that will enable the transition from current to future state, with each consisting of a number of recommendations.

The four themes are:

- Trade and market access
- Production
- Supply chain improvements and optimisation
- Collaboration and innovation.

The recommendations are all co-dependent. Without market access and supply chain relationship development there is less need to establish intensified production or to invest in supply chain infrastructure, logistics and processing equipment. While some recommendations would benefit the growth of the agricultural industry in North Queensland over time, the more recommendations implemented the better.

Table 6: Overview of supply chain recommendations

	Theme	Recommendation
1	 **Trade and Market Access**	**Trade and improved market access and development** While this study recommends that production is increased and/or intensified, export market access and supply chain relationships must be established and developed, including free trade access and the removal of non-tariff trade barriers (for example through establishing suitable protocols) to incentivise producers and supply chain participants to act (and invest).
2	 **Production**	**Production establishment and intensification** The implementation of alternate production scenarios proposed by this report will require the identification of suitable producers and specific sites for intensified, diversified and/or increased production. The phasing of new production with relevant supply chain infrastructure will be critical to ensure the region's capacity to efficiently service demand that has been generated. Facilitation of training and/or up-skilling of labour will be required, together with collaboration with research institutions and relevant industry bodies to ensure the requisite technical capabilities are developed.
3	 **Supply Chain**	**Supply chain improvement and optimisation** This report's assessment of the current state of the supply chain for the respective priority products has identified gaps and opportunities for investment. These recommendations relate to the establishment of efficient channels to market for both raw and value-added goods. As noted above, the development of infrastructure will need to be closely coordinated with the development of production capabilities.

	Theme	Recommendation
4	 **Collaboration and Innovation**	**Collaboration and innovation** Producers, researchers, supply chain participants and consumers must collaborate to optimise the efficiency of the value chain. The creation of cooperative models (to develop collaborative approaches to solving issues) to share data and create economies of scale is crucial. The adoption of digital solutions to collect and disseminate data will improve efficiency and profitability of production and broader supply chain, also enabling greater transparency between producers and consumers.

Where possible, recommendations include reference to key examples or case studies where an initiative has proven successful before. Full case studies of these examples can be found in Appendix D: Case studies.

The following priority product summaries identify approximate timeframes for the commencement of recommended actions. The allocation of timeframes serve to prioritise actions for each product, acknowledging that some tasks will need to commence immediately and others will be informed by the outcome of further investigation. The timeframes provided in Table 7 are indicative only and form a starting point for detailed analysis by working groups established for each product.

Table 7: Overview of action plan priorities

Commencement Timeframe	Actions
<6 months	• Launch and socialise the report with key stakeholders to confirm industry and producer interest, review existing data to identify suitable channels for distribution and customers in target markets. • Commence immediately to identify in principle interest from primary producers, supply chain participants and government at all levels.
<12 months	• Further actions to assess the environmental impact of revised production scenarios, review digital capabilities of regions to inform mid-to-long term planning and ongoing market development. • Confirm sector specific strategies, form collaborative models and working groups to progress agendas, such as grouping R&D, resources etc.
<3 years	• These actions will be dependent on confirmation of the strategy for respective sectors and/or products. Commence planning and construction of key infrastructure to ensure completion in line with production, processing and logistical requirements. • Confirm approvals, funding/investment and commence construction activities.
<5 years	• Actions should commence immediately, and may take a number of years to implement. These actions will likely require ongoing support. • Commence market access initiatives including trade missions, supplier and supply chain relationship development.

Source: KPMG.

An overview of recommendations for each product and a timeline for action, followed by detailed recommendations has been provided below.

Beef

Rationale for change

The major flooding event across Northern Queensland in February 2019 has had a significant impact on the beef industry with livestock losses and supply chain infrastructure. As such, the opportunity for the beef industry should be viewed in the context of the recovery effort, assisted by the Federal Government that has committed more than $3 billion in aid. The future market demand outlook for Australian beef is still very strong, driven by favourable trade agreements (China - Australia FTA signed in 2015 will see tariffs on Australian beef eliminated by 12-25% by 2024), increasing preferences for red meat in Asia, and strong market positioning for safe and high quality produce (Australia is one of the few beef exporters free of Foot and Mouth Disease). The live export market is also well established in North Queensland. That said, there is significant unmet demand for value-added beef in a number of key export markets in close proximity to the study region. The growth and diversification of the beef sector into more intensified production and value-added processing provides the region with an opportunity to capture greater supply chain value while simultaneously diversifying its customer base.

Key outcomes of the intensification of beef cattle scenario:

$228m production value	**$220m** of export value	**Additional 50** direct FTE jobs

Trade & Market Access

Highest demand potential in Japan, China, Indonesia and Korea. These markets are all FTA enabled markets, however some non-tariff barriers to trade do exist. Targeted relationships must be established throughout the supply chain and with customers to inform the development of production and supply chain capabilities.

Supply Chain

The development of an intensive beef production industry is limited by insufficient grain storage, water access, feedlots and processing facilities. The development of adequate access routes (road, rail and port), cold chain infrastructure, and air and sea freight services to priority export markets are crucial to the success of an intensified production strategy.

Production

Producers will require consistent access to water for supplementary grazing and grain for feedlots. Up skilling of producers on intensified beef operations will be necessary. Engagement with regional research, development and extension capabilities and industry bodies is crucial to achieve this and ensure the region has increased capability to produce and finish cattle to meet new market demands.

Collaboration & Innovation

The industry must establish cooperative structures to share knowledge (data), develop skills, infrastructure and secure market access. The implementation of digital solutions will improve the efficiency of production, supply chain and marketing activities by enabling greater communication between all members of the value chain.

townsville enterprise KPMG Premise AEC

Recommendations timeline

The below is an indicative timeline within which recommendations for the intensive beef sector should be commenced.

< 6 months

Develop future state supply chain feasibility including infrastructure and end user customer relationships in priority markets

Complete assessments to plan for diversification and intensification of beef production in North Queensland (i.e. environment, resources, genetics)

Expand regional research, development and extension capabilities to support production

< 1 year

Establish co-operative and/or collaborative structures to facilitate R&D, production, processing, storage and handling and marketing functions

Support development of direct customer relationships through in-market activities in priority markets (Japan, China, Indonesia, Korea)

Actively advocate for review of existing free trade agreements including tariffs, quotas and uptake

Develop workforce to service an intensified production system and improved supply chain

< 3 years

Support the future state operating model by undertaking pre-feasibility and construction of enabling infrastructure

As part of greenfield development analyse supply chain logistics i.e. cold storage requirements, biosecurity and road/rail upgrades

Secure protocol access and reduce non-tariff barriers in priority markets

< 5 years

Support DFAT in securing future priority market free trade agreements (Hong Kong, India)

Construct regional beef processing facility, including looking towards value-added products

Support the digitisation and tech enablement of the supply chain to enable track and trace and drive on farm margin capture

Recommendations		Actions	Investment required	Time to commence
Trade and market access				
1.1	Develop future state supply chain including end user customer relationships in priority markets (Japan, China, Indonesia, Korea)	Utilise existing data to identify most suitable and priority channels for distribution, such as retail, food service or industrial.	FTE	<6 months
		Identify key in-market target customers for partnering with within each priority market. Qualify each and confirm demand.	FTE	<6 months
		Conduct full feasibility and scoping on top scenario/use cases to confirm end-to-end, closed loop marketing arrangement in key market (e.g. boxed beef ex-Townsville direct to retail outlet in Shanghai).	Consultant	6-12 months
		Undertake in-market engagement with identified partners to progress commercial arrangements and confirm policy pathway.	FTE	6-12 months

Recommendations		Actions	Investment required	Time to commence
Trade and market access				
1.2	Support development of direct customer relationships through in-market activities in priority markets (Japan, China, Indonesia, Korea)	Ensure ongoing active engagement with MLA and AMIC to drive NQLD awareness as part of ongoing red meat growth discussions.	FTE	6-12 months
		Where required and/or invited actively participate in in-market hosting opportunities as they relate to priority markets.	FTE	6-12 months
1.3	Actively advocate for review of existing free trade agreements (Japan, China, Indonesia, Korea)	Actively engage with DFAT via MLA, AMIC and CCA to ensure review schedules of existing FTAs are delivered to advance beef in a reasonable timeframe and where feasible, ensure tariff reductions (including quota reviews) are expedited or delivered on time.	FTE	12 months
1.4	Secure protocol access and reduce non-tariff barriers in priority markets (Japan, China, Indonesia, Korea)	Ensure active advocacy and outreach continues for priority markets non-tariffs barriers (e.g. subsidies, technical imposts) applied to beef to enhance trade access.	FTE	1-3 years
1.5	Support DFAT in securing free trade Agreements with future priority markets (Hong Kong and India)	Continue to work with DFAT, MLA and AMIC to ensure Australia continues to advance FTA negotiations and prioritisation for future market opportunities (e.g. Hong Kong and India).	FTE	1-5 years

Recommendations		Actions	Investment required	Time to commence
Production				
2.1	Complete assessments to plan for diversification and intensification of beef production in North Queensland	Socialise report with producers in NQLD to raise awareness of beef production opportunities (e.g. intensification through irrigated pivots and/or feedlots).	FTE and expenses	<6 months
		Undertake a climate impact assessment to understand the environmental impact of diversification and intensification. Ensure access to, and security of, water.	FTE and consultant	6 months
		Whole of farm economic assessment for beef enterprise conversion capturing water, infrastructure and supply chain.	FTE and consultant	6 months
		Identify producers willing and able to explore beef intensification opportunities.	FTE	6-12 months
		Quantify, based on market demand, end product specific breed requirements and herd	FTE and consultant	6-12 months

Recommendations		Actions	Investment required	Time to commence
Production				
		building/stocking requirements and required breeder stock numbers to meet growing market demand.		
2.2	Develop workforce to service an intensified production system and improved supply chain	Up skill existing producers to intensify production with new breeds for new customer markets.	FTE and/or consultant	6-12 months
		Develop and implement training programs focused on beef production for new beef producers.	FTE and/or consultant	12 months
2.3	Expand regional research, development and extension capabilities to support production	Ensure future research priorities and investments include NQLD intensive beef production to meet direct consumer demand.	FTE	<12 months

Recommendations		Actions	Investment required	Time to commence
Supply chain				
3.1	Support the future state operating model by undertaking pre-feasibility and construction of enabling infrastructure	Conduct economic and greenfield feasibility for enabling infrastructure value-added processing, feedlot production, water infrastructure, road upgrades and a NQLD abattoir at two locations (e.g. export node at airport and/or port or an inland location, noting Charters Towers existing feasibility study).	Consultant	6-12 months
		Identify investors and developers that need to be considered as part of the business case (e.g. Cargill, ACC).	FTE and consultant	6-12 months
		Undertake closed loop supply chain pilots/tests to ensure ability to deliver and commence processing and export operations.	TBC – dependent upon investment identified	3 years
3.2	Analyse supply chain logistics as part of greenfield development	Ensure adequate supply chain infrastructure (e.g. cold chain, biosecurity facility, road, rail, port, airport) are established and operational at all export nodes in line with production timeframes.	TBC – dependent upon investors identified	3 years
3.3	Construct regional beef processing facility including consideration of value-added products	Following establishment of new beef supply chain, undertake further feasibility assessment into new value-added processing opportunities (e.g. ready-made meals, food ingredients).	Consultant	3-5 years

Recommendations		Actions	Investment required	Time to commence
Collaboration and innovation				
4.1	Establish cooperative and/or collaborative structures to facilitate in R&D, production, processing, storage and handling and marketing functions	Investigate regional cooperative and/or collaborative structure opportunities centred on intensive beef production. Focus efforts on shared R&D including trials, collaborative and single regional/product marketing and/or supply chain logistics.	TBC – dependent upon investors identified	12 months
4.2	Support the digitisation and tech enablement of the supply chain to enable track and trace and the drive on-farm margin capture	Integrate whole of supply chain traceability underpinned by a technology platform to drive enhanced provenance, product traceability, enhanced marketing options and reduce compliance costs. Engagement of producers and supply chain participants is crucial.	Consultant	3-5 years

Avocado

Rationale for change

Current avocado production in North Queensland is limited however future market demand outlook for this product is particularly strong in Asian markets such as Malaysia, Singapore and Hong Kong. The global demand for the fruit which was once highly niche is growing consistently year-on-year, with a 33 per cent increase in Australian exports from 2015-2016 to 2016-2017. There is growing demand for avocado in a number of South East Asian markets, also serving as a proxy for the production of other high value tree crops. The production of alternative tree crops such as avocado, or other high value tree crops, provides an opportunity for the region to diversify production. Land suited to production has been identified as part of the study and the production capacity of the region will only be enhanced further by increased irrigation availability.

Key outcomes of the intensification of avocado scenario, noting that this is included as a broader transition from existing land use into other horticulture:

$213m production value	**$124m** of export value	**Additional 800** direct FTE jobs

Trade & Market Access

Demand is currently highest in Malaysia, Singapore and Hong Kong, however other markets such as China and Japan prove favourable markets with the reduction of non-tariff barriers (e.g. improved protocols). Avocado producers will also need to be wary of the impact of biosecurity risks on market access.

Supply Chain

There is a limited existing supply chain with minimal opportunity for value-added production. Establishment of storage facilities, cold chain infrastructure and air and sea freight access to priority markets is crucial to the development of the industry. A regional processing facility will ensure production can meet both domestic and export market demand for value-added products.

Production

Current production in the study region is limited. Facilitation of training for existing farm labour should be implemented to grow regional capabilities. Engagement with research institutions should be promoted to ensure best practice methods and development initiatives are implemented. Investment in production and harvesting equipment is required in due course given the lead time to establish fruit bearing trees.

Collaboration & Innovation

The industry must establish cooperative structures to share knowledge (data), develop skills, infrastructure and market access initiatives. A cooperative structure will provide economies of scale for the purchase of inputs and marketing of outputs. The implementation of digital solutions will improve the efficiency of production, the supply chain, and enhance communication.

Recommendations timeline

The below is an indicative timeline within which recommendations for the avocado sector should be commenced.

< 6 months

- Complete assessments to determine viability of avocado production through diversification in North Queensland (i.e. environmental, R&D capability)
- Expand regional research, development and extension capabilities to support production

< 1 year

- Assess capacity of supply chain to service demand (i.e. biosecurity, air freight, processing facilities)
- Support development of direct customer relationships through in market activities
- Investigate opportunities to move from commodity to value-added product
- Facilitate workforce training and development to enable production and processing
- Develop future state supply chain including end user customer relationships in priority markets

< 3 years

- Secure protocol access to priority markets (non-tariff barriers)
- Support the future state operating model by undertaking pre-feasibility and construction of enabling infrastructure

< 5 years

- Support the digitisation and tech enablement of the supply chain to enable track and trace and drive on-farm margin capture
- Construct on-farm and/or regional avocado storage and processing facility
- Establish co-operative and/or collaborative structures to facilitate R&D, production, processing, storage and handling and marketing functions
- Support DFAT in securing and evaluating effectiveness of existing free trade agreements, target future priority market access

Recommendations		Actions	Investment required	Time to commence
Trade and market access				
1.1	Develop future state supply chain including end user customer relationships in priority markets (China, Japan, Indonesia, Malaysia, Hong Kong, Singapore)	Utilise existing data to identify suitable channels for distribution, such as wholesale, retail and food service.	FTE	<6 months
		Identify target customers for partnering with in each priority market. Qualify each and confirm demand.	FTE	<6 months
		Conduct full feasibility for top use cases to confirm closed loop supply chain opportunities (e.g. HPP avocado products into Japan, raw/unprocessed products into Indonesia).	FTE and consultant	<12 months
		Undertake in-market engagement with identified partners to progress commercial arrangements.	FTE	<12 months
1.2	Support development of direct customer relationships through in-	Ensure ongoing engagement by AA and HIA to drive awareness of avocado production in, and supply capacity from, NQLD.	FTE	<12 months

Recommendations		Actions	Investment required	Time to commence
Trade and market access				
	market activities in priority markets (China, Japan, Indonesia, Malaysia, Hong Kong, Singapore)	Where required and/or invited actively participate in in-market hosting opportunities as they relate to priority markets.	FTE and expenses	<12 months
1.3	Support DFAT in securing and evaluating effectiveness of existing free trade agreements (Japan, China, Indonesia, Singapore, Hong Kong, Malaysia)	Continue to work with DFAT, AA and HIA to ensure Australia continues to advance FTA negotiations and prioritisation for future market opportunities (e.g. South Korea, China).	FTE	1-5 years
		Actively engage with DFAT via AA and HIA to ensure review schedules for existing FTAs are delivered to advance avocado trade in priority markets and expedite tariff reductions where possible.	FTE	1-3 years
1.4	Secure protocol access and reduce non-tariff barriers in priority markets	Continue to advance the reduction in non-tariff barriers into priority markets (refer to recent protocol development for Hass avocados into Japan).	FTE	1-3 years
		Ensure biosecurity compliance of orchards and supply chain (refer to packing and inspection requirements for compliance with Queensland fruit fly restrictions).	FTE	1-3 years

Recommendations		Actions	Investment required	Time to commence
Production				
2.1	Complete assessments to determine viability of avocado production through diversification in North Queensland	Socialise report with prospective producers in the in-scope region to raise awareness of avocado production opportunities.	FTE	<6 months
		Quantify production requirement derived from market demand, including for specific processed products.	FTE and consultant	<12 months
		Undertake an environmental impact assessment of avocado production in the region.	Consultant	<12 months
		Conduct a whole of farm economic assessment.	Consultant	<12 months
2.2	Facilitate workforce training and development to enable avocado production and processing	Facilitate up skilling and/or training for prospective producers in avocado production, storage and handling.	FTE	<12 months
		Investigate availability of contract labour and production equipment to supplement shortfalls identified in regional capabilities.	FTE	<12 months
		Facilitate training to develop commercial avocado processing capabilities.	FTE	<12 months

Recommendations		Actions	Investment required	Time to commence
Production				
2.3	Expand regional research, development and extension capabilities to support production	Engage with research institutions and industry bodies to prioritise investment in avocado production to meet established consumer demand, both domestic and international.	FTE	<12 months
		Engage with James Cook University and CSIRO to develop relevant research programs to support increased production, development of improved avocado varieties for the in-scope region.	FTE	<12 months
2.4	Construct on-farm or centralised storage capabilities	Undertake economic feasibility of storage and handling facilities to accommodate forecast production, reviewing potential for centralised/shared storage.	FTE and consultant	<12 months
		Ensure storage and handling facilities meets best practice standards to manage quality and biosecurity risks.	FTE and consultant	1-2 years
		Identify investors, engineers and contractors to verify the business case for avocado temperature controlled storage.	FTE and consultant	1-2 years
		Build storage facilities in line with business case recommendations.	TBC – pending investors identified	3-5 years

Recommendations		Actions	Investment required	Time to commence
Supply chain				
3.1	Support the future state operating model by undertaking pre-feasibility and construction of enabling infrastructure	Conduct economic and greenfield feasibility for enabling infrastructure of an avocado processing facility located in NQLD, focus on node at/near port, contemplating potential to process similar products (e.g. HPP application to mangoes).	FTE and consultant	<12 months
		Identify investors, engineers and contractors to verify the business case for an avocado (and broader fruit) processing facility.	FTE and consultant	<12 months
		Construct pilot processing facility to establish viability of core capabilities cleaning, drying, polishing, sorting, HPP, packaging and/or storage of value-added products.	TBC – pending investors identified	1-2 years
		Expand processing facility to achieve scale and accommodate growing regional production of avocado and similar fruits (refer future irrigation catchment in broader NQLD).	TBC – pending investors identified	3-5 years
3.2	Assess capacity of supply chain to service demand	Investigate biosecurity risks at farm level and develop risk management plan (refer to Queensland fruit fly coverage and treatment options).	FTE and consultant	<12 months

Recommendations		Actions	Investment required	Time to commence
Supply chain				
		Establish adequate biosecurity facilities at port/airport to enable export through Townsville.	TBC – pending size and scope of facility	<12 months
		Ensure access to food grade, controlled atmosphere refrigerated containers for export of value added products via Port of Townsville.	FTE	<12 months
		Advocate for air freight services (passenger or freighter) ex-Townsville to access key markets for perishable products.	FTE	<12 months
		Ensure investment in storage and processing facilities contemplates capacity of viable production areas outside of the study region (refer future irrigation catchment in broader NQLD).	FTE and consultant	<12 months
		Construct suitable temperature controlled storage for collation of value-added products (consider in processing facility feasibility study noted above).	TBC – pending investors identified	2-5 years
3.3	Investigate opportunities to move from commodity to value-added product	Investigate innovative packaging to meet target export market requirements and ensure protocol compliance.	FTE	<12 months
		Investigate potential for processing to meet growing demand for ready-made meals and processed products (e.g. dips, pastes and oils).	FTE	<12 months
		Coordinate regional production modelling with complementary ingredients to maximise value-adding opportunities (e.g. ready-made meals and processed products).	FTE	<12 months

Recommendations		Actions	Investment required	Time to commence
Collaboration and innovation				
4.1	Establish cooperative and/or collaborative structures to facilitate R&D, production, processing, storage and handling and marketing functions	Establish cooperative and/or collaborative structures to enable knowledge and data sharing capabilities.	FTE and consultant	<12 months
		Establish cooperative and/or collaborative structure to aggregate inputs (seed, agronomy, fertiliser, chemicals), harvesting equipment, storage and marketing requirements to achieve scale.	FTE and consultant	1-2 years
		Explore collaborative structures for ownership of key supply chain assets (e.g. storage, processing facilities).	TBC – pending investors identified	2-5 years

Recommendations		Actions	Investment required	Time to commence
Collaboration and innovation				
4.2	Support the digitisation and tech enablement of the supply chain to enable track and trace and drive on-farm margin capture	Undertake economic feasibility study to confirm connectivity in proposed production areas.	Consultant	<12 months
		Assess benefits of implementing digital solutions in production, storage and the broader supply chain (e.g. to enable efficiencies and mitigate risks).	FTE and consultant	<12 months
		Construct connectivity infrastructure in required areas to enable use of digital solutions.	TBC – pending confirmation of requirement	<12 months
		Investigate production traceability platforms to underpin export market development (e.g. certification of provenance, quality, biosecurity, and protocol compliance).	FTE and consultant	1-2 years
		Trial and/or implement digital solutions to inform production, storage and supply chain decisions (e.g. IoT).	FTE and consultant	3-5 years

Macadamia

Rationale for change

The macadamia industry in North Queensland is relatively new yet has significant potential. The global market value of macadamias has been steadily increasing with consistent, year-round demand. As with avocado, the production of macadamia provides an opportunity for the study region to diversify production. There is established demand for macadamia in the priority export markets of Korea and China, with an appetite for both raw and value-added macadamia products. Land suited to the production of macadamia has been identified as part of the study and the production capacity of the region will only be enhanced by increased irrigation availability.

Key outcomes of the intensification of macadamia scenario, noting that it is included as a broader transition from existing land use to other horticulture:

$213m production value	**$124m** of export value	**Additional 800** direct FTE jobs

Trade & Market Access

Demand is currently highest in Korea and China with potential growth markets such as Japan and India. Relationships must be formed with key customers and supply chain partners to verify market potential. The industry must also continue negotiations and advocate for the reduction of non-tariff barriers (e.g. improved protocols).

Supply Chain

Minimal current production dictates that raw product is sent to southern processing facilities with no opportunity to capture value-adds. Establishment of storage and drying facilities, temperature controlled infrastructure and air and sea freight access to priority markets is crucial to the development of the industry. A regional processing facility will ensure production can meet both domestic and export market demand.

Production

Current production in the Study region is limited with suitable areas of land being identified in the study region. Facilitation of training for producers should be implemented to grow regional capabilities. Engagement with research institutions should be promoted to ensure best practice methods and development initiatives are implemented. Investment in production and harvesting equipment is required in the future to underpin market position and exports.

Collaboration & Innovation

The industry must establish cooperative structures to share knowledge (data), develop skills, infrastructure and market access initiatives. A cooperative structure will also provide economies of scale for the purchase of inputs and marketing of outputs. The implementation of digital solutions will improve the efficiency of production, the supply chain, and enable greater communication.

Recommendations timeline

The below is an indicative timeline within which recommendations for the macadamia sector should be commenced.

< 6 months

- Complete assessments to determine viability of macadamia production through diversification in North Queensland (i.e. environmental)
- Expand regional research, development and extension capabilities to support production

< 1 year

- Establish co-operative and/or collaborative structures to facilitate R&D, production, processing, storage and handling and marketing functions
- Facilitate workforce training and development to enable production and processing
- Develop future state supply chain feasibility including end user customer relationships in priority markets
- Support development of direct customer relationships through in market activities
- Investigate opportunities to move from commodity to value-added products

< 3 years

- Actively advocate for existing free trade agreements review
- Secure protocol access and reduce non-tariff barriers in priority markets
- As part of greenfield development analyse supply chain logistics (e.g. storage requirements and biosecurity)
- Analyse supply chain logistics and requirements (i.e. biosecurity, cold chain and freight)

< 5 years

- Support DFAT in securing free trade agreements with future priority markets
- Support the digitisation and tech enablement of the supply chain to enable track and trace, and drive on-farm margin capture
- Support the future state operating model by undertaking pre-feasibility and construction of enabling infrastructure
- Construct on-farm or centralised storage facilities

Recommendations		Actions	Investment required	Time to commence
Trade and market access				
1.1	Develop future state supply chain including end user customer relationships in priority markets (Korea, China, Japan and India)	Utilise existing data to identify most suitable and priority channels for distribution, such as retail, food service or industrial.	FTE	<6 months
		Identify key in-market target customers for partnering with within each priority market. Qualify each and confirm demand.	FTE	<6 months
		Conduct full feasibility and scoping on top scenario/use case to confirm end-to-end closed loop marketing arrangement in key market (e.g. raw kernels, shelled kernels, processed kernels or ingredients).	Consultant	6 - 12 months
		Undertake in-market engagement with identified partners to progress commercial arrangements.	FTE	6 - 12 months
1.2	Support development of direct customer relationships through in-	Ensure that AMS has been engaged to drive improved awareness of future macadamia potential production in North Queensland.	FTE	6 months - 2 years

Recommendations		Actions	Investment required	Time to commence
Trade and market access				
	market activities in priority markets	Participate in in-market hosting opportunities as they relate to priority markets.	FTE and expenses	<12 months
		Undertake in-market activities with key existing buyers as they relate to priority markets to capitalise on new production volumes in North Queensland.	FTE and expenses	<12 months
1.3	Support DFAT in securing free trade agreements with future markets; review existing agreements where required	Actively engage with DFAT via AMS to advance macadamia export opportunities in a reasonable timeframe (particularly to India or Hong Kong, where there is no full FTA in place and tariffs are charged).	FTE	1-2 years
		Review existing FTAs to ensure they remain relevant in the context of macadamia export opportunities (e.g. removal of tariff barriers).	FTE	1-5 years
1.4	Secure protocol access and reduce non-tariff barriers in priority markets	Ensure active advocacy and outreach continues for priority market non-tariffs barriers (i.e. subsidies, technical requirements) applied to macadamia to enhance trade access.	FTE	2 - 3 years
1.5	Ensure adequate biosecurity facilities are established	Importing priority countries have specific biosecurity requirements (e.g. freedom from pests on in-market 'weed schedules'/food sanitation schemes, fumigation requirements, etc.), ensure produce leaving the North Queensland market adequately meets these requirements to prevent product dumping.	FTE	6 months - 3 years

Recommendations		Actions	Investment required	Time to commence
Production				
2.1	Complete assessments to determine viability of macadamia production through diversification in North Queensland	Socialise report with producers in North Queensland to raise awareness of identified macadamia production opportunities (e.g. establishing new orchard sites or integrating with sugarcane).	FTE and Expenses	<6 months
		Undertake a climate impact assessment to understand the environmental impact of recommendations to establish commercial macadamia production in North Queensland. Ensure access to, and security of, water.	FTE and Consultant	<6 months
		Undertake a whole of farm economic assessment for macadamia production, particularly where the enterprise is to be established concurrently with existing production systems (e.g. sugarcane).	FTE and Consultant	<6 months
		Identify producers willing and able to explore macadamia production opportunities.	FTE	6-12 months

Recommendations		Actions	Investment required	Time to commence
Production				
		Quantify, based on market demand, end product requirements (e.g. kernel, processed foodstuffs, or ingredients only).	FTE and Consultant	6-12 months
2.2	Facilitate workforce training and development to enable production and processing	Upskill existing producers to increase production to meet in-market quantified demand and to manage enterprise diversification.	FTE and/or Consultant	6-12 months
		Develop and implement training programs focused on macadamia production and processing for any new producers.	FTE and/or Consultant	12 months
2.3	Expand regional research, development and extension capabilities to support production	Engage with research institutions and industry bodies to prioritise investment in North Queensland macadamia production to meet identified demand.	FTE	<12 months
		Engage with James Cook University and CSIRO to develop relevant research programs to support increased production, including development of specific macadamia varieties (e.g. short statured tree varieties that are more resistant to possible cyclone damage).	FTE	<12 months
2.4	Construct on-farm or centralised storage facilities	Undertake economic feasibility study to understand capacity and capability of existing storage and handling facilities (not necessarily for facilities only for macadamia but other nuts and grains which may be used) to accommodate forecast production, reviewing potential for centralised/shared storage.	FTE and consultant	<12 months
		Ensure storage and handling facilities meet best practice standards to manage quality and biosecurity risks.	FTE and consultant	<12 months
		Identify investors, engineers and contractors that may need to be consulted to verify the business case for establishing/increasing storage.	FTE and consultant	3-5 years
		Build storage facilities in line with business case recommendations.	TBC – pending investors identified above	5 years

Recommendations		Actions	Investment required	Time to commence
Supply chain				
3.1	Support the future state operating model by undertaking pre-feasibility and	Conduct economic and greenfield feasibility for enabling infrastructure of a macadamia processing facility located in North Queensland, focus on node at/near port, contemplating potential to process similar grains (e.g. soybean).	FTE and consultant	1-2 years

Recommendations		Actions	Investment required	Time to commence
Supply chain				
	construction of enabling infrastructure	Identify investors, engineers and contractors that need to be consulted to verify the business case for a macadamia/grains processing facility.	FTE and consultant	1-2 years
		Construct pilot processing facility to establish viability of core capabilities, including cleaning, drying, processing, packaging and/or storage of value-added products.	Identified investors	<5 years
		Expand processing facility to achieve scale if required.	Identified investors	5 years
3.2	As part of greenfield development analyse supply chain logistics (e.g. storage requirements and biosecurity)	Ensure adequate supply chain infrastructure (e.g. temperature controlled storage requirements, road and rail upgrades and biosecurity) is established and operational at all export nodes in line with production timeframes.	Identified investors	<3 years
3.3	Investigate opportunities to move from commodity to value-added product	Undertake feasibility assessment into transitioning part of future supply into value-added processing (e.g. nuts for desserts and packaged confectionary products).	FTE or/and Consultant	<12 months

Recommendations		Actions	Investment required	Time to commence
Collaboration and innovation				
4.1	Establish cooperative and/or collaborative structures to facilitate R&D, production, processing, storage and handling, and marketing functions	Establish cooperative structures to enable knowledge (practical production and processing), and data sharing (technology effectiveness and efficiency) capabilities.	FTE and consultant	<12 months
		Establish cooperative structure to aggregate inputs (seed, agronomy, fertiliser, chemicals), harvesting equipment, storage, and marketing requirements to achieve scale.	FTE and consultant	1-2 years
		Explore collaborative ownership structures for ownership of key supply chain assets (e.g. storage, processing).	TBC – pending cooperative structure above	2-5 years
4.2	Support the digitisation and tech enablement of the supply chain to enable track and trace, and to drive on-farm margin capture	Investigate where whole of supply chain traceability can be underpinned by a technology platform to drive enhanced provenance, product traceability, enhanced marketing options and reduce compliance costs. Engagement of producers and all supply chain players in this would be pivotal.	Consultant	<5 years

On-shore aquaculture

Rationale for change

There is currently some on-shore aquaculture in the study region and the fundamental requirements of a successful sector are present. There are established entities producing products such as cobia, barramundi and tiger prawns. There is suitable land in close proximity to port and airport infrastructure, high unmet demand in priority markets, available labour and an opportunity to further diversify the agricultural production of the region. Tropical rock lobster was selected on the basis of its demand in priority South East Asian markets and this example serves as a proxy for other on-shore aquaculture species.

Key outcomes of the intensification of aquaculture scenario:

$150m production value	Export value will be dependent on total volume produced	**Additional 300** direct FTE jobs

Trade & Market Access

Demand for tropical rock lobster is highest in Korea, Thailand and China, these three markets have FTAs in place and there are no tariffs on the goods, however some non-tariff barriers exist. Other priority markets include Japan and Hong Kong. Continued advocacy by industry bodies is required to raise awareness of production in the study region and reduce non-tariff barriers.

Supply Chain

The existing supply chain is currently limited with aquaculture farms growing, processing and storing on single sites before distributing to domestic markets. Investment in cold chain facilities encompassing processing and packaging capabilities is vital. Access to refrigerated container freight, together with live air freight market access to key export markets will provide a diverse range of pathways to market for production.

Production

Current production in the Study region is limited. Facilitation of training for producers should be implemented to grow regional capabilities. Engagement with research institutions should be promoted to ensure best practice methods and development initiatives are implemented. Commercial operators must be engaged to develop production hatcheries, ponds and related infrastructure to underpin market position.

Collaboration & Innovation

The aquaculture industry has shown that cooperative structures can benefit the industry through the collation of knowledge (data), skills, infrastructure, and market access initiatives. The implementation of digital solutions will improve the efficiency of production, the supply chain and enable greater communication between consumer and producer (e.g. certifying product quality and provenance).

townsville enterprise KPMG Premise AEC

Recommendations timeline

The below is an indicative timeline within which recommendations for the on-shore aquaculture sector should be commenced.

< 6 months

- Develop future state supply chain feasibility including end user customer relationships in priority markets
- Expand regional research, development and extension capabilities to support production

< 1 year

- Facilitate workforce training and development to enable production and processing
- Analyse site specific infrastructure requirements as part of greenfield aquaculture development areas (i.e. water pumps, power and road access)
- Establish co-operative and/or collaborative structures to facilitate R&D, production, processing, storage and handling and marketing functions
- Support development of direct customer relationships through in market activities in priority markets
- Facilitate development of the 'Townsville aquaculture development area' as a best practice development site

< 3 years

- Secure protocol access and reduce non-tariff barriers in priority markets
- Investigate dedicated air freight ex Townsville Airport (cross product recommendation)
- Expand on-shore aquaculture development areas for greenfield development opportunities

< 5 years

- Support DFAT in securing free trade agreements with future priority markets
- Support the digitisation and tech enablement of the supply chain to enable track and trace, and drive on-farm margin capture

Recommendations		Actions	Investment required	Time to commence
Trade and market access				
1.1	Develop future state supply chain including end user customer relationships in priority markets (China, Japan and Hong Kong)	Identify key in-market target customers for partnering with within each priority market. Qualify each and confirm demand.	FTE	<6 months
		Conduct full feasibility to confirm end-to-end closed loop marketing arrangements in key priority markets (e.g. live tropical rock lobster ex-Ex-Townsville airport direct to market in Shanghai).	Consultant	<6 months
		Undertake in-market engagement with identified partners to progress and confirm commercial supply arrangements.	FTE	<6 months
1.2	Support development of direct customer relationships through trade missions and	Ensure ongoing active engagement with priority export markets by aquaculture industry associations (e.g. Aquaculture Association of Queensland (AAQ)) to drive NQLD awareness.	FTE	<12 months

Recommendations		Actions	Investment required	Time to commence
Trade and market access				
	marketing activities in priority markets (China, Japan and Hong Kong)	Where required and/or invited, actively participate in in-market hosting opportunities as they relate to priority markets.	FTE	<12 months
1.3	Support DFAT in securing free trade agreements with future markets, review existing agreements where required	Actively engage with DFAT via AAQ to advance on-shore aquaculture export opportunities in a reasonable timeframe.	FTE	1-5 years
1.4	Secure protocol access and reduce non-tariff barriers in priority markets	Ensure active advocacy and outreach continues for priority markets non-tariffs barriers (i.e. subsidies, technical imposts) applied to aquaculture to enhance trade access.	FTE	1-3 years

Recommendations		Actions	Investment required	Time to commence
Production				
2.1	Facilitate development of the Townsville aquaculture development area as a best practice development site	Identify commercial parties interested in developing the Sleeper Log/Leichhardt Creek site 30km north of Townsville.	FTE	<6 months
		Commercial operator to invest and construct the operation endorsed by TIQ and DAF.	Privately funded by commercial operator	<12 months
		Confirm ownership model and possible integration of contract grow-out producers of juvenile tropical rock lobsters to maturity for export.	Privately funded by commercial operator	<12 months
2.2	Facilitate workforce training and development to enable production and processing	Utilise education institutions, such as James Cook University, and confirm there is suitable resources for up skilling existing unskilled workforce to tailor skills for on-shore aquaculture production.	FTE	<12 months
		Facilitate training for existing producers, i.e. prawn and barramundi farmers, to diversify into higher value export-ready aquaculture production such as tropical rock lobsters.	FTE	<12 months
2.3	Expand regional research, development and extension capabilities to support production	Support research institutions, i.e. JCU or CQ, with their aquaculture research and development initiatives, such as tropical rock lobster juvenile production, to develop the new industry in the Townsville region.	FTE	<6 months
2.4	Expand on-shore aquaculture development areas for	State Government to review Crown land holdings that may be appropriate for aquaculture development		<12 months

Recommendations		Actions	Investment required	Time to commence
Production				
	greenfield development opportunities	State Government to collaborate with industry to confirm necessary land ownership model, such as free hold with title transfer or leased land to contract with 'grow-out' producers.	FTE	1-3 years

Recommendations		Actions	Investment required	Time to commence
Supply chain				
3.1	Investigate dedicated air freight ex-Townsville Airport (cross product recommendation)	Investigate feasibility of utilising a dedicated freighter aircraft from Townsville airport to priority export destination (i.e. China).	FTE and consultant	<12 months
		Collaborate with other industries, such as the beef industry, to investigate supply arrangement to fill a dedicated freight aircraft from Townsville airport to priority export destination (i.e. China).	FTE and consultant	<1-3 years
3.2	Analyse site specific infrastructure requirements as part of greenfield aquaculture development areas i.e. water pumps, power and road access	Ensure adequate supply chain infrastructure (e.g. cold chain, live aquaculture transport and biosecurity facility) is established and operational at all export nodes.	TBC – dependent upon investors identified	<12 months

Recommendations		Actions	Investment required	Time to commence
Collaboration and innovation				
4.1	Establish cooperative and/or collaborative structures to facilitate R&D, production, processing, storage and handling, and marketing functions	Investigate regional cooperative and/or collaborative opportunities. Focus cooperative efforts on shared R&D including trials, collaborative and single regional/product marketing, and/or supply chain logistics.	Consultant	6-12 months
4.2	Support the digitisation and tech enablement of the supply chain to enable track and trace, and drive on-farm margin capture	Investigate whole of supply chain traceability underpinned by a technology platform to drive enhanced provenance, product traceability, enhanced marketing options and reduce compliance costs. Engagement of producers and supply chain participants is crucial.	Consultant	<12 months

Soybean

Rationale for change

Australia is positioned to deliver safe and high quality produce, with potential to capture a niche market in the production of non-GMO soybean for high value Asian markets. As a result, the future market demand outlook for soybean has significant potential especially for value-added opportunities such as tofu, soy meals and noodles. The development of a soybean industry in the study region can be beneficial on a number of levels. The demand for soybean in key export markets is high and growing, supplemented by strong domestic demand. Soybean can be used as a rotational crop with sugarcane, as a broad acre crop in its own right, and as a by-product for use in the intensive livestock and aquaculture industries as a source of feed.

Key outcomes of the intensification of the soybean rotational scenario:

$46m production value	**$18m** of export value	N/A direct FTE jobs – existing sugarcane labour supply

Trade & Market Access

Demand for soybean is highest in China, Japan, Indonesia and India, with growing demand in Korea. China and Japan are FTA markets, however India and Indonesia are not. All markets have tariff and non-tariff barriers. Targeted supply chain and customer relationships must be established in conjunction with ongoing advocacy from producers and industry bodies to raise the awareness of North Queensland production and to help minimise barriers to trade.

Supply Chain

The provision of on-farm and/or centralised storage and processing facilities will provide producers with greater flexibility (risk mitigation) and access to multiple markets. Rail, port and airport infrastructure will provide producers with a diverse range of channels to established markets. The supply chain must also contemplate potential production from the broader North Queensland region to ensure its capacity to handle a sustainable, increased volume of soybean.

Production

Current production in the study region is limited. Facilitation of training for existing farm labour should be implemented to grow regional capabilities. Engagement with research institutions should be promoted to ensure best practice methods and development initiatives are implemented. Investment in equipment will be required to enable efficient production. The consistent production of soybean is required to underpin market position and supporting infrastructure.

Collaboration & Innovation

The industry must establish cooperative structures to share knowledge (data), skills, infrastructure and market access initiatives. A cooperative structure will also provide economies of scale for the purchase of inputs and marketing of outputs. The implementation of digital solutions will improve the efficiency of production and the supply chain, and enable greater communication between consumer and producer.

Recommendations timeline

The below is an indicative timeline within which recommendations for the soybean sector should be commenced.

< 6 months

- Develop future state supply chain, including feasibility and end-user customer relationships
- Expand regional research, development and extension capabilities to support production

< 1 year

- Establish co-operative and/or collaborative structures to facilitate R&D, production, processing, storage and handling and marketing functions
- Support development of direct customer relationships through in market activities in priority markets
- Investigate opportunities to move from commodity to value-added products
- Complete assessments to determine viability of soybean production through diversification in North Queensland
- Facilitate workforce training and development to enable production and processing

< 3 years

- Secure protocol access and reduce non-tariff barriers in priority markets
- Construct on-farm and/or centralised storage capabilities
- Actively advocate for existing free trade agreements review including tariffs, protocols and uptake
- Assess capacity of supply chain to service demand

< 5 years

- Support the future state operating model with construction of enabling infrastructure.
- Support the digitisation and tech enablement of the supply chain to enable track and trace and drive on-farm margin capture
- Support DFAT in securing free trade agreements with future priority markets

Recommendations		Actions	Investment required	Time to commence
Trade and market access				
1.1	Develop future state supply chain including end user customer relationships in priority markets (Korea, Japan and China)	Utilise existing data to identify suitable channels for distribution, such as wholesale and retail.	FTE	<6 months
		Identify target customers for partnering with within each priority market. Qualify each and confirm demand.	FTE	<6 months
		Conduct full feasibility for top use cases to confirm closed loop supply chain opportunities (e.g. fermented soybean products to Korea [export], intensive livestock feed requirements in NQLD [domestic]).	FTE and consultant	<12 months
		Undertake in-market engagement with identified partners to progress commercial arrangements.	FTE	<12 months

Recommendations		Actions	Investment required	Time to commence
Trade and market access				
1.2	Support development of direct customer relationships through in-market activities in priority markets	Ensure ongoing engagement by AOF to drive awareness of soybean production and supply in NQLD.	FTE	<12 months
		Where required and/or invited actively participate in in-market hosting opportunities as they relate to priority markets.	FTE and expenses	<12 months
1.3	Support DFAT in evaluating effectiveness of existing free trade agreements	Actively engage with DFAT via AOF to ensure review schedules for existing FTAs are delivered to advance soybean trade in priority markets and expedite tariff reductions where possible.	FTE	1-5 years
1.4	Secure protocol access and reduce non-tariff barriers in priority markets	Continue to advance the reduction in non-tariff barriers into priority markets.	FTE	1-3 years

Recommendations		Actions	Investment required	Time to commence
Production				
2.1	Complete assessments to determine viability of soybean production through diversification in North Queensland	Socialise report with sugarcane producers in NQLD to raise awareness of soybean production opportunities (e.g. rotational cropping or sowing of additional irrigated land).	FTE	<6 months
		Identify producers willing and able to explore production opportunities for soybean.	FTE	<12 months
		Quantify production requirement derived from market demand, including specific processed products for human consumption, industrial products (domestic and export markets) and feed (domestic markets).	FTE and consultant	<12 months
		Undertake an environmental impact assessment of soybean production in the region.	Consultant	<12 months
		Conduct a whole of farm economic assessment on water (security and volume), infrastructure and supply chain.	Consultant	<12 months
2.2	Facilitate workforce training and development to enable soybean production and processing	Up skill existing sugarcane and prospective soybean producers in soybean production, storage and handling.	FTE	<6 months
		Facilitate training for new soybean producers in production, storage and handling of soybean.	FTE	<6 months

Recommendations		Actions	Investment required	Time to commence
Production				
		Investigate availability of contract labour and production equipment to supplement regional capabilities.	FTE	<12 months
		Facilitate training to develop commercial soybean processing capabilities.	FTE	<12 months
2.3	Expand regional research, development and extension capabilities to support production	Engage with research institutions and industry bodies to prioritise investment in NQLD soybean production to meet established consumer demand.	FTE	<6 months
		Engage with James Cook University and CSIRO to develop relevant research programs to support increased production, development of improved soybean varieties for NQLD.	FTE	<12 months
2.4	Construct on-farm or centralised storage capabilities	Undertake economic feasibility of storage and handling facilities to accommodate forecast production, reviewing potential for centralised/shared storage.	FTE and consultant	<12 months
		Ensure storage and handling facilities meet best practice standards to manage quality and biosecurity risks.	FTE and consultant	<12 months
		Identify investors, engineers and contractors that must be consulted to verify the business case for soybean storage.	FTE and consultant	1-3 years
		Build storage facilities in line with business case recommendations.	TBC – pending investors identified	1-3 years

Recommendations		Actions	Investment required	Time to commence
Supply chain				
3.1	Support the future state operating model with construction of enabling infrastructure	Conduct economic and greenfield feasibility for enabling infrastructure of a soybean processing facility located in NQLD, focus on node at/near port, contemplating potential to process similar grains.	FTE and consultant	<12 months
		Identify investors, engineers and contractors that need to be consulted to verify the business case for a soybean processing facility.	FTE and consultant	<12 months
		Construct pilot processing facility to establish viability of core capabilities cleaning, drying, processing, packaging and/or storage of value-added products.	TBC – pending investors identified	1-2 years

Recommendations		Actions	Investment required	Time to commence
Supply chain				
		Expand processing facility to achieve scale and accommodate growing regional production (refer future irrigation catchment in broader NQLD).	TBC – pending investors identified	2-5 years
3.2	Assess capacity of supply chain to service demand	Investigate biosecurity risks at farm level and develop risk management plan.	FTE and consultant	<12 months
		Ensure access to food grade containers for export via Port of Townsville.	FTE	<12 months
		Establish adequate biosecurity facilities at port/airport to enable export through Townsville.	TBC pending size and scope of facility	<12 months
		Advocate for air freight services (passenger or freighter) ex-Townsville to access key markets for perishable products.	FTE	<12 months
		Ensure investment in storage and processing facilities contemplates capacity of viable production areas outside of the study region (refer future irrigation catchment in broader NQLD).	FTE and consultant	<12 months
		Construct suitable temperature controlled storage for collation of value-added products (consider processing facility in feasibility study noted above).	TBC – pending investors identified	1-2 years
3.3	Investigate opportunities to move from commodity to value-added product	Investigate innovative packaging to meet target export market requirements and ensure protocol compliance.	FTE	<12 months
		Investigate processing of soybean to produce food grade, industrial and residual products, extracting maximum value from production.	FTE	<12 months
		Coordinate regional production modelling with emerging industry requirements (intensive livestock, aquaculture feed products) to maximise revenue streams for soybean.	FTE	<12 months

Recommendations		Actions	Investment required	Time to commence
Collaboration and innovation				
4.1	Establish cooperative and/or collaborative structures to facilitate	Establish cooperative and/or collaborative structure to enable knowledge and data sharing capabilities.	FTE and consultant	<12 months

Recommendations		Actions	Investment required	Time to commence
Collaboration and innovation				
	R&D, production, processing, storage and handling, and marketing functions	Establish cooperative and/or collaborative structure to aggregate inputs (seed, agronomy, fertiliser, chemicals), harvesting equipment, storage, and marketing requirements to achieve scale.	FTE and consultant	<12 months
		Explore collaborative ownership structures for ownership of key supply chain assets (e.g. storage and processing).	TBC – pending investors identified	<12 months
4.2	Support the digitisation and tech enablement of the supply chain to enable track and trace and drive on-farm margin capture	Undertake economic feasibility study to confirm connectivity in proposed production areas.	Consultant	<12 months
		Assess benefits (e.g. efficiencies and risk mitigation) of implementing AgTech solutions in production, storage and the broader supply chain.	FTE and consultant	<12 months
		Construct infrastructure in areas determined to have insufficient connectivity to enable use of digital solutions.	TBC – pending confirmation of requirement	<12 months
		Trial and/or implement digital solutions to inform production, storage, and supply chain decisions (e.g. IoT).	FTE and consultant	1-2 years
		Investigate production traceability platforms to underpin export market development (e.g. certification of provenance, quality, and biosecurity compliance).	FTE and consultant	2-5 years

Next steps

The NQAMSCS was an extensive body of work that provides a roadmap for the region's agricultural production, infrastructure and export sectors to meet existing and future international market demands. As the North Queensland region looks to intensify and improve its agricultural production to capture better high-value premiums in export markets there are two key future scenarios that should be operationalised:

1. Intensify and introduce the growth of specific products and their industries, to increase the volume of raw commodity available for export. Improving the capacity and capability of all supply chain operators, creating a better accumulation and processing hub/node at Townsville, increasing exports from the Port of Townsville and re-opening international services from the airport will be critical to achieving this.
2. Intensify and introduce the growth of the specific products to increase the volume of raw commodity produced for value-adding and additional processing stages to capture better premiums in export markets. This future state would also critically depend upon the whole supply chain being improved, centralised and amalgamated.

There are a number of considerations and next steps that need to be undertaken to achieve the desired future scenario, including further research, full commercial feasibility studies and further stakeholder engagement. In order to initiate this process the following short-term actions should be completed to progress the opportunities identified in the study:

1. Launch the NQAMSCS study with key stakeholders including producers, government and industry.
2. Utilise the study as a base, socialise recommendations and actions to prioritise opportunities and supply chain investments with key stakeholders. Determine stakeholder ownership of prioritised actions.
3. Undertake full commercial feasibility and detailed economic modelling of each priority product value chain to inform producers and commercial operators, and drive the required investment both on-farm and across the supply chain.
4. Identify new investors or participants to invest and/or operate in each product's future scenario supply chain.
5. Model the required air freight volumes to validate regular cargo air freighters ex-Townsville Airport to key priority markets based on intensification and increasing production of priority products.
6. Continue dialogue with producers, commercial operators, industry bodies and State and Federal Government to drive the study recommendations and agricultural strategy for the region.

The region and individual sectors cannot move forward in isolation and require a holistic approach to long-term infrastructure planning. Industry interests should be prioritised over regionalised approaches to supply chain investment. Therefore there is the need for an industry led statewide supply chain developmental mapping process. Working with key government agencies, a statewide approach would ensure targeted investment prioritising each sector's development in line with primary producer interests, intensification of production, improving supply chain and industry efficiencies and finally ensuring access to target markets.

The study partners TEL, NQROC and the CRCNA have an ongoing leadership role in driving the next steps and implementing the recommendations of this study.

townsville enterprise KPMG Premise AEC

Appendices

Appendix A: Market assessment

Market identification method

A market assessment matrix was used to quantitatively prioritise ten key Asian and Middle Eastern markets, using a desktop analysis based on publically available demographic, importation and economic data sources. The criteria for the market assessment and corresponding rationale for each is outlined below. For each criteria a scale was developed that allowed a view of whether that market was favourable or not for increased exports.

Demographic data

Countries with a high rating exhibited: increasing population, low areas of land under cultivation, improved shipping/logistics, and were closer to Townsville.

Table 8: Demographic data assessment criteria

Assessment criteria	Rationale
Population (current and per cent change p.a.)	Indicator of export market consumer demand volume and future demand trend.
Land (ha), and area under agricultural cultivation	Indicator of potential for export market production capability and current agricultural production.
Proximity to Townsville	Indicator of supply chain complexity due to transit time and distance to export market.

Source: KPMG analysis of World Population Meter, FAO Country Profiles, World Bank – Logistics Performance Index 2016.

Import and agricultural data

Countries with a high rating exhibited: currently existing market access, low country risk and are already trading partners with Australia (particularly if an FTA is in place). Export market had demand for agri-foods produced in Australia and had a low-to-moderate level of their own production only (lower food security).

Table 9: Import and agricultural data assessment criteria

Assessment criteria	Rationale
Market access for trade	Indicator of ability of new exporters or new products to enter a market without being hindered by technical barriers to trade (e.g. licence requirements, customs, phytosanitary measures, technical barriers to trade etc.)
Market potential index (MPI) rating	Indicator of economic and market structure of an importing country that provides an indication of its suitability for expansion by a new exporter.
Country risk rating	Indicator of a market's macroeconomic, financial and political status to provide an overall view on a country's ability to assume credit risks that may influence its businesses financial commitments.
Trading partner status	Indicator of Australia's current trade relationship with the market in question. Markets with higher two-way trade are easier to access for new exporters.
FTA status	Indicator of a lack of trade barriers which may hinder an exporter, such as tariffs, quotas or safeguards.
Appetite for Australian agri-foods	Indicator of opportunity for Australian exporters to enter the market with existing or new products.
Current import/export information	Indicator of a market's current imported food and where this food is sourced from. This data provided insights on whether there was opportunity to provide new supply to that country (be that in additional volume or new products).
Current domestic production	Indicator of the variety and volume of agricultural production within the market, which provided insight into its need to procure certain products (i.e. a country with low production and high population will need to procure a large volume of goods to maintain food security).

Source: KPMG analysis of Department of Agriculture and Water Resources (DAWR), Michigan State University MPI, Department of Foreign Affairs and Trade, 'Co-face for trade', Food Innovation Australia Limited, Organisation for Economic Cooperation and Development.

Economic data

Countries with a high rating exhibited: average gross domestic product (GDP), income per capita and normalised inflation rates, and a high logistics performance index rating.

Table 10: Economic data assessment criteria

Assessment criteria	Rationale
GDP (and five year forecast, USD)	Indicator of the export market's economic strength and future economic activity.
Average income per capita	Indicator of the consumer's propensity to consume imported agricultural product with disposable income.
Inflation	Indicator of the export market's purchasing power and therefore ability to consume imported agricultural products.
Logistics performance index (LPI) rating	Indicator of global competitiveness for logistics performance and ability to operate an effective supply chain.

Source: World Bank and International Monetary Fund data.

Using the assessment criteria outlined above, the ten key export markets with the highest rating were identified. These markets were also validated through consultation with industry, government and commercial stakeholders, in addition to desktop research.

Market prioritisation

The markets selected for further analysis, listed below is not an exhaustive list of target export markets; these markets are the highest rating as per the market assessment matrix. Additional markets with export potential within Asia and the Middle East should still be considered, however for the purpose of this report these markets have not been analysed further. However the recommendations and findings from this report will still be relevant for international export markets identified in the future.

Table 11: Potential markets prioritised for export of agri-food goods

Ranking	Key insights	Detailed profile	
1	**Korea**	Korea represents an existing mature export destination for Australian products such as beef which the region should seek to diversify its export offerings with premium produce and finished goods. Korea's appetite for ready-made, processed foods needs to be supported by facilities in the region capable of supplying this directly to the end user.	Page: 58

Ranking	Key insights	Detailed profile	
2	**China**	The Chinese market represents a large scale opportunity where the North Queensland region can position itself to export high volume and high-value products direct to market. The existing FTA and protocols in place will enable future growth. With average income expected to continue increasing in the next decade, North Queensland is well placed to supply premium Australian products to meet the expectations of Chinese quality conscious consumers.	Page: 60
3	**Japan**	As a net importer with high purchasing power, Japan is an attractive market that will demand a range of products produced in the North Queensland region as raw materials and finished good form, i.e. pre-packaged ready to eat meals. Japanese consumers are willing pay a premium for Australian produce. For example, soybean produced for tofu finished good products are in high demand and producers can command a premium price for the raw material non-GM variety.	Page: 62
4	**Indonesia**	Food security is high on the Indonesian Government's agenda, especially access to protein (beef) which means the region is well placed to meet that demand. As average incomes increase, consumer demand for protein will continue to rise and be enabled by better infrastructure, such as access to refrigeration for imported processed beef. The Townsville export facilities will require suitable infrastructure to export this product direct to market, such as cold storage for pre-packaged beef products.	Page: 64
5	**Singapore**	Singapore is a net importer with low food security and heavy reliance on imports. As such, given the diverse production base (beef, horticulture, seafood), the North Queensland region is well placed to increase exports utilising the existing FTA and established trade relationships. Singapore operates as a regional re-export hub that results in greater import volumes and provides an opportunity for the North Queensland region to export higher volumes consistently. High GDP and per capita income in Singapore represents an opportunity to market premium produce directly from the region and command a premium price.	Page: 66
6	**UAE**	High average incomes and presence of expatriates in the UAE create demand for products from North Queensland such as meat, nuts, citrus and stone fruits, as well as pre-packed ready to eat meals that have been processed prior to export. The lack of suitable agricultural production area in the UAE encourages strong import demand and long term supply security for North Queensland producers.	Page: 68
7	**Malaysia**	Malaysian consumer's appetite for high quality, healthy fresh foods as well as pre-prepared foodstuffs positions the region well to supply the market with fresh fruit and vegetables. The FTA in place will enable future export growth but investment must be made to develop export partnerships with local enterprise.	Page: 70

Ranking	Key insights	Detailed profile	
8	**Hong Kong**	With no, or very limited, agricultural production, Hong Kong is well suited as a long term export market with a propensity to consume high-value fresh produce. Like Singapore, Hong Kong acts as a regional re-export hub to neighbouring countries that results in greater import volumes and provides an opportunity for the North Queensland region to export higher volumes consistently. As a protocol free and re-export market, there is strong demand for high-value and volume products from the North Queensland region to supply the well-established market.	Page: 72
9	**Thailand**	In line with the Thai Government's desire to manufacture processed and prepared food products, the Townsville region can supply raw material ingredients across all agri-food types. High-value Australian produce would be supplied to meet only the niche upper class urban market that consume a variety of quality 'clean and green' produce.	Page: 75
10	**India**	The large economy and population size of the Indian market presents a significant opportunity for rapid and sustained future export growth. With consumers increasingly influenced by Western consumption trends, demand potential for Australian agri-products will continue to grow. Despite the lack of a FTA in place, this market should still be a focus for producers in the North Queensland region to target in the future because the level of the demand is so significant in comparison to other export markets.	Page: 77

Source: KPMG analysis.

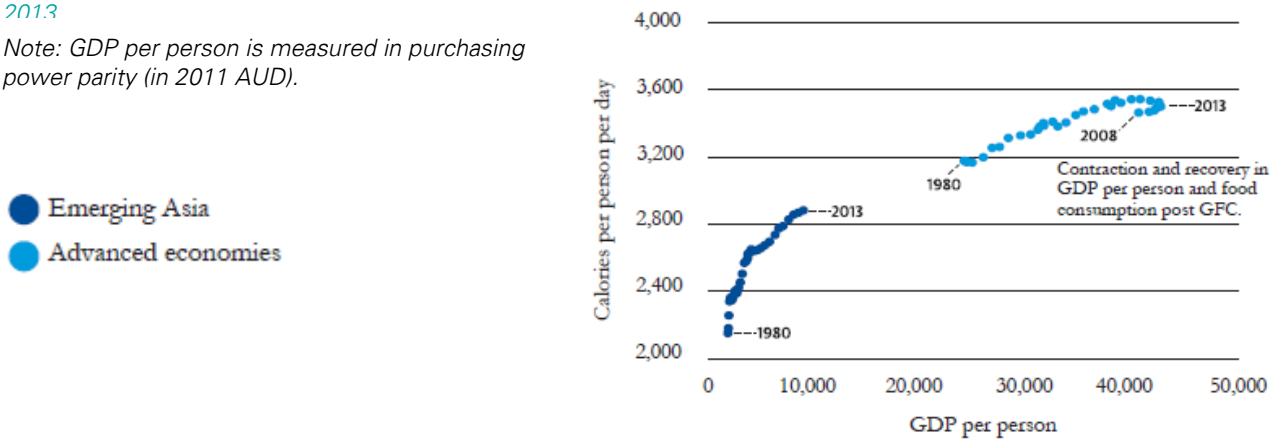
Growing demand for food

The selected markets represent growing demand for food in Asia and the Middle East. This growing demand is within the context of increased global food demand that is expected to grow by between 59 per cent and 98 per cent by 2050, fuelled by rising GDP per capita which is expected to increase USD$10,000 to USD $14,000 by 2030 (Harvard, 2016). Rising levels of income per person are anticipated to translate into increasing demand for food, both in absolute terms and also on a quality-substitution basis. Simply, as the living standards across the world improve, those people in the lower income ranges will be able to purchase more food, such that their daily calorific intake increases from subsistence levels to levels closer to the world average (KPMG, 2018). People in higher income ranges are likely to adjust their buying behaviour such that they purchase better quality food products (either in terms of attributes like taste, substance, use of chemicals, producer provenance, etc.).

This trend has already been seen, with the fastest increase in food consumption in countries where incomes have grown most rapidly (KPMG, 2018 from ABARES, FAO and IMF analysis). Australia's food production sector has benefitted from this rise in global incomes – especially income growth in Asian economies – and pull-through demand for basic and value-added agricultural products in Asia. Over the past decade demand for Australia's farm exports has been strongest from Asian neighbours, including China, India, Indonesia, the Philippines, South Korea and Vietnam; with this strong rise in demand from emerging Asia economies is expected to be maintained into the short to medium term (KPMG, 2018).

Figure 1: Changes in calorie consumption and GDP per person, emerging Asia and advanced economies 1980 to 2013

Note: GDP per person is measured in purchasing power parity (in 2011 AUD).



Food demand in Asia

The Asian market specifically is expected to grow by over 750 million people by 2050 (KPMG, 2018). Asia is being transformed by the urbanisation and westernisation of the middle-class. There is a strong desire for the highest quality product, where provenance and safety are non-negotiable. Food safety scandals across Asian countries are driving this trend – the best known being melamine contamination of milk powder in China in 2011, which has led to such strong demand for Australian-sourced product so that consumers can now only buy two cartons per purchase in Australia (KPMG, 2018). Asian consumers want to buy the food that Australian's consume and that they can prove is made here. Market sentiment towards Australia and its produce is strong, but it is essential that any product comes with the appropriate endorsement, enabled by an efficient supply chain in order to get product directly to the end user.

The North Queensland region is well placed to capitalise on the opportunity presented by the population and demand growth in Asian markets given its geographic proximity to markets, and mature export infrastructure at the Townsville Port and Airport (lack of passenger services notwithstanding) which provide a sound foundation for expansion and development. For the products identified in this study, further improvements will be identified to facilitate effective export to the markets identified to enable sustainable long term growth in the region.

Market profiles

Korea

Demographic rating	Unfavourable	Favourable
Trade and agricultural rating	Unfavourable	Favourable
Economic rating	Unfavourable	Favourable

POPULATION
51.2 million

AGRI-LAND ('000 ha)
1,748

GDP & 2023 FORECAST
2018: $35,538 p.c
2023: $52,745 p.c

URBAN POPULATION
81.6%

AVERAGE INCOME
$35,623 p.a.

INFLATION
0.97%

Insights for the North Queensland in-scope regions:

- Korea represents an existing mature export destination for Australian products such as beef; the region should seek to diversify its export offerings with premium produce and finished goods.
- Korea's appetite for ready-made, processed foods needs to be supported by facilities in the region capable of supplying this directly to the end user.

Korea is an established trading partner of Australia. The FTA between Australia and Korea has facilitated agricultural trade and is supported by the growing number of protocols being established for food products. Products that are benefiting from these changes include beef, wheat, sugar, wine, dairy, horticultural produce and seafood, as these all had very high tariffs prior to the introduction of the agreement. The benefits are expected to increase as the tariffs are eliminated in full (2033), although there are some products that had immediate tariff elimination.

Korean consumers are less familiar with Australian produce, with lower awareness of traditional 'Brand Australia' and 'clean and green' branding. This sentiment is beginning to shift positively and there is still high demand for fresh meat, dairy, fruit and vegetable produce and for ready-made, processed foods. Korean consumers like convenience food stores and generally lack household cooking facilities. Food needs to be tailored to these demographic considerations to meet their expectations (i.e. with pre-packaged meals).

Market access considerations

- Korea is Australia's fourth ranked two-way trading partner. Trade of agri-foods has historically been low but is growing following the establishment of the Korean-Australia FTA and will only increase as tariffs are progressively eliminated.
- Korea is ranked eighth in the global MPI, demonstrating that the market still has high growth possibilities.
- Korea has an 'A2' level country credit risk, meaning that Korea has the second best rating for average influence over its business's financial commitments across various sectors (including agri-food).
- Korea is a mid-to-moderate distance from Townsville, and can be accessed by both sea and air. In regards to actual, physical market accessibility Korea has a very well-established and efficient logistics system. This will be explored in greater detail in the supply chain assessment.

Agricultural trade and information

Korea already imports various agricultural products from Australia, including:

- beef
- sugar, molasses and honey sweeteners
- wheat
- other meat products

Where Korea is not importing food produce from Australia, its significant in-market sources are:

- USA and Germany (meat)
- Brazil (sugar)
- USA (wheat)
- Thailand and USA (other meat)

Korea has limited agricultural land, and thus its agricultural production volumes are low, the top agricultural products produced in country are:

- rice
- fish
- milk and other fresh dairy products

Even though its production volumes are low, Korea does export some food products, however the volumes are minimal with only fish and sugar having more than 500 tonnes of trade. Overall, it should be noted that Korea is a net trade importer, particularly in food products. This demonstrates that there is a lot of potential for North Queensland to provide goods to service this demand.

Economic data

- Korea has a mature economy that is growing at only a relatively moderate rate (with inflation less than one per cent).
- Korea's GDP is set to nearly double in the next 5 years, increasing to $52,744 at its current trajectory. Additionally, Korean's are well paid with the annual average income above USD$30,000 per annum. Strong economic conditions can help to drive demand for Australian produce, which tends to be slightly more expensive that its competitor markets, but is typically of improved quality and is 'clean and green'.

China

Demographic rating	Unfavourable	Favourable
Trade and agricultural rating	Unfavourable	Favourable
Economic rating	Unfavourable	Favourable

POPULATION
1.41 billion

AGRI-LAND ('000 ha)
515,000

GDP & 2023 FORECAST
2018: $13,000 p.c
2023: $19,500 p.c

URBAN POPULATION
59.3%

AVERAGE INCOME
$10,648 p.a.

INFLATION
2.00%

Insights for the North Queensland in-scope regions:

- The Chinese market represents a large scale opportunity for the North Queensland region to position itself to export high volume and value products direct to market.
- The existing FTA and protocols in place will enable future growth.
- With average income expected to continue increasing in the next decade, North Queensland is well placed to supply premium Australian products to meet the expectations of Chinese quality-conscious consumers.

Australian produce is in high demand in China. The large population, higher protein demand, and increasing wealth of the country is leading to more food being required from export markets. China is Australia's number one two-way trading partner, has an established FTA and a number of protocols already established for the import of Australian fresh produce. As more protocol markets are opened, demand for produce is only expected to increase. Total food demand in China is so high that it does source from other markets, and Australia will need to ensure that it can remain competitive.

Market access considerations

- Australia is a favoured trading partner with China already. Market access for most food products is only limited by lack of import protocols and inability to meet specific import or export requirements (e.g. phytosanitary).
- China is the highest ranked market with expansion potential according to the MPI.
- China has 'B' level country credit risk, meaning that China has average influence over its business's financial commitments across various sectors (including agri-food).
- China is a moderate distance from Townsville, and can be accessed by both sea and air. In regards to logistics, China has a very highly established and efficient system due to its large global trade volumes. This will be explored in greater detail during the supply chain assessment.

Agricultural trade and information

China already imports various agricultural products from Australia, including:

- grains (barley, wheat)
- beef
- milk and milk products
- a variety of protocol permitted fruit, vegetables and nuts (e.g. citrus, table grapes, stone fruit, mangoes, lettuce and asparagus)

Where China is not importing food produce from Australia, its significant in-market sources are:

- USA (wheat)
- New Zealand and USA (beef)
- Germany (milk)

China's own production is largest in cropping, the top five agricultural products produced in country are:

- maize
- sugar
- rice
- wheat
- protein meals

Overall, it should be noted that China is a net trade exporter not importer. However the volumes of trade are significantly higher than any other country in the world, so still ensures that exporting goods to the country is sustainable.

Economic data

- China has a considerably sized economy that is still growing, however wealth is dominated in the upper and growing middle classes. Thus average annual income and total GDP per capita are skewed.
- China's economy is inflating at a moderate rate

Japan

Demographic rating	Unfavourable	Favourable
Trade and agricultural rating	Unfavourable	Favourable
Economic rating	Unfavourable	Favourable

POPULATION
127 million

AGRI-LAND ('000 ha)
4,519 ha

GDP & 2023 FORECAST
2018: $50,318 p.c
2023: $61,999 p.c

URBAN POPULATION
93.7%

AVERAGE INCOME
$49,046 p.a.

INFLATION
- 0.12%

Insights for the North Queensland in-scope regions:

- As a net importer with high purchasing power, Japan is an attractive market that will demand a range of products produced in the North Queensland region as raw materials and finished good form, i.e. pre-packaged ready to eat meals.
- Japanese consumers are willing pay a premium for Australian produce, for example, soybean produced for tofu finished good products are in high demand and producers can command a premium price for the raw material non-GM variety.

Japan is a favourable market for Australia to continue to grow its market share for agricultural exports. While historically fresh produce exports have been low, despite high demand, the increasing creation of produce protocols and the establishment of the Japan-Australia economic partnership agreement (a FTA) is boosting Japan's trade demand. Demand for fresh food produce stems from a lack of agricultural land, a highly urbanised and domesticated population and an overall lack of food security/self-sufficiency. These factors mean that Japan is almost 100 per cent reliant upon imports of a variety of its agri-food consumed products.

Australian products are favoured in the market for their clean, green, fresh fruit and vegetable produce that can be supplied counter seasonally to its strong northern hemisphere competitors (particularly the US, China and the EU). The affluent lifestyles of the Japanese, including their higher wealth and stable economy is leading to a rise in ready-to-cook or ready-to-eat, convenience foods as well as a market for premium, niche food gifts particularly snack-sized or confectionary (sold in specialised containers at unique standalone style stores). Thus, there are opportunities to trade beef, mandarins, macadamia, mangos, leafy greens, aquaculture, some dairy and sugar. There is a growing demand from consumers who are willing to pay a higher price where ingredients are traceable back to Australia.

Market access considerations

- Japan is Australia's second ranked two-way trading partner. This trade has not necessarily been focussed on food and produce to date, however the demand for these goods are increasing as tariffs are reduced, as quality is demonstrated and as variety can be supplied to meet demand.
- While Japan does have an agreement in place with Australia to facilitate trade, this agreement is being phased in and as such a number of tariff rates have not been completely removed. In time these will be phased out significantly.
- Japan has strict phytosanitary regulations and this can create some market access hurdles, whereby strict evidence of pathogen and pest free status must be proved upon arrival into Japan.
- Japan is ranked sixth in the MPI, showing that there is a large potential to increase trade value and volumes compared to other markets.
- Japan has an 'A2' level country credit risk, meaning that it has one of the highest ratings in regards to influence over its business's financial commitments across various sectors (including agri-food).
- Japan is a moderate distance from Townsville, and can be accessed by both sea and air. Japan has a very well established logistics systems and only minor modifications may need to be made to ensure that the supply chain is prepared to handle a possible increase in volume of fresh produce. This will be explored in greater detail during the supply chain assessment.
- The Japanese logistics network is well-established.

Agricultural trade and information

Japan already imports various agricultural products from Australia, including:

- beef
- some avocado
- dairy products
- sugar

Overall, Japan is a net importing country (however it does have very strong exports in other industries). In regards to food and produce, Japan's top five imported products are:

- maize
- wheat
- fish
- soybean
- other oilseeds

Where Japan doesn't import products from Australia, it sources its food from:

- USA (maize and wheat)
- China (fish)

Japan's own agricultural industry has shifted significantly over the last 100 years. While traditionally being a subsistence style industry that focussed largely on rice, dairy and vegetable production, recent urbanisation has led to a decline in agricultural land availability and the sector overall. Despite this, the top five agricultural products are:

- rice
- milk
- other fresh dairy products
- fish
- sugar beet

Japan currently exports fish, rice, poultry and sugar to external markets, however the volumes traded are low (in some instances less than 100 tonnes) due to the need to consume products domestically.

Economic data

- Japan has one of the strongest economies in the world. This gives them enormous buying power in the market, and evidences their purchasing power for high-value and high-quality goods.
- Japan's GDP and average annual income are high, this is expected given the advanced, urban economy. It should be noted that Japan does have a deflating economy, however the rate of this is minimal.

Indonesia

Demographic rating	Unfavourable	Favourable
Trade and agricultural rating	Unfavourable	Favourable
Economic rating	Unfavourable	Favourable

POPULATION
267 million

AGRI-LAND ('000 ha)
57,000 ha

GDP & 2023 FORECAST
2018: $4,652 p.c.
2023: $7,702 p.c.

URBAN POPULATION
54%

AVERAGE INCOME
$4,388 p.a.

INFLATION
3.53%

Insights for the North Queensland in-scope regions:

- Food security is high on the Indonesian Government's agenda, especially access to protein (beef) which means the region is well placed to meet that demand.
- As average incomes increase, consumer demand for protein will continue to rise and be enabled by better infrastructure, such as access to refrigeration for imported processed beef. The Townsville export facilities will require suitable infrastructure to export this product direct to market, such as cold storage for pre-packaged beef products.

The Indonesian market can present obstacles for importers. The Indonesian Government has been known to radically change its domestic food related policies without significant notice or reason, with quotas and tariffs in place on imported fresh produce at varied levels (generally, dependent on local supply). These policies are also largely designed to drive domestic production increases that will create food self-sufficiency and has led to growth in the domestic food and beverage industry. While this could reduce demand for food in Indonesia in the future, for now local production cannot meet current calorific demand and thus food imports are expected to be relied upon.

Indonesia's economy is dominated by a growing, wealthy middle class. The rate at which this middle class is increasing however, is not on par with other markets. Middle class consumers demand not only increased volumes of food but also higher quality and nutrient dense foods. Overall the opportunities for Australia to export are in red meat, other proteins, bakery goods, sugar, fruit and nuts, and fresh vegetables. Products that have already shown promise are recognised branded products such as Bega cheese and Tim Tams. Rising wealth is leading to higher demand for ready-to-eat foods too, such as preserved food, snacks, noodles and breads. The population of Indonesia does not have high disposable income and thus steady demand for staple, commodity products is expected to remain stable.

Market access considerations

- Indonesia is not in Australia's top ten two-way trading partners, as the trade of agri-foods has historically been low. The ASEAN-Australia FTA (which includes Indonesia) does support the trade of tariff reduced food and fibre into Indonesia, however some commodities still have very high tariff rates (e.g. sugar, rice and boxed beef).
- Market access to Indonesia is expected to increase as the more recently agreed to Comprehensive Economic Partnership Agreement between Australia and Indonesia begins to take effect. Already, the Agreement has nominated Australia as a 'favoured' trading partner.
- Also limiting market accessibility into Indonesia, aside from tariff and quota restrictions, is the associated requirements of the National Agency for Food and Drug Control that stipulates registration, labelling and product standardisation for imports. The registration of products for the Indonesian market must be done with a local or on-the-ground agent and cannot be done from Australia.
- Indonesia is ranked eleventh in the global MPI. There is enormous prospects for agri-food exports to Indonesia in the short term while local food demand is unmet and this is supported by growing middle class food demand and country wealth. It will be important to monitor potential in the long term, if Indonesia's own production increases, demand food imports may decline.
- Indonesia has an 'A4' level country credit risk, meaning that Indonesia has a moderate risk rating across various sectors (including agri-food).
- Indonesia is one of the most proximal markets that was assessed in this study and is only approximately 4000km from Townsville. It has both sea and airport facilities, however these ports, and the whole logistics network, are notoriously unreliable with delays frequently occurring (particularly at sea) due to infrastructure, planning, approvals processes and staffing inabilities. This could be a risk when considering export of perishable foods, as these may need to be air-freight only, a more costly enterprise.

Agricultural trade and information

Indonesia already imports various agricultural products from Australia, including:

- wheat
- sugar, molasses and honey
- beef and live cattle
- milk and other dairy products

Where Indonesia is not importing food produce from Australia, its significant in-market sources are:

- Canada (wheat)
- Thailand (sugar)
- New Zealand (milk)

Indonesia's agricultural industry is growing, albeit slowly and unpredictably, largely due to domestic government efforts to improve production for greater food security and self-sufficiency. However, there are some inefficiencies in poor infrastructure, finance, and transportation that are preventing the holistic growth of the industry to be on par with Western farming standards. The top five agricultural products produced in country are:

- rice
- sugarcane
- fish
- maize
- root and tuber vegetables

Indonesia is an overall net trade exporter, and export of agri-food products is higher than imported products, however this just reflects the domestic government policies on the import of agricultural goods and the encouraged growth of the local agricultural industry. The top five exported agri-food products are wheat, protein meals, sugar and maize.

Economic data

Indonesia has a moderate economy, with a growing middle class. Inflation is steady.

- Indonesia's GDP is in the average range compared to other ASEAN countries, however is expected to grow by approximately $3,000 per capita over the next five years. Average annual income is below $5,000 per annum, and this does restrict purchase of some higher quality food products.

Singapore

Demographic rating	Unfavourable	Favourable
Trade and agricultural rating	Unfavourable	Favourable
Economic rating	Unfavourable	Favourable

POPULATION
5.8 million

AGRI-LAND ('000 ha)
0.66 ha

GDP & 2023 FORECAST
2018: $71,299 p.c
2023: $95,647 p.c

URBAN POPULATION
100%

AVERAGE INCOME
$66,961 p.a.

INFLATION
- 0.5%

Insights for the North Queensland in-scope regions:

- Singapore is a net importer with low food security and heavy reliance on imports. As such, given the diverse production base (beef, horticulture, seafood), the North Queensland region is well placed to increase exports utilising the existing FTA and established trade relationships.
- Singapore operates as a regional re-export hub that results in higher imports and provides an opportunity for the North Queensland region to export higher volumes consistently.
- High GDP and per capita income in Singapore represents an opportunity to market premium produce directly from the region and command a premium price.

Singapore presents a very unique export destination for high-value produce. It has a stable, yet small, urban population, with minimal local agricultural production relying on imports of food for more than 90 per cent of consumption. The Singaporean population is wealthy, with low unemployment and a high disposable income. The high proportion of expatriates and tourists, means that Western style, high quality foods are in demand more.

However, it is not Singapore's own domestic consumption that is going to drive increased export opportunities. Singapore's location, port size and duty free status mean that it is the world's largest logistics and re-export destination. Goods pass through the Singaporean port to be sent on to other locations (particularly other Asian markets), as both raw materials and finished goods. Singapore has more than twenty FTAs; goods that travel to other destination through Singapore do not incur import tariffs in the final country by the original exporter.

Produce with high demand in Singapore includes fruit, vegetables, meats, dairy, grains, pulses and aquaculture (all major foods and ingredients). North Queensland does have the capacity to fulfil some of this demand, and is proximally located). However, other South East Asian countries located closer to Singapore, such as Malaysia, Indonesia and China mean that competition is high. Australia will need to establish competitive advantages through quality and brand value to maintain valuable market share. Where potential is greatest is in the export of ingredients and functional food produce that can be reprocessed and prepared in country for meals, pre-cooked foods and processed snacks.

Market access considerations

- Singapore is Australia's fourth ranked two-way trading partner. This includes trade of food and ingredients, other goods and services for re-exports. There is potential for this to expand if Australia can own greater market share, however the competition into this port city is high.
- Singapore and Australia have had a free trade agreement in place since 2003 that has been amended and updated numerous times. The amendments have reduced tariffs and quotas over time and most food and beverages enter the market tariff free.
- Market entry requirements that remain in place include some phytosanitary requirements, food standards and reporting. These requirements essentially mirror Australian standards however and should not require additional investment by the exporter.
- Singapore is ranked equal sixth in the MPI, showing that there is a large potential to increase trade value and volumes compared to other markets. However, it should be noted that this potential also includes re-export potential. Re-exported food products are not consumed in Singapore.
- Singapore has an 'A2' level country credit risk, meaning that it has one of the highest ratings in regards to influence over its business's financial commitments across various sectors (including agri-food).
- Singapore is a moderate distance from Townsville, and can be accessed by both sea and air. There are established trade routes between Singapore and Townsville port too, however these are intermittent. Export volumes and values would benefit from more frequent ship departures from Townsville to Singapore, especially given Singapore's centrality to other significant markets. This will be explored in greater detail during the supply chain assessment.

Agricultural trade and information

Singapore already imports various agricultural products from Australia, including:

- beef and other meats
- dairy products
- eggs
- honey
- fruit and nuts.

Overall, Singapore is a net exporting country (this is largely over inflated due to re-exports). In regards to food and produce, Singapore imported more than $10,000 million in food in 2016. Produce that was imported includes eggs, chicken, vegetables, fish, pork, rice, fruits and mutton.

When it does not import food from Australia, it sources its food from:

- Malaysia
- New Zealand
- China
- Brazil
- Indonesia

Singapore's own agricultural industry is very small, limited by land availability and resource constraints. The Singaporean Government has made concerted efforts recently to increase local production to boost food security, for example through hydroponics, however this is not sufficient to support the whole population and focuses mainly on vegetables not meats or other protein sources. Given this, the top five agricultural products are:

- leafy green vegetables
- bean sprouts
- mushrooms
- some poultry and eggs
- intensive fish farming
- some fruits (durian, rambutan and mangosteens)

While most products leaving Singapore are re-export foods, some domestic production does leave the city, largely this is vegetables, orchard fruit and fish (however quantities are very low).

Economic data

- Singapore has a strong economy and is a global business and trade hub. However, Singapore's economy is very much linked to other dominant global players, such as China. Where these strong economies are still growing, Singapore has begun to flat line (inflation is negative).
- Singapore's GDP and average annual income are high, this is expected given the advanced, urban economy. Consumers have disposable incomes to spend on high-value, quality food produce.

United Arab Emirates (UAE)

Demographic rating	Unfavourable	Favourable
Trade and agricultural rating	Unfavourable	Favourable
Economic rating	Unfavourable	Favourable

POPULATION
9.5 million

AGRI-LAND ('000 ha)
382 ha

GDP & 2023 FORECAST
2018: $45,670 p.c
2023: $54,860 p.c

URBAN POPULATION
90%

AVERAGE INCOME
$48,857 p.a.

INFLATION
1.62%

Insights for the North Queensland in-scope regions:

- High average incomes and presence of expatriates in the UAE create demand for products from North Queensland such as meat, nuts, citrus and stone fruits, as well as pre-packed ready to eat meals that have been processed prior to export.
- The lack of suitable agricultural production area in the UAE encourages strong import demand and long term supply security for North Queensland producers.

Australia already does significant trade with the UAE, and there is opportunity to leverage off existing trade routes to increase the volume of agri-foods being exported to this market. There is significant opportunity to access the UAE through passenger flights from Australia which can move more than 2 million tonnes of cargo a year. Fresh cargo could reach the UAE in under 24 hours after being harvested on one of the 320 flights that leave Australia per week. Additionally, the local logistics system is established and efficient, offering re-export opportunities into other markets too. There is strong competition in this market from both the USA and European Union (EU).

Demand is highest in niche (e.g. healthy and organic), pre-cooked and ready-to-cook, prepared/processed foods and premium foods. There is also a growing appetite for Westernised foods as the Emirati middle to upper class grows and the number of expatriates who live in Dubai increases. These population groups demand high quality, safe foods – such as those sourced from Australia. There is significant appetite for meat, dairy, broad beans, chickpeas, lentils, carrots, onions, potatoes, fruit and tree nuts (macadamia and almonds), grapes, pears, citrus, stone fruit and melons. Due to its climate and lack of agricultural production land, the UAE cannot produce these products itself in the required volumes. The most in-demand products in the UAE are ready-for-sale (pre-packed or pre-cooked items, or the ingredients to create these items) in the Emirati hypermarkets. The less processing that is required in-country the better.

Market access considerations

- The UAE is a top-ten two-way trading partner with Australia, even without a FTA in place. The lack of FTA between the UAE and Australia does mean that tariffs are still in place, however these are not extortionate, and negotiations to establish an Agreement have been underway for some time.
- Market access to the UAE is strict. Certificates of import readiness (including being fit for consumption) and country of origin labelling are mandatory in the UAE. Australia and the UAE have a Memorandum of Understanding on food safety however, and Australia must leverage its position as a clean, green food producer to maintain its market share against competitors who do not have these in place.
- The UAE is ranked ninth in the global MPI. This ranking is at the higher end of the index and reflects the more mature and stable economy.
- The UAE has an 'A4' level country credit risk, meaning that the UAE has a moderate-low risk rating across various sectors (including agri-food).
- The UAE market is the second furthest away from Townsville. While it does have sea, and airport facilities, the distance adds transportation costs. The high number of aircraft moving through the country's airports, including with Australian origins, could be leveraged to move fresh produce through the country at a fast, safe rate.
- The logistics network is highly established and efficient, however there are some infrastructure and safety issues on-ground domestically. It will need to be ensured that any products sent to the UAE are handled and stored correctly.

Agricultural trade and information

The UAE does already import agricultural and food products from Australia, including:

- boxed and chilled lamb and beef (including halal products)
- wheat
- malt
- some fresh fruit and vegetables

Where the UAE is not importing food produce from Australia, its significant in-market sources are:

- Spain (lamb)
- Canada (wheat)
- Singapore (malt)

Domestically, the UAE does not have an established or well-sized agricultural industry, it is significantly constrained by lack of space and water (as well as exhausted natural resources that have been depleted due to historical over-production). Given the lack of production space there has been a rise in hydroponic, intensive protected farming, however this is not enough to fully support local production. Products that are grown in the UAE include:

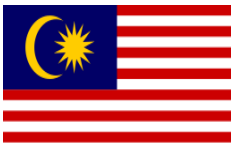
- date palms
- fodder crops
- annuals (wheat, sorghum)
- poultry
- some fruits and vegetables (e.g. tomatoes, gherkins, cucumbers)

The UAE is a net importer of agri-food products, however it does have a small export market. The top five exported products are dried fish, dates, confectionary, some dairy produce and cocoa.

Economic data

The UAE has a large economy that has grown off the back of the oil-rich trade that flourished through the 90s and 2000s. Over the last ten years, this has declined and the economy has shifted to property development, tourism and business. The GDP of the UAE is high, and growing, however not at the rate of other developing countries. Its economy is inflating at a moderate level, however not strongly.

Malaysia



Demographic rating	Unfavourable	Favourable
Trade and agricultural rating	Unfavourable	Favourable
Economic rating	Unfavourable	Favourable

POPULATION
32 million

AGRI-LAND ('000 ha)
7,839 ha

GDP & 2023 FORECAST
2018: $12,099 p.c
2023: $21,195 p.c

URBAN POPULATION
74.8%

AVERAGE INCOME
$12,725 p.a.

INFLATION
2.13%

Insights for the North Queensland in-scope regions:

- Malaysian consumer's appetite for high quality, healthy fresh foods as well as pre-prepared foodstuffs positions the region well to supply the market with fresh fruit and vegetables.
- The FTA in place will enable future export growth but investment must be made to develop export partnerships with local enterprise.

Malaysia is a growing country both in population and in economic prospects. It has a growing number of upper and middle class consumers, who have increasing disposable incomes. These consumers have a preference for high quality, healthier foods as well as pre-prepared foodstuffs. There is also a preference for food that can be traced back to its country-of-origin for proof of its production method being environmentally appropriate (or organic if possible), with demand for Australian produce increasing in this regard. Demand is also high for Halal products, particularly meat goods, due to dominance of Muslim consumers in the Malaysian population. In regards to the pre-prepared style foodstuffs, where Australia can fulfil demand is in providing ingredients for the domestic manufacturing industry. Particularly dairy, cereals, spices, and fruits and vegetables for making sauces, condiments, juice and snacks.

Currently, Malaysia sources a large amount of its produce from China and Japan (particularly fresh fruit and vegetables). However the Australian-Malaysian FTA does facilitate better trade between the two countries, and will provide ongoing benefits if tariffs and permits on dairy, meat and aquaculture are further reduced as some of these are still in place. It is advised that exporters looking at entering the Malaysian market partner with a local enterprise to help facilitate brand growth and longer-term success.

Market access considerations

- Malaysia is Australia's ninth ranked two-way trading partner. While Australia does have some food and beverage trade with Malaysia, there is scope to increase this trade to compete with other exporting countries as currently Australia only exports wheat, sugars/honey, and beef/meat products.
- Malaysia is an ideal market to trade into due to the Malaysian-Australian FTA and the lack of requirements for product entry into country (including customs, packaging and labelling specifications). There are still some permit requirements on dairy, meat and aquaculture goods though.
- Australia is Malaysia's third largest supplier of food, behind China and Japan.
- Malaysia is ranked 28th in the MPI, showing that while there are favourable and advantageous trade conditions in Malaysia, there are other factors which may limit market access, including a presence of competitors.
- Malaysia has an 'A3' level country credit risk, meaning that it has an average rating in regards to influence over its business's financial commitments across various sectors (including agri-food).
- Malaysia is a moderate distance from Townsville, and can be accessed by both sea and air. Malaysia has well-developed shipping and port facilities in particular, and is a re-exporter. Malaysia has a high rating on the LPI due to the established and efficient set up of the network. This will be explored in greater detail during the supply chain assessment.

Agricultural trade and information

Malaysia already imports various agricultural products from Australia, including:

- wheat
- sugar, molasses and honey
- beef and non-beef products

Overall, Malaysia is a net importing country (however it does have very strong exports in other industries). In regards to food and produce, Malaysia's top five imported products are:

- maize
- sugar
- wheat
- vegetable oils

Where Malaysia doesn't import products from Australia, it sources its food from:

- Argentina (maize)
- Brazil (sugar)
- USA (wheat)

Malaysia does have a small agricultural industry, however this is constrained by access to agricultural land and sprawling urbanisations. Despite this, the top five agricultural products are:

- vegetable oils
- protein meals
- rice
- wild catch fish
- aquaculture farmed fish

Malaysia currently does have a small export market, sending vegetable oils, protein meals, fish, wheat and white sugar overseas. However, some of these volume good are re-exports.

Economic data

- Malaysia has a strengthening economy that is expected to grow by nearly $10,000 GDP per capita over the next five years. This, coupled with their growing population, is going to contribute to the increasing demand for high quality foodstuffs over the short to long term.
- Malaysia's GDP and average annual income are moderate and growing. Inflation is above 2 per cent per annum.

Hong Kong

Demographic rating	Unfavourable	Favourable
Trade and agricultural rating	Unfavourable	Favourable
Economic rating	Unfavourable	Favourable

POPULATION
57.4 million

AGRI-LAND ('000 ha)
7 ha

GDP & 2023 FORECAST
2018: $56,139 p.c
2023: $81,814 p.c

URBAN POPULATION
100%

AVERAGE INCOME
$55,422 p.a.

INFLATION
3.2%

Insights for the North Queensland in-scope regions:

- With no, or very limited, agricultural production, Hong Kong is well suited as a long term export market with a propensity to consume high-value fresh produce.
- As a protocol free and re-export market, there is strong demand for high-value and volume products from the North Queensland region to supply the well-established market.

Hong Kong represents a significant market opportunity for exports of high quality, high-value foods. Hong Kong is demographically varied, with a wealthy local business population, significant proportion of expatriates and high pass-through tourism numbers. These population groups demand high quality food, and have the disposable incomes to spend on it. Hong Kong however is a very small island, with no significant agricultural production, and more than 95 per cent of food must be imported. This includes both fresh, processed foods and ready-to-eat meals (as Hong Kong doesn't have domestic processing or preparation capacities). The emergence of single location shopping facilities and the decline in local markets is changing the way that consumers shop in Hong Kong.

For example, single serve, pre-cut, pre-cooked, healthy and organic foods are now in high demand at convenience and supermarket locations such as cooked meat and pre-packed salad boxes.

As is the case with a number of the North East Asian markets assessed, competition for food exports into Hong Kong is high. Australia needs to hold and increase its market share by focussing on high quality and premium food stuffs instead of lower value, high volume staple foods. Products that are in demand from Australia include proteins from meat and meat by-products,

particularly chilled and frozen beef and lamb, seafood and dairy (fresh and processed). While fruit and vegetable exports are competitive into Hong Kong, there is opportunity for Australia in oranges, apples, table grapes, pears, mandarins, mangoes, papaya, melons, nectarines and cherries and in vegetables, including onions, tomatoes, lettuce, celery, asparagus, carrots, cabbages, cauliflower, cucumbers and other root vegetables. Finally, Hong Kong is also a re-export market, particularly for products into mainland China. Since Hong Kong is a protocol free market, goods that are moved through Hong Kong can sometimes gain access through to the Chinese market.

Market access considerations

- Hong Kong is an Australian trade destination however it is not in Australia's top-ten two-way trade partners. Australian trade is relatively low in value and volume compared to other countries, this is due the competitive nature of the market and the ability of other countries to export cheaper, albeit sometimes lower quality goods, into the country.
- While Hong Kong is a favourable export market, it can be a lesser preferred market compared to China (which is a similar distance, has more food demand and much larger population).
- Hong Kong is one of the most freely accessible markets in the world. This makes it also one of the most competitive. Australia will need to leverage its high quality producer status to hold, or gain, market share.
- The only regulation to market entry is the need to meet local food laws, however these are similar to those expected in Australia so do not add complexity to export considerations (e.g. no contamination, free from microbial residues).
- Hong Kong and Australia do not have a FTA in place, however one is under negotiation. Generally, market entry is not difficult even without a FTA in place.
- Hong Kong is ranked second in the MPI, this places them in the highly favourable range of the index.
- Hong Kong has an 'A2' level country credit risk, meaning that it has high rating in regards to influence over its business's financial commitments across various sectors (including agri-food).
- Hong Kong is a moderate distance away from Townsville in this study, and can be accessed by both sea and air. It has a very high rating on the LPI and needs to improve domestic supply chain logistics. It should be noted though, that due to Hong Kong's proximity to China some favourability to the larger demand could be seen.

Agricultural trade and information

Hong Kong already imports some agricultural products from Australia, including:

- proteins (including beef, lamb and seafood)
- dairy (both fresh and processed)
- cereals (particularly for bakery and processed food preparation)
- some fruits and vegetables

Where Hong Kong is not importing products from Australia, it sources its food from:

- Netherlands (dairy)
- China (cereals)

Overall, Hong Kong is a net importing country. In regards to food and produce, Hong Kong's top five imported products are:

- meat and meat by-products
- edible fruits, nuts and peels
- fish and aquatic animals for consumption
- dairy products
- eggs

Hong Kong has an almost non-existent agricultural industry, it is limited to market garden style cropping only. Value of crop production doesn't exceed more than $250 million per annum. Nearly all production is horticultural, including: white cabbage, lettuce, kale, radish, mustard and onions.

While there is an export market out of Hong Kong, these products are nearly all re-exports. The main goods traded in this capacity are: meat and by-products, fruits and vegetables, eggs, honey, and seafood (reflecting the same products that are imported).

Economic data

Hong Kong has an established and stable economy with a high GDP and good annual incomes for disposable expenditure for high quality, premium and niche foods. Inflation in Hong Kong is high, with 3.2 per cent expected per annum.

Thailand

Demographic rating	Unfavourable	Favourable
Trade and agricultural rating	Unfavourable	Favourable
Economic rating	Unfavourable	Favourable

POPULATION
69.2 million

AGRI-LAND ('000 ha)
22,110 ha

GDP & 2023 FORECAST
2018: $7,706 p.c
2023: $12,091 p.c

URBAN POPULATION
51.5%

AVERAGE INCOME
$7,280 p.a.

INFLATION
0.19%

Insights for the North Queensland in-scope regions:

- In line with the Thai Government's desire to manufacture processed and prepared food products, the Townsville region can supply raw material ingredients across all agri-food types.
- High-value Australian produce would be supplied to meet only the niche upper class urban market that consume a variety of quality 'clean and green' produce.

Thailand is a developing country and as such has some domestic food security and agricultural self-sufficiency policies in place. These are designed to boost local agricultural production, and reduce reliance on higher cost imported foods. However, the Thai economy and level of disposable income is disparate between the urban population and the rural poor. While the rural poor focuses upon food subsistence and self-sufficiency, the urbanised, expatriate and tourist populations are demanding more variety and higher quality produce.

Australia is seen as a clean, green food supplier in Thailand, the high standard of food exports needs to be leveraged in the Thai market to establish a greater competitive advantage. Food in-demand from Australia includes meat, dairy products, aquaculture, cereals, fruit and vegetables and other ingredients that can be used in the processing and packaging of snack foods (particularly salty snacks, delicacies, confectionary and read-to-eat meals). Finally, the Thai Government believes that it can leverage its low labour costs and central location to be a 'kitchen to the world', and use imported ingredients to manufacture processed and prepared foods. To do so, Thailand will need a large and consistent volume of both staple and niche ingredients.

Market access considerations

- Thailand already does a sizeable amount of trade with Australia. In regards to food however, there is a lot of competition in the market from both northern hemisphere and southern hemisphere markets (particularly the US, Peru, Chile, South Africa and New Zealand).
- Thailand and Australia have total elimination on tariffs for food goods due to the FTA between the two countries. However, some products have been exempt from tariff elimination, including: beef, cheese, some dairy ingredients and potato seed stock. While dairy and potato are unlikely to be high-value exports from the North Queensland region to Thailand, high tariffs on beef could limit the viability of exports.
- Market access to Thailand is hindered by strict import, food marketing, distribution and sales controls in place. These controls apply to both fresh and processed foods. Any food related imports require registration with the Thai Food and Drug Administration; it is easier however to register raw commodities or ingredients than it is to register pre-cooked or pre-prepared value added foods. Additionally, meat products require specific permits issues by the Department of Livestock Development.
- Thailand is ranked 55th in the MPI, this places it in the middle range of markets assessed in the Index.
- Thailand has an 'A4' level country credit risk, this is a moderate rating in regards to influence over its business's financial commitments across various sectors (including agri-food). This reflects the fact that Thailand is still a developing country.
- Thailand is located a moderate distance away from Townsville port relative to the markets assessed (it is accessible by sea and air). The logistics system has a moderate to high rating and has some established infrastructure however, there is room for improvement in this consideration.

Agricultural trade and information

Thailand already imports some agricultural products from Australia, including:

- malt
- non-durum wheat
- cotton (not pre-carded or combed)
- milk powders

When it does not import food from Australia, it sources its food from:

- Singapore (malt)
- New Zealand (milk)

Overall, Thailand is a net food exporting country (and this may be reflective in its desire to be a significant processor of raw food ingredients for re-sale as prepared foods). The top five products that were imported include:

- wheat
- soybean meal
- fresh soybean
- fish (specifically frozen fish)
- whey powder

Thailand's agricultural industry is somewhat divided into staple food producers and subsistence farmers. When examining the country's top food exports, products included:

- rice
- sugar
- tubers (particularly cassava)

Sugar is also processed in Thailand into various forms and sold as cane, molasses, raw sugar and white sugar, to name a few.

Economic data

Thailand has a unique, divided economy that is split between rural poor and urban rich, expatriate and tourist populations. Given this its economy is smaller than some of its other South East Asian market competitors. Thailand has a low GDP and a small averaged annual income. The inflation rate is very low however and indicates some weakness in the power of the already small economy.

India

Demographic rating	Unfavourable	Favourable
Trade and agricultural rating	Unfavourable	Favourable
Economic rating	Unfavourable	Favourable

POPULATION
1.35 billion

AGRI-LAND ('000 ha)
179,700 ha

GDP & 2023 FORECAST
2018: $3,219 p.c
2023: $4,224 p.c

URBAN POPULATION
33.2%

AVERAGE INCOME
$2,155 p.a.

INFLATION
4.94%

Insights for the North Queensland in-scope regions:

- The large economy and population size of the Indian market presents a significant opportunity for rapid and sustained future export growth. With consumers increasingly influenced by Western consumption trends, demand potential for Australian agri-products will continue to grow.
- Despite the lack of a FTA in place, this market should still be a focus for producers in the North Queensland region to target in the future because the level of the demand is so significant in comparison to other export markets.

India is a rapidly expanding economy, in the future it is expected to overtake the population and consumption habits of China, currently Australia's biggest export market. Recent population growth, rising middle class household income and an increase in urbanisation are leading to an increase in food demand. While India currently has protectionist food trade policies and is an unpredictable market consumer, it is expected that in the future the need for food and improved market accessibility will increase the ability for Australian exporters to send produce to the market. This will be boosted further should a FTA be established, however an inability to negotiate on this to date demonstrates that this may not achieved in the short term and may be a long term plan.

Market access considerations

- While India is a favoured top-ten trading partner with Australia, its self-sufficiency and protectionist quota and tariff policies in relation to food imports have stymied agri-food trade between Australia and India. India has unpredictable and often very high tariffs and quotas, in some years these can be reduced significantly when India has domestic deficits while in other years these can be increased when domestic production is favourable. This variability makes the Indian market, as it stands, highly volatile as demand is inconsistent.
- India is ranked third in the MPI, showing that although the market is still relatively immature there is significant potential as it matures for trading partners such as Australia to trade with India more feasibly.
- India has a 'B' level country credit risk, meaning that India has average influence over its business's financial commitments across various sectors (including agri-food).
- In regards to logistics, India has an established and efficient system, however if trade of food products is to increase then some in-market supply chain modifications may need to be made to facilitate increased volumes and variety.

Agricultural trade and information

India already imports various agricultural products, including:

- vegetable oils
- raw sugar
- sugar
- wheat
- various oilseeds

These products are sourced from:

- Indonesia (vegetable oils)
- Brazil (sugar)
- Ukraine (wheat)

India does not regularly import large amounts of agricultural food products from Australia due to market access limitations. Overall, India is a net trade exporter.

India's own production focuses on raw, staple commodities for domestic consumption. This includes farmers who are both subsistence/semi-subsistence and larger scale producers. India's agricultural production is somewhat hindered by the high price of domestic agricultural inputs and there has been minimal investment and adoption of modern, technological farming techniques. Despite this, the top five agricultural products are:

- sugarcane
- milk
- rice
- fresh dairy
- wheat

India currently exports rice, sugar, beef/veal and cotton to external markets, however the volumes traded are low due to the need to consume products domestically.

Economic data

India has a large economy that is expanding rapidly reflected in its high inflation rates. The size of the economy is a reflection of the country's population however, and less so any extremely valuable industries.

India's GDP and average annual income are low per capita this is expected given that a large proportion of the population is rural, not urban and rely on semi-subsistence lifestyles still.

Appendix B: Product assessment

Current, emerging or possible future markets across Asia and the Middle East have been assessed to understand demand and supply requirements. The key activities performed were as follows:

Products:

- Shortlisted five high-value products which represent the best return on investment for further analysis on trends and identify the forecast or estimated volumes required across the target markets.
- Conducted international engagement to connect with in-country insights into the market developments for selected commodities and scenarios.
- Considered scale of demand for identified produce from Townsville, North Queensland/ Northern Australia.
- Considered the five product key requirements for market entry, including:
  - product specifications (consistency, quality, seasonality)
  - supply chain volumes for economic production
  - food safety protocols
  - trade restrictions
  - export/supply chain method
- Considered the five product opportunities, including:
  - crop/product
  - opportunity size
  - value adding options
  - key target market(s)
  - key competitors

Product identification method

Product identification was undertaken to gain a view of the type, volume and value of products demanded in priority export markets. Not only was current demand and supply considered for the purposes of the study but also future demand, future market access considerations and future trade relationships. Using the ten markets identified, three key processes were undertaken to identify possible priority products for export. These were then refined to five priority products.

1. International Trade Centre's export potential map

- The International Trade Centre's (ITCs) Export Potential Map is a tool that compares market potential with Australia's (or other exporters) actual value of traded products to calculate untapped potential for exports of agricultural products.
- The ITC's Export Potential Map incorporates data from various sources including import and export data, tariffs, gross domestic product, and geographic data.
- For the 10 export markets identified in the market scan (as per Appendix A: Market assessment), the top 20 agri-food products with unmet demand potential were identified using the ITC's Export Potential Map.

Table 12: In-scope products identified as potential goods for export

Ranking	Product	Untapped demand potential in the 10 identified international export markets (USD)
1	Beef	$3,000,986,300
2	Wheat	$2,364,031,100
3	Oilseed	$1,362,391,700
4	Dairy	$665,009,500
5	Chickpeas, dried and shelled	$396,600,000
6	Lamb	$277,434,100
7	Lobster	$270,087,400
8	Peas, dried and shelled	$230,323,300
9	Malt	$220,897,100
10	Lentils, dried and shelled	$214,400,000
11	Flours of meat or offal	$193,800,000
12	Lucerne	$152,857,100
13	Almonds	$151,160,900
14	Barley	$136,600,000
15	Preparations used in animal feeding	$126,332,000
16	Food preparations	$123,784,100
17	Grapes, fresh	$97,302,100
18	Nuts (not elsewhere specified) including macadamia	$84,318,200
19	Food preparations for infant use	$82,704,600
20	Meat bi-products	$82,067,100

Source: ITC, 2018.

2. Stakeholder consultation

- A number of relevant Government, industry and commercial stakeholders were consulted to gauge a broad cross section of views and ensure any bias was avoided.
- Stakeholders were consulted to obtain their views on the total potential demand value, agronomy, climate, production and competition to determinate the viability of priority products.
- Stakeholders consulted included: Central Queensland University (CQU), Horticulture Innovation Australia (HIA), TIQ, DAWR, Department of Agriculture and Fisheries (DAF), Meat and Livestock Australia (MLA), industry and commercial subject matter experts, and the KPMG global network of Agribusiness experts.

Table 13: Reasons for exclusion from further analysis of top five priority products*

Product	Reason for exclusion
Chickpeas	– Low tolerance to soil type, and a heavy reliance on stored water during drier months – Disease issues – Requires short day lengths to reach optimum maturity and seed size – Price fluctuations on the global market (particular in relation to Indian demand).
Table grapes	– Require lower minimum temperature to promote flowering – Require higher maximum temperature to prevent fungal disease – Harvest aligns with wet season – Difficulty to recover from cycles (occur every ~four years) compared to production cycle every five years.
Cocoa	– Not suitable due to climatic conditions (low temperature environment reduces productivity outside of wet tropics and does not create an optimum drying environment) – Susceptible to disease – Lack of grower expertise and processing experience, with proximal competitor markets already advanced in this area – High competition with other South East Asian exporters.
Citrus	– Climate will limit flowering resulting in low fruit yield – Perennial trees are a cyclone risk – Prior attempts to grow citrus in the region have not been successful largely due to climate, disease and a lack of volume to justify supply chain facilities.
Almonds	– Require an arid, Mediterranean style climate with hot dry summers – Susceptible to fungal root diseases – Perennial trees are a cyclone risk – Soil moisture and general humidity may prevent nuts drying out prior to collection.
Melons	– Already some production established in the region – Export markets are wary of Australian product due to food safety issues – Most in-scope markets already have domestic sources of melons – Risk of damage while exporting to market.

*N.B. This does not exclude them from continued production under current farming systems.
Source: KPMG analysis, stakeholder discussions and desktop research.

3. Desktop analysis

- Desktop research was performed to further inform identified product demand, agronomy, climate, production and competition.
- Existing publically available research and reporting was reviewed and taken into consideration during the decision making process to ensure alignment with current initiatives, such as the Hells Gates Dam Feasibility Study.

Product prioritisation

The following five agricultural products selected through the above outlined demand driven analysis have the greatest potential to generate future economic returns in the North Queensland region.

Table 14: Final product prioritisation

#	Products	
1	Beef	Page 83
2	Avocado	Page 93
3	Macadamia	Page 102
4	On-shore aquaculture (tropical rock lobster)	Page 110
5	Soybean	Page 119

The products collectively contain the following favourable attributes:

- demand identified from the ten overseas export markets
- high-value
- future growth potential in the in-scope region
- viable to produce in the in-scope region
- have at least some infrastructure (or an ability to establish it) in the North Queensland region readily
- value add finished good potential.

Refer to remainder of this appendix for individual product profiles and detailed analysis.

While the five products identified will be analysed in detail through this report, this is not an exhaustive list of products that can be introduced or intensified for production in the in-scope region. The findings in this report will have common benefits for other products regarding supply chain improvements, such as export capabilities at the Townsville Airport or Port of Townsville.

Beef - Intensification

KEY INIGHTS

- Large scale existing beef production in the in-scope region already exists with a concentration of the industry in Charters Towers; making Charters Towers the most suited to production intensification and supply chain development to support export.
- Significant demand from priority export markets for beef and beef products: Korea, Singapore, China, UAE, Japan, Malaysia, Hong Kong, Thailand and Indonesia. The highest priority markets are Vietnam, greater China (including Hong Kong) and Malaysia.
- Value add opportunities exist, such as processed ready to eat packaged meals, to provide significant margin for food processors. Supply chain development of both the commodity and value added products should be investigated.
- The in-scope region requires supply chain and infrastructure to export the product to consumers in <24-48 hours.

Current production, supply and demand

Production in the North Queensland region:

Beef production in the in-scope region is currently split into three industries:

- grass-fed operations (both natural and improved pastures)
- grain-fed feedlotting for slaughter for domestic and international consumption
- grain-fed feedlotting for live cattle export.

The cattle produced are a mix of temperate and tropical varieties, however there is a higher proportion of *Bos Indicus* genetics in the herd. Common breeds are:

- *Bos Indicus:* Brahman, Santa Gertrudis, Droughtmaster, Braford, Brangus
- *Bos Taurus:* Angus, Hereford, Charolais, and Wagyu or Wagyu cross-breeds.

Figure 2: Map of beef production in Queensland.
Source: QLD DAF.

Currently regional production is dependent on natural fodder and water availability, as this determines the type of cattle farmed and the end-product output. Generally, the climate within the coastal areas of the in-scope region has been favourable for grass-fed farming and grain-fed feedlotting, with locations further away from the coast experiencing a drier climate and production skewed more towards grass-fed, with some grain finishing. Currently cattle numbers in the region are slightly lower than average, as ongoing herd rebuilding occurs (DAF, 2018a).

Beef production is seasonal, turn-off (for consumption or to feedlots) and slaughter can be dependent upon climatic conditions, feed availability, market price and consumer demand (both internationally and domestically) at the time and varies throughout the year (DAF, 2018a). Turn-off is typically a direct transaction between farmers and processors as over-the-hook or as live-exported cattle, however the volume of cattle live-traded out of Queensland has declined in the last two years, and this is largely due to food safety issues, trade and tariff agreements, and animal welfare concerns.

Meat processing is one of the largest industries in Queensland, with a total value in 2016-17 of $2.39 billion, employing more than 18,000 people. Significant opportunity still exists in developing the beef supply chain in the in-scope region. While processed beef is already the state's largest agricultural export, a ramp up in production (through intensification), development of finishing facilities (e.g. feedlot) and creating more value-adding operations is likely to generate significant value. Intensification and development of the beef supply chain to specifically meet the demands of export markets (e.g. ready-to-eat, ready-to-cook, premium and secondary cuts etc.) will be critical to capturing this value.

Current demand in priority export markets

Of the top ten priority markets nine featured bovine products in their top food products with unmet demand.[1] The only country with no unmet demand for beef was India, this is largely due to its own domestic production of beef and substitute buffalo products as well as the country's food self-sufficiency policies.

Current demand for Australian beef is accounted for in four types of bovine products, fresh or chilled (bone in or out), frozen (bone in or out), offal and live-exported cattle. In 2017, the following were exported into the demand markets (to the nearest million dollars, AUD):

- meat that is fresh or chilled: $1.96 billion or approximately 150,673 tonnes
- meat that is frozen: $2.9 billion or approximately 508,164 tonnes
- offal (fresh chilled and frozen): $649 million or approximately 132,655 tonnes
- live-exported cattle: $925 million, or approximately 620,000 head.

Future demand in priority export markets

Unmet demand for Australian bovine products in the identified priority export markets totalled approximately an additional $2.5 billion dollars annually.[2] This is not reflective of demand that could be fulfilled by increases in production in the in-scope region specifically however. The value does however demonstrate the enormous potential in export markets for this product from Australia.

[1] Current supply and demand for products was determined using the *International Trade Centres Trade Map,* which sources figures from the Australian Bureau of Statistics and the UN Comtrade Database.

[2] Unmet demand (representative of future demand in priority export markets) for products was calculated by summing the value of any untapped demand for the featured products between each market and Australia using the *International Trade Centre's Export Potential Map.*

Townsville is well placed to capture this future demand due to its proximity to priority export markets (leading to improved freight costs), track record of producing beef in the region, ability to develop the supply chain to increase overall volumes of production and to capitalise upon value-add opportunities.

- fresh or chilled $167.3 million
- frozen $1.95 billion
- prepared meat and offal (fresh or frozen) $268.7 million
- live-exported cattle $157 million
- other bovine carcases or fats $94.7 million.

Current supply originating from Townsville region

In 2016/17 $374.6 million of cattle and calves were 'disposed' in the in-scope region, including through slaughter and live export (ABS, 2018). This represents 6.5 per cent of Queensland's total cattle and calve disposals, which totalled approximately $5.7 billion in 2016/17. These cattle were produced on 313 cattle farms, only making up approximately four per cent of all cattle farms in Queensland (ABARES, 2018).

Market entry considerations

Product specifications

Korea: Korean consumption is dominated by grain-fed beef, not grass-fed beef, however Australia has increased its volume of grain-fed production over the past ten years and is more capable of meeting this demand. There is a specific preference to purchase cuts of beef as opposed to half or full-carcasses too, which is the Australian preference for export. Korea does have country-of-origin labelling (CoOL) requirements on all beef products.

Korea has a preference for meat suitable for Yakiniku (table top barbecue style cuts) such as skirt, loins and offal with high marbling factors and brisket cuts for soups (MLA, 2017). These cuts are typically purchased through hypermarket and supermarkets. Current exports for Korean beef are highest in frozen grass and grain-fed, with chuck roll, blade, and manufacturing and beef brisket the highest imports by cut. There is a small market for imported high-end cuts, such as loin, for gifting and premium food service. Korean's value guaranteed safe-to-consume, cost-effective and country-of-origin assured products.

Beef bound for Korea is typically exported frozen (80 per cent or $904,872,000 in 2016).

China: Chinese demand for beef is only a small share compared to other proteins consumed however this is growing. Demand is highest in the middle-to-higher income group who use stir fry, stewing or processing cuts in traditional Chinese dishes. The most popular cuts are brisket, shin/shank and trimmings. As is the case with other Asian markets, there is a small portion of demand for very high-value, high quality steak cuts of meat. However this demand is focussed in the premium food service and gifting sector of the market.

Consumers are quality conscious, the top things looked for when buying meat are its natural state (i.e. it is 100 per cent beef with no hormonal growth promotants added), date of packing, freshness, country of origin, meat colour, brand and lack of hormone additives.

Beef bound for China is typically exported frozen (89 per cent or $656,412,000). China also has agreements in place with Australia to receive live exported cattle for slaughter, however this export method is still largely limited due to protocol complexity.

Japan: With their strong economy and large population, Japanese demand for beef is strong, but steady (given it is a secondary protein source behind chicken/pork). While Japan has a preference for its own meat (e.g. Wagyu) Australian beef is the next most in demand followed by the USA.

Consumers prefer fattier, although high quality, cuts of meat that can be sliced thinly for barbecuing or cooked as a steak (versatility in the cut is favoured, so it can be used in various meals). Given this, the most

exported cuts (following manufacturing beef) are brisket, loin and silverside/outside. The majority of exported beef (60 per cent) is exported for the food service sector for hamburgers or Gyudon (rice bowls) as brisket or manufacturing cuts, for yakiniku barbecue (skirts, loins, offal) and for hotel and restaurants (loins and hindquarters). The emergence of steaks is due to an increasing curiosity in Western foods and bistros, however demand for this product has not reduced demand for the fattier, processing and barbecuing cuts of traditional dishes. An increase in convenience food consumption (i.e. bento boxes) is a newer source of beef demand in Japan.

Beef bound for Japan is typically exported chilled (61 per cent, or approximately $1.09 billion).

Indonesia: As the population, and wealth continue to grow domestically in Indonesia demand for Australian beef products is rising, particularly for boxed beef. The Indonesian's use Australian beef for a variety of products, however one of the most popular is the bakso ball, cooked into a soup. This is made from lower quality cuts of beef. Following these manufacturing cuts, the highest demand products are brisket, striploin and thick flank or knuckle cuts. Consumers are overall looking for high quality, animal-welfare-assured beef products. Muslim consumers have a distinct preference for halal certified meat. This needs to be taken into consideration given the majority of the Indonesian population is Muslim. The emergence of other cuisines from other Asian cultures into Indonesia is also increasing demand for beef, such as Korean BBQ and Japanese rice dishes served with beef.

Beef bound for Indonesia is typically exported frozen (92 per cent or $278,535,000) or as live cattle exports (more than $600 million in value yearly, currently). Live cattle are typically slaughtered in local abattoirs and sold at wet markets. These cattle are typically *Bos Indicus* varieties with a generally lower quality meat.

Singapore: Demand for beef in Singapore is not a total reflection of its domestic population's demand. The high number of transient business people and tourists that increase the number of people through Singapore on an annual basis do however have a preference for high quality beef cuts for consumption, mainly in the higher-end hospitality sector.

Beef for these industries is typically higher value, grain-fed products, specifically loin cuts. The next highest demand cuts are neck and manufacturing or processing cuts.

UAE: As the retail sector expands in the UAE, there is expected to be an increase in chilled beef sales with strong demand coming from the increasing urban, westernised and expat populations who have disposable incomes. These groups are starting to demand premium, branded and country-of-origin assured beef. It has also been found that products that are supported by celebrities, through advertising or by cooking shows, are found to be more influential in beef purchase decision-making at the retail point-of-sale.

Consumer preferences are for grass-fed beef with the more ready-to-cook cuts being popular (e.g. ground beef, trimmings, topside and inside and carcase). The majority of these cuts are consumed in food service or sold at small retail outlets, a small portion goes into the processing of prepared foods (e.g. burger meat, minced meat goods and deli meats). For those not purchasing premium cuts, most beef goes into stews, is slow cooked or grilled for kebabs, burgers or as pastry filling.

Beef bound for Gulf countries, including the UAE, is typically exported chilled (55 per cent, or $167.8 million in value in 2016).

Malaysia: Beef is not the most commonly consumed protein in Malaysia due to its higher price point, however consumption is increasing as the middle class grows and consumers see beef as a superior meat choice (especially over chicken and pork, which is still very popular elsewhere). Compared to other South East Asian markets however these increases are volume based, with less interest in the quality of cut (and thus price). Given this, cuts that are consumed tend to be lesser quality, such as manufacturing or processing cuts, followed by neck or striploin and rib eye rolls. Finally, there is a growing consumption of convenience style, pre-cooked foods in Malaysia. These ready-made meals often contain red meats that are typically cooked in-market, leaving Australia as a raw, chilled good.

Beef bound for Malaysia is typically chilled and grain-fed. Australia does export live cattle to Malaysia.

Hong Kong: Of all examined markets, Hong Kong has the highest beef consumption per capita, ranking high than the US, Brazil and Australia (all major beef production markets). The domestic population of Hong Kong consumes quite a significantly higher portion of beef than mainland China. The population is 100 per

cent urbanised, more educated and generally wealthier. This means they have a higher disposable income, eating more westernised, meat-protein-rich diets.

Demand for Australian beef is in both the high end retail and food service and preparation sectors. While traditional southern-Chinese meals are common, the effect of British colonisation and an increase in tourism and expatriates means that meals are more international. Beef is consumed largely at home, in steakhouses and in high-end restaurants. The most in demand cuts are sirloin, tenderloin, rib-eye steak, t-bone steak and ribs. The younger, working population is now starting to demand ready-made meals and frozen foods too.

Beef bound for Hong Kong is typically chilled (82 per cent, or $76.6 million). Beef from Hong Kong is also known to be re-exported to China. As more food safety and market access is facilitated into China for beef exporters, it is expected that the volume of beef meat moving through Hong Kong will shift.

Thailand: Of the examined markets, Thailand has the least demand for Australian beef. Its economic growth, population (and tourism numbers) and consumption of red meat proteins is lower than other South East Asian markets (MLA, 2015).

Beef bound for Thailand is typically exported frozen, or as live cattle as Thailand has an established feedlotting industry with trade connections into nearby Asian markets (although cattle numbers exported from Australia are low, less than 10,000 head per annum, however there is capacity for this to increase to approximately 40,000 head) (AEC for WAAA, 2016).

India: Domestic production and enforced trade regulations in India means that demand for Australian beef products is non-existent.

Food safety protocols

Market	Import permit required	Phytosanitary Certificate (PC) required	Additional declarations/endorsements required
Korea	✓ Meat export facility must be registered with Korean Ministry of Food and Drug Safety (MFDS).	✓/✗ No official certificate, however stringent Korean MFDS phytosanitary requirements in place.	Korea's MFDS issued a new assurance regulation for imported food products into Korea in 2017, the Special Act on Imported Food Safety Management. The system generated by this act creates stringent import requirements, such as labelling, nutrition, packaging and claims (include HACCP, ISO 22000, Kosher and Vegan).
China	✓ Registration through China's General Administration of Quality Supervision, Inspection and Quarantine.	✗ No true certificate, however phytosanitary inspection required upon product entry by China entry-exit inspection and Quarantine Bureau.	Labelling must be in simplified Chinese. In accordance with governmental general standards. Food processors that manufacture value-added products (including beef) must be registered with Chinese quarantine organisations (including the facility) (Austrade, 2017).
Japan	✓ Import licence for animal products, import permit for live cattle.	✓ Sanitary inspection certificate.	No major reported technical barriers, generally Japan is satisfied if Australian meat regulations have been met. Temperature controlled cargo transportation is required.
Indonesia	✓ Import permit (stipulates exporter quotas).	✓ Certification, as stipulated by Australian Quarantine (on behalf of Indonesia).	Specific requirements for evidence of commercial invoice, bill of lading and packing list as well as strict requirements on product labels and packaging (Austrade, 2018). Regulations in place regarding the import of halal meat.
Singapore	✓ An import licence and registration with domestic authorities.	✓/✗ No official certificate is required however the 'conditions of beef and beef product imports' stipulate phytosanitary safety must be ensured (only plants require a certificate) (AVA, 2017).	Domestic legislative requirements on sale, labelling requirements, date marking, nutritional information, claims, advertising etc. are required to be met at all times.
UAE	✓ Documentation of permission to import.	✓ Health certificate.	Technical trade barriers exist in relation to product age and expiry dates (this includes high standards for shelf life, e.g. 90 days for vacuum packed beef). Documentation requirements are rigorous (including for temperature travel records, halal slaughter certificates, CoOL labelling, packaging etc.) (ABFCA, n.d).
Malaysia	✓ Import permit.	✓ Veterinary and health certificate.	Food imports must be in compliance with the Malaysian Government's Food Act and Food Regulations (MOH, 2017). Regulations in place regarding the import of halal meat.
Hong Kong	✓ Import licence.	✓ Health certificate.	No additional requirements if health certificate conditions have been met (GHKSAR, 2018).

Market	Import permit required	Phytosanitary Certificate (PC) required	Additional declarations/endorsements required
Thailand	✓ Import Certificate from the Thai Department of Livestock Development.	✓ Certificate of wholesomeness, as a health certificate.	Certificates of origin (export verification) are required. Regulations in place regarding the import of halal meat.
India	N/A		

General considerations:

All meat exports from Australia must be conducted by a registered meat-export establishment, meet Australian Standards (set out in the Electronic legislation, manuals and essential references – ELMER 3 administered by the DAWR) and any other relevant Australian regulations and programs, such as the:

- National Residue Survey
- E.coli and Salmonella Monitoring Program
- Australian Export Meat Inspection System (AEMIS)
- Export Control Act 1982 (and sub-schedules, regulations etc. such as the accepted chemicals)
- Export Control (Meat and Meat Products) Orders 2005
- Australian Meat and Livestock Industry Act 1997
- Must be accredited by AUSMEAT
- Microbiological Manual for Sampling and Testing of Export Meat and Meat Products – demonstrate compliance with the relevant Australian standards and to meet certification requirements for export meat and meat products
- Sanitary and Phytosanitary (SPS) considerations – quarantine and biosecurity measures
- Exporter Supply Chain Assurance System (ESCAS) – for live export cattle.

Trade restrictions

Korea: Under KAFTA, beef tariffs will be reduced from 29.3 per cent to zero in 2028. A safeguard volume is still in place however, with an ability to reintroduce relatively high tariffs if safeguard import levels are reached (currently around 175,000 tonnes p.a.) (ABARES, 2018a).

China: While there is a FTA in place between China and Australia, tariff-free market access is still being phased in. Beef exports are not expected to be tariff free until 2024.

Japan: The JAEPA is expected to reduce tariffs on chilled and frozen beef into Japan to 23.5 per cent and 19.5 per cent respectively. These tariff rates are lower than competitors (e.g. the US). There are trigger levels in place however, when imports exceed approximately 135,000 tonnes or 200,000 tonnes slaughter weight for chilled and frozen meat (safeguards change yearly however).

Indonesia: Indonesia is a part of the Australian New Zealand Free Trade Agreement (AANZFTA) and has the Indonesia-Australia Cooperative Economic Partnership Agreement (however this Agreement is regularly negotiated). Additional trade regulations are in place for Indonesia, designed to both encourage domestic production to increase local food security and maintain the floor price of beef. These include policies relating to live cattle trade too (e.g. 5 + 1 breeder to feeder policy, weight restrictions, feedlot restrictions etc.). There are no longer quotas in place for boxed beef or live cattle imports in terms of total volume, however exporters will still require an import permit and to follow the Ministry of Agriculture and Ministry of Trade's

regulations of meat and offal types that are allowed to be imported. While there are no quota limits, permits are used to manage volume in some regard.

Singapore: The market is open into Singapore for most food products including beef, so there are no tariffs in place. Singapore is also a part of the ASEAN-ANZFTA.

UAE: Generally beef exports to the Middle Eastern Gulf Countries (including the UAE) have tariffs ranging between zero and five per cent for chilled and frozen meat respectively. Given that that majority of the population in the UAE is Muslim, it is generally expected that beef is slaughtered in a religiously appropriate way.

Malaysia: There are currently no tariffs on imports of beef into Malaysia, as it has a FTA in place as well as the wider ASEAN-Australia-NZ FTA

Hong Kong: Hong Kong does not have tariffs in place, however Australia has begun to negotiate a FTA with Hong Kong to confirm Australian bovine products tariff-free status and import volumes into the future.

Thailand: Thailand is also a part of the ASEAN- NZ FTA, and under this agreement there is a safeguard volume in place that increases the tariff rate to 50 per cent for beef imported above a specified volume.

India: N/A, no demand for Australian beef in-market.

Export method

Chilled and frozen beef accessing the international markets is distributed from various Australian sea and air ports. Sea freight volumes currently are significantly higher than air freight. Brisbane has the highest volume of exports, followed by Melbourne, Sydney, Fremantle, Adelaide and Bell Bay (Tasmania) (DAWR, 2018a). Live cattle leave port at Darwin, Townsville, Freemantle, Broome, Portland and Brisbane. In Townsville in 169,000 head of cattle left port during the 6 months to December 2018, the largest volume on record (MLA, 2018).

Value add opportunities

Case study:
Andrews Meat Industries, 'ready-to-serve' and 'ready-to-eat' meals

Domestically, Andrews Meat Industries (AMI) has invested heavily in its value-add processing business located in NSW to transform primary and secondary cuts of meat into ready-to-serve or ready-to-eat packages. By transforming meat that was typically not on-sold to wholesale customers, AMI has been able to grow their business by 130 per cent over the past five years.

Previously AMI had been a butchery only meat service, buying carcasses and preparing primary cuts for the wholesale or retail market. They have expanded their operating facilities to include a large commercial kitchen facility however that now gives them the ability to cook and package two specific types of valued-added meals. Secondary meat cuts are *sous vide* and packaged for sale to the food service industry (e.g. slow cooked meats, pre-prepared bolognaise sauces [top image] pre-made soups etc.) not only does this generate additional income for AMI, but it is reducing costs for the food service industry. In addition to ready-to-serve, ready-to-eat meal packages (meat and vegetables, both pre-cooked such as steak, beans and broccoli [bottom image] are also produced at the facility. These are being sold direct to retail outlets and onto consumers.

AMI is currently in the process of having its 'ready-to' options cleared for export to Asia.

Source: Andrews Meats Industries (www) and Beef Central: 'Value-adding: AMI unveils new $20 million sous-vide kitchen'.

Key competitors

International competition for beef exports is strong, particularly from countries with similar climates, low population to land mass ratios and access to water. Australia has comparative advantages due to its largely pasture based production system, as this equates to lower costs compared to feedlot systems (however, feedlot systems are becoming more prevalent in Australia) (ACCC, 2017). Australia loses out however due to its strict regulatory compliance environment, high processing and labour costs and immature export-based supply chain infrastructure relative to other developed countries.

Table 15: International competitors for beef products

International competitors	In-scope markets effected
United States of America	Korea, Singapore, UAE, Japan, Hong Kong, Thailand, Malaysia, Indonesia
Canada	Korea, Japan
New Zealand	China, Singapore, Japan, Malaysia, Indonesia
India (cattle and buffalo)	Korea, UAE, Malaysia, Thailand
Uruguay	China
Argentina	China
Mexico	Japan, Indonesia
Brazil	China, UAE, Malaysia, Hong Kong,
EU	Hong Kong

Source: MLA Global Snapshot: Beef 2017

Domestically, Townsville produces a relatively moderate value of beef compared to other regions of the state. Production is higher in the Mackay-Isaac-Whitsunday, Central Queensland, Darling Downs-Maranoa and Outback Queensland regions.

Table 16: Domestic competitors for beef products

Domestic competitors (by SA4 region)	Type of competition
Townsville	Gross value of livestock cattle slaughter and disposals $374.5 million
Western Queensland (including Queensland Outback)	Gross value of livestock cattle slaughter and disposals $1.99 billion.
North and Coastal Queensland (including Cairns, Mackay-Isaac-Whitsunday, Central Queensland and Darling Downs)	Gross value of livestock cattle slaughter and disposals $2.82 billion.
South Eastern Queensland (including Wide Bay, Sunshine Coast, Moreton Bay, Toowoomba, Ipswich, Brisbane, Logan-Beaudesert, Gold Coast).	Gross value of livestock cattle slaughter and disposals $541 million

Source: Australian Bureau of Statistics (ABS), cat. 7503 Value of Agricultural Commodities Produced, 2016-17.

Avocado

KEY INSIGHTS:

- Suitable production areas exist in the in-scope region and the while the trees are possibly at risk in cyclone weather events they can recover well from damage even though they already undergo rigorous pruning cycles.
- Production in the five LGAs in the in-scope region does not currently occur at scale, production occurs further north near Cairns. However, agronomically viable conditions have been identified in the Burdekin, Palm Island and Hinchinbrook.
- Existing demand from Malaysia, Singapore and Hong Kong is expected to increase in line with current export volumes, this is largely due to shifting demographics and consumer preferences for the fruit.
- Finished good potential to produce premium value-added 'Australian made' avocado pulp, smoothies or baby food does exist, however demand is equally as strong for the raw commodity itself.

Current production, supply and demand

Production in the North Queensland region:

The avodcado industry in North Queensland is experiencing a period of substantial growth due to demand and supply considerations both domestically and internationally.

Due to increased new plantings in recent years, production has increased in North Queensland to more than 13,000 tonnes a year, which accounts for 23 per cent of national production (Avocados Australia, 2017). As young orchards develop and reach peak maturity in the coming years, rapid production growth is forecast. Other existing production in Queensland is currently dominant in the Bundaberg and Childers regions.

Nationally, Australia produced almost 66,000 tonnes of avocado in 2016/17 with a gross value of production estimated at $398 million (Avocados Australia, 2017).

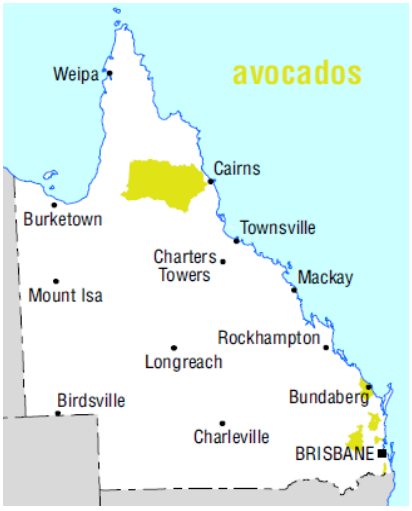


Figure 3: Map of avocado production in Queensland.
Source: QLD DAF.

Two varieties dominate Australian production, with volumes in 2016/17 being spread across (DAF, 2018a):

- Hass, an oval shaped avocado with dark-green, pebbly skin which darkens when ripe. Hass avocados accounted for 80 per cent of fresh production in Australia
- Shepard, a lighter green, pear shaped avocado which does not darken when it ripens. Shepard avocados accounted for 17 per cent of fresh production in Australia
- Other varieties, accounted for 3 per cent of fresh production in Australia.

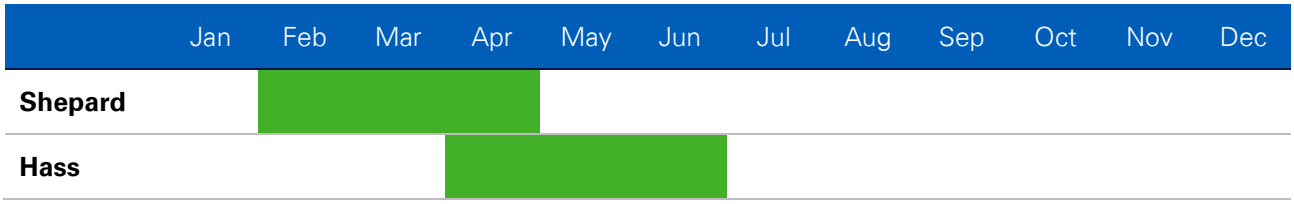


Figure 4: North Queensland avocado production seasonality by variety

As per Figure 4, the harvest of avocado in North Queensland begins in Feburary and runs through until the typically warm dry month of June. Shepard avocados are the first to ripen followed by Hass avocados which typically commence harvest in April. Peak avocado production in North Queensland is counter-seasonal to southern Australia. This provides an advantage to proximal supply markets (both domestic and interational) when international demand is high (Port of Townsville, 2018).

The avocado fruit is typically harvested within one to two months of maturity. Mature fruit do not ripen and soften on the tree allowing some flexibility in the harvest schedule to align to logitics schedules. Hard green mature Hass avocados may be stored up to four weeks, while Shepard avocados may be stored up to two weeks. This storage time until maturity is an enabler for international export allowing sufficient time from the farm gate to end users in-market (Port of Townsville, 2018).

It is widely accepted that the key barrier to export growth has been a lack of a large quantity of domestic supply and not a lack international demand. While there are export success stories in the industry, the approach to export is typically reative and not proactive. Producers have typically concentrated on domestic supply and therefore have not explored international export opportunities. Due to increasing domestic production and consumption there is an exciting opportunity for the North Queensland region to supply the global market and meet growing demand from Asia and the Middle East.

Current demand in priority export markets

Exports, though relatively small in volume, have increased consistently over the last ten years from less than 100 tonnes, or 0.3 per cent of local production to around 2,000 tonnes, equivalent to about 4 per cent of production. In 2016/17 Australia exported over 2,315 tonnes of avocado which is approximately 33 per cent increase on the previous year. The two key export markets that demand avocados and are currently supplied to the majority of exports are Singapore and Malaysia that both received 39 per cent of exported fresh avocado (900 tonnes). Hong Kong received 10 per cent of exports (217 tonnes). Despite the current export market being dominated by both Singapore and Malaysia there is growing demand from other markets in Asia too (Avocados Australia, 2018).

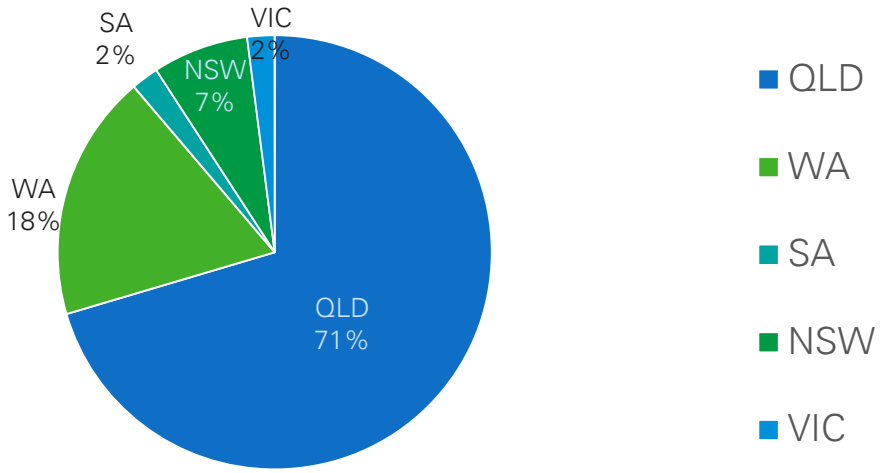


Figure 5: Australian avocado production by state.

Future demand in priority export markets

In order to defend, maintain and strengthen current Australian avocado exports the industry must continue to secure and improve access to both existing export markets and focus on capturing potential future markets. Gaining access into new markets will provide the Australian avocado industry opportunities to diversify supply channels and maintain growth opportunities. This is a long term objective and will prepare the industry for any adverse changes to the current domestic situation i.e. potential oversupply in the domestic market or a drop in domestic prices (Avocados Australia, 2014). Without the achievement of these long term objectives, the ITC's Export Potential Map identifies that untapped future demand for Australian avocados is only $560,000. This identifies demand largely comes from Korea, Japan and India.

Avocado consumption is relatively low in Singapore however recent growth in avocado imports into Singapore has been driven by trends in healthier eating, which has seen conscious consumers purchase more fruit and vegetables. Some importers also attribute growth in avocado consumption to a growing expatriate population in Singapore, which has seen a strong shift towards western cuisines. Western dishes that utilise avocado including guacamole, salads, dips and spreads and baby food are now recognised in Singapore as popular ways of consuming this fruit (TIQ, 2014).

Current supply originating from Townsville region

There is currently minimal production in the in-scope regions of this study. Research indicates there is as little as 10ha of avocado orchards in the in-scope region (HIA Australian Tree Crop Rapid Response Map, 2017). This limited production represents a significant opportunity for the region to explore expanded production and develop international export opportunities.

Market entry considerations

Product specifications

Importers of fresh avocado for all markets identified have very similar product specification requirements. These are designed to ensure that fruit meets quarantine and consumer requirements and prolongs shelf life when in a retail environment.

Typically importers prefer a smaller sized product which is relatively small compared to Australia's domestic market requirements (Avocados Australia, 2014). This presents an opportunity for Australian producers to segregate their production according to market specification. It allows producers to achieve an attractive return for the fruit and avoid food waste. Importers also prefer a hard, green and unblemished fruit in order to allow for ripening schedules that align to customer requirements and to allow sufficient time for on sell of fruit to other merchants.

Retail consumers in the identified markets also prefer the smaller size fruit due to its reduced price on a per item basis. Consumers are conscious of appearance and prefer green and clean avocados whereas commercial customers (i.e. restaurants) prefer fully ripened fruit and will accept blemishes. Hass avocados are preferred by consumers, as this variety is considered more flavoursome, with a higher oil content and creamier texture when compared to green skin varieties.

Australian avocados are sold predominately in mid-to-upper tier retail supermarkets and department stores. Low end retail outlets and retail vendors at wet markets do not usually sell avocados given the price premium that is placed on this product. In retail stores, avocados are typically displayed loose in aisle displays or in refrigerated cabinets, with labelling detailing country of origin. This also presents an opportunity to display a Brand Australia label to attract quality and provenance conscious consumers.

Food safety protocols

Market	Import permit required	Phytosanitary Certificate (PC) required	Additional declarations/endorsements required
Korea	N/A		
China	N/A		
Japan	✖ This is a protocol market. Only avocado of the Hass cultivar are permitted by Japan MAFF. Avocado must only be sourced from officially recognised areas free from Queensland fruit fly, Western Australia, Riverland (South Australia) and Tasmania.	✓	The Australian NPPO has to have verified that the avocado fruit contained in this consignments are produced, sorted and packed according to the agreed protocol (EXDOC Endorsement No 5465)

Market	Import permit required	Phytosanitary Certificate (PC) required	Additional declarations/endorsements required
Indonesia	✗	✓ The importation of fruit originating from production areas that are not free from Queensland fruit fly, Jarvis fly or Mediterranean fruit fly must be treated prior to arrival in Indonesia. Details of treatment are to be endorsed on the PC in the treatment section.	The product is treated by cold treatment during shipment (in-transit cold treatment) with temperature record as in attachment or the produce has been subjected to cold treatment prior to shipping (EXDOC Endorsement No 2784).
Singapore	✗	✗	N/A
UAE	✗	✓	N/A
Malaysia	✗	✗ Avocado are classed as fruits (as they develop from a flower) and any specifically listed conditions or generic SPS conditions apply.	N/A
Hong Kong	✗	✗	✗
Thailand	✓	✓ The following treatment details are required on the phytosanitary certificate in the treatment section: treatment temperature, and treatment duration (number of consecutive days).	This is a protocol market. Fruit sourced from outside fruit fly pest-free areas or districts with declared outbreaks must be treated for fruit fly and are subject to onshore cold treatment or in-transit cold treatment.
India	N/A		

Trade restrictions

The in-scope region has distinct geographical advantages to Asia, and the avocado industry is and should be focused on this market. It enjoys zero tariffs to most countries in the ASEAN region due to the ASEAN-AANZFTA, but no access into what is considered to be high-value markets in Asia: South Korea, Taiwan and China. Trade into one of its existing key markets, Thailand, has halted due to unfavourable import conditions (Avocados Australia, 2014).

See below for a summary for trade restrictions for the ten identified export markets:

South Korea: The Korea-Australia FTA (KAFTA) which came into force on 12 December 2014 strengthens these opportunities by improving market access for Australian companies, creating new services opportunities, enhancing protection for Australian investors in South Korea and safeguarding Australia's competitiveness in this large market (Austrade, 2018b). Unfortunately there is currently no access for Australian avocado.

China: The China-Australia FTA was signed on 17 June 2015 and entered into force on 20 December 2015 when 7,289 individual Chinese tariffs were either cut, or eliminated completely. A second tariff cut took place on 1 January 2016 and a third on 1 January 2019 (TIQ, 2019).The Australian Avocado industry is in the process of negotiating protocol access to China with this market representing a significant opportunity for future export potential as consumer preferences evolve.

Japan: The Japan-Australia Economic Partnership Agreement (JAEPA) entered into force on 15 January 2015. JAEPA delivers substantial benefits for the Australian economy, making it easier to do business with Japan, our second largest trading partner (TIQ, 2018). As of May 2018, there is a new protocol in place to support market access for Hass avocados to Japan. This will provide a significant trade boost for Australia's avocado industry, allowing producers in regions free of Queensland fruit fly to access the Japanese market without a requirement to treat produce (DAWR, 2018b). At present this restricts the export of avocado from the North Queensland region due to the existence of fruit fly.

Indonesia: Australia is one of few countries allowed to export avocado through the major ports of Indonesia including Jakarta. With its large population, emerging economy, growing middle to upper class and the growing western influence on this market segment, there may be opportunity to supply more high quality avocado to this market (Avocados Australia, 2015).

Singapore: The Singapore-Australia FTA (SAFTA), which came into effect in July 2003, is a comprehensive agreement giving non-protocol market access to the country. Singapore has been a consistent importer of Australian avocado which is likely to grow in the future.

UAE: The UAE is an open market with zero tariffs. Australian avocado would have a niche in this market with strong growth opportunities.

Malaysia: The Malaysia-Australia FTA, which has been in place since 2013, has boosted avocado exports to Malaysia. Much like Singapore, Malaysia is a market where Australia is the market leader for imported avocado.

Hong Kong: Hong Kong is a major export market for Australian avocado fruit and is considered the gateway to mainland China. Despite direct access into China, many exporters still prefer to trade through Hong Kong because of existing trade relationships and lower trading costs and risks.

Thailand: With new protocols effective July 2013, Australian avocado trade into Thailand has ceased. Cold treatment protocols are not commercially viable with temperature requirements too low and exposure period too long.

Export method

Air freight:

Avocados can be exported by air freight when product perishability is an issue. The current lower export volumes are also more suited to air logistics. Air freight gives Australia a competitive advantage as fruit can be harvested and landed in Asian markets within 48 hours, ensuring maximised product quality. Townsville airport is a significant enabler for this but needs to have consistent international flight capabilities. Once these connections are established produce could be moved on either LD3 (250 tray) or LD7 (732 tray) pallets.

The development of markets for high quality, perishable avocado products will drive the requirement for air freight capabilities.

Sea freight:

In the current absence of dedicated air freight services, sea freight is the most appropriate method of avocado export via controlled atmosphere refrigerated containers. Sea freight orders are specially picked and packed to ensure that avocado are delivered to the vessel in the shortest possible time. Pallets and trays have been designed to have the maximum air flow to ensure that sea freighted avocado reaches its destination in the freshest possible condition. Sea freight requires larger volumes to be cost effective, 6m reefer containers need 1440 trays while 12m reefers need 3120 trays.

To remain competitive with other avocado producing markets, the transportation of avocado by air or sea freight is contingent on the production of suitable volumes to underpin investment in controlled atmosphere containers (sea) or to accommodate the higher cost of air freight. A detailed assessment of consumer preferences in priority markets will drive decision making for investment in either or both export methods.

Value add opportunities

Case study:
Fresh Produce Alliance (FPA), Manjimup (WA)

There is currently an avocado producer in Manjimup, Western Australia that has launched a packaging facility with other growers. The company Fresh Produce Alliance owns the Avo Vita avocado brand and seeks to utilise food waste from the production of fruit and vegetables. This uses the 30 per cent of production that is often blemished or misshaped to make finished goods through a cold pressure food processing (HPP) machine. The company also produces Avo Vita, which are products such as avocado chocolate mouse and ready-to-drink smoothies made, creating value-added products. The company currently exports to Singapore with plans for future expansion.

Source: Australian Business News Source: Fresh Produce Alliance and Sydney Morning Herald 'How avocado farmer Jenny Franceschi is taking on food waste'

Case study:
Sunfresh, Sunshine Coast (QLD)

Sunfresh is a marketing cooperative based on the Sunshine Coast, Queensland. Sunfresh have invested in a processing facility that allows it to process avocado into a finished good that is packaged, sealed and ready for export with no chemicals or preservatives added. The vacuum seal ensures the product has a long shelf life, ideal for export readiness and retail environments in overseas markets. The company is currently exporting to Hong Kong.

The avocado pulp can also be utilised by importers in overseas markets to value add the product into items such as avocado smoothies or guacamole.

Source: Sunfresh website.

Case study:
Banana retail store, South Korea

A South Korean retail store has utilised a technique when packaging fruit to avoid the issue of overripe fruit. These bananas have been ordered from most-to-least ripe to promote a banana-a-day consumption as the bananas will be ripe for six consecutive days.

This packaging technique could be applied to avocado sold in retail outlets in Asia to ensure consumers were not discouraged by the potential issue of over ripened fruit. It would also encourage consumers to purchase a greater volume of fruit rather than a single unit.

Producers in the North Queensland region would require avocado packaging facilities for avocado and suitable transportation that did not damage the fruit in packaging.

Source: Nine News 'Customer outrage over bananas wrapped in plastic'.

Key competitors

Australia's ability to supply high quality, fresh produce (air freighted) is seen as a key advantage over our biggest competitor Mexico. Mexican product quality is often poor on out turn as the fruit is older when it arrives, given it is generally shipped via sea freight resulting in internal quality problems such as vascular browning and discolouration of the flesh.

Table 17: International competitors for avocado

International competitors	In-scope markets effected
Mexico	Japan, Malaysia, Singapore, Hong Kong
South Africa	UAE
New Zealand	Thailand, Japan, Malaysia, Singapore
Chile	Hong Kong, Thailand, Japan, South Korea, Singapore
Peru	Thailand, South Korea

Source: Avocados Australia.

Most of the above countries have lower production costs, are generally able to supply avocado at a cheaper price compared to Australia (i.e. approximately $16/ 5kg carton in Mexico) and their price is generally consistent throughout the season (in comparison with the Australian price that fluctuates considerably). Australia, and to a greater extent, the North Queensland region holds a significant advantage over these competitors due to its proximity to the market (e.g. Singapore, Malaysia and Japan) and access to fast and cost effective logistics via air freight. Australia's ability to get the produce directly to market quickly means it is often of higher quality and fresher upon arrival.

Table 18: Domestic competitors for avocado (in-scope markets)

Domestic Competitors	Type of competition
South East Queensland ~22,000 tonnes	Direct competitor that will be using the same supply chain to international markets, however production window is later in the year.
North Queenland (Cairns) 15,000 tonnes	Direct competitor that will be using the same supply chain to international markets during a similar window of production.
Western Australia 18,600 tonnes	Producer of Hass avocado but timing for the majority of supply (July - March) does not overlap with the north Queensland production cycle (February - Jun).

Source: Avocados Australia.

Macadamia

KEY INSIGHTS:

- No large scale production currently occurs in the North Queensland region, however suitable growing conditions exist in the North Queensland region.
- Any new production undertaken to capitalise upon demand in export markets would require careful grower management to mitigate impact of cyclones, such as reduction of tree height.
- With this in mind, the most suitable regions for production are Burdekin, Palm Island and Hinchinbrook as they have suitable access to water, land availability and favourable agronomic conditions.
- Existing demand is very high from countries such as Korea and China as these already have well-established markets for macadamia.
- For macadamia, demand for husked and de-husked nuts is high, however there is also numerous value add opportunities (e.g. processing the nut into snack food items, such as chocolate and other confectionary).

Current production, supply and demand

Production in the North Queensland region:

In Australia, macadamia are typically grown along the eastern coast of Nambucca Heads to Cairns with small plantings in Western Australia. Approximately 40 per cent of the Australian crop is produced in Bundaberg and 40 per cent in the Northern Rivers region. Macadamia are evergreen trees, typically propagated from grafts that require up to ten years to establish. Once fruiting, macadamia can continue to produce nuts for more than a hundred years.

Macadamia prefer fertile, well-drained soils and warm temperatures. They are shallow rooted, tall trees that are prone to storm damage. Macadamia require quite specific orchard management, including root management, ground cover control, channel and water flow management, tree monitoring and pruning and integrated pest control (HIA, 2016). Once grown to maturity fruit forming flowers generate the nuts that fall to the ground to be harvested (typically every couple of weeks). Macadamia are sold as in-shell to retail consumers domestically (or as a kernel to processers) but in the export market the majority of nuts are exported in-shell as it protects the nut.

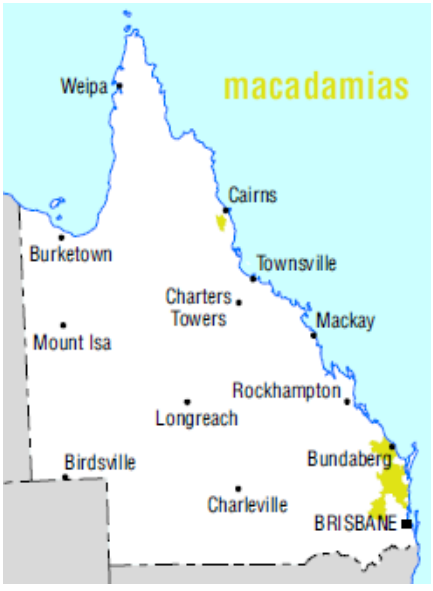


Figure 6: Map of macadamia production in Queensland.
Source: QLD DAF.

In the most recent production season (see Figure 6), Queensland produced nearly 8,000 MT of kernels. In the same year, approximately a quarter of this Queensland product was exported (2,213 MT) (HIA, 2017b). The Australian crop totalled 46,000 MT, averaging a price of $5.62 per kg in-shell for $247 million in farm gate value (HIA, 2017b).

Currently production in the Townsville Burdekin region is below 20 ha, however there has been more, yet still small, orchards in the past (HIA, 2016). Recent work by the Australian Macadamia Society has identified short statured varieties that may be suited to the region and offer an opportunity to boost current production volumes and export value capture.

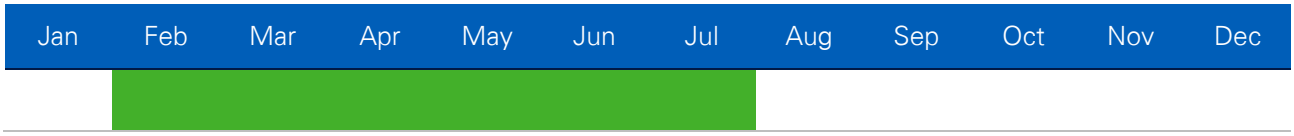


Figure 7: Macadamia season - Queensland

Growth in macadamia production, consumption and exports is being driven by strong prices, an increasingly health-conscious consumer mindset and rising popularity by emerging markets within Asia. Export markets recognise Australia as a source of premium quality nut. The industry has specifically focussed on developing an export agenda to continue, if not improve, value capture along the supply chain. Increases in export sales are being seen, a 39 per cent and 66 per cent increase in export value in 2016 and 2017 respectively were recorded year-on-year (HIA, 2017b).

Already nearly 70 per cent of the total Australian macadamia nut crop is exported, totalling approximately $253 million (19,366 MT) with $114.6 million of this being attributed to Asia and $5 million to Middle Eastern exports (HIA, 2017b).

Current demand in priority export markets

Of the top ten priority markets all featured some current demand for raw nuts (as laid out in the Harmonised System (HS) system under 0802 for fresh or dried nuts that are shelled or peeled [see Figure 8]). This demand includes demand for shelled and unshelled macadamias, which in 2017 accounted for 89 per cent of exported nuts (AMS, 2016). The total nut demand from Australia to in-scope markets in 2017 was just over 50,000 tonnes. The demand was greatest in India and China and least in Indonesia, Singapore, Malaysia and Korea. The 50,000 tonnes of exported nuts translated to $402.7 million dollars of export value in 2017.

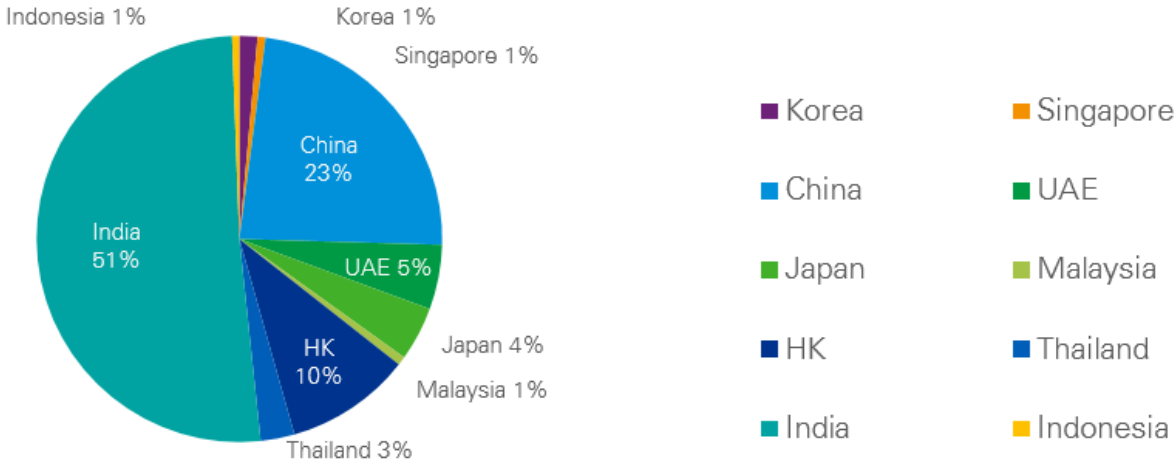


Figure 8: Current demand for Australian nuts (including macadamia)

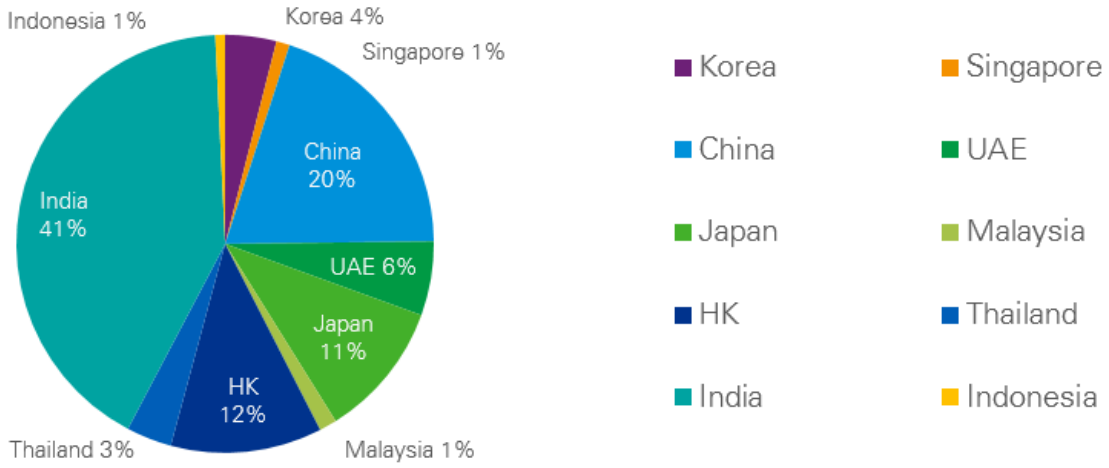


Figure 9: Current export value for Australian nuts (including macadamia)

Macadamia can also be accounted for in export of prepared and preserved plant parts (HS code 2008). The total current demand for these products (including macadamia) in the in-scope markets in 2017 was $28.3 million or 3085 tonnes. The current demand for this type of product is lower than the direct fresh or dried nut products described above.

Future demand in priority export markets

Unmet demand for Australian nuts (including macadamia) and prepared or preserved plant parts in the in-scope export markets totalled $63.9 million. This is not reflective of demand that could be fulfilled by increases in production of macadamia alone in the North Queensland region though. It does however, demonstrate the enormous potential in export markets for nut products from Australia. Townsville is well placed to capture this demand by creating new macadamia orchards, establishing processing facilities and packaging for export sale. It should be noted however that demand for nuts and processed nuts in some of the in-scope markets was met or in-fact over supplied. For nuts, this included Korea and Japan and for processed or prepared plant parts this included Singapore, China, the UAE, Japan, Hong Kong, Thailand, India and Indonesia. Future demand will thus definitely be greater in the nuts (fresh or dried) market than in the processed/prepared market.

Current supply originating from Townsville region

In 2016/17 there was no known macadamia production in the North Queensland region. In the most recent production season, Queensland produced nearly 8,000 MT (17.4 per cent of the national crop) of kernels a quarter of this was exported (2,213 MT) (HIA, 2017b). The Australian crop totalled 46,000 MT, averaging a price of $5.62 per kg in-shell for $247 million in farm gate value.

Market entry considerations

Product specifications

Prior to export macadamia are graded on a style scale that dictates the kernel size range and the proportion of whole kernels on scale of 0-8 (0 is whole kernels, greater than 20 mm, while 8 is kernel chips of less than 4 mm). The whole products (0) tend to be used for direct consumption, while styles 4-5 are more for bakery, cereal and snack foods, style 8 tends to be an ingredient only product (e.g. as flavouring or as a flour replacement). It is preferred that kernels are firm, crunchy, light golden in colour and are free of rancidity in flavour and odour.

Generally macadamia are used for human consumption (as snack foods or ingredients), or further processed into macadamia oil (mainly for human consumption as an ingredient). There has been some recent emergence in the use of macadamia for beauty products.

Korea: There is a growing premium snack market for macadamia in Korea. While they are not consumed as frequently as walnuts or almonds, they are given more of a premium status and thus price. Generally Koreans like macadamia packed into small pack sizes. The use of e-commerce is also increasing and nuts that are ready-for-sale or packaged-for-sale are preferred for these platforms.

The preference for macadamia is in kernels.

Singapore, Malaysia, Indonesia and Thailand: These four markets have been identified as growth markets for macadamia exports. As such preferences for product are not clear as volumes exported are still small. It is expected that these markets will begin to demand more specific products if their imports increase.

The preference for macadamia in these markets is in kernels.

China and Hong Kong: There is increasing market penetration in China from Australia's competitors (particularly Hawaii in the USA). Australia needs to capitalise on the indigenous origin of its product. There is a distinct preference for the nuts to be in-shell, and the price point of these nuts compared to individual kernels is quite different. Chinese consumers use macadamia for gifts, as they are associated with premium, export and highly valuable sentiments. If not gifted, then macadamia are a snack food, where the shell is cracked open to reveal the nut on consumption. Opportunity also lies in branding macadamia as premium compared to other nuts, in preparing flavoured snack products and in packaging that differentiates the product (AMS, 2014). The use of e-commerce is also increasing and nuts that are ready-for-sale or packaged-for-sale are preferred for these platforms as opposed to large wholesale quantities.

The preference for macadamia is in-shell.

Japan: Currently macadamia are used as ingredients for confectionary (e.g. chocolate covered nuts) and baked goods in the domestic market in Japan.

The preference for macadamia is in kernels.

UAE and India: There is currently negligent future demand.

Food safety protocols

Market	Import permit required	Phytosanitary Certificate (PC) required	Additional declarations/endorsements required
Korea	✓	✓	Certificate of origin.
China	✓ Import certificate	✓ Depending on packaging method this may need to include heat treatment certification.	Certificate of declaration or origin. Certificate of product quality.
Japan	✗	✓ No certificate is required for processed kernels.	Consignments of macadamia must be free from pests, soil, weed seeds and extraneous material. Additional food sanitation laws apply for processed kernels.
Indonesia	✓ Indonesian food and drug agency is required to approve every shipment of processed and raw nuts or ingredient nuts (WTO, 2013)	✓	Consignments of macadamia must be free from pests, soil, weed seeds and extraneous material.
Singapore	✓ Traders' licence/registration (which includes an import permit) with the Singaporean Agriculture and Veterinary Authority (AVA, 2017)	✓	Consignments of macadamia must be free from pests, soil, weed seeds and extraneous material. Certificate of origin. Must be labelled appropriately.
UAE	✓ Import licence	✓	Certificate of fitness for human consumption (USDA, 2014). Certificate of origin.
Malaysia	✓ Import permit	✓ Veterinary and Health certificate.	Food imports must be in compliance with the Malaysian Government's Food Act and Food Regulations (MOH, 2017).
Hong Kong	✓ Import licence	✓ Health certificate.	N/A
Thailand	✓ Import permit	✓	Post-entry Quarantine Certificate
India	✗	✓	Consignments of macadamia must be free from pests, soil, weed seeds and extraneous material (including those on India's weed seeds schedule). Nuts must be treated with methyl bromide fumigation or heat treated prior to export as per Indian quarantine orders.

Trade restrictions

Korea: Under Korean-Australia FTA the tariff for macadamia was eliminated.

China: Under the China-Australia FTA the tariff for macadamia is 4.8 per cent however this was reduced to zero in January 2019.

Japan: Under the JAEPA the tariff for macadamia was eliminated. There are no import quotas or safeguards in place for Japan.

Indonesia: Under the ASEAN–AANZFTA the tariff for macadamia was eliminated.

Singapore: Under the ASEAN–AANZFTA and the Singapore-Australia FTA the tariff for macadamia was eliminated. There are no import quotas or safeguards in place for Singapore.

UAE: There is no FTA in place in the UAE, the tariff on macadamia is 5 per cent.

Malaysia: Under the Malaysia-Australia FTA the tariff for macadamia was eliminated. There are no import quotas or safeguards in place for Malaysia.

Hong Kong: Hong Kong is a free trade port.

Thailand: Under the ASEAN–AANZFTA the tariff for macadamia was eliminated. There are no import quotas or safeguards in place for Thailand.

India: 100 per cent tariff on macadamia.

Export method

As there is currently negligible production of macadamia or processing of macadamia related products in the in-scope region there is no utilisation of existing channels to export markets.

The development of markets for high quality, perishable macadamia products will drive the requirement for air freight capabilities, while sea freight is a more economic option. Sea freight in particular has become more advanced in the freight of perishable produce, and reefer containers are equipped to cold store products requiring temperature controlled transport. To remain competitive with other macadamia producing markets, the transportation of macadamia by air or sea freight is contingent on the production of suitable volumes to underpin investment in controlled atmosphere containers (sea) or to accommodate the higher cost of air freight. A detailed assessment of consumer preferences in priority markets will help to drive decision making for investment in either or both export methods.

Value add opportunities

Case study:
O'Tree Macadamia Holic snack foods, South Korea

South Korean company O'Tree Food Village makes premium snacks from single and mixed nuts. Recently they have launched a new snack food range of flavoured macadamia in single serve sachets.

The product launch is in collaboration with an online shopping platform (GS Home Shopping) which allows the company to access a wide range of consumers, particularly younger generations who have a preference for online shopping.

The snack range demands a premium price, due to both the quality of the Australian nut and the flavour combinations used (truffle and maple). Throughout the product development nuts from Hawaii and South Africa were also tested, however the Australian kernel was favoured for its flavour qualities.

O'Tree is now also re-exporting the processed goods into China and Malaysia and has plans to expand the product range in the near future.

Source: AMS Macadamia Holic Snack Range Launches in South Korea.

Case study:
Meiji, Japan

Meiji is a global food trader who imports raw products for sale and re-export as transformed goods. Meiji has been producing chocolate coated macadamia for some time but has recently launched a new chocolate coated confectionary product that combines both the flavours of the hojicha (roasted green tea) and macadamia to appeal to younger, millennial consumers.

Macadamia was preferred as the supplementary ingredient for the chocolate due to its creamy, nutty and sweet flavour. Already hojicha is a popular product in Japan, and combining the flavour with macadamia is appealing to health-conscious consumers who want the benefits of functional ingredients as well as the sweetness of confectionary.

The chocolates are currently being sold as a seasonal product and have been successful to date.

Source: AMS 'Meiji appeals to health conscious millennial women with new macadamia hojicha chocolate'.

Key competitors

Australian macadamia kernels are seen as premium quality compared to other competitor markets. Australian macadamia nuts are cheaper to produce, higher yielding and contain indigenous country-of-origin genetics.

Table 19: International competitors for macadamia

International competitors	In-scope markets effected
USA	Hong Kong, India, Japan, South Korea, UAE, China
Iran	Hong Kong, India, UAE, China, Singapore, Japan, Malaysia
South Africa	China
Kenya	China

Source: Australian Nut Industry, Growing for Success, 2016

Table 20: Domestic competitors for macadamia (in-scope markets)

Domestic competitors	Type of competition
Queensland Bundaberg	In-shell and kernels. 19,000 tonnes in shell (equivalent) in 2016.
Queensland Gympie	In-shell and kernels. 19,250 tonnes in shell (equivalent) in 2016.
New South Wales Northern Rivers	In-shell and kernels. 3,480 tonnes in shell (equivalent) in 2016.
New South Wales Glasshouse Mountains	In-shell and kernels. 2,820 tonnes in shell (equivalent) in 2016.
New South Wales Nambucca	In-shell and kernels. 2,350 tonnes in shell (equivalent) in 2016.
Western Australia Margaret River	In-shell and kernels. 800 tonnes in shell (equivalent) in 2016. Note: this figure includes tropical Queensland from 1-2 growers.

Source: Australian Macadamia Society, Macadamia Yearbook 2017.

On-shore aquaculture (tropical rock lobster)

KEY INSIGHTS:

- Onshore aquaculture is well suited to the North Queensland region with access to coastal water, suitable climate conditions and land availability. Additionally, establishing on-shore facilities is not overly land intensive, and thus could be conducted in the Townsville LGA (where more broad, large scale production of agricultural commodities cannot occur).
- Current onshore aquaculture operations in the region produce largely fish and smaller crustacean products, but demand for live lobster, particularly in Asian countries, presents an opportunity to expand into other seafood.
- Significant global demand for lobster comes from Asian markets, particularly those with growing wealth such as Thailand, China and Korea, and those who consume lobster as an occasion food.
- Advances in tropical rock lobster production technology will facilitate onshore commercial operations.

Current production, supply and demand

Production in the North Queensland region:

Tropical rock lobster (generally *Panulirus* and *Jasus* species) and slipper lobsters (commonly referred to as Moreton Bay or Balmain Bugs in Australia) are some of the most valuable salt-water fisheries products despite having low catch volumes. Their bodies and tails contain meat which is cooked or served fresh. Rock and slipper lobsters are known to have slightly larger body to tail size compared to traditional lobsters.

Traditionally lobster in the open environment spawn between November and April and have a larval life cycle over six months after which they grow rapidly to mature size at around three to five years of age (QLD DPI, 2004). They are wild-caught off-shore, from near-shore and mid-shelf reef systems. Slipper lobster are more common on the southern Queensland coast while rock lobster are more prevalent from Cairns northwards. Generally they are commercially fished with rubber spear rods or hand caught, recreationally they are hand caught only.

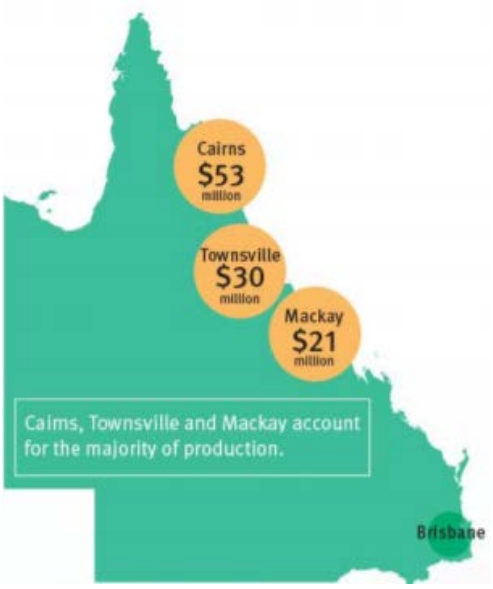


Figure 10: Map of aquaculture production in Queensland. Source: QLD DAF.

Rock lobster and bug production in Queensland has remained steady over the past three years, averaging 804 tonnes per annum (ABARES, 2017). This has equated to a production value of $29.45 million (2017-2018), however this is less than three per cent of the total national value of lobster production demonstrating that low volume crop is highly valuable (ABARES, 2017). The gross value of lobster aquaculture (as opposed to wild caught) is much lower but has increased in recent years in Queensland, and the total commodity value is only expected to continue to increase over the next five years (by approximately 15 per cent) (ABARES, 2018c).

To capitalise on both the increasing value and demand for rock lobster and bugs, opportunities to establish on-shore aquaculture facilities should be investigated in the North Queensland region. Critical work on the breeding of lobster for commercial on-shore facilities is currently underway at the *Australian Research Council's Research Hub for Commercial Development* at the University of Tasmania's Institute for Marine and Antarctic Studies (IMAS). The work of IMAS has identified methods of growing lobster in a closed lifecycle culture system through refining the required larval rearing systems, water treatment, health specifications, nutrition requirements and genetics (ARC RHCD, 2018). The research has been able to generate the ability to produce seed-stock for large-scale commercial operations of lobster production, including specifically the tropical rock lobster and slipper lobsters that have the identified high export value opportunities (ARC RHCD, 2018).

To establish a lobster aquaculture system in the North Queensland region will be a large undertaking. It will require not only the pond and/or tank production system establishment but also the development of specific supply chain infrastructure for the harvest and processing of the lobster following production. Establishment costs can be upwards of $350,000 for single farms, exclusive of land costs (BQ, 2016). The benefit of establishing aquaculture production of lobster aquaculture is the establishment of year-round production.

Current demand in priority export markets

In 2016-17 Australian lobster exports were $676 million (fob) globally. Production, particularly of rock lobster, is increasing in value due to export opportunities and is only forecast to grow further (particularly in the live export trade (FRDC, 2018). Currently China and Hong Kong made up the majority of the export market for rock lobster, followed by the US. The Asian growth stems from an increasingly wealth population who have a growing preference for very high quality foods, particularly proteins. In 2016-17, exports from Queensland totalled $21.75 million, travelling to Hong Kong, China, USA and New Zealand. Demand in the Asian markets is still expected to be the largest source of continued demand into the future (FRDC, 2018).

To determine current demand, the trade of lobster products (HS code 0306) between Australia and the top ten priority markets showed that nine of the ten markets currently import lobster. The only countries that did not have any trade with Australia were India and Indonesia. The four types of lobster traded included:

- lobster, not frozen
- rock lobster and sea crawfish, frozen
- rock lobster and sea crawfish, not frozen
- lobster (not elsewhere specified), frozen.

Total demand for lobster from the priority markets (India had no demand) was approximately $129.3 million, equating to just over a little more than 7000 tonnes. The breakdown of this demand can be seen in Figure 11.

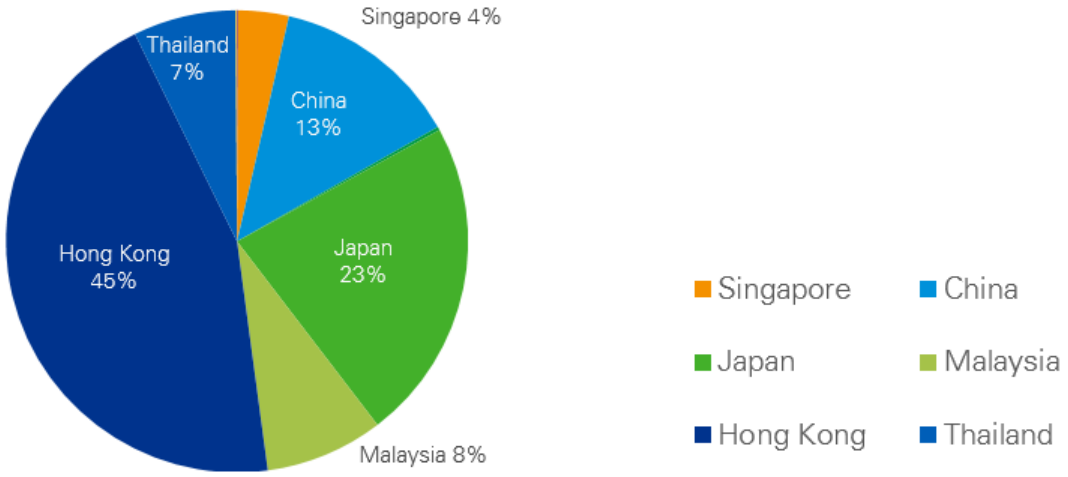


Figure 11: Current demand for Australian lobster (including rock lobster) by value (AUD) and market share

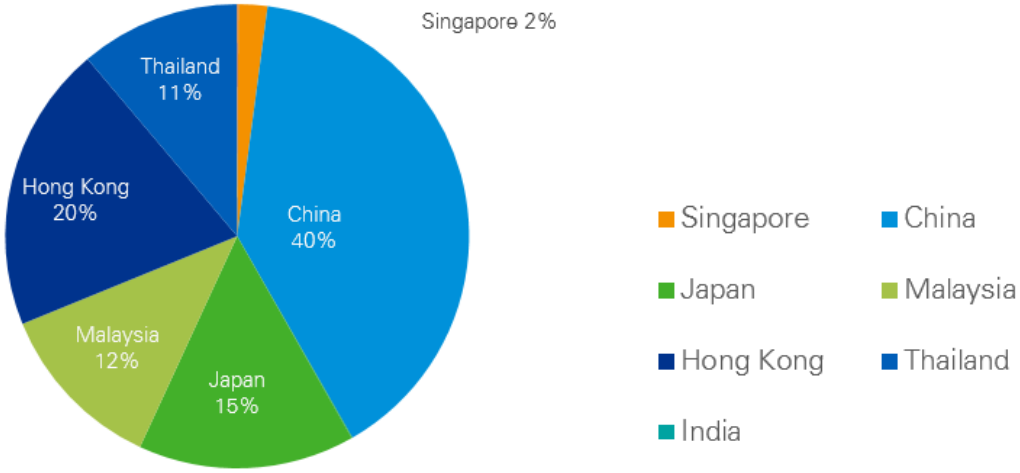


Figure 12: Current demand for Australian lobster (including rock lobster) by quantity (tonnes) and market share

Future demand in priority export markets

Unmet demand for Australian rock lobster (frozen and fresh) products was approximately $302.87 million. This is not reflective of demand that could be fulfilled by increases in production in the North Queensland region alone. It does however, demonstrate the enormous potential in export markets for rock lobster products from Australia. There are opportunities to develop the on-shore aquaculture industry in the North Queensland region so the value from this unmet demand can be captured effectively.

Current supply originating from Townsville region

Current aquaculture production in Queensland (2015/16) was $118.3 million or 7,621 tonnes of production, however this is largely made up of small fin fish and crustaceans as on-shore aquaculture production of rock lobster is not yet commercialised (ABARES, 2017).

Market entry considerations

Product specifications

Korea: Korea currently has low demand for Australian lobster and bug products, however does import large volumes from other markets. Generally lobster is still a gourmet food, used in food service and restaurants rather than for home consumption. For this purpose, Australian lobster is favoured over USA and Canada lobster.

Lobster bound for Korea is generally shipped frozen, however there is a small demand for live, fresh animals.

China: A rising population of middle class consumers is leading to an increased demand in lobster, as is seen in other proteins. Consumption of seafood in China now averages around 35 kg p.a., higher than Australia's and the US's (Smith, 2018). Generally lobster is still consumed at restaurants or food outlets, with direct sales to consumers low. There is also a preference for lobster not produced in China, which stems from consumer concerns about food safety. Any new export of lobster into China should ensure that a food safety and quality message is emphasised.

Lobster bound for China is shipped fresh or chilled, however there is a small demand for frozen product (ABARES, 2017).

Japan: Japan is the second biggest importer of crustaceans in the world, however recent transitions to more Westernised dietary preferences has seen a decline in crustacean consumption, including rock lobster. The lack of knowledge in how to prepare seafood meals at home means that consumption is concentrated in the food service and restaurant industries (AAC, 2017). Purchase, preparation and consumption of whole lobster at home does still remain high in the holiday periods, such as Christmas.

Lobster bound for Japan is shipped both live and frozen/chilled, recently there has been a shift in preference towards chilled or frozen (ABARES, 2017).

Singapore: Seafood consumption, including lobster, is higher in Singapore than in most Asian countries. This is largely due to the higher average wealth and expatriate population as well as the large number of high end restaurant outlets that serve exotic dishes. Fresh/live seafood is more expensive than frozen varieties however the Singaporean Government is marketing the benefits of more economical frozen varieties (USDA, 2017).

Lobster bound for Singapore is shipped both live and frozen/chilled (ABARES, 2017).

UAE: Seafood imports have increased in recent years into the UAE to meet growing food demand, particularly in the high end tourism and related restaurant industries. As the population of expatriates and high income tourists increases the market for lobster is expected to increase. There is strong consumer preference in these industries for seafood, and in particular lobster, to be high quality, clean and guaranteed safe-to-eat (AAC, 2015). It will be important for products to meet these specifications to hold and develop market share and favourability over products sought from closer markets (i.e. India and other Gulf countries). Lobster that is prepared fresh (i.e. from live, frozen or chilled) as opposed to pre-cooked and packaged prior to import is preferred.

Lobster bound for the UAE (Gulf countries) is typically shipped frozen, however demand for live product is increasing (ABARES, 2017).

Malaysia: Increased foreign investment into Malaysia has driven up the retail of luxury foods, such as lobster, due to the higher disposable incomes of the urban population. Compared to other Asian markets however, the demand for value-added lobster goods is high in Malaysia. There is a clear consumer preference, and thus opportunity, for ready-to-eat or ready-to-cook lobster, such as pre-portioned tails, ravioli and pizza (GSA, n.d.). Total consumer demand in Malaysia is low compared to other in-scope markets as it does have a domestic industry established. Leveraging quality and provenance are important specifications to capturing higher prices.

Lobster bound for Malaysia is generally shipped frozen, however there is some import of live lobster (ABARES, 2017).

Hong Kong: Hong Kong's luxury food service market is well-established; consumers demand high quality, fresh and healthy seafood and have disposable incomes to spend. Seafood, including lobster, is also a traditional food in Hong Kong. High end restaurants have a large, and steady, demand for both live and frozen lobster, however competition in the retail sector is increasing as lobster becomes available at supermarkets and other retail outlets (FEA, 2015).

There is some demand in Hong Kong for product that can be re-exported, particularly to China, however with the establishment of the China-Australia FTA direct export to China has reduced demand for re-exportable lobster.

Lobster bound for Hong Kong is generally shipped not frozen, however there are some frozen products imported (ABARES, 2017).

Thailand: Lobster has generally been served in the hotel and restaurant industry in Thailand. Recently however, there has been a shift towards food courts and fast-food outlets to service the middle income population with a high quality, safe food source (USDA, 2018). As the number of these stores increase, seafood consumption in Thailand is expected to increase in general. While it is not expected that these outlets will supersede traditional wet markets entirely there is a clear emerging demand for foreign imported, processed and pre-packed foods that are ready-to-cook or consume (including chilled or frozen lobster).

Lobster bound for Thailand is generally shipped live or chilled, the volume of frozen product imported is lower (ABARES, 2017).

India and Indonesia: There is currently negligent future demand, thus there are no product specification requirements.

Food safety protocols

Market	Import permit required	Phytosanitary Certificate (PC) required	Additional declarations/endorsements required
Korea	✓ DAWR export registration	✓ Aquatic cultured crustaceans require an Aquatic Animal Health and Sanitary Certificate for Export of Crustaceans for Human Consumption.	Antibiotics, anaesthetics and presence of heavy metals are restricted in imported seafood.
China	DAWR export registration, an establishment listing by China in accordance with their provisions on the Administration of the Registration of Foreign Manufacturers of Imported Food.	✓ Registration with the General Administration of Quality Supervision, Inspection and Quarantine.	Strict labelling (Chinese and English) and inspection-on-arrival requirements are in place. Traces of sulphur dioxide are prohibited from seafood goods (typically allowed under Australia under certain regulation limits).
Japan	✓ DAWR export registration and a Food Import Permit issued by the Ministry of Health and Welfare (Austrade, 2018c).	✓ Animal products require an Inspection Certificate.	Labelling of products in Japanese is required, this needs to include description of contents, name and address of importer and date of importation. Port-of-entry checks may be conducted.

Market	Import permit required	Phytosanitary Certificate (PC) required	Additional declarations/endorsements required
Indonesia	✓ DAWR export registration	✗ N/A	Exported foods (including lobster) must be tested against the nominated microbiological standards of the Singaporean National Association of Testing Authorities.
Singapore	✓ DAWR export registration	✓ Generally most food items require a health and phytosanitary certificate (ABFCA, n.d.).	Live, farmed lobster cannot be exported to the UAE as Halal if fed porcine products (must be confirmed by a UAE-accredited Halal certification body). Any processed foods labelled GM free must be accompanied by a statement from an Australian Government agency supporting this claim.
UAE	✓ DAWR export registration and an Import Licence from the Malaysian Ministry of International Trade and Industry.	✓ Live animals require a health certificate (demonstrate fitness-for-consumption).	Live animals require an additional permit from the Wildlife Department and Department of Veterinary Services.
Malaysia	✓ DAWR export registration	✓/✗ Health certificate issued by Department of Agriculture will expedite customs clearance, and a Health Certificate/Certificate of Origin.	The FX46HK Certificate must also include an Endorsement 4621, this includes compliance with inspected facilities, hygienic practices etc. Tolerance limits on heavy metal content and chemical contamination are in force.
Hong Kong	✓ DAWR export registration	✓ The Administration and Ministry of Public Health may request a declaration from Australian Quarantine Inspection Services (AQIS) stating that food exported complies with HACCP standards.	The FX46HK Certificate must also include an Endorsement 510.
Thailand	✓ DAWR export registration	✓ Aquatic cultured crustaceans require an Aquatic Animal Health and Sanitary Certificate for Export of Crustaceans for Human Consumption.	Antibiotics, anaesthetics and presence of heavy metals are restricted in imported seafood.
India	N/A		

General considerations:

All rock lobster or crustaceans (live or otherwise) exported from Australia to the in-scope markets with demand for these seafood products are done so under prescribed goods export regulations. The following, in addition to any specific guidelines set out above, are required:

- a declaration of compliance under Australia's Export Control (Fish and Fish Products) Orders 2005
- a FX46KR certificate (a health certificate) that verifies condition, fitness for human consumption and Australian origin. The certificate contains attestations of:
  - the sound condition of seafood
  - the fitness for human consumption
  - its origin (Australia).

Trade restrictions

Korea: Korea-Australia FTA phased out tariffs on lobster (fresh, chilled and frozen) in 2016. There are no quotas or safeguards.

China: The lobster market is now much more open due to China-Australia FTA tariff reductions, with full elimination in January 2019. Previously large volumes of lobster were sent to Hong Kong and Vietnam prior to entering the Chinese market. Prior to the China-Australia FTA the average price per unit was $51/kg, however under China-Australia FTA this has increased to $83/kg.

Japan: Under the Japan-Australian Economic Partnership Agreement, tariffs on rock lobster imports were eliminated.

Indonesia: Under the ASEAN-AANZFTA the tariffs for rock lobster import were eliminated.

Singapore: Singapore-Australia FTA, there are no tariffs, quotas or safeguards in place.

UAE: There is no FTA in place between the UAE (through the Gulf countries) and Australia. Tariff rates are capped at five per cent for most goods, however some agricultural goods, including lobster, are imported under unique tariff-free specifications. There are no quotas or safeguard limits on lobster due to the reliance on imports for consumption/food.

Malaysia: Under both the Malaysian-Australia FTA and the ASEAN-AANZFTA the tariffs for rock lobster import were eliminated.

Hong Kong: Hong Kong is a free trade port, there are no tariffs in place for rock lobster.

Thailand: Under both the Thailand-Australia FTA and the ASEAN-AANZFTA the tariffs for rock lobster import were eliminated.

Value add opportunities

Case study:
Spring Bay Seafood

Spring Bay Seafood is a Tasmanian mussel producing company. Spring Bay grows the mussels from a commercial hatchery operation after which they are transferred to suspension lines to grow-out in deeper water.

They clean, process and pack all their products on-site at their facilities in Tasmania. The facility allows them to pack product to consumer preferences, i.e. fresh and alive, pre-cleaned and ready to cook or pre-cooked and flavoured for at home consumption.

While not an example of an on-shore aquaculture operation, Spring Bay's ability to vertically integrate from production to processing and then direct to consumers demonstrates how differentiation can generate value capture opportunities along the supply chain. Processing of rock lobster into ready-to-eat and ready-to-cook packages would create a secondary income source to the more conventional live and chilled whole or tail exports that currently occur from off-shore operations.

Source: Spring Bay Seafood website.

Key competitors

There are a lot of competition for lobster export into the in-scope markets assessed in this study. In most instances, on price and quantity, competitors are more likely to export rock lobster than Australia. However, Australia has a comparative advantage in the quality of its final product, and demand for Australian sourced seafood is rising in Asian markets because of this. In the UAE, quality is less of an issue and India provides a highly competitive product into the market. While the volume of goods exported is still not comparable to USA and Canada, Australian lobster has a higher average export price per unit than competitors.

Table 21: International competitors for lobster products

International competitors	In-scope markets effected
United States/Canada Canada	Canada and the US account for the majority of global frozen lobster production and exports. They dominate the market due to their abundance of low priced product, particularly into markets with FTAs in place. Korea, Singapore, China, Gulf Countries (including UAE)
India	Gulf countries (including UAE).
Vietnam	Japan
Thailand	Japan

Brazil	Japan, Singapore, China, UAE, Thailand, Hong Kong
New Zealand	China
South Africa	Hong Kong, China, Japan

Source: The Observatory of Economic Complexity (Rock Lobster and other sea crawfish, frozen and not frozen, 2016).

The establishment of air freight routes into Asia is likely going to facilitate better access of Australian rock lobster into Asia and the UAE. These routes however benefit all domestic players who have a nearby departure point. As such, Townsville will need to differentiate its production method and ability to value-add to ensure that it out-competes other domestic suppliers.

Table 22: Domestic competitors for lobster products into in-scope markets

Domestic competitors	Type of competition
New South Wales Rock lobster, wild-catch	$11.8 million in value, 158 tonnes of lobster caught, in 2015-2016. Of which only $3.02 million was exported.
Victoria Rock lobster, wild-catch	$24.5 million in value, 288 tonnes of lobster caught, in 2015-2016. Of which, $96.8 million was exported.
South Australia Rock lobster, wild-catch	$137.7 million in value, 1,592 tonnes of lobster caught, in 2015-2016. Of which just under a quarter was exported.
Western Australia Rock lobster, wild-catch	$394.1 million in value, 5,712 tonnes of lobster caught, in 2015-2016 season. Of which, most of this was exported in fact, in some years 99 per cent of product is air-freighted direct to China.
Tasmania Rock lobster, wild-catch	$92.9 million in value, 1,138 tonnes of lobster caught, in 2015-2016. Of which, $27.4 million was exported.

Source: Fisheries Research and Development Cooperation.

Soybean

KEY INSIGHTS:

- Production of non-GM soybean is viable in the North Queensland region, with production systems well suited to growing in rotation with sugarcane given it is a legume.
- There is some small-scale existing production in the North Queensland region however there is scope to expand this production by increasingly using soybean as a rotation crop into sugarcane, or by leveraging land that is available in neighbouring LGAs (that also have favourable agronomic conditions).
- Demand is driven from Asian markets that traditionally consume high volumes of soy in their diets. Particularly China, Japan, Indonesia and India. While these countries don't have high imports of soybean from Australia currently (instead they look to source from the Americas), there is a lot of potential for Australia to capture a niche market given we only grow non-GM soybean.
- There is a lot of value-add opportunities in the soy product market as soybean can be transformed into tofu, soy meal and noodles.

Current production, supply and demand

Production in the North Queensland region:

Soybean (glycine max) is a type of legume, native to eastern Asia. They are either used directly as a whole seed, or are processed and incorporated as a high protein ingredient for both human and animal feed consumption. Soybeans mainly comprise of water and protein, but also contain a good amount of carbohydrates and fats, making them a valuable dietary product.

There are two primary types of soybean production, GM and non-GM. Queensland soybean (and all other Australian producing regions) are non-GM.

The two main markets for soybean include crushing grade grain for oil, and culinary grade grain for the edible trades (AOF, 2008). Queensland soybean is used to produce various products such as soy flour, soy protein, tofu, soy milk, soy sauce and soybean oil. The main varieties of soybeans grown in Queensland include Cowrie, Soy 791, Bunya, A6785, Surf, Oakey, Fraser, Warrigal, Stuart, Leichhardt, Manark, Dragon and Jabiru (AOF, 2008).

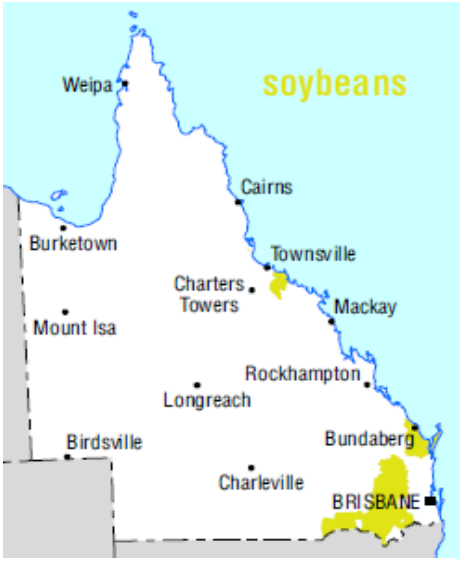


Figure 13: Map of soybean production in Queensland.
Source: QLD DAF.

In coastal Queensland, soybean is deemed a suitable rotation crop with sugarcane, providing proven benefits including establishing a disease break and enriching the soil with fixed nitrogen and organic matter for the following crop to use (AOF, 2008).

Soybean crops achieve maximum yield potential when free from moisture-stress throughout the season. Harvesting of the crop should start when seed-moisture levels reach 16 per cent with the maximum moisture level for crushed beans in 13 per cent and 12 per cent for edible beans (DAF, 2018b).

Over the 2017/2018 summer, Australia had 37,000 hectares of soybean crop and produced 63 kilo tonnes of soybean, with Queensland crops contributing 13,000 hectares and 22 kilo tonnes of soybean. Australian soybean is sold for an average of $497 AUD per tonne, according to 2018 quarter one data (ABARES, 2018d).

Soybean production in Australia is relatively small compared to other countries, however key advantages include favourable shipping proximity to Asian markets, where the demand for soy products is high, and soy beans in Australia are harvested in the opposite season to northern hemisphere crops, creating a strong demand from importers.

Current demand in priority export markets

Of the top ten priority markets current demand for soybean from Australia is $8.8 million, or just under 25,000 tonnes. The majority of this current demand comes from Korea, Singapore and Malaysia. Soybean is not a major broadacre crop in Australia, most of the harvest is consumed domestically in value added products for human foodstuffs or as animal feed (such as soy milk and tofu or animal-feed soymeal).

Future demand in priority export markets

There is enormous potential for soybean exported from Australia due to the non-GM status of the Australian crop. Unmet demand from the in-scope markets equated to an approximate additional $6.5 million. This figure is deceptively low however since the soybean market as quantified by the ITC does not account for the status of GM or non-GM varieties. Thus while demand for Australian soybean is relatively low, stakeholder consultation confirmed that if production of Australia's non-GM soybean increased, high soybean-demanding countries would likely pay a premium price for increased supply above that recorded.

Current supply originating from Townsville region

Current production of soybean in the North Queensland region is relatively limited at approximately 1,000 ha. However there is significant scope for rapid expansion through the use of existing sugarcane and rotation cropping which expands >36,000ha in the region.

Market entry considerations

Product specifications

Korea: Soybean products such as Kanjang (fermented soy sauce) and Doenjang (fermented soybean paste) occupy an important place in Korean's daily lives, typically used as seasonings and to be incorporated in many side dishes. Due to the frequent consumption of these products in the Korean diet, the demand from manufacturers is high. The majority of imported soybean is sourced from the USA and Brazil. Korean food manufacturers source Australian products, either non-GM or organic, to achieve a point of difference and premium positioning (USDA, 2018).

China: Chinese demand is twofold. In recent years, China has experienced a large increase in demand for soybean for animal feed due to the expansion of pig and poultry operations that use soymeal for feed. Additionally, consumption of soy based food products such as tofu still remains popular for lower-income earners. On a global scale, China has the largest demand for soy products, with over 60 per cent of the world's soybean exports being used to operate the pig and poultry industry (SCMP, 2016). The majority of soybean is sourced from the US, however Canada and Brazil also contribute significantly to their soybean

imports. Chinese soybean consumption is forecasted to be greater than 117 million tonnes in 2018-19, despite higher import prices slowing the demand for soymeal as animal feed when compared to previous year's growth (South China, 2016).

Japan: Japanese customers are demanding convenience and freshness in food products, with health concerns being a strong driver. Japan is a major soybean consuming market, and manufacturers of tofu, natto, miso, soy milk, soy sauce and kinako require affordable imported soybean in order to keep the food industry profitable. Japanese buyers demand their suppliers have quality assurance, consistency, commitment and differentiation (i.e. organic) (USSEC, 2012). All soybean used in Japan must be non-GM. The Japanese also enjoy edamame as a popular side dish, which is steamed and salted soybean that remain in their pods (USSEC, 2012).

Indonesia: Tempeh is a traditional soy product originating from Indonesia and is made from fermented soybean that have been transferred into a cake-like form. It is a popular form of protein due to its much lower price point in comparison to meat and chicken. Indonesia does not produce non-GM soybean which are required for the production of tempeh, and therefore the import rate for non-GM soybean is relatively high. Large amounts of tofu are also used in Indonesian cuisine.

Malaysia: Malaysia does not produce soybean, therefore all goods must be imported. Almost 80 per cent of soybean imported is crushed to produce soymeal which is then processed for animal feed. Soybean crushing is growing in line with the poultry industry, which is largely driven by a six per cent Goods and Services Tax imposed on beef, seafood and pork resulting in consumers switching to a cheaper protein source such as dressed poultry (USDA, 2018c). The forecasted 2020 per capita consumption of poultry in Malaysia projected to be 53kg, which is up six per cent from 2016. Approximately 20 per cent of imported soybean is for human consumption, with the finished goods typically being soy milk and tempeh (USDA, 2018c).

Hong Kong: Market driven factors (such as exporting requirements of finished goods) mean major soybean processors in Hong Kong require non-GM soybeans (USDA, 2017b).

Thailand: Due to low domestic production, almost all domestic consumption of soybeans for animal feed, vegetable oil and food in Thailand is met by imported goods. Thai regulations require all soybean imports used for human consumption be GM free. Goods produced from imported soybean include soy milk, tofu, and soy bean sauces. Total domestic soybean consumption is forecasted to further increase too due to a greater use of full fat soybean and increased soybean oil production capacity resulting from a new operational facility (USDA, 2018d). Soybean imports are expected to grow in proportion to consumption. Imported soy beans are also crushed to produce soymeal for animal feed. As the amount of crushed soybean increases, soybean oil extraction will also increase (USDA, 2018d).

UAE and Singapore: There is limited demand for soybean.

Food safety protocols

Market	Import permit required	Phytosanitary Certificate (PC) required	Additional declarations/endorsements required
Korea	✗	✓ Phytosanitary Certificate	✗ Labelling must include: product name, product type, importer's name and address, manufacture date, shelf life or best before date, contents (calories), ingredients name and content, additives, allergens and nutrients.
China	✓ Import permit	✓ Phytosanitary Certificate	✓ Quarantine inspection permit (QIP). A QIP can technically cover multiple load/containers and is valid for six months. Biosafety Import Certificate, if the product contains registered GMs. Distinct labelling is also required for all biotech products.
Japan	✗	✓ Phytosanitary Certificate	N/A
Indonesia	✓ Import permit	✓ Phytosanitary Certificate	✓ Fresh food of plant origin safety certificate. GM content certificate which states, it may contain GM, from products derived from soybean.
Singapore	✗	✗	✗ Labelling should indicate: country of origin, packaging dimensions, name and address of manufacturer, composition and expiry dates.
UAE	✓ Import trade licence is required.	✓ Phytosanitary Certificate	Goods should be packed to provide protection against extreme heat and humidity, storage in the open and possible unloading into lighters. Labels of imported goods must have the following information; the origin of all animal fats, net contents in metric units, production and expiry date, country of origin, manufacturer's name and address, and special storage and preparation instructions if any.
Malaysia	✓ Import permit	✓ Phytosanitary certificate must be issued within 14 days of the consignment being exported from Australia.	N/A
Hong Kong	✗	✗	✓ Labelling can be in English or English-Chinese (bilingual) and must include the following: name of the food, ingredients, including food additives, durability period, special condition for storage or instruction for use, quantity and name and address of manufacturer or the packer.

Market	Import permit required	Phytosanitary Certificate (PC) required	Additional declarations/endorsements required
Thailand	✗	✓ Phytosanitary Certificate	N/A
India	✗	✓ Phytosanitary Certificate	✓ Labelling must include: product name, product type, importer's name and address, manufacture date, shelf life or best before date, contents (calories), ingredients name and content, additives, allergens and nutrients.

General considerations:

Consignments are to be free from pests, soil, weed seeds and extraneous material.

Trade restrictions

Korea: Due to the Korea-Australia FTA there is no tariff for soybean. The Korea-Australia FTA tariff for soybean oil however is 2.7 per cent.

China: Under the China-Australia FTA the tariff has a base rate of three per cent, however importers are able to unilaterally reduce the applied tariff at any time.

Japan: Due to the JAEPA there is no tariff on soybean.

Indonesia: Due to the ASEAN-AANZFTA there is no tariff on soybean. When domestic soybean are available, as determined by the Government of Indonesia, import may be more difficult as the government has food self-sufficiency goals.

Singapore: Under the ASEAN-AANZFTA there is no tariff on soybean. The Port of Singapore includes a duty-free zone where goods in transit are permitted to be stored, resorted or repacked without incurring duty.

UAE: There is no tariff on imported soybean, crushed or whole into the UAE (however on some subsidiary products e.g. soy sauce the typical five per cent tariff is applied).

Malaysia: Due to the Malaysia-Australia FTA and the ASEAN-AANZFTA there is no tariff on soybean.

Hong Kong: Hong Kong is a free port with no general tariff on imported goods.

Thailand: The Thailand-Australia FTA and ASEAN-AANZFTA permits unlimited imports at a zero percent tariff.

Export method

Export is typically via ship due to the non-perishable nature of the product. The majority of soy beans are exported in crushed form to satisfy the market demand for animal feed, however due to the increasing demand for human consumption of soy products, the rate of whole bean exports is increasing (AOF, 2011).

Value add opportunity

Case study:
QSF Queensland

QSF is a company based in Slacks Creek, Queensland that seek to "encourage healthy eating which is why we actively strive to manufacture only the highest quality foods from Australian grown soybean. We source high quality, GM-free soybean from Toowoomba, Queensland. QSF has established an excellent reputation in the soy industry within the Asian market through providing exceptional customer service and delivering only the highest quality products." (QSF)

The company uses Australian GM-free soybean to produce tofu, soy milk, soy custard and noodles. The GM-free soybean produced in Australia presents value add opportunity to display Brand Australia in global export markets and attract a premium price.

Source: Queensland Soy Factory.

Key competition

The USA, Argentina and Brazil dominate on a global scale for soybean exportation however as at 6 July 2018, China has imposed a 25 per cent tariff on soybean and other farm goods on USA agricultural products and this is generating significant opportunities for Australia to re-enter the export market and provide large volumes of supply to the market, particularly with the premium non-GM varieties grown. However, it should be noted that this trade war is not likely to be long-term.

Table 23: International competitors for soybean products

International competitors	In-scope markets effected
United States	China, Indonesia, Japan, Thailand, Malaysia, Korea, Singapore, Hong Kong
Argentina	China, Malaysia, Korea
Brazil	China, Singapore, Korea, Japan
Canada (non-GM)	Malaysia, Japan, Korea, Singapore

Source: World Atlas.

Table 24: Domestic competitors for soybean products (in-scope markets)

Domestic competitors	Type of competition
Tropical/coastal regions (NT and QLD)	All producers in Australia produce a non-GM soybean that will compete with production in the North Queensland region. However given the scale of demand in the international export markets identified there is strong potential for production in the North Queensland region to increase production and take advantage of the increased demand.
Subtropical regions (northern NSW and south-eastern QLD)	
Dryland regions of northern NSW	
Inland irrigated regions of central NSW	
Riverina	

Source: Agrifutures, Soybean.

Appendix C: Scenario analysis

Capacity and capability for agricultural production

Section Snapshot

What? Assessment of land in the in-scope region for agricultural production capacity and capability

How? Review of publicly available data to classify land types, water availability and labour status

Key insights

- The region has the capacity and capability to produce products for high demand markets
- Strengths: favourable climate, proximity to Asia, available labour, regional sea port and airport infrastructure
- Challenges: extreme weather events, export market access (air freight), high transport costs, climate change, supply chain limitations

Opportunities: expansion of irrigation, export of high-value products, improvement of supply chain infrastructure, use of renewable energy and utilisation of regional labour sources (seasonal and permanent)

Land

The following sections describe the data that is currently available to assess the existing agricultural production capacity and capability in the in-scope region.

The guidelines for agricultural land evaluation in Queensland (DSITI and DNRM 2015), define land capability as a classification that evaluates the potential of land for broadly defined land uses (e.g. cropping, pastoral, non-agricultural). In contrast, land suitability classification assesses the potential of land for a specific land use (e.g. furrow irrigated cotton). Both land capability and land suitability assessments rely on the best available description of primary attributes of mapping units obtained during a land resource survey. These attributes are converted into land use limitations.

Table 25: LGA snapshot: land and labour capability

LGA	Key characteristics
Charters Towers	Existing beef industry workforce, land suited to intensification of beef industry, capacity to develop irrigation for production of soybean (and other grains)
Hinchinbrook	Existing sugarcane industry provides base for transferable skills, land suited to production of high-value crops in addition to/in rotation with sugarcane, irrigation development required
Townsville	No agricultural industry employment, land suited to development of aquaculture and related storage and/or processing facilities due to proximity to ports
Burdekin	Existing sugarcane industry provides base for transferrable skills, land suited to production of high-value crops in addition to/in rotation with sugarcane, irrigation development required
Palm Island	Capacity for agricultural employment, land suited to high-value crops, irrigation development required

Queensland Agricultural Land Audit

The Queensland Agricultural Land Audit (QLD DAFF, 2013) (Audit) identified the following issues for North Queensland:

- The region has infrastructure and water to support existing operations and future growth in agriculture. Although some roads are susceptible to flooding in the wet season, meat processing in Townsville is not affected because it does not operate during this time.
- The proximity to Asia and existing port and airport facilities in Townsville provide opportunities for exporting fresh horticultural commodities to Asia.
- Land degradation has lowered the carrying capacity of the grazing land in the region and there are many invasive plants. There are opportunities to raise production through improved land management.

In the in-scope region, two areas have been identified as important agricultural areas with a total area of 360,603 ha. An important agricultural area is an area that has all the requirements for agriculture to be successful and sustainable, is part of a critical mass of land with similar characteristics and is strategically significant to the region or the state. These include:

1. Herbert River and Ingham area – The area around Ingham, up the Herbert and Stone rivers and south to Rollingstone is an important sugarcane growing area, has soils and climate suitable for broadacre cropping and has grazing, forestry, aquaculture and some horticulture. The total area mapped is 160,477 ha.
2. Lower Burdekin – The area around Home Hill and Ayr, west to Giru and south along the Burdekin River is an important sugarcane and horticulture area. It is also suitable for hardwood timber plantations and broadacre cropping. The eastern part of the area has potential for aquaculture. The total area mapped is 200,126 ha.

Land capability and land suitability are discussed in further detail below.

Capability

Land capability classification in Queensland is the evaluation of land attributes for arable, pastoral and other agricultural land uses involving current technology and agronomic management practices. It is recommended for studies where evaluation for a limited range of agricultural land uses is required at a small or broad scale (1:250,000 or smaller) over large areas.

Suitability

Land suitability classification is consistent with the FAO method (FAO, 1976) and is recommended for studies where more specific information, at medium or large scales (1:100,000 or larger, i.e. more detailed), is required. Land suitability classification in Queensland is the evaluation of soil and land attributes based on the requirements of a specified land use using current technology and management. In this context, a land use is the combination of a crop and its management options (e.g. dryland maize, furrow irrigated cotton, trickle irrigated apples, rain fed sorghum, drip irrigated grapes). In some cases, the growing season, summer or winter, may also be specified. Socio-economic factors are considered in general terms only, either at the start of the study or in the definition of the level of inputs required to overcome each limitation.

Five land suitability classes are defined for use in Queensland, with land suitability decreasing progressively from class 1 to class 5. These classes are used to describe an area of land in terms of suitability for a particular land use allowing optimum, sustainable production using current technology, while minimising degradation to the land resource in the short, medium or long term.

Land is considered less suitable as the severity of limitations for a specified land use increase.

Limitations include:

- reduced potential for production
- increased inputs required to achieve an acceptable level of production

- increased inputs required to prepare the land for successful production
- increased inputs required to prevent land degradation.

The five land suitability classes are:

- Class 1 – Suitable land with negligible limitations
- Class 2 – Suitable land with minor limitations
- Class 3 – Suitable land with moderate limitations
- Class 4 – Unsuitable land with severe limitations
- Class 5 – Unsuitable land with extreme limitations

The first three classes of land (classes 1 to 3) are considered suitable for the specified land use because the benefits obtained from that land use in the long term should outweigh the inputs required to initiate and maintain production. Class 3 land may be as productive as class 1 or 2 land; however, increased inputs (e.g. fertiliser, land preparation and maintenance operations) would generally be required.

Seventeen limitations and 20 land management options were used to assess land suitability in the Bowen and Lower Burdekin area and 13 limitations and 39 land management options were used to assess land suitability in the Wet Tropics and Tablelands area (Table *26*).

Table 26: Limitations and land management options in the Bowen and Lower Burdekin, and Wet Tropics and Tablelands areas

Bowen and Lower Burdekin		**Wet Tropics and Tablelands**	
Limitations	**Land management options considered**	**Limitations**	**Land management options considered**
1. Acid drainage water hazard potential 2. Water erosion 3. Flooding 4. Furrow irrigation 5. Soil water availability 6. Nutrient supply 7. Nutrient toxicity 8. Nutrient deficiency 9. Soil depth 10. Rockiness 11. Soil salinity 12. Soil surface condition 13. Outflow potential 14. Microrelief 15. Slope 16. Wetness 17. Landscape complexity	1. Aubergine-furrow irrigated 2. Aubergine-trickle irrigated 3. Avocado-trickle irrigated 4. Aubergine-trickle irrigated 5. Beans-furrow irrigated 6. Beans-trickle irrigated 7. Capsicum-furrow irrigated 8. Capsicum-trickle irrigated 9. Cotton-furrow irrigated 10. Maize-furrow irrigated 11. Mango-trickle irrigated 12. Pumpkin-furrow irrigated 13. Sorghum-furrow irrigated 14. Soybean-trickle irrigated 15. Sorghum-furrow irrigated 16. Squash-furrow irrigated 17. Squash-trickle irrigated	1. Climate 2. Water erosion 3. Flooding, soil water availability 4. Nutrient supply 5. Soil reaction trend 6. Soil adhesiveness 7. Narrow moisture range 8. Surface condition 9. Rockiness 10. Salinity 11. Slope 12. Wetness 13. Landscape complexity	1. Avocado 2. Avocado-irrigated 3. Banana 4. Banana-irrigated 5. Citrus 6. Citrus-irrigated 7. Coffee 8. Coffee-irrigated 9. Cucurbit 10. Cucurbit-irrigated 11. Custard apple 12. Grapes – irrigated 13. Longan 14. Lychee 15. Lychee-irrigated 16. Macadamia nuts 17. Macadamia nuts-irrigated 18. Mango 19. Mango-irrigated 20. Maize 21. Papaw 22. Papaw-irrigated

Bowen and Lower Burdekin		Wet Tropics and Tablelands	
Limitations	**Land management options considered**	**Limitations**	**Land management options considered**
	18. Sugarcane-furrow irrigated 19. Tomato-furrow irrigated 20. Tomato-trickle irrigated		23. Peanut 24. Persimmon-irrigated 25. Pineapple 26. Potato 27. Potato-irrigated 28. Rambutan 29. Soybean 30. Soybean-irrigated 31. Stone fruit 32. Stone fruit-irrigated 33. Sugarcane 34. Sugarcane-irrigated 35. Sweet corn 36. Sweet potato 37. Tea 38. Vegetables 39. Vegetables-irrigated

Source: DNRM and DSITIA (2013).

Assessment and mapping

The audit indicates that about 25 per cent of the area of the state is at 1:250,000 or better – a scale upon which broad regional planning decisions can be based with some confidence – and the balance is at scales of between 1:500,000 and 1:1 million – a scale upon which broad regional planning decisions can be based with only low confidence.

Land potential was determined by the audit through an approach largely based on the established Agricultural Land Classification (ALC) for strategic planning in Queensland (DPI, 1990). Current land use was identified largely from existing QLUMP datasets (Witte et al., 2006). Important agricultural areas were identified by combining the outputs of these two processes in a multi-criteria approach. The audit used a desktop-based method analysing existing datasets or data developed from existing datasets and presented them using existing tools and expert knowledge in a Geographic Information System (GIS).

The audit indicated that data about land/soil resources has been collected in Queensland by a large number of separate projects (in excess of 250) over many decades. Each of these projects covers different parts of the state. These projects vary in the attributes they report, the quality with which the information has been collected (and hence the confidence with which it can be used) and the scale and accuracy of the mapping.

Hence, for the purposes of the audit it was necessary to first collate these diverse datasets into a single map layer and to establish a consistent scheme for classifying land according to inherent soil characteristics that reflect its fitness for agricultural use.

The audit is based on the Queensland Agricultural Land Class approach as detailed in Chapter 5 of the Guidelines for Agricultural Land Evaluation in Queensland (DPI, 1990) and uses a four-tier hierarchy. However, the audit draws on a broader wealth of experience in land evaluation from within Queensland and internationally and interprets existing land resource information for use in strategic land use planning in Queensland. The Land Class codes used in the audit and their descriptions are provided in Table *27* and range from Class A (arable land) through to Class D (land that is unsuitable for agriculture). The standard definitions published in the Guidelines was amended slightly to better match the requirements of the audit.

Table 27: Audit Agricultural Land Class codes and description

Code	Description	
A	**Crop land** Land that is suitable for a wide range of current and potential crops with nil to moderate limitations to production.	
	A1	Land that is suitable for a wide range[a] of current and potential broadacre and horticulture crops with limitations to production that range from none to moderate levels.
	A2	Land that is suitable for a wide range of current and potential horticultural crops only, with limitations to production that range from none to moderate levels.
B	**Limited crop land** Land that is suitable for a narrow range[b] of current and potential crops. Land that is marginal for current and potential crops due to severe limitations but is highly suitable for pastures. Land may be suitable for cropping with engineering and/or agronomic improvements.	
C	**Pasture land** Land that is suitable only for improved or native pastures due to limitations which preclude continuous cultivation for crop production. Some areas may tolerate a short period of ground disturbance for pasture establishment.	
	C1	Suitable for grazing sown pastures (with ground disturbance for establishment) or has native pastures on higher fertility soils.
	C2	Suitable for grazing native pastures with or without the introduction of pasture species – not suitable for ground disturbance to establish pastures.
	C3	Suitable for light grazing of native pastures in accessible areas, and includes steep land more suited to forestry or catchment protection.
D	**Non-agricultural land** Land not suitable for agricultural uses due to extreme limitations. This may be undisturbed land with significant conservation and/or catchment values, land that may be unsuitable because of very steep slopes, shallow soils, rock outcrop, poor drainage, salinity, acidic drainage, or is an urbanised area.	

[a] A wide range of crops is defined as four or more existing crops of local commercial significance. In areas where specialised infrastructure to support an agricultural industry is present, the land may only be currently suitable for two or more crops, providing at least one is regionally significant.
[b] A narrow range of crops is defined as three or less crops of local commercial significance (or less than two where specialised infrastructure is present).

The following appendix contains additional information and data used to inform the land capability assessment within the scenario analysis, including references to the methodology undertaken.

Development and use of land suitability frameworks

For the Regional Land Suitability Frame Work for Queensland (DNRM and DSITI, 2013), appropriate land uses were selected for each regional study area by reviewing existing land evaluation studies and through consultation with appropriate professionals, landholders and organisations. General land use requirements (for practices such as plant growth, machinery use, land preparation and prevention of soil erosion) have been defined in the guidelines (e.g. rock free soil, adequate soil water, minimum soil loss due to erosion).

Limitations are soil or land attributes that impede the productive growth of crops or pastures. Limitations may be expressed as land use requirements stated in a negative sense (e.g. rockiness, wetness) and are the main focus of the land suitability process.

The soil and land attributes that are selected to assess each limitation (e.g. abundance and size of coarse fragments for rockiness, site drainage class for wetness) are also termed diagnostic attributes. Limitation categories are then selected to cover the range of values for each diagnostic attribute for each limitation that will apply across all land uses. The limitation categories are ranked as suitability subclasses on a scale of 1 to 5, from most suitable to unsuitable, for each limitation for each land use. The land suitability framework is essentially a matrix for each limitation, showing the suitability subclass for each land use against each limitation category.

An overall suitability class for each land use is then determined for each mapping unit (unique map area, UMA) on a scale of 1 to 5. This is usually determined by the most severe suitability subclass that applies in that particular UMA (Table *28*). If a particular land use has a suitability subclass of 4 (marginal) for several different limitations, it may be deemed appropriate to downgrade the suitability class in that particular UMA to 5 (unsuitable).

Table 28: UMA 121 classifications

UMA 121	Limitation	Suitability subclasses for four land uses			
100 per cent Red Kandosol on 10 per cent slope	**Categories for three different limitations**	**Sugarcane**	**Peanuts**	**Banana (irrigation)**	**Rambutan (irrigation)**
	Soil water availability-4	3	4	2	2
	Rockiness-3	3	5	2	1
	Wetness-3	3	3	3	2
	Overall suitability class for the UMA	3	5	3	2

Three land use suitability frameworks apply to the study area:

1. Most of the study area has been assessed in the Regional Land Suitability Frameworks for Queensland (DNRM and DSITIA, 2013).
2. The coastal area to the north has been assessed within the suitability framework for the Wet Tropics and Tableland areas (DNRM and DSITIA, 2013, Chapter 12).

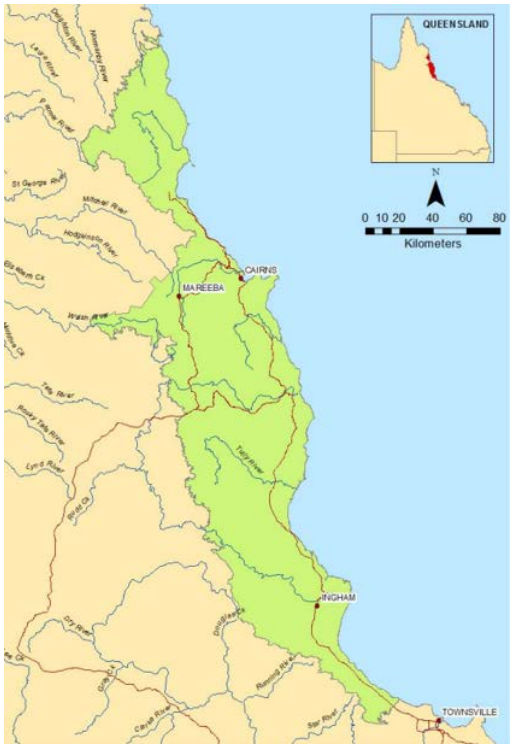


Figure 14: Area covered by the Wet Tropics and Tablelands suitability framework.

3. The coastal area to the south has been assessed within the suitability framework for the Bowen and Lower Burdekin area (DNRM and DSITIA, 2013, Chapter 11).

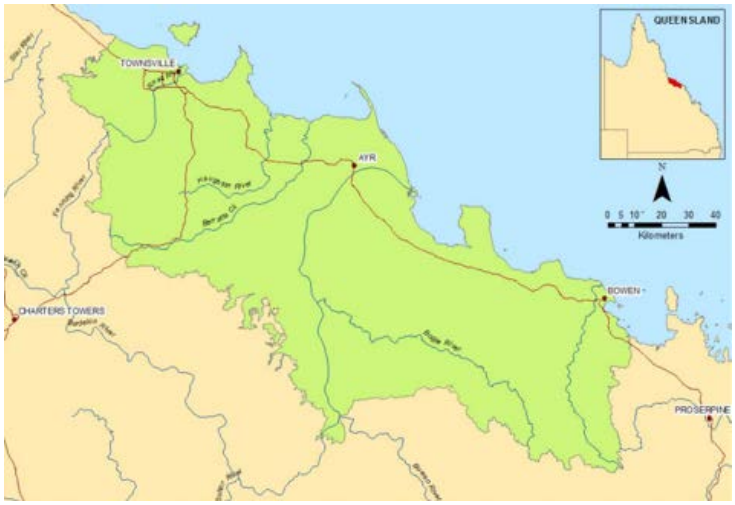


Figure 15: Area covered by the Bowen and Lower Burdekin suitability framework.

Agricultural land classes

Agricultural land classification in Queensland (DNRM and DSITIA, 2013) follows a simple hierarchical scheme that is applicable across the state. It allows the presentation of interpreted land evaluation data to indicate the location and extent of agricultural land that can be used sustainably for a wide range of land uses with minimal land degradation. Provision is also made to highlight areas that may be suitable for one specific crop considered important in a particular area. Three broad classes of agricultural land and one non-agricultural land class are identified:

- Class A – Crop land
- Class B – Limited crop land
- Class C – Pasture land
- Class D – Non-agricultural land.

The classes imply a decreasing range of land use choice and an increasing severity of land use limitations and/or land degradation hazard. The classification is hierarchical, with Class A land having the greatest potential for producing the widest array of crops and Class D land being unsuitable for any agricultural land use.

The four classes include subclasses. For example, Class A (crop land) has two subclasses: A1 – land suitable for a wide range of broadacre and horticulture crops and A2 – land suitable a wide range of horticultural crops only. This allows better discrimination of crop land at both local and state-wide levels.

Class B (limited crop land) is land that is not suitable for a wide range of crops (broadacre and/or horticultural) but is suitable for a narrow range of crops or crops with specialised requirements e.g. tea, pineapples, plantation forestry. Class B land may be suitable for a wider range of crops with increased knowledge, economics or technology. It is also suitable for sown pastures and pasture phases may be an integral part of a cropping system on this type of land.

Data confidence

As part of the validation process for the audit data confidence maps were developed. These maps reflected the variation across the state (from area to area and from project to project) in the relative precision and accuracy in the data used. Confidence in land resource data is broadly related to the scale of original mapping. Mapping at better than 1:100,000 is considered highly adequate for regional planning. Mapping at between 1:100,000 and 1:250,000 is considered to be adequate but still requiring some caution in its use. Mapping at greater than 1:250,000 is considered to be marginally adequate for regional planning and should be used for this purpose only with a high degree of caution (e.g. decisions should not be based on this information alone without cross-validation with other sources). Data mapped at scales of 1:2 million or greater (such as data from CSIRO's Atlas of Australian Soils; (CSIRO, 2013) is considered inadequate for audit purposes. The audit assessed the quality of available land resource data and data confidence in the Charter Towers region as low (96 per cent low and 4 per cent medium), meaning most of the mapping was undertaken at a broad scale.

Data availability

A comprehensive review of all existing information and data relevant to the project was conducted. The information was largely sourced from the audit and the Queensland Spatial Catalogue (QLD DNRM, 2018). All available soil and land suitability reports (31) and spatial data was collated in Table *29*.

The Charters Towers region (incorporating all LGAs in the audit excluding Palm Island) is 7.96 million hectares in size. 86 per cent of the region's land area is used for agriculture, with the majority (84 per cent) used for grazing. There is 851,529ha or 10.7 per cent of the total area that is mapped at a scale of 1:100,000 or larger. This is appropriate to determine land suitability (the crop and its management options) with confidence. Beneficially, although a low percentage, this mapping is contained within key important agricultural land areas.

Brief summaries of the information sources used in the study, and relevant collated findings from these resources are provided in the following sections.

Table 29: Regional soils and land suitability mapping

Project code	Project name	Survey type	Start date	End date	Scale	Area (ha)	Sites	Sites with lab data	Agricultural land classification (ALC) assessment	Land suitability assessment
ARS	Soil survey of Ayr Research Station, North Queensland	Soil survey	01/01/1983	20/12/1986	5,000	42	72	6	N	N
ZEC	Soil survey of the CSIRO Lansdown Pasture Research Station, North Queensland	Soil survey	01/01/1966	31/12/1966	11,880	3,026	20	0	N	N
IAS	Acid sulfate soils of Halifax, North Queensland	Acid sulfate soil survey	01/01/2000	01/07/2009	25,000	2,164	136	135	N	N
HTC	Soil and land suitability of the Burdekin River Irrigation Area, Haughton Central section, North Queensland	Soil and land suitability survey	01/01/1990	31/12/1994	25,000	4,382	802	6	Y	Y
HTN	Soil and land suitability of the Burdekin River Irrigation Area, Haughton North section, North Queensland	Soil and land suitability survey	01/01/1989	31/12/1994	25,000	5,039	946	12	Y	Y
HTS	Soil and land suitability of the Burdekin River Irrigation Area, Haughton South section, North Queensland	Soil and land suitability survey	01/01/1987	31/12/1993	25,000	4,151	808	43	Y	Y
INK	Soil survey of the Burdekin River Irrigation Area, Inkerman Section, North Queensland	Soil and land suitability survey	01/01/1984	31/12/1994	25,000	9,303	1829	20	Y	Y

Project code	Project name	Survey type	Start date	End date	Scale	Area (ha)	Sites	Sites with lab data	Agricultural land classification (ALC) assessment	Land suitability assessment
JFD	Soil survey of the Burdekin River Irrigation Area, Jardine section, North Queensland	Soil and land suitability survey	01/01/1988	31/12/1992	25,000	5,824	884	13	Y	Y
LDR	Soil and land suitability survey of the Burdekin River Irrigation Area, Leichhardt Downs Relift section, North Queensland	Soil and land suitability survey	01/01/1986	31/12/1994	25,000	1,969	442	7	Y	Y
MLG	Soil and land suitability survey of the Burdekin River Irrigation Area, Mulgrave section, North Queensland	Soil and land suitability survey	01/01/1984	01/12/1993	25,000	8,587	1547	13	Y	Y
NHC	Soil and land suitability survey of the Burdekin River Irrigation Area, Northcote section, North Queensland	Soil and land suitability survey	01/01/1986	07/05/1995	25,000	7,872	1246	8	Y	Y
NLH	Soil and land suitability survey of the Burdekin River Irrigation Area, Leichhardt Downs section, North Queensland	Soil and land suitability survey	01/01/1983	31/12/1990	25,000	9,660	995	14	Y	Y
SLK	Soil and land suitability survey of the Burdekin River Irrigation Area, Selkirk section, North Queensland	Soil and land suitability survey	01/01/1990	31/12/1994	25,000	5,597	1053	17	Y	Y
BDS	Soil survey of the Burdekin River delta, North Queensland	Soil survey	01/07/2001	31/07/2005	50,000	68,311	1471	26	Y	Y

Project code	Project name	Survey type	Start date	End date	Scale	Area (ha)	Sites	Sites with lab data	Agricultural land classification (ALC) assessment	Land suitability assessment
RBO	Soil survey of the Burdekin River Irrigation Area, Right Bank, North Queensland	Agricultural suitability survey	01/01/1989	01/12/1994	50,000	40,185	193	0	Y	Y
BRB	Soil survey of the lower Burdekin River - Elliot River area, North Queensland	Soil survey	01/01/1977	31/12/1977	100,000	90,703	69	65	N	N
BRL	Soils of the Lower Burdekin River - Barratta Creek - Haughton River Area, North Queensland	Soil and land suitability survey	01/01/1978	31/12/1984	100,000	107,212	394	67	N	N
DUSLARA	The Desert Uplands Strategic Land Resource Assessment Database	Land unit survey	01/03/1999	31/12/2005	100,000	8,511,988	1708	380	Y	N
MAJCK	Land Resources of the Major Creek Area North Queensland	Soil survey	01/01/1997	31/12/1998	100,000	65,852	277	0	Y	N
BSA	Soil survey of the lower Burdekin River, Redbank Creek to Bob's Creek and Bowen River Area, North Queensland	Soil and land suitability survey	01/01/1979	31/12/1990	100,000	214,826	28	28	Y	Y
WTC	Soil and land suitability survey of the Ingham area, North Queensland	Soil and land suitability survey	01/01/1980	31/12/1990	100,000	319,631	574	158	Y	Y
ZED	Soil Survey of the Townsville Coastal Plains, North Queensland	Soil and other unspecified	01/01/1975	31/12/1975	100,000	240,365	17	0	Y	Y

Project code	Project name	Survey type	Start date	End date	Scale	Area (ha)	Sites	Sites with lab data	Agricultural land classification (ALC) assessment	Land suitability assessment
		evaluation survey								
DLR	Soil survey of Dalrymple Shire, North Queensland	Soil survey	01/01/1990	31/12/1999	250,000	6,767,981	2432	1071	Y	N
SAT	Soil and land resource survey of the Einasleigh-Atherton area, Far North Queensland	Soil and land capability survey	01/01/1985	01/06/1989	250,000	3,515,944	192	0	Y	N
ZCI	Land Systems of the Townsville-Bowen region, North Queensland	Land System survey	01/01/1950	31/12/1953	253,440	1,699,125	0	0	N	N
CHL	Central Highlands Land Management Manual	Land resource area survey	01/01/1988	04/04/2013	500,000	8,679,499	0	0	N	N
FWA2	Western Arid Region Land Use Study - Part 5	Land System survey	03/02/2003	31/12/2008	500,000	8,952,688	0	0	Y	N
ZCQ2	Land Systems of the Nogoa-Belyando area, Central Queensland	Land System survey	01/01/1964	31/12/2008	500,000	8,878,693	0	0	Y	N
GRIP	An Assessment of the Agricultural Potential of Soils in the Gulf Region, North Queensland	Soil and land suitability survey	30/03/1998	01/02/1999	500,000	5,396,967	62	0	Y	Y

Project code	Project name	Survey type	Start date	End date	Scale	Area (ha)	Sites	Sites with lab data	Agricultural land classification (ALC) assessment	Land suitability assessment
ZEG2	Land systems survey of the Leichhardt-Gilbert area, Far North Queensland	Land System survey	03/02/2003	31/12/2008	1,000,000	30,358,613	0	0	Y	N

Queensland agricultural land audit (key information source)

The objective of the audit was to identify land important to current and future agricultural production across Queensland. The audit considers all land across the state where natural resources are, or could be, used for agricultural activities. The audit analyses agricultural production activities up until the product leaves the farm gate, including:

- broadacre cropping
- sugarcane
- grazing
- intensive livestock
- horticulture
- forestry

The audit provides information regarding socio-economic data, overlapping land uses, infrastructure and other opportunities and constraints to agricultural development, enabling Queensland to better identify and plan for future food production. Queensland's 12 regional planning areas form the basis of each regional chapter, including analysis of issues at the state level. The regional planning area of Charters Towers (Chapter 7 of the audit) covers almost the entire in-scope region, with the exception of Palm Island.

Current land use in the in-scope region is presented in Table *30* based on the current datasets, 86 per cent of the region's land area is used for agriculture, with the majority (83.6 per cent) used for grazing. The region is important for sugar, with 32 per cent of the Queensland's sugarcane area occurring in this region. It should be noted that due to current vegetation constraints (including national parks and state forests), 6.9 million hectares (87 per cent of the region) cannot be cleared.

Table 30: Audit current and potential land use

Queensland land use mapping program (2009)	Current land use			Potential land use*	
	Area (ha)	Percentage of region	Percentage of ALUC† that occurs in region	Area (ha)	Percentage of region
Broadacre cropping	8,314	0.10	0.23	151,311	1.90
Sugarcane	180,839	2.27	32.00	1,192,741	14.98
Perennial horticulture	4,167	0.05	4.74	1,469,648	18.46
Annual horticulture	1,232	0.02	2.61	1,553,376	19.51
Grazing	6,650,663	83.56	4.50	6,877,721	86.40
Sown pastures	903,868	11.35	5.63	1,531,329	19.24
Intensive livestock	78	0.00	0.21	2,254,730	28.32

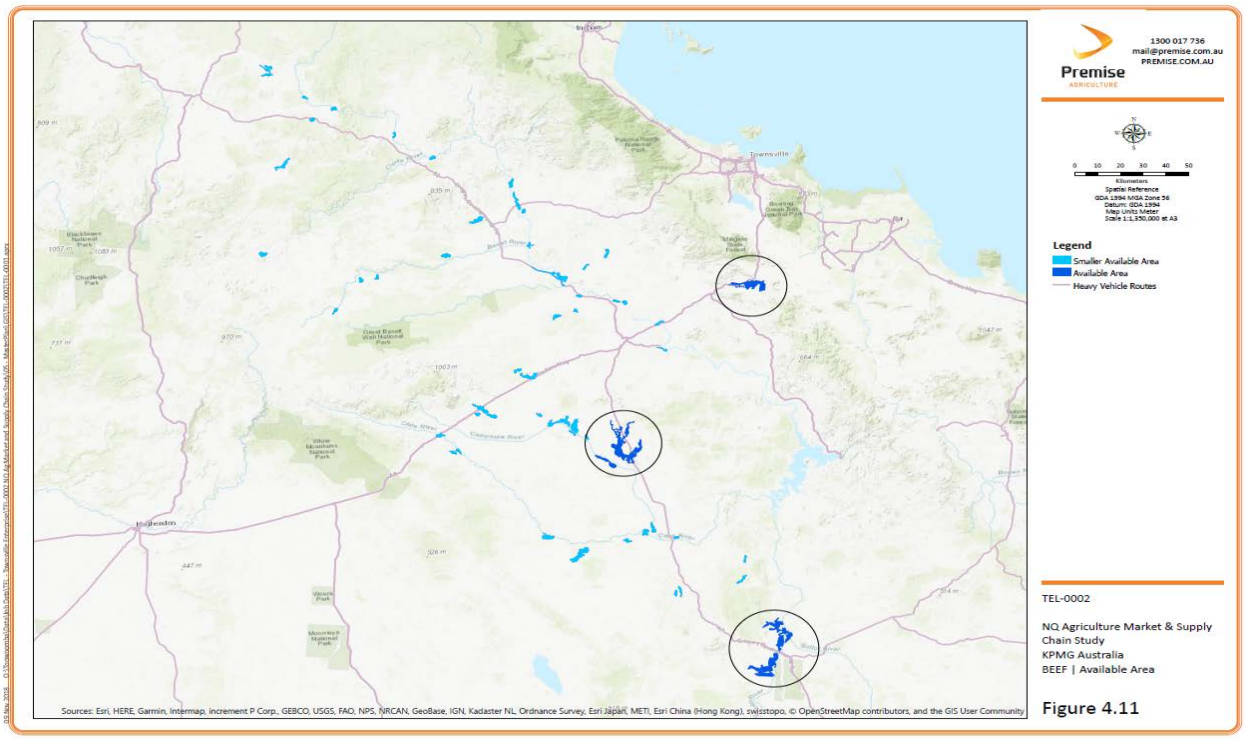
Aquaculture	605	0.01	13.31	14,696	0.18
Other land use (non-agricultural land uses, may include forestry)	1,113,360	13.99	5.55		
Total	**7,959,258**	**100.00**			

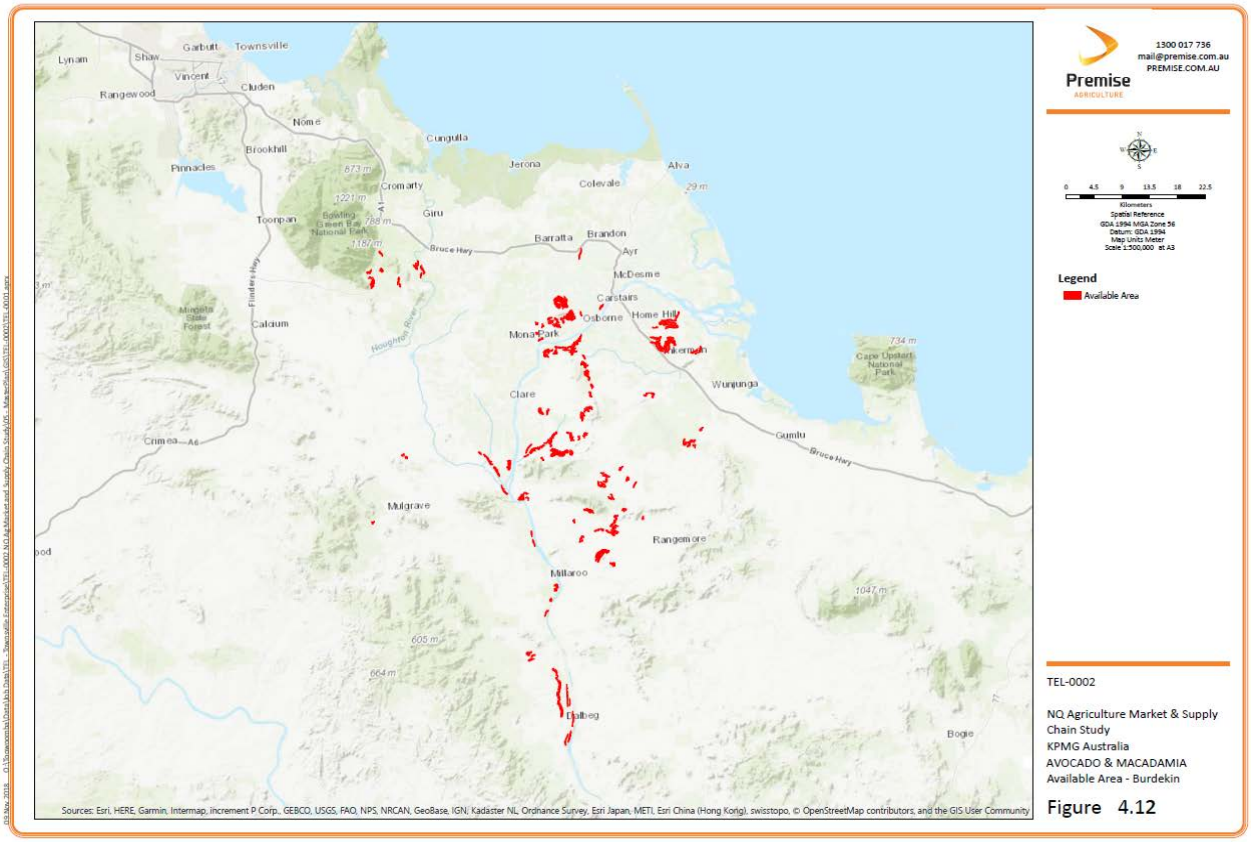
Source: QLD DAFF (2013).

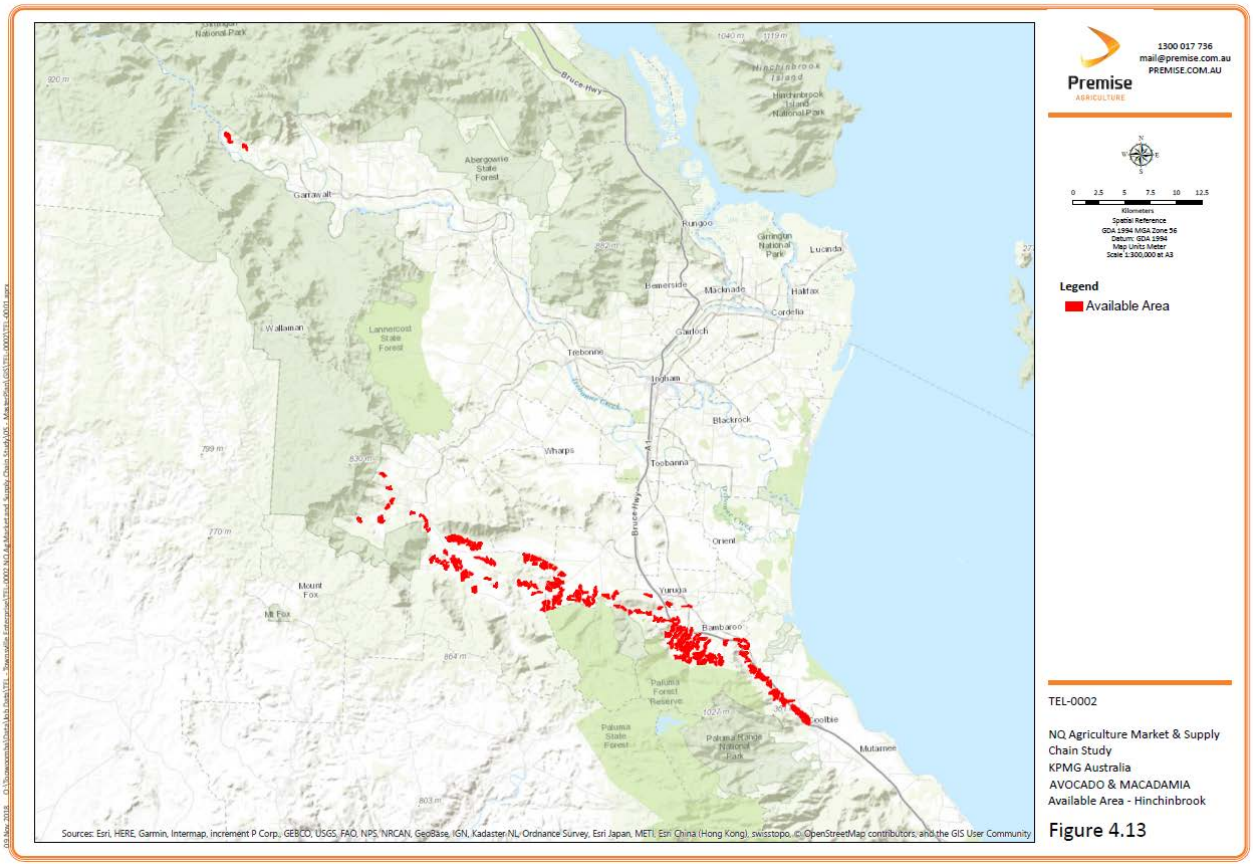
Product suitability assessment method

The mapping of Agricultural Land Use Classification and Agricultural Land Use Class in the Audit provides baseline data for determining land suitability for particular products in the in-scope region. This study has involved a review of this information in the development of a product specific methodology for assessing land suitability in the in-scope region.

Potential production area maps







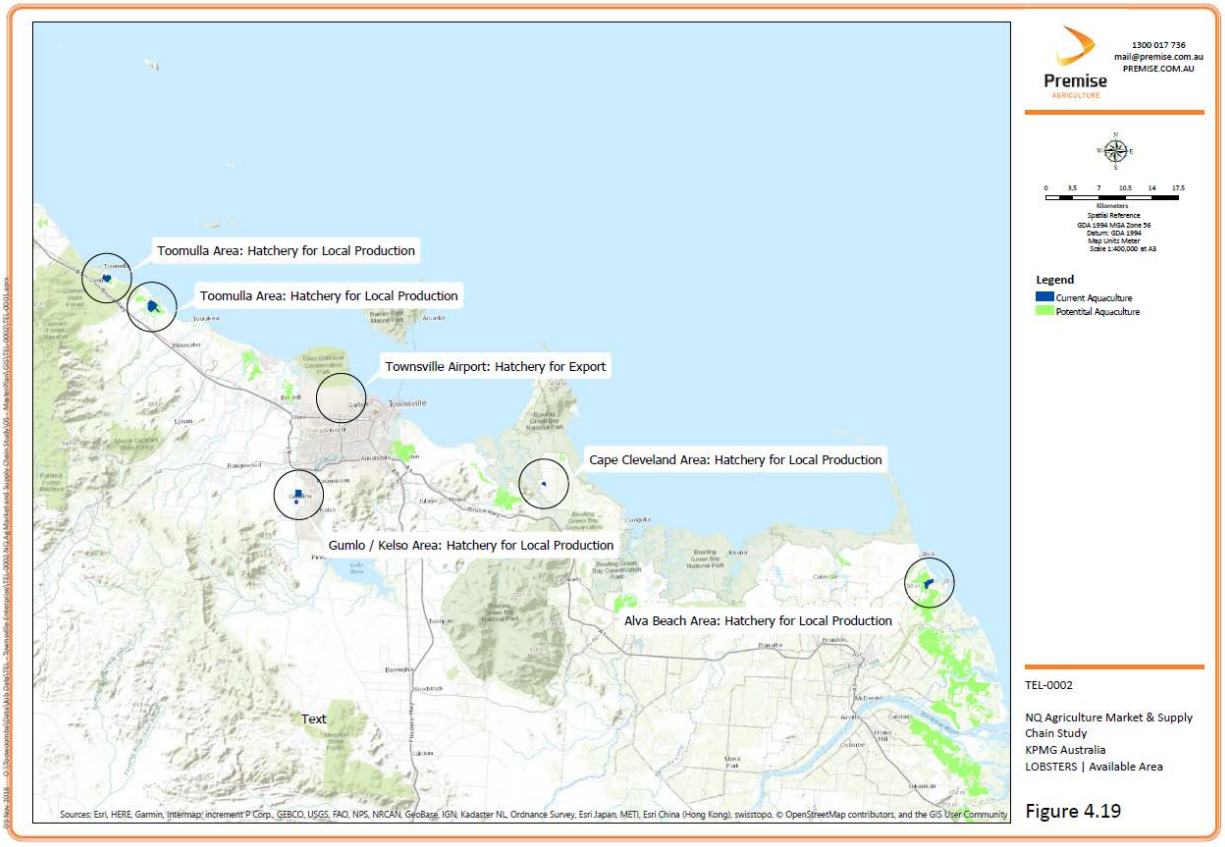


Figure 4.19

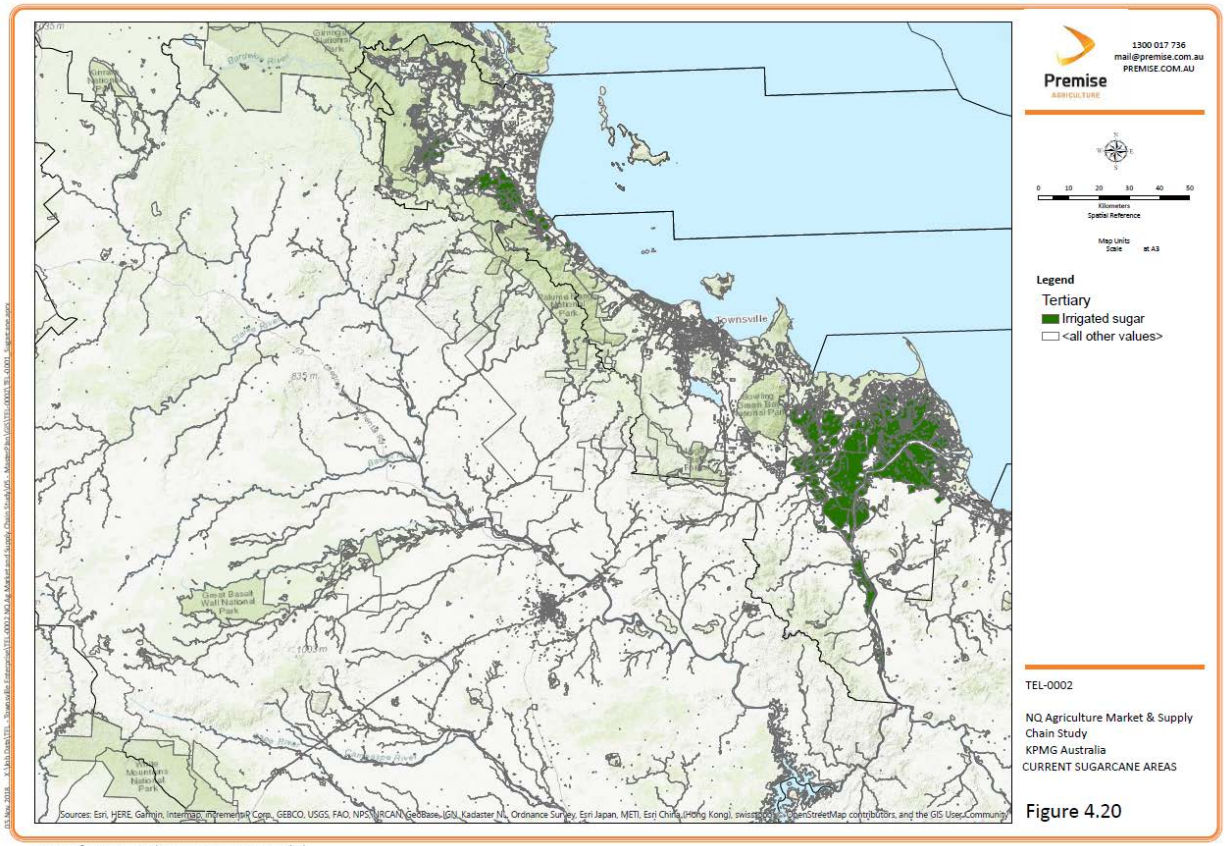


Figure 4.20

Data source: © State of Queensland (Department of Natural Resources and Mines)

Water

Availability

The Burdekin Basin Water Resource Plan (DNRM, 2001) defines the availability of water across much of the in-scope region and the Burdekin Basin Water Management Protocol (DNRM, 2017) provides the most up to date volumes of unallocated water held in reserve.

High rainfall events are regular and increased water storage will underpin lower risk and high-value farm systems in the key areas for growth including intensive beef, soybean (as a rotational crop with other established systems such as sugarcane) and permanent plantings. This reinforces the requirement for the pre-feasibility study into the Hells Gates Dam and the potential to unlock a substantial amount of agriculturally productive land.

Table 31: Total volume of water held in Burdekin Basin region reserve

Reserve	Total mean annual volume (ML)
General reserve	200,000
Strategic reserve for State purposes	35,000
Sun Water reserve	8,744
Strategic reserve for a future raising of Burdekin Falls Dam	150,000
Strategic reserve for water infrastructure for the Bowen and Broken sub-catchments	150,000
Total	543,744

Source: DNRM (2017).

The northern coastal area (around Ingham) was included in the draft Far North Queensland Water Resource plan area, which has not been finalised. There is a moratorium on new water licences for the area while the plan is being developed. There is no water resource plan for the coastal areas between Mutarnee and just south of Townsville.

Since the Queensland Agricultural Land Audit was developed, the Water Resource (Wet Tropics) Plan 2013 (Queensland) was finalised (Figure 16). Details of unallocated water are shown in Schedule 6 of the Plan, which nominates the total volumes of strategic, general, Indigenous and high flow reserve unallocated water. The total volumes of water available in these categories are listed in Table *32*.

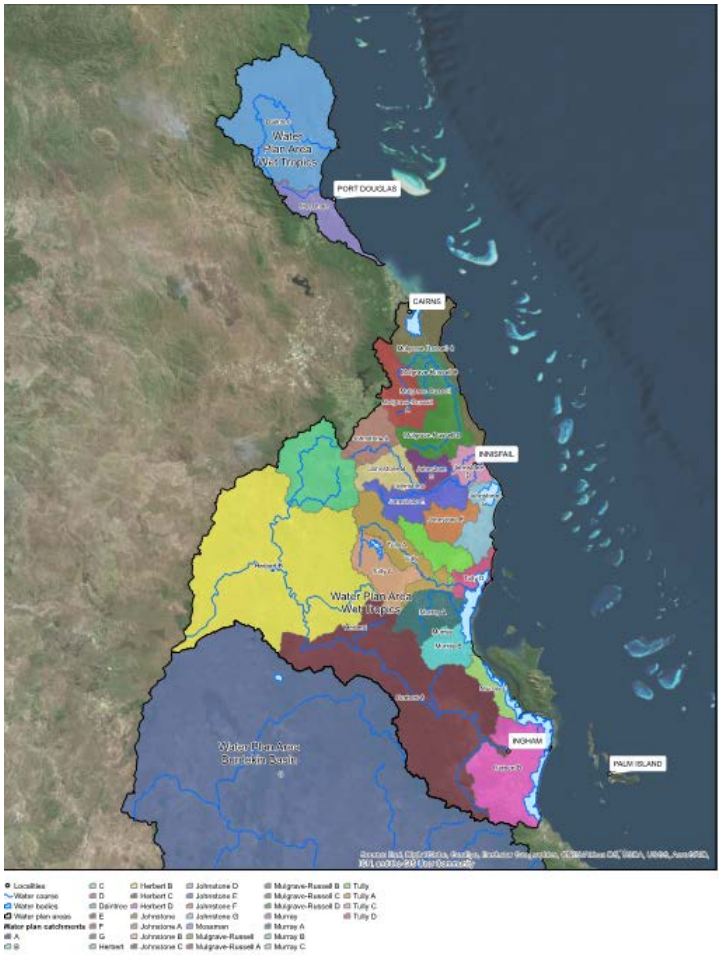


Figure 16: Wet Tropics water resource plan location map.

Table 32: Wet Tropics total volume of unallocated water

Wet Tropics unallocated water purpose	Total volume (ML)
Strategic unallocated water for State purposes	35,900
Strategic unallocated water for Indigenous purposes	52,000
General unallocated water	16,350
High flow unallocated water (ML)	870,000
Total	927,450

Price

The price of water in Queensland is variable. In north and far North Queensland, water is trading at a price of up to $3,000 per ML due to water scarcity. However, according to sale contracts, water apportionments range from $50 to $90 per ML (Hill, 2017). The average annual trade price of surface water allocations in the Burdekin in 2016 is unclear, but based on data from 2011 and 2012, where an increase from < $250 per ML to > $2,000 per ML was observed, trades in the region could exceed $2,000 per ML.

Labour

The region has a strong agricultural workforce of 3,351 by place of work, representing 3.5 per cent of total regional employment (ABS, 2017). However, employment is heavily concentrated within the subsectors of sugarcane farming (42.5 per cent of industry employment) and extensive/semi intensive beef cattle farming (19.7 per cent of industry employment). Regional employment across key sub-sectors of interest are presented in Table *33* and Table *34* below. Expansion of skills and grower/support services will be required to support the transition to the diversified production opportunities.

Table 33: Summary of 2016 Census population and employment statistics (agricultural industries for in-scope LGAs)

Parameter	Australia	Queensland	Charters Towers	Hinchin-brook	Townsville	Burdekin	Palm Island
People	24.1 m	4.8 m	11,876	10,885	186,757	17,074	2,446
Median age	38	37	40	50	34	44	24
Unemployment	6.9	7.6	8.80 per cent	6	8.9	5.8	29.6
Population in beef cattle farming (per cent)	0.4	0.8	10.8	N/A	N/A	N/A	N/A
Population in sugar can growing (per cent)	0	N/A	N/A	11.1	N/A	11.7	N/A
Population in sugar manufacturing (per cent)	0.2	N/A	N/A	9.1	N/A	8.5	N/A

Source: ABS (2017).

Table 34: Employment by Industry Key Agricultural Sectors (PoW, 2016)

Sub sector	Regional employment, selected sub sectors	Per cent of total agricultural employment
North Queensland – Total		
Agriculture, forestry and fishing support services	371	11.2 per cent
Beef cattle farming (specialised)	660	19.7 per cent
Beef cattle feedlots (specialised)	4	0.1 per cent

Sub sector	Regional employment, selected sub sectors	Per cent of total agricultural employment
Sugarcane growing	1,423	42.5 per cent
Fruit tree and nut growing	112	3.3 per cent
Vegetable growing (outdoors)	222	6.6 per cent
Aquaculture	45	1.3 per cent
Townsville		
Agriculture, forestry and fishing support services	52	10.2 per cent
Beef cattle farming (specialised)	0	0.0 per cent
Beef cattle feedlots (specialised)	4	0.8 per cent
Sugarcane growing	25	4.9 per cent
Fruit tree and nut growing	70	13.8 per cent
Vegetable growing (outdoors)	54	10.6 per cent
Aquaculture	14	2.8 per cent
Burdekin		
Agriculture, forestry and fishing support services	217	13.2 per cent
Beef cattle farming (specialised)	78	4.7 per cent
Beef cattle feedlots (specialised)	0	0.0 per cent
Sugarcane growing	913	55.4 per cent
Fruit tree and nut growing	35	2.1 per cent
Vegetable growing (outdoors)	159	9.7 per cent
Aquaculture	25	1.5 per cent
Hinchinbrook		
Agriculture, forestry and fishing support services	89	13.8 per cent
Beef cattle farming (specialised)	35	5.4 per cent
Beef cattle feedlots (specialised)	0	0.0 per cent
Sugarcane growing	481	74.3 per cent
Fruit tree and nut growing	9	1.4 per cent
Vegetable growing (outdoors)	0	0.0 per cent

Sub sector	Regional employment, selected sub sectors	Per cent of total agricultural employment
Aquaculture	9	1.4 per cent
Charters Towers		
Agriculture, forestry and fishing support services	12	2.3 per cent
Beef cattle farming (specialised)	454	88.2 per cent
Beef cattle feedlots (specialised)	0	0.0 per cent
Sugarcane growing	0	0.0 per cent
Fruit tree and nut growing	5	1.0 per cent
Vegetable growing (outdoors)	9	1.7 per cent
Aquaculture	0	0.0 per cent
Palm Island		
Agriculture, forestry and fishing support services	0	N/A
Beef cattle farming (specialised)	0	N/A
Beef cattle feedlots (specialised)	0	N/A
Sugarcane growing	0	N/A
Fruit tree and nut growing	0	N/A
Vegetable growing (outdoors)	0	N/A
Aquaculture	0	N/A

Source: ABS (2017)

Charters Towers Local Government Area

Compared to Australian averages, the Charters Towers LGA has an older population and a relatively high rate of unemployment (ABS, 2016). The major industry is beef, with 10.8 per cent of the population employed in beef cattle farming. The average median value of residential properties in the Charters Towers regional area was $49,500 in 2017 (DNRME, 2018) and the median value of rural residential land was $110,000. The total land values of industrial, commercial, and rural land were $15.3 million. $18.3 million, and $443.5 million respectively.

The major agricultural opportunities specific to the Charters Towers LGA include expansion of the beef industry into more intensive production and development of irrigation areas for grain production. Major constraints to implementation of these opportunities include climate, water access, legislation, and lack of processing facilities for grain-fed beef.

Hinchinbrook Local Government Area

The Hinchinbrook LGA has an older population and a lower rate of unemployment than Australian and Queensland averages (ABS, 2016). A total of 20.2 per cent of the population of Hinchinbrook are employed in the sugar industry according to the 2016 census. The average median value of residential properties in the Hinchinbrook Shire was $56,000 in 2017 (DNRME, 2018) and the median value of rural residential land was $95,000. The total land values of industrial, commercial, and rural land were $15.0 million. $39.1 million, and $318.3 million respectively.

The major agricultural opportunities specific to the Hinchinbrook LGA include rotations of high-value crops (such as soybean or other broadacre crops) into sugarcane growing regions and expansion of suitable crops into non-sugarcane areas. Major constraints to implementation of these opportunities include climate, legislation, land suitability, older population, lack of processing and export facilities, and export markets.

Townsville Local Government Area

The Townsville LGA has a younger population and a higher rate of unemployment than Australian and Queensland averages (ABS, 2016). According to the 2016 census, there are no records for people being employed in an agricultural industry. DNRME (2018) did not have detailed information on land values for the Townsville LGA.

The major agricultural opportunities specific to the Townsville LGA include development of aquaculture facilities and hatcheries, development and improvement of facilities to support supply chains and export of produce from the Townsville Port and Airport. Major constraints to implementation of these opportunities include legislation, lack of secure export markets, lack of investment in export infrastructure, and lack of investment in improved transport infrastructure, such as rail.

Burdekin Local Government Area

The Burdekin LGA has an older population and a lower rate of unemployment than Australian and Queensland averages (ABS, 2016). A total of 20.2 per cent of the population of Burdekin are employed in the sugar industry according to the 2016 census. DNRME (2018) did not have detailed information on land values for the Burdekin LGA.

The major agricultural opportunities specific to the Burdekin LGA include rotations of high-value crops (such as soy bean) into sugarcane growing regions and expansion of suitable crops into non-sugarcane areas. Major constraints to implementation of these opportunities include climate, legislation, land suitability, and lack of processing and export facilities, and export markets.

Palm Island Local Government Area

The Palm Island LGA has a younger population and a higher rate of unemployment than Australian and Queensland averages (ABS, 2016). According to the 2016 census, there are no records for people being employed in an agricultural industry. DNRME (2018) did not have detailed information on land values for the Palm Island LGA.

The major agricultural opportunities specific to the Palm Island LGA include introducing and expanding high-value crops. Major constraints to implementation of these opportunities include lack of expert labour and young population, legislation, climate, land suitability, and lack of processing and export facilities, and export markets.

Strengths, challenges and opportunities

The North Queensland region has the following opportunities and challenges to develop the agricultural productivity of the region:

Table 35: Strengths, challenges and opportunities for the expansion of agriculture in the study area

Strengths	Challenges
– Favourable climate – Reliable supply of water from the Burdekin Falls Dam – Established processing and transport infrastructure for sugarcane – Major regional abattoir with high processing rates – Cattle saleyard at Charters Towers – Sea port at Townsville – Access to major road and rail links to southern markets from Townsville – Labour pools along the coast (including Townsville, Ayr, Home Hill and Ingham) – Seasonal backpackers provide labour – Many professionals (agriculture, finance, legal, educational and medical) to support agriculture – Local research and development expertise in tropical agriculture (e.g., from JCU/CQ, CSIRO, and the Queensland Government) (QLD DAFF, 2013).	– Airfreight access to export markets – Biosecurity issues (e.g. invasive plants and animals, insect pests and diseases) – High evaporation and poor rainfall distribution – Extreme weather events (e.g. flooding, cyclones) – High transport costs – Degradation in natural resource condition, particularly soil erosion – Heavy reliance on roads for transporting cattle – Remnant vegetation, which cannot be cleared – Urban expansion – Climate change – Mining – Road deterioration from increased use – Woodland thickening (impacts pasture growth) – New legislation and regulation
Opportunities	
– Expand irrigation agriculture by raising Burdekin Falls Dam Spillway – Export high-value products to SE Asia – Expand on-shore aquaculture – Improve supply chain infrastructure	– Increase forestry – Use renewable energy – Increase use of travelling labour and promote agri-tourism – Promote locally grown produce for fruit and vegetables that can be grown out of the growing season

Current and future industry and supply chain assessment

Section Snapshot

What? Identification of production areas, supply chain constraints and infrastructure gap analysis

How? Production mapping, desktop analysis and stakeholder consultation

Key insights

- The region can diversify and/or expand its production for high demand export markets. Value-added production will be crucial for success in these markets
- Supply chain constraints identified include access to inputs, production and processing capability, export market access
- Infrastructure gaps identified include irrigation, storage (cold and standard), abattoirs, hatcheries and ponds, harvesting equipment and roads
- Production of all identified products must attain critical mass through cooperative structures and/or collaboration with regional producers outside the study area to ensure the viability of investment and utilisation of existing key infrastructure (e.g. Townsville port and airport)
- Existing and underutilised infrastructure can be used and re-purposed for new products

Major infrastructure projects such as Hells Gate and Burdekin Dam upgrade will provide the basis for expansion of productive areas to support the long term viability of existing and new agricultural sectors.

Methodology for assessment

Production mapping

Each of the five products has a large range of preferred soils, climates, topography and associated constraints which must be considered in a site-specific assessment. For the purposes of this project, the main constraints have been considered to allow for broad production areas to be identified, and much of these are outside normal land suitability mapping guidelines. These constraints were used to develop maps of potential production areas for each product (overview of potential areas provided in Table *36*). Information relating to the production potential of each product in the study area is presented below, along with the development of maps and identification of production areas. Due to the lack of detailed soils and existing land suitability mapping data, a unique method for each product was developed, and these are described below. Across all product opportunities, it has been assumed that production will only occur under current regulatory constraints, such as native vegetation management.

Table 36: Potential production area by product

Product	Potential area*
Intensive beef	35,000ha
Avocado	8,000ha
Macadamia	8,000ha
On-shore aquaculture	6 sites identified
Soybean	36,000ha

**Potential land use subject to allocation of land between products*

Supply chain constraints and infrastructure gaps

Following an assessment of suitable production areas, a supply chain and infrastructure gap analysis was conducted. This identified the current and future (potential) state of the supply chain for each product. Gaps were identified and considerations provided to increase and/or commence production of the respective products. The assessment details a number of constraints and gaps consistent across the supply chain for each product, including a lack of expertise (e.g. agronomy, production techniques), equipment (e.g. harvesting, storage), processing capabilities (e.g. abattoirs, packaging), infrastructure (roads, rail, water) and access to markets (e.g. air freight for export).

Opportunities and considerations

Having identified potential constraints and gaps, opportunities to address (or mitigate) these challenges are considered to provide a suitable environment for the production of prospective products and development of associated sectors.

While there are a number of potential new irrigation projects that may provide increased opportunities for agriculture in northern Queensland (including Hells Gates and the Gilbert River Irrigation Project west of the in-scope region), this project focussed only on agricultural production that could be developed in the short term. There are a number of legislative and policy barriers on the alternative projects. Major irrigation projects may take up to 10-20 years to be complete, and with the outlook of this study including the next 30 years, the project team agreed that it was imperative that findings be applicable for implementation on project completion, rather than relying on the completion of major irrigation projects, none of which have yet been formally approved.

The analysis in this report is confined to the products identified by demand driven analysis however findings can be applied to similar products within the broader sectors of livestock, broadacre cropping, horticulture and aquaculture to suit the specific agronomic, climatic, supply chain and/or infrastructure characteristics of a specific LGA.

Table 37: LGA snapshot of demand driven product(s), supply chain constraints and infrastructure priorities.

LGA	Product (s)	Supply chain constraints	Infrastructure priorities
Charters Towers	Intensive beef Soybean	Access to feed Cattle limitations Production capability Processing capability Export market access	Irrigation Grain storage Feedlots Abattoirs Cold chain
Hinchinbrook	Soybean Avocado Macadamia	Production capability Processing capability Export market access	Irrigation Production equipment Storage Processing equipment
Townsville	On-shore aquaculture	Production capability Processing capability Export market access	Ponds and hatcheries Cold chain facilities Airfreight service
Burdekin	Soybean Avocado Macadamia	Production capability Processing capability Export market access	Irrigation Production equipment Storage Processing equipment
Palm Island	Avocado	Production capability	Irrigation

	Macadamia	Processing capability Export market access	Production equipment Storage Processing equipment

Source: KPMG.

Beef – intensification

Identification of production areas

Due to the diverse nature in which beef is produced (i.e. extensive grazing, grazing under irrigation, and intensive lot feeding), potential constraints have been simplified to allow broad production areas to be identified. These have focussed mainly on the supply of grain/fodder rather than the location of the feedlot itself, including:

- Regulated vegetation – a significant amount of the study area is mapped as containing Category B remnant vegetation. Clearing of this vegetation is restricted and these areas have been removed from the analysis. Clearing for cropping (irrigated or dryland) and grazing are not considered relevant purposes. As intensive beef production systems require a large area for feed production and generally, effluent irrigation, areas of Category B vegetation are deemed unsuitable.
- Class A land that may be suitable for irrigation that is currently Category X vegetation.
- Less than 4 per cent slope. Conventional feedlots require a slope of 3-4 per cent. Covered feedlots and/or irrigation areas can be located on flat or gently sloping land. It is possible, but not desirable, to put feedlots on steeper slopes. The disadvantages of this include increased erosion potential, increased animal welfare risk, and increased earthworks costs.
- Proximity to B Double or road train approved routes. Locating feedlots close to B Double or road train approved routes will minimise transport costs and reduce any potential upgrades required for local rural roads.
- Feedlots must be located on land that is free from inundation during a 1 in 100 year flood event.
- For the purposes of this study, the identified production area for feedlots is within the area to the west of the Great Dividing Range. Although not strictly limiting on feedlot development, the current land use, flood hazard and climatic conditions on coastal land limits the potential for feedlot developments.
- Proximity to large rivers, identified as being a Stream Order 5 or greater for irrigated grain production. This is not specifically limiting for feedlots, but feedlots are preferably located in areas of reliable grain production. This limits the cost of feed and transport for a feedlot. A maximum separation distance of 50km from a SO5 or higher watercourse has been applied between the feedlot and the grain growing region. Grain production areas have been limited to a maximum 3km separation distance from these watercourses (for pumping efficiency purposes).

Additional site-specific constraints, which are not possible to identify on this scale include that feedlots require:

- large lots, preferably greater than 100 ha
- a separation distance of at least 5km from towns
- depth to groundwater of at least 10m
- a mixture of gravel (pen construction) and clay (pond construction) soil types across the property
- effluent management areas (ponds and/or irrigation areas) not located in a drinking water catchments.

The above list of constraints is indicative only and further constraints may be relevant on a site-specific basis.

Processing

With a processing capacity of 1,800 head per day, Townsville is currently the only Queensland beef processor north of Rockhampton. The abattoir only processes grass-fed cattle for the domestic market. Currently, grain-fed cattle in the region are sent to south and central Queensland, which is associated with high transport costs. There are several components to a beef abattoir and some abattoirs may have all or some of these components. Abattoirs generally include areas or facilities for cattle handling, holding, washing and intake (lairage). Cattle enter the kill floor where they are stunned and killed. By-products (e.g. hides and offal) are removed and carcases can be halved, quartered or boned and sliced into individual cuts.

Abattoirs may include a rendering facility or solid waste can be removed for rendering off-site. An abattoir will also require a wastewater treatment system which may consist of a series of ponds and treatment plants. Wastewater is then required to be sustainably irrigated. Wastewater treatment and utilisation results in the need for large areas of land that allows sustainable application of nutrients to soils and appropriate separation distances from sensitive receptors.

Abattoirs require a large, skilled workforce and are generally suited to larger towns. Upskilling of the local workforce is usually required, and labour hire arrangements are common. Smaller feedlots with minimal feedmill operations have a low labour requirement. Larger feedlots with an on-site feedmill can require a large, highly skilled labour force consisting of veterinary staff, maintenance staff, administrative and management personnel and nutritionists. Generally, larger feedlots are located within a reasonable daily commute from a large town or provide on-site accommodation for workers and visitors.

An assessment of the commercial viability of new processing facilities in Queensland has identified Charters Towers (among eleven others) as a potential location for a new facility, subject to detailed feasibility (Meateng, 2018).

Intensive beef production area map

To build the map of potential intensive beef production areas the following constraints were considered:

- within 3km of stream order 5 for irrigation
- class a land that may be suitable for irrigation
- large polygon sizes (at least 100 ha) to be viable irrigation
- b-double road train access
- are currently marked as Category X vegetation.

Given the main constraint to expanding intensive beef production is the lack of feed, the constraints analysis of potential production areas has focused on where suitable irrigated grain and forage production could occur west of the Great Dividing Range. This has been done in isolation of the site-specific feedlot requirements described above.

The potential production areas maps (Page 141) shows the potential production areas, with significant clusters highlighted. The area circled is approximately 18,000 ha, with the total area being almost double that at 35,000 ha.

To determine the carrying capacity of these potential interviews the following parameters were used:

- 18,000ha of land available to grow grain and forage
- cattle on feed for 70 days
- grain yield of 10t/ha/yr and forage yield of 20t/ha/yr
- cattle consume 15kg/head/day in a ration of 80 per cent grain.

Given these parameters approximately 190,000 head could be fed per annum, 36,000 head at any one time.

Value-adding opportunities

Although the focus of a North Queensland intensive beef industry would be the export of quartered beef, value-adding opportunities for beef are extensive. Boxed and branded beef attracts a much higher price in international markets and the creation of a North Queensland brand could add value across the industry. This would require confirmation that the identified markets have appropriate end-consumer demand for these value-added products however. Producers could also implement traceability measures to reinforce product provenance claims, underpinning the development of a regional brand.

The returns from boxed and branded beef may be increased by using high pressure processing (HPP) to ensure a high-quality product which has an extended shelf-life. Value adding opportunities using HPP also include marinated, sliced and ready-made meals. However, the stakeholder engagement process identified that the lack of export protocols for pre-prepared meals may be a constraint to developing this market.

Generally undertaken on a smaller scale, such as on-farm, the production of beef jerky can significantly increase the value of lower quality cuts. This could be supplied to a local or export market as the dehydration and packaging of beef significantly increases its shelf-life.

Further research is required to understand the demand profile for specific finished goods, including the investment in processing, packaging and product certification to meet specific market requirements.

Supply chain constraints and infrastructure gap analysis

The most significant hurdle for an intensive beef industry is the supply of quality feed. Due to high cost of transporting grain and roughage, existing local grain production must be significantly increased before a competitive intensive beef industry could be established. Prospective beef producers can discuss feed requirements with local broadacre crop producers, providing a market for rotational crops. Exploration of alternative feed sources and supplementary feeding may also reduce the amount of grain required for an intensive beef industry.

To establish or expand intensive beef production operations, additional processing facilities are required that will enable processing of grain-fed cattle. There are four additional abattoirs that have been proposed for northern Australia at locations including Townsville, Hughenden, Charters Towers, Julia Creek and Emerald. Many of these proposed abattoirs intend to cater for grain-fed beef.

Suitable road access has been identified as a significant constraint to the development of abattoirs in regional areas across Queensland. Often, rural roads are not developed to a standard suitable for the high volume of heavy vehicles required by an abattoir. The costs associated with the upgrade of these roads may prohibit the proposed projects being realised until sufficient investment is secured.

Due to the staff required by an abattoir, the identification of suitable locations for further abattoir development should be focussed on areas within 20km from large towns or regional centres. Alternatively, workers accommodation may be provided.

Current state:

The current beef supply chain in the region consists of the nodes displayed in Figure 17. The majority of beef is produced on extensive breeding and grazing properties on native and improved pastures before being transported to:

1. Holding at pre-export quarantine (PEQ) facilities for live export from the Townsville Port;
2. To JBS Townsville Plant, which processes up to 1,800 grass-fed beef cattle per day for export or processed beef that is transported to JBS Brisbane; or
3. To feedlots further south for finishing and domestic processing.

There are a small number of local feedlots with a combined capacity of at least 31,600 head that produce higher value grain-fed cattle. These are currently directed to southern abattoirs in Rockhampton and Brisbane for processing. Supplementary feeding or direct grazing under centre pivots or other irrigation

systems is an emerging industry in Australia. This study did not conduct interviews with any such producers and this type of beef production is considered to currently be negligible in North Queensland.

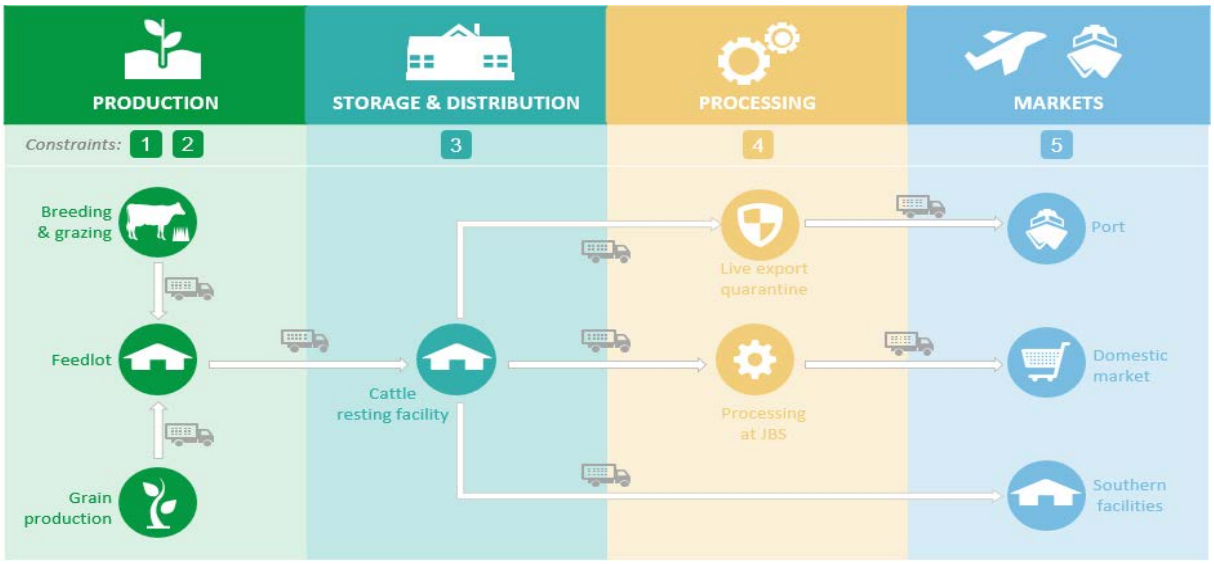


Figure 17: Current beef supply chain in the in-scope region.

Future state:

Figure 18 indicates the potential supply chain given implementation of the key upgrades and additions. Additional irrigation facilities focussed on under-pivot grazing or grain production for supplementary feeding or lot feeding would offer an alternative market for existing extensive breeding and grazing operations. This would facilitate increased production of higher value cattle. Unless an abattoir for grain-fed cattle was developed in the region, this higher value beef would need to be transported to abattoirs in Rockhampton or Brisbane. However, with the addition of one or more abattoirs in Charters Towers and/or Townsville, there would be local market opportunities for more intensively produced beef. It is important that the sector works collaboratively to ensure the development of appropriate infrastructure (in terms of both capacity and function). TEL could facilitate this communication. The positioning of an abattoir in the region would also create an opportunity for the port to export frozen, chilled or boxed beef directly to international markets. Furthermore, with the development of cold storage facilities at the airport, there may be a future opportunity for air freight of high-value beef products. All the developments discussed above will depend on a reliable transport network to achieve ultimate success. It is recommended that any proposed developments consider existing and required infrastructure so that the most efficient transport networks can be identified and appropriate upgrades funded. Identification of the upgrades should consider existing infrastructure and the proposed upgrades identified in the Northern Australia Beef Roads Program. The beef industry must engage with government and advocate for road upgrades necessary for the efficient operation and growth of the industry.

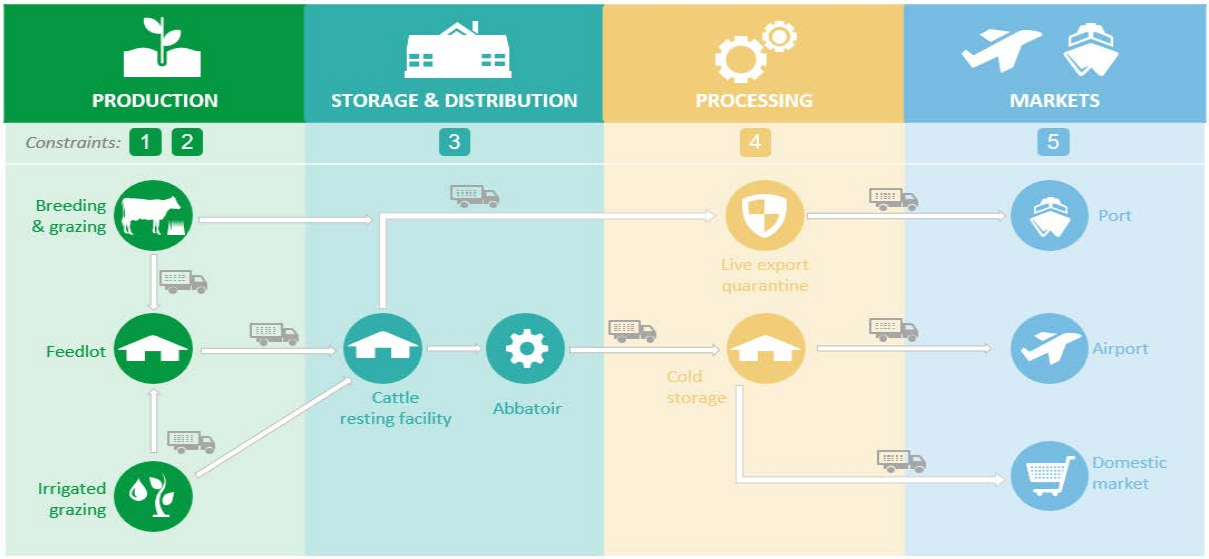


Figure 18: Beef supply chain given implementation of recommended strategies.

The analysis of supply chain constraints and infrastructure gaps is summarised in Table 38 below.

Table 38: Beef supply chain constraints and opportunities

Ref	Constraint	Gap	Cost estimate	Opportunities and considerations
1	Location – impact on operation	Access to water Access to required services and labour Proximity to feed	24ML/1,000 head/annum required	Consider location for implications regarding heat stress to cattle, feedlot construction, water access (24ML/1,000 head/annum). Locate feedlot and processing facilities in close proximity to regional towns to assist employment of skilled labour (e.g. operations, nutritionist, environmental, veterinary). Collaborate with universities to establish pilot scale initiatives for both training of staff and small scale commercialisation.
2	Feed – access and storage	Irrigation equipment Grain storage Water storage Farm machinery	Grain storage (silos) ~$100-$200/mt stored subject to features required*	Development of new irrigation areas to grow grain for feed, silage production or direct grazing for supplementary feeding. Explore installation of individual and/or cooperative grain storage to enable the cost effective purchase and timely access to feed. **Cost will vary depending on scale and functionality of operation (estimate assumes 1,000mt of storage)*
2	Cattle supply – limitations of traditional breeds	Feedlots – includes grain storage, steam flaking, silage production, pen infrastructure, staff amenities, office, effluent management.	~$700 to $1,200 per head (Qld Country Life, 2017)	Develop feedlots or supplementary feeding/irrigation grazing facilities to produce higher value cattle to achieve a premium in domestic or export markets. Develop export markets for traditional cattle breeds (e.g. Brahman). Investment per head will depend on presence of existing infrastructure, site specifications and scale of operation. Consider engaging suitable engineers for

Ref	Constraint	Gap	Cost estimate	Opportunities and considerations
				feedlot design to meet specific requirements and accurately quantify investment.
3	Transport – suitable road and rail quality, port access	Road improvements (e.g. widening, sealing) Rail transport Access to port/airport	~$650,000 per km for road upgrades average figure, will vary pending scope of upgrade (ADIRDC, 2018)	The beef cattle supply chain is heavily reliant on a reliable transport network to ensure strong links between supply chain nodes and to markets. Align new feedlot and abattoir facilities with proposed upgrades to facilitate rapid development of new facilities. Refer the Northern Australian Beef Roads Program, which utilised the CSIRO Transport Network Strategic Investment Tool (TraNSIT). Improved rail infrastructure into the Port of Townsville may further strengthen the potential for expansion of the beef industry in the region. Development of a regional supply chain co-ordinator (SCC) to improve overall efficiency of the transport network, utilising data to plan and schedule freight movements.
4	Processing – proximity to and capacity of processing facilities	Abattoir facilities including packaging, staff amenities, waste treatment and water management	$50-90m capital expenditure $120k-$200k daily operating costs	Confirm suitable location for abattoir to service intensified beef production in North Queensland. Review capacity of regional abattoirs, limited processing facilities – the only processing facility available for producers in the region is the JBS Townsville plant, which only processes grass-fed beef. Align current and prospective processing capacity with prospective regional herd size. *Operating costs ~100,000 head/day and ~200,000 head/day (Meateng, 2018)* *Capital expenditure for abattoirs dependent on scale and complexity (Bloomfield, 2014)*
5	Market access – cold chain and air freight	Refrigeration facilities at port and processing facilities Access to belly space for air freight (passenger, freight or charter services) Export protocols for pre-prepared meals Packaging alignment with market requirements	~$2,100-$2,600 per m2 for cold storage construction (Everage, 2017)	Establish air freight capability from Townsville airport to enable supply of processed beef to export markets. Develop cold storage facility at or in close proximity to airport. Investigate product traceability platforms to underpin export market development (e.g. to certify provenance, quality, compliance). Investigate export protocols for target export markets. Investigate innovative packaging to meet target export market requirements.

Avocado

Identification of production area

Avocado prefer deep, well-drained soil in areas that are free from regular flooding. They tolerate sandy or stony soil that would be deemed unsuitable for broadacre cropping or sugarcane production. They are tolerant of sloping lands of up to 15 per cent, which usually have adequate elevation to ensure they are free from acid sulfate soils. Heavy clay soils should be avoided due to risks of root diseases.

The clearing of regulated vegetation for horticulture is not considered a relevant purpose and production will generally not be possible on land with regulated vegetation. Generally, marginal areas near existing cropping or sugarcane production are more likely to be subject to historic clearing. There are concerns from cane producers and processors that tree crops will reduce production areas over time, making sugar mills unviable.

Potentially suitable land for avocado may include sloping or hilly areas adjacent to sugarcane production areas. These may be considered marginal or unsuitable for sugarcane production. One example is the Mount Kelly area to the west of Home Hill, which shows large areas of horticulture production adjacent to sugarcane land.

Where possible, areas subject to extreme cyclonic winds (>150km) should be avoided as significant damage from cyclones can result in setbacks due to the time required to establish new trees. Minor to moderate damage from cyclones can be managed through pruning and treatment of tree crops.

One of the main limiting factors for industry expansion is the low supply of suitable rootstock. This is being alleviated by new technology however needs to be considered before any wide-spread planting occurs.

Avocado production area map

The following constraints were considered in the development of a map of potential production areas:

1. Locations susceptible to >150km per hour winds were excluded.
2. Areas with land slope between 2 and 15 per cent, to provide good drainage.
3. Class A or B land.
4. Land to the east of the Great Dividing Range where irrigation is available or rainfall higher.
5. Polygons of less than 10 hectares.
6. Areas with remnant vegetation were excluded.

The map of production area for avocado in the Burdekin and in Hinchinbrook are shown on page 141.

The maps show that there is approximately 8,000ha that are potentially available for avocado and or macadamia in the study area. To put that into perspective, the total area of avocado production in Queensland at present is around 6,000ha (DAF, 2018b). The location and availability of irrigation water in both Hinchinbrook and Burdekin has not been considered in this analysis.

Harvest and processing

Whole fruit are harvested, dried, polished, sorted and refrigerated. These processes can be carried out on-farm using a range of equipment depending on capacity. The processing equipment ranges from cost effective, small volume machines to larger machines for higher volumes and further processing. The fruit are extremely sensitive to damage, which can result in production of large volumes of low-grade fruit.

There are two current fruit processors in Townsville with potential capacity to process avocado. Processing can include, slicing, pulping, drying and packaging of fruit. The cleaning and packing of avocado can be undertaken on a variety of scales resulting in the ability for on-farm packing.

Value adding opportunities

Value adding opportunities for avocado have been extensively developed due to the need to utilise low grade fruit. The production of avocado oil is common for both food grade oil and for cosmetics. Cold pressing ensures the natural flavour and beneficial compounds from the fruit are retained in the oil.

HPP can be used to produce high-value processed food such as chocolate mousse, smoothies and baby food infused with avocado flavour. These products can be made for the vegan, allergen free and preservative free markets. Currently, there are only a small number of Australian companies with HPP technology. Investment in HPP technology at existing avocado processing facilities is known to cost approximately $6 million.

A Queensland company has developed a world first patented process incorporating the use of an enzyme, combined with controlled temperature and pressure, to inhibit the browning of avocado flesh and extend the shelf-life of cut or pulped avocado (Nichols, 2016). Sliced and pulped avocado can be stored in high pressure packets and remain fresh for up to 10 days after opening.

Further research is required to understand the demand profile for specific finished goods, including the investment in processing, packaging and product certification to meet specific market requirements.

Supply chain constraints and infrastructure gap analysis

Current state:

The current study has identified that the average avocado production in North and Central Queensland from 2015-2017 was 15,000 and 14,900 tonnes respectively (Avocado Australia, HIA Avocado Fund, 2017). This represents 51 per cent of Australia's total production of avocado. However, this study has found that production in the Townsville region does not currently occur at scale (only 10ha of avocado orchards in the in-scope region), with most production occurring further north around Cairns and south around Bundaberg and Brisbane. Most of the avocado produced in Australia is for the domestic market, with only approximately 2 per cent of production exported in 2016/17.

The current avocado supply chain in the region is depicted in Figure 19. While a small amount of production may currently be processed in processing facilities in the in-scope region (we have identified at least 2 processing plants in Townsville), this is thought to be negligible. For the sake of this study we assume that all avocado produced in the region goes to the domestic market.

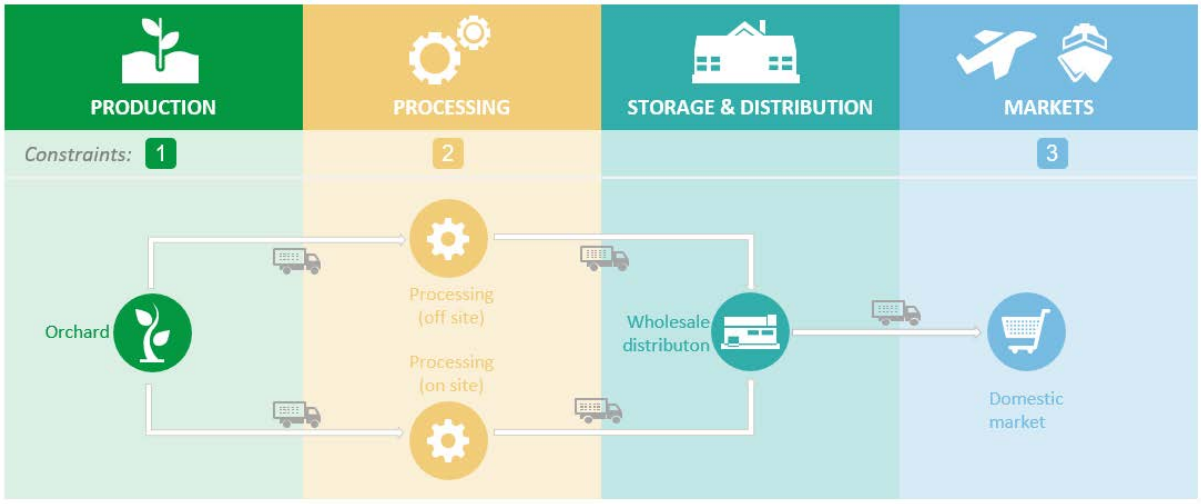


Figure 19: Current avocado supply chain in the in-scope region.

As there are at least two fruit processing plants in the Townsville region, the most effective way to increase the processing capacity of the avocado supply chain is to assist these processors to incorporate avocado processing and value-adding technology.

Future state:

Figure 20 indicates the potential supply chain given implementation of the key upgrades and additions listed in Table *39*. Utilisation of a processing facility will enable potential producers to produce value-add products from both quality produce and waste. These products could be directed into both export and domestic markets. For an avocado export market to become viable, a suitable cold storage facility would be required at Townsville Airport. It is considered that the airport, rather than the port, is more suitable for avocado export due to the short shelf life. However, if value-adding includes production of a longer shelf-life product, export via the Port may be viable.

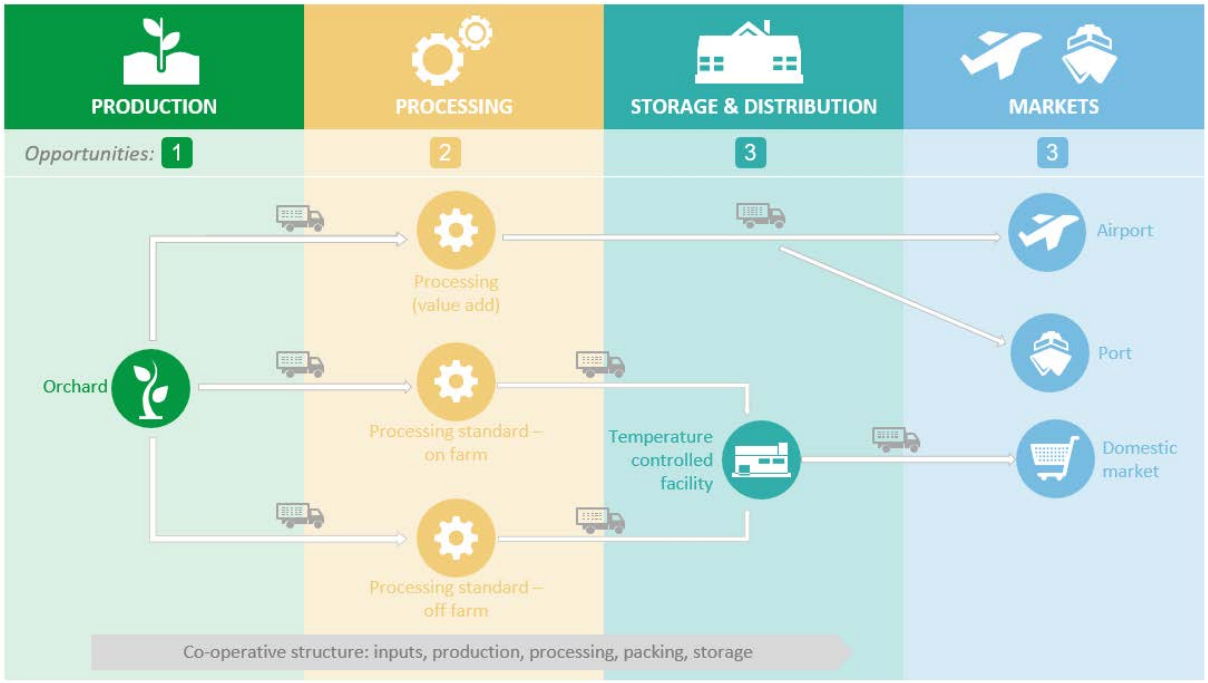


Figure 20: Potential avocado supply chain with implementation of recommended upgrades and additions.

The analysis of supply chain constraints and infrastructure gaps is summarised in Table *39* below.

Table 39: Avocado supply chain constraints and opportunities

Ref	Constraint	Gap	Cost estimate	Opportunities and considerations
1	Location – impact on operation	Labour – agronomy, R&D and extension services		Consider suitable locations to mitigate risk of adverse weather conditions (e.g. high winds) that can impact plant maturity and revenue. Locate in close proximity to regional towns to assist employment of skilled labour (e.g. agronomy, production, processing). Collaborate with universities to establish pilot scale initiatives for both training of staff and small scale commercialisation. Consultation with peak industry organisations such as HIA Avocado Fund that invests in R&D and the overall development of the avocado industry.

Ref	Constraint	Gap	Cost estimate	Opportunities and considerations
1	Lead time – production lag			Review project finance arrangements in line with forecast production (6-8 years until revenue stream) Incorporate avocado as part of a mixed farming strategy to leverage existing cash flow for production development activities.
1	Production – scale and consistency of supply	Consolidated storage for accumulation of production		Review merits of a dedicated entity (i.e. grower groups or cooperatives) to accumulate and market regional produce. Identify and cultivate export markets through the entity noted above for accumulation and sale of produce, wholesaling capability.
1	Production – land preparation, and harvest capability	Production equipment Storage Labour (refer above)	$2,500-$5,500 per ha. for centre pivot irrigation systems (MPPD, 2011) Machinery pricing subject to confirmation of size and specification	Consider soil preparation machinery, irrigation systems, herbicide/pesticide sprayers, monitoring devices, harvesting equipment (ladders, hydraulic picking platforms, cherry pickers). Establish a framework for collaboration with research institutions. Lease, contract services or co-invest in equipment required for preparation of land and harvesting of avocado. Review potential for collaborative groups or structure where inputs can be aggregated (e.g. seeding, agronomy services, fertiliser, chemicals, equipment).
2	Processing – standard product	Packing shed Processing equipment	$100-$150 per m^2 for packing sheds, includes structure and footing (CB, 2019)	Utilise existing fruit processing facilities with excess capacity. Lease, contract services or co-invest in equipment required for processing of avocado. Review potential for shared storage and packing (can be on-farm or off site). Appropriate storage can improve longevity of product, providing flexibility for marketing and distribution. Typical processing equipment includes drying and polishing equipment, sorting machine, cooling facility, ripening facility, post-harvest chemical treatment spray (disease control).
2	Processing – for value added products	Washing and polishing machines Pulping machines High pressure processing (HPP) Packaging equipment	~$5-6,000 per m^2 for construction advanced processing and packaging facility (Wiley, 2015), example of industry investment $0.70-$1.20 per kg or litre using HPP toll processing system	The only currently available option for producers in North Queensland is the domestic market. Review potential markets for processed avocado products (slicing, pulping, drying [and freeze drying], and packaging of fruit. Develop a processing facility to produce value added products and to assist with cleaning and packing, which is often undertaken on farm. This would add longevity and shelf-life to the product to allow for export. Review potential for toll processing that can accommodate multiple products (e.g. mango). Design system to suit scale of operation and obtain accurate pricing of capital expenditure required. Example

Ref	Constraint	Gap	Cost estimate	Opportunities and considerations
			(Preshafruit, 2019) $6m HPP processing facility	components include (and indicative cost): washing and polishing machine (~$13,820 - $83,000), pulping machines (~$23,500 - $66,500), sorting machines (~$44,000 to $56,000), drying machines (~$7,000 to $28,000)
3	Market access – cold chain, air freight and export protocols	Refrigerated storage and transportation Access to belly space for air freight (passenger or charter services) Export protocols for standard and processed product Packaging alignment with market requirements	~$2,100-$2,600 per m^2 for cold storage construction	Establish air freight capability from Townsville airport to enable supply of un-processed and processed avocado to export markets. Develop cold storage facility at or in close proximity to airport. Investigate product traceability platforms to underpin export market development (to certify provenance, quality, biosecurity compliance). Investigate export protocols for priority markets. Investigate innovative packaging to meet priority market requirements.

Macadamia

Suitable growing regions and limitations

Macadamia production is suited to similar areas as avocado. However, macadamia trees are extremely susceptible to high winds produced during cyclones. Damage can be extensive and areas subject to medium-to-high risk of cyclonic winds in excess of 75km/hour should be avoided, with tree heights and densities requiring careful consideration.

Macadamia trees can tolerate slopes up to 15 per cent. They prefer well drained sandy loam to light clay soils, which are commonly found in sloping landscapes. However, they also prefer deep soils, which can be limited in sloping areas. Elevations of 600m or more above sea level are not suitable.

The clearing of regulated vegetation for horticulture is not considered a relevant purpose and production will generally not be possible on land with regulated vegetation. Similar to avocado, macadamia orchards are best located on land that is not subject to flooding and has been subject to historical clearing. However, due to the increased cyclone and wind risks associated with coastal areas, macadamia orchards may not be suited to areas surrounding sugarcane farms.

Minimum macadamia production areas can be from 5-10ha with suitable irrigation.

Macadamia production area map

To build the map of potential macadamia production areas the following constraints were considered:

1. Locations susceptible to > 150km per hour winds were excluded (negligible area available it 75km per hour winds are excluded; Areas with land slope between 2 and 15 per cent, to provide good drainage.
2. Class A or B land.
3. Land to the East of the Great Dividing Range where irrigation is available or rainfall higher.
4. Polygons of less than 10 h.
5. Areas with remnant vegetation were excluded.

The map of production area for macadamia provided on page 140 shows that there is approximately 8,000ha available for avocado and macadamia production in the in-scope region.

Harvest and processing

Mature nuts fall from the tree and are harvested off the ground using specialised pin wheel equipment. Equipment required for harvesting will vary depending on the size of the orchard. Equipment may include large harvesters attached to tractors right through to small push harvesters. To minimise contaminants, the ground area beneath the trees should be maintained with all premature nuts, husks and grass mulched in the weeks prior to nut maturation (December to January). Nuts should be regularly harvested every four weeks, or more during wet periods, to prevent spoilage.

Following harvest, the green husk must be removed and the nut in shell dried. This can be undertaken on-farm or at a nearby processor. Often it will be undertaken on-farm and nuts stored in silos until adequate volume is available for cost-effective transport. Small commercial de-husking or cracking machines are available where nuts are sold to customers from the farm gate. This provides flexibility for the end product at the farm gate.

Large processors can undertake all processing from de-husking to value-adding (e.g. roasting and flavouring). Modern processors use electronic colour sorting to grade each kernel. The sorting machine scans each kernel and, utilising machine learning, determine the nuts suitability. Defects are identified by analysing the kernel for colour and size and a sharp burst of air then discards low grade nuts. Manual sorting is then undertaken. Husk waste can also be utilised to produce heat for drying.

Value adding opportunities

Similar to avocado, macadamia nuts have a high oil content. This makes them suitable for value added products such as oils for food and cosmetics. Wholesale value-adding opportunities include the processing of macadamia into different sizes (e.g. halved, chipped, crushed) and the production of macadamia paste. Macadamias can also be roasted, flavoured and packaged for retailers.

Further research is required to understand the demand profile for specific finished goods, including the investment in required processing, packaging and product certification to meet specific market requirements.

Supply chain constraints and infrastructure gap analysis

Current state:

The current study has not identified existing macadamia production areas within the region. A report from 1992 suggests that a small planting of macadamia existed at Woodstock, south of Townsville and that macadamia had been planted in the region since 1978 (Everage, 2017). There are also likely to be a number of smaller growers within the region growing currently less than 20ha (HIA, 2016), but these are considered to make a negligible contribution to Australia's current macadamia production.

In general, macadamia are produced as far north as Mackay, however there is a known operation, Wondaree Macadamia Nuts, in the Atherton Tablelands. This operation initially cracked and sorted nuts on site, however, due to the labour and equipment requirements, now transport nuts to Sun Coast Gold Macadamias at Gympie for processing. There are also other macadamia operations in regions further north of the study area that partially processed (de-husk and dry) nuts on-site before being sent to processors in southern and central Queensland.

The current macadamia supply chain in the region is depicted in Figure 21.

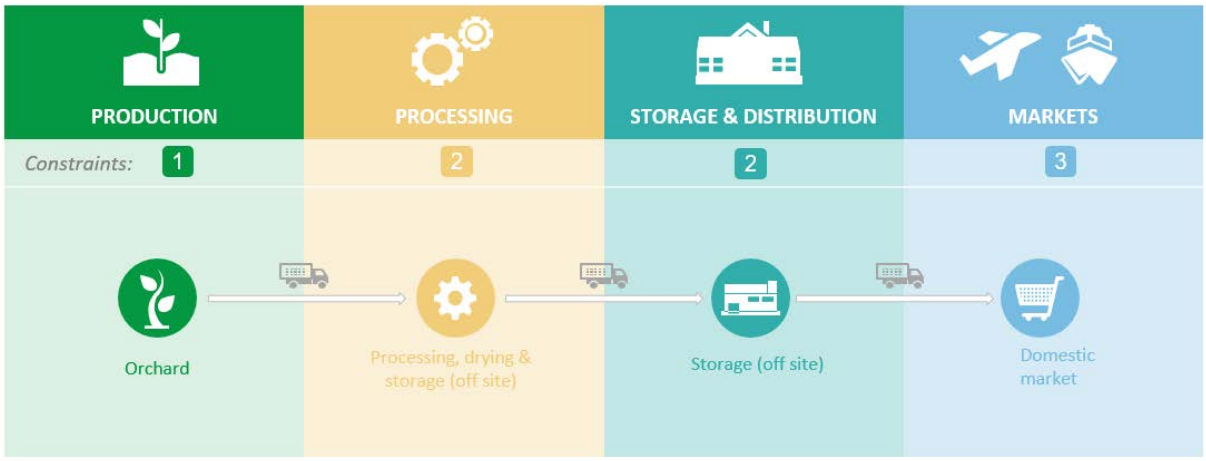


Figure 21: Current macadamia supply chain in the in-scope region.

Future state:

Figure 22 indicates the potential supply chain given implementation of the key upgrades and additions listed in Table *40*. If the addition of these facilities can be co-located and can also be located with the pre-export storage and port or airport facilities, significant savings on transporting products will be achieved. Addition of a centralised facility for sorting, de-husking, drying and storing nuts would enable potential producers in the region to save on costs associated with conducting these activities on farm.

Once the industry becomes more established, the region could consider investing in a processing facility for value added products.

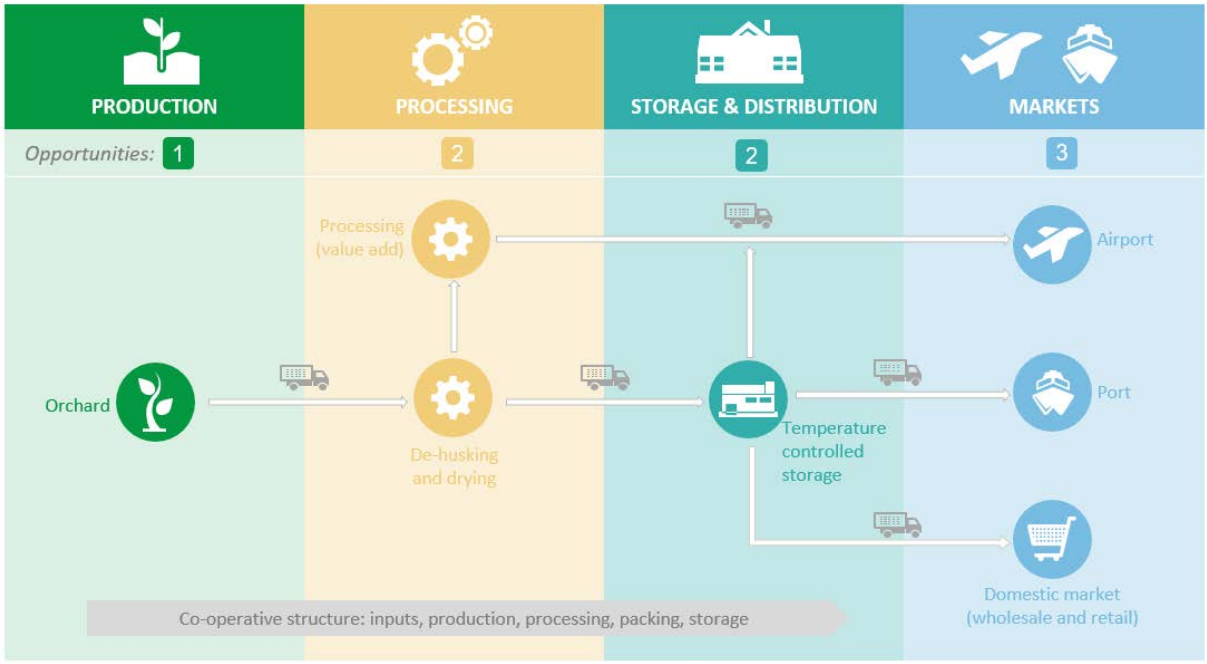


Figure 22: Potential macadamia supply chain with implementation of recommended upgrades and additions.

The analysis of supply chain constraints and infrastructure gaps is summarised in Table 40.

Table 40: Macadamia supply chain constraints and opportunities

Ref	Constraint	Gap	Cost estimate	Opportunities and considerations
1	Location – impact on operation	Labour – operations, agronomy, R&D and extension		Consider suitable locations and varieties (e.g. short statured) to mitigate risk of adverse weather conditions (e.g. high winds) that can impact plant maturity. Locate close proximity to regional towns to assist employment of skilled labour (e.g. agronomy, production, processing). Collaboration with regional universities regarding agronomy services, develop pilot programs for commercialisation. Consultation with HIA Macadamia Fund that invests in R&D and the overall development of the macadamia industry.
1	Lead time – production lag			Review project finance arrangements in line with forecast production (4-5 years until revenue stream). Incorporate macadamia as part of a mixed farming strategy to leverage existing cash flow for production and market development activities.
1	Production – scale and consistency of supply	Consolidated storage for accumulation of production	Refer storage section below	Review merits of a dedicated entity (i.e. grower groups or cooperative structures) to accumulate and market regional produce. Identify and cultivate appropriate export market relationships to inform production volumes.

Ref	Constraint	Gap	Cost estimate	Opportunities and considerations
1	Production – land preparation, production and harvest	Production and harvesting equipment	Annual cost of production estimated ~$7,000-$9,000/ha* ~$30-80,000 boom sprayer ~$250,000 air seeder (Farm Tender, 2019)	Lease, contract services or co-invest in equipment required for preparation of land, production and harvesting of macadamia. Review potential for cooperative structure where inputs (e.g. seeding, agronomy services, fertiliser, chemicals, equipment) can be aggregated. Production equipment includes tractors, cultivation equipment, seeders or row crop planters, boom sprayers, irrigation equipment, monitoring devices, harvesting equipment, chemical application. Cost of equipment will vary pending age and specification of equipment. **Estimated cost of production includes current labour, R&D, crop nutrition, administration, contractors, management, fuel and oil, crop protection, leases, government charges, utilities, consultants, irrigation, freight and hire.*
2	Storage – construction of and access to storage	Storage (temperature controlled)	~$2,100-$2,600 per m^2 for temperature controlled storage	Engage engineering (civil, structural and process) services to design system tailored to basic and value-added requirements of priority markets. Review potential for cooperative investment in storage.
2	Processing – de-husking, sorting, drying	Processing equipment	Dehusking machines ~$15,000 Sorting machines ~$44,000 to $56,000 Drying machines ~$7,000 to $28,000	Engage engineering (civil, structural and process) services to design system tailored to basic processing requirements of priority markets. Review potential for toll processing that can accommodate multiple products. Review potential for cooperative investment in processing.
2	Processing – value added processing capability	Processing facility	6,000mt production plant capacity, $12 million (Derry, 2011)	Engage engineering (civil, structural and process) services to design cost for system tailored to value-added processing requirements of target markets. Review potential for toll processing that can accommodate multiple horticultural products. Review potential for cooperative processing facility, centralised location. Review value added production to including roasting, chips, oil extraction, meal, paste.

Ref	Constraint	Gap	Cost estimate	Opportunities and considerations
3	Market access – export markets, air freight, cold chain	Access to belly space for air freight (passenger, freight or charter services) Export protocols for standard and processed product Packaging alignment with market requirements		Establish air freight capability from Townsville airport to enable supply of un-processed and processed macadamia nuts to export markets. Develop cold storage facility at or in close proximity to airport. Investigate product traceability platforms to underpin export market development (e.g. to certify provenance, quality, biosecurity compliance). Investigate export protocols for target export markets. Investigate innovative packaging to meet target export market requirements.

On-shore aquaculture

Identification of production areas

There are a number of on-shore aquaculture industries that would be suitable for development in the in-scope region. This study has focused on tropical rock lobster, however, any commercial shell fish varieties that are suitable for growth in North Queensland will benefit from this analysis of the potential for development of a tropical rock lobster industry.

The location of a potential tropical rock lobster hatchery would depend on the priority market. For the live export of tropical rock lobster fingerlings, the most suitable location is immediately adjacent to the airport or port on industrial or agricultural land. This reduces the need for additional storage facilities as the fingerlings can be loaded straight from the hatchery into the plane or ship. If quarantine or fumigation is required, it can be undertaken in storages at the hatchery. The land should not be subject to inundation during a 1-in-100-year flood event or in a storm surge risk area.

Utilising new hatchery technology, the export of tropical rock lobster may be possible from Townsville. This could include the export of fingerlings, young lobster, or mature adults. Fingerlings could be produced in a hatchery with covered tanks and minimal land requirements. Adults could be produced in tanks or potentially in open ponds. As there is no existing industry, the potential for adult production is unknown. Indoor production would result in better water efficiency and allow for no-release systems.

The commercial production of tropical rock lobster in north Queensland could also have ecological benefits as, pending biosecurity controls, a hatchery could assist in boosting natural populations (Queensland Government, 2018; Science, 2018).

As they are endemic to North Queensland, farming of adult tropical rock lobster may be possible in open aquaculture ponds, similar to Barramundi farms. The farming of adult tropical rock lobster would be a new industry but could succeed in North Queensland. Live adults could be exported or sold domestically to restaurants.

For a local tropical rock lobster on-shore aquaculture industry, the ideal location for a hatchery would be in areas where aquaculture developments currently exist. This would allow for the diversification of existing aquaculture developments. There is a small pocket of on-shore aquaculture activities in Gumlow, west of Townsville, mainly barramundi farms and a large development at Alva Beach, north west of Ayr, producing high-value algae. The on-shore aquaculture activities in Gumlow are subject to current and future housing pressure, which may not provide a suitable, long term, location for aquaculture. There is also an existing prawn and fish aquaculture facility in the Burdekin. If the export of adult tropical rock lobster is proposed, storage and processing (cooking and freezing) facilities will be required adjacent to the airport.

Alternatively, local councils could earmark an on-shore aquaculture precinct. Ideally, such an area would have soils with a high clay content for constructing and sealing ponds, have an average slope of less than 1-3 per cent and not be in an area subject to inundation during a 1-in-100-year flood event.

On-shore aquaculture production area map

To build the map of potential production areas the following constraints were considered:

1. Proximity to nearest town.
2. Proximity within road network to connect to the Townsville port, airport, or existing on-shore aquaculture facilities.

The map of current and potential production area for on-shore aquaculture is shown on page 141. The map shows that there are approximately six sites that are reliably available for on-shore aquaculture production in the study area, however given the growing conditions and type of lobster, location at Townsville itself is probably the most ideal situation.

Value adding opportunities

Whole live lobsters are highest value, therefore, value-adding opportunities have not been widely explored. Value adding opportunities exist for an adult tropical rock lobster industry and range from cooked whole lobster or tails, usually frozen. These products are common for other rock lobster species.

Further research is required to understand the demand profile for specific finished goods, including the investment in processing, packaging and product certification to meet specific market requirements.

Supply chain constraints and infrastructure gap analysis

Current state:

There is currently a number of on-shore aquaculture developments in the north, however, there is not currently an established industry. The Pacific Reef Fisheries grow cobia and black tiger prawns across 100ha in Ayr. Their produce is for the high end domestic restaurant market and domestic supermarkets, where the main competition is from imported product, with the main hurdle to producing for the export market being that the industry does not currently have the scale to justify an export market. There are also constraints around regulation, business risks (high capital requirement), biosecurity and disease. This operation processes on site and sells into the fresh and frozen market and harvests produce from late December/early January through to June.

The current on-shore aquaculture supply chain in the region is depicted in Figure *23*. Currently, aquaculture production, processing, and storage are all practiced on one site prior to transport to the domestic market, as is the case for the Pacific Reef Fisheries.

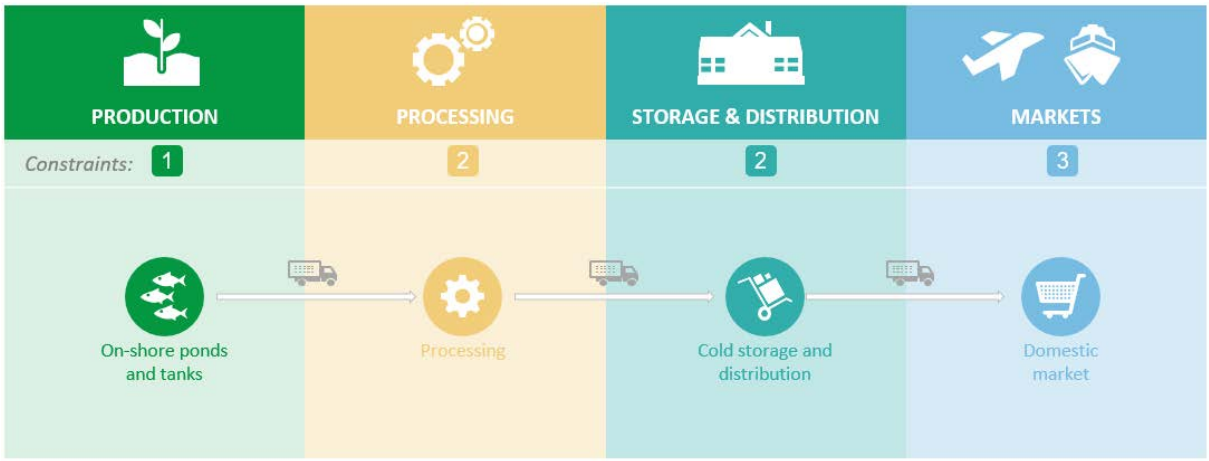


Figure 23: Current on-shore aquaculture supply chain in the in-scope region.

According to the findings of this study, there is potential to develop a rock lobster on-shore aquaculture (or other suitable shellfish) facility at the sites identified in the production area map for aquaculture. The seedstock for a rock lobster industry could be facilitated by the University of Tasmania, who have partnered with a company to develop a rock lobster hatchery in Tasmania. Commercial production is set to begin by 2021.The estimated development cost for this facility is $20 million.

A local hatchery is required to develop a tropical rock lobster industry in North Queensland. This allows for the export of juvenile lobsters as well as a potential local industry for the domestic market. Given the lag time for the currently proposed hatchery in Tasmania, a North Queensland industry is unlikely to be established for the next 5 to 10 years.

Future state:

Figure 24 indicates the potential supply chain given implementation of the key upgrades and additions listed in Table 41. Development of a hatchery would facilitate growth of the existing on-shore aquaculture industry and also a new market exporting fingerlings. If a local industry is a priority, the hatchery and aquaculture ponds would ideally be located at the same site, to reduce costs of transport between the two facilities. If the processing, packaging, and storage facilities were also located at one site close to the airport, this would further save on transport costs. It is noted that refrigerated shipping containers would be required to transport hatchery and aquaculture produce. A hatchery near the airport would support a fingerling export industry, but this is not shown in Figure 24.

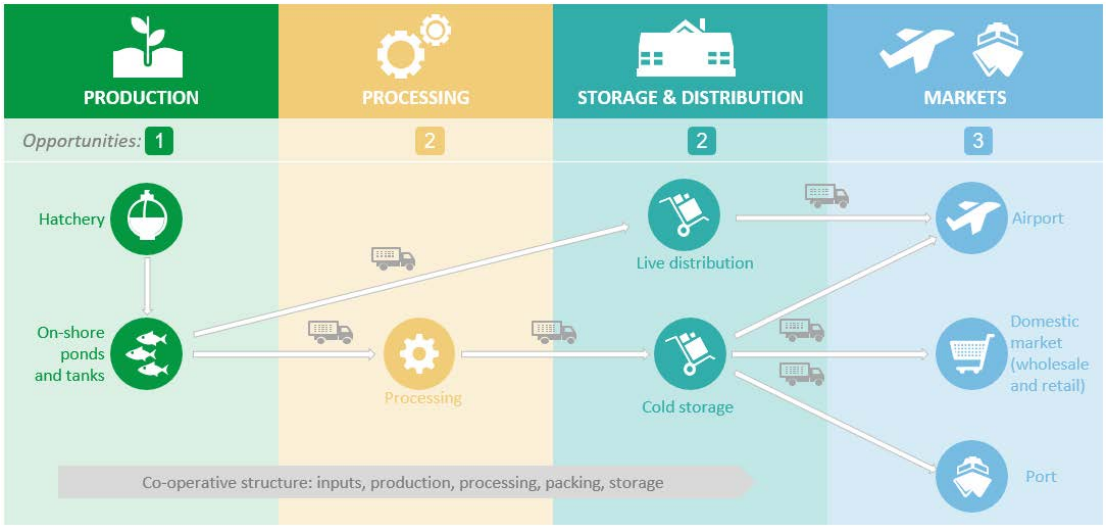


Figure 24: Potential on-shore aquaculture supply chain with implementation of recommended upgrades and additions.

The analysis of supply chain constraints and infrastructure gaps is summarised in Table 41.

Table 41: Supply chain constraints and opportunities

Ref	Constraint	Gap	Cost estimate	Opportunities and considerations
A	Location – access to labour, R&D, management of biological risks	Co-location of research and industry Exposure to water borne biological disease		Collaborate with regional universities regarding on-shore aquaculture services, develop pilot programs for commercialisation (refer University of Tasmania for aquaculture, review sector capabilities of JCU/CQ). Consult with Fisheries Research and Development Corporation (FRDC) for aquaculture investment, R&D and extension initiatives.
2	Production – lag time			Review project finance arrangements in line with forecast production (5-10 years until revenue stream).
B	Production – lack of facilities	Storage Hatcheries Ponds Aquaculture farms	$100,000 - $150,000 per ha. for prawn facilities (BQ, 2016) Indicative start-up cost of ~$350,000 for a semi-intensive redclaw farm(BQ, 2016)	Review potential to source feed from local legume meal (e.g. soy) and other grains suitable for growth in the region. Engage engineering services (civil, structural and process) to design cost of facility tailored to value-added processing requirements of target markets. Invest in development of facilities such as a rock lobster hatchery and aquaculture farms. Other examples on-shore aquaculture developments include (~ $25 million for 100ha aquaculture development, ~ $20 million for hatchery).
3	Processing – lack of facilities	Processing Holding facility	~$3.5 million for 80-tonne lobster holding/processing facility in Geraldton (WA, 2017)	Invest in development of facilities for processing, packaging, and storing rock lobster products. This could be strategically located near the airport to facilitate entry into the export market.

Ref	Constraint	Gap	Cost estimate	Opportunities and considerations
C	Market access – cold chain and air freight for export markets, export protocols	Access to belly space for air freight (passenger, freight or charter services) Cold chain facilities Export protocols for fresh and processed product Packaging alignment with market requirements	~$2,100-$2,600 per m^2 for temperature controlled storage	Establish air freight capability from Townsville airport to enable supply of unprocessed and processed aquaculture products to export markets. Develop cold storage facility at or in close proximity to airport. Investigate product traceability platforms to underpin export market development (e.g. to certify provenance, quality, biosecurity compliance). Investigate export protocols for target export markets. Investigate innovative packaging to meet target export market requirements.

Soybean

Identification of production areas

The most suitable land for soybean production in North Queensland is existing sugarcane cropping land in the Atherton Tablelands where it is used in rotation with cane during the replant phase. It has been indicated that the conversion of 20 per cent (1 year in 5) of the existing sugarcane farming land in the region would facilitate establishment of an industry. According to QALA, there is 180,000ha of existing sugarcane land in the region. This equates to a potential production area of 36,000ha (20 per cent of total area). The use of sugarcane land, where farmers may already be growing soybean as a green manure crop, will generally contain suitable soils as well as existing knowledge and skills.

The clearing of regulated vegetation would not be possible to establish new production areas.

Soybean production area map

The map of potential production areas for soybean was restricted to current sugarcane growing areas.

The map of production area for soybean is indicated by the area for sugarcane, which is shown on page 141. The map shows that there are approximately 36,000ha per annum that are potentially available for the production of soybean in the study area.

Harvest and processing

Like most grains, combine harvesters and chaser bins are used for the harvesting of soybean. For the varieties suitable to North Queensland, harvest occurs early in the year and aligns with the wet season. This presents issues for both disease and harvest. Soybeans are harvested at 15 per cent moisture but stored at 10-12 per cent moisture below 13°C to prevent spoilage. Storage, drying and aerating facilities are needed to enable harvesting at high moisture contents and ensure a viable industry in North Queensland.

The processing of soybean varies depending on end use of the product. For the production of oil, hulls are removed, and soybean is usually cracked, cooked, rolled and oil extracted using a solvent. The by-product of oil extraction is soybean meal which is utilised for stock feed. Most soybeans are sold to grain traders who identify appropriate markets (DAFF, 2013).

Value adding opportunities

In Australia, the use of soybean for human consumption is less common than oil and meal uses. Products for human consumption include tofu, tempeh, soy milk and noodles. Demand for these products is growing as niche markets, such as vegan and lactose intolerant consumers, are increasing. In Queensland, there are limited food processors who process soybean for human consumption. Similar to avocado and macadamia, high pressure processing (HPP) has potential for use with soybean.

Edamame is a cuisine that originated in Asia in which the entire soybean pod is boiled and steamed. Traditionally, soybean pods are hand harvested to prevent damage to the seed pod. According to James (2007), the Bunya variety is most suited to edamame production and may have potential in the Burdekin region. Given the low processing requirements, this may be suitable for the early development of a soybean industry, and access to labour would be critical (James, 2007).

As noted above, the generation of soybean meal may provide opportunities for collaboration with other emerging industries in North Queensland (e.g. intensive beef or on-shore aquaculture as a source of feed).

Further research is required to understand the demand profile for specific finished goods, including the investment in processing, packaging and product certification to meet specific market requirements.

Supply chain constraints and infrastructure gap analysis

Current state:

Production of soybean in the Townsville region is ad hoc and exposed by its lack of proximity (refer freight differential) to more consistent southern markets. Approximately 1,000ha of soybean is currently grown in the region, which is mostly for seed production for green manure crops in rotation with sugarcane. There are a range of reasons that contribute to producers being unwilling to grow soybean such as inadequate agronomic expertise, lack of water, price of water, and selling price of soybean (M'Gee, 2012). Specific to North Queensland, the lack of sufficient infrastructure and distance from end use processors is noted as a significant deterrent for potential growers. According to Soy Australia Ltd (2010), there is one soybean buyer in North Queensland, located in Tolga. The remaining buyers are located in southern Queensland or further south. The buyer in Tolga currently only purchases soybean to produce seed for planting soybean as a green manure crop on sugarcane farms, however there are indications that other processing facilities are being constructed in Tolga at the moment. The nearest high-value buyer and processor for human consumption markets is in Kingaroy.

The current soybean supply chain in the region is depicted in Figure 25. According to the findings of this study, production of soybean in the region for anything other than the green manure market is considered to be negligible. While there is an option for growers to produce soybean for southern processors and markets, due to constraints and costs around transport and volatile selling price of soybean, this is a very high risk market that few producers would currently be willing to commit to in the long term.

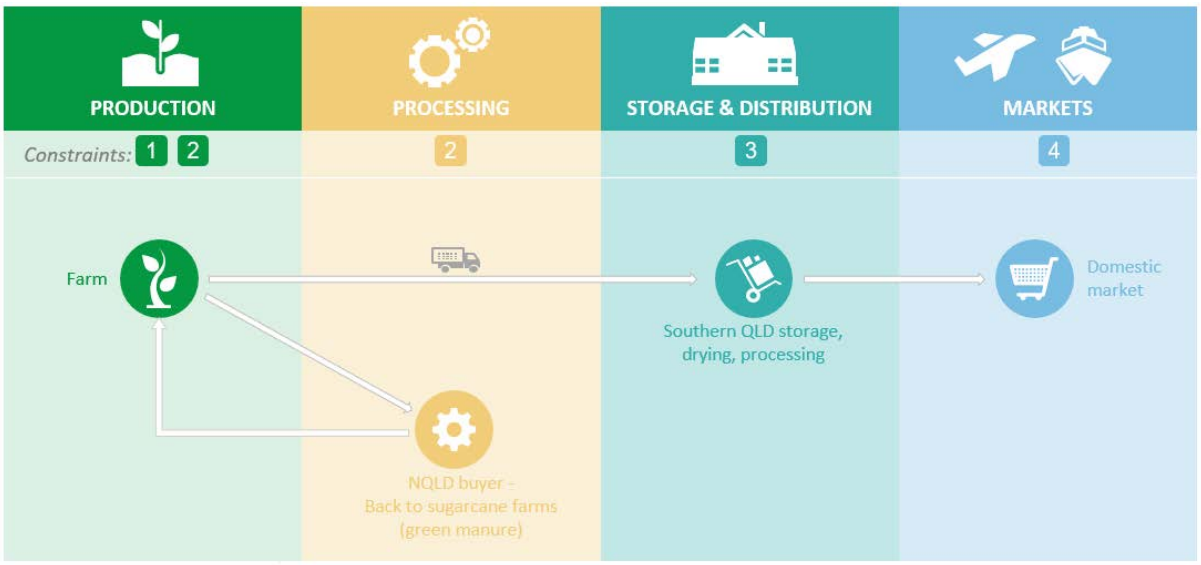


Figure 25: Current soybean supply chain in the in-scope region.

There are two varieties of soybean suitable for production in coastal North Queensland. These are Stuart and Leichardt, which are slow maturing varieties that are well-suited to rotation with sugarcane (Soy Australia Ltd, 2010). The Stuart variety is suitable for soybean flour, tofu, tempeh and soymilk production, while the Leichardt variety is suitable for crushing for animal feed.

The local manufacture of soy products for human consumption would require a processor to be established in North Queensland. Strategically, this should be located in Townsville due to access to a labour force and to facilitate export opportunities.

The storage and transport of soybean requires the establishment of drying facilities in North Queensland. Given the North Queensland climate, incorrect storage and transport could result in significant losses. This also requires an investment in suitable food grade transport containers.

Future state:

Figure 26 indicates the potential supply chain given implementation of the key upgrades and additions listed in Table 42. Planting of suitable varieties will assist producers to overcome constraints to successful harvesting. Development of a processing facility designed to make soy flour, soy milk, and tofu from the Stuart variety and crushed animal feed from the Leichardt variety will mean that producers will have a local option to direct produce into value-adding rather than back into green manure. Investment in processing facilities should include investment in food grade transport containers to ensure that soybean meets human consumption quality and export market standards. Finally, positioning of the processing facility at or near either the Port or the Airport, and establishment of an export market or markets, will facilitate growth of a robust industry.

To ensure the viability of investment in grain storage and handling infrastructure, and to effectively utilise the key air and sea ports of Townsville consideration must be given to the potential for soybean production outside the study area.

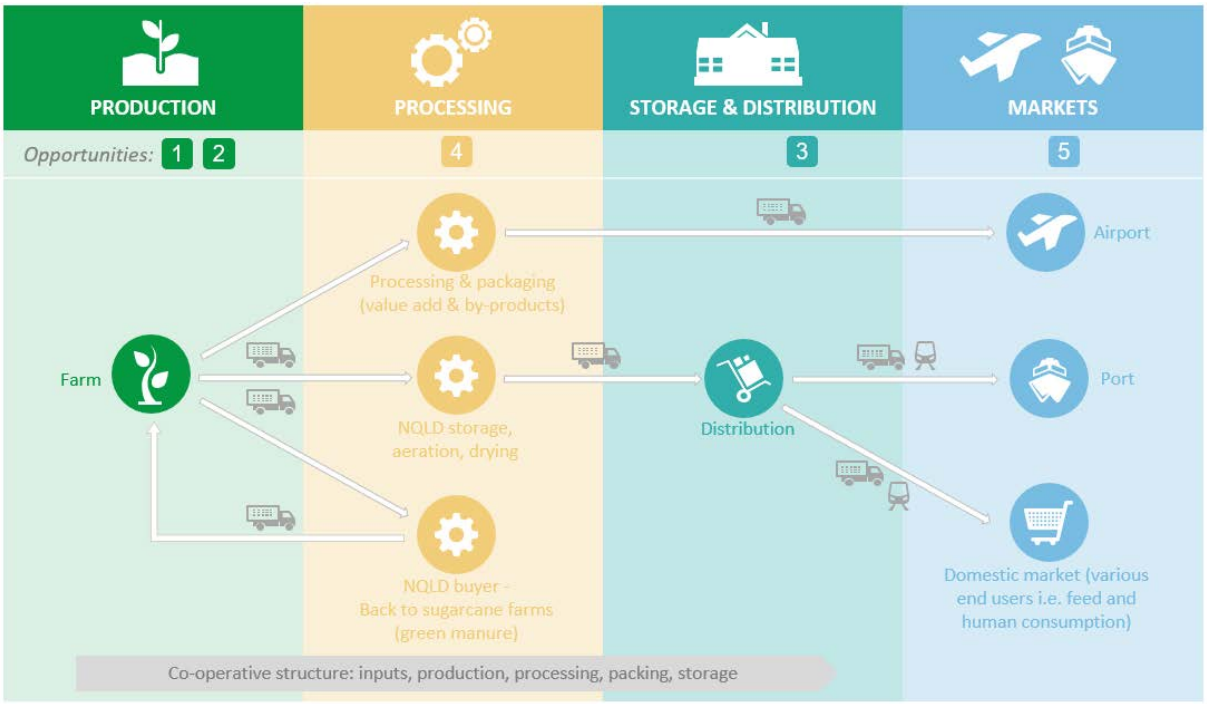


Figure 26: Potential soybean supply chain with implementation of recommended upgrades and additions.

The analysis of supply chain constraints and infrastructure gaps is summarised in Table 42.

Table 42: Supply chain constraints and opportunities

Ref	Constraint	Gap	Cost estimate	Opportunities and considerations
1	Location – agronomy, R&D and extension capabilities	Co-location of expertise, research and industry		Select varieties suitable for the region (e.g. Sturt, Leichardt). Collaborate with regional universities, Grains Research and Development Centre (GRDC) regarding agronomy services, develop pilot programs for commercialisation. Establish a soybean growing cooperative to share information and resources to develop markets for soybean.
1	Marketing – scale and consistency of supply	Production equipment, storage and handling equipment	Variable dependent on consumer requirements (refer further comment in processing below)	Review merits of a dedicated entity (i.e. grower cooperative) to accumulate, process and market regional production Explore potential of multiple sectors (domestic and export) to extract maximum value from production. Examples include: – Broadacre crop – Rotation crop (for sugarcane) – Livestock and on-shore aquaculture feed (local buyers) – Human consumption (e.g. oil, flour, milk, tofu) – Industrial (e.g. adhesives and lubricants)

Ref	Constraint	Gap	Cost estimate	Opportunities and considerations
				– Pharmaceutical
1	Production – land preparation, production and harvest	Production and harvesting equipment	~$30-80,000 boom sprayer ~$250,000 air seeder (Farm Tender, 2019) Combine Harvesters ~$6-700k (new) - $2-300k (used), subject to features required	Lease, contract services or co-invest in equipment required for preparation of land, production and harvesting of soybean. Review potential for cooperative structure where inputs (e.g. seeding, agronomy services, fertiliser, chemicals, equipment) can be aggregated. Production equipment includes tractors, cultivation equipment, seeders or row crop planters, boom sprayers, irrigation equipment, monitoring devices, harvesting equipment, chemical application. Cost of equipment will vary pending age and specification of equipment.
2	Storage and handling – limited infrastructure	Storage Handling equipment Drying equipment	Grain storage (silos) ~$100-$200/mt stored subject to features required* Grain handling (augers) ~$20k (used)	Utilise contract harvesting services to minimise initial investment. Drying and aeration capabilities critical to management of temperature and humidity of local environment. Explore cooperative purchasing of harvesting, storage and/or handling equipment. Explore storage and handling requirements of growers outside of the in-scope region to underpin the financial viability (utilisation) of common infrastructure. **Cost will vary depending on scale and functionality of operation (estimate assumes 1,000mt of storage)*
2	Processing – lack of capacity and proximate facilities	Processing facility Packing facility Cold storage	Industrial soymilk processing machines ranging from $205,000 - $1.37 million, tofu production lines are available for $63,000 - $82,000*. ~$2,100-$2,600 per m^2 for construction (temperature controlled storage)	Develop a processing facility that can produce value added products. Explore collaborative ownership models. ** Design services to be engaged to confirm system based on specification and capacity of system, following consultation with priority markets*

Ref	Constraint	Gap	Cost estimate	Opportunities and considerations
3	Market access – bulk, packaged and containerised products, export protocols	Access to belly space for air freight (passenger or charter services) Food quality containers Road improvements (e.g. widening, sealing) Export protocols Packaging alignment with market requirements	Double door shipping containers are available from $3,900 - $4,400 (10' container), $6,900 - $7,900 for (40'). These are non-refrigerated. ~$650,000 per km for road upgrades (ADIRDC, 2018)	Establish relationships with domestic consumers (food grade, feed grade) and freight contractors for bulk road transport. Invest in suitable food grade transport containers to facilitate shipping of soybean to consumers (predominantly used for export markets). Establish air freight capability from Townsville airport to enable supply of un-processed and processed macadamia nuts to export markets. Develop cold storage facility at or in close proximity to airport. Investigate product traceability platforms to underpin export market development (e.g. to certify provenance, quality, biosecurity compliance). Investigate innovative packaging to meet priority market requirements

Summary of product constraints and inputs matrix

Table 43: Summary of product constraints and inputs matrix

Option	Beef	Macadamia	On-shore aquaculture	Avocado	Soybean
Yield per hectare	N/A	3.5-4 tonnes/ha NIS; 0.86 tonnes saleable kernel	N/A	9-20 tonnes/ha	1.5-2.5 tonnes/ha
Production season	May be limitations in the wet season due to access	Year round, production stages include harvesting (Feb-Aug), cracking (Mar-Oct), crop estimates (Jan-Apr), price/volume estimates (Feb-May), contract finalisation (Mar-Jul), supply (Jun-Apr)	N/A	Central Queensland supply of Hass variety from April to August and supply of Shepard from March to April	December to February. Soybean flowers in response to shortening day length – planting too early produces a crop that takes longer to flower and can result in excessive vegetative growth. Planting too late hastens flowering resulting in a crop that produces shorter plants with pods set closer to the ground. Planting in December is preferred in central Queensland
Irrigation requirement	N/A	Natural rainfall of 1200 to 2300 mm; 40L per tree per week during dry conditions in first year, 150L per tree per week during dry/hot conditions, after 4 years	N/A	Water storage reserve of 5ML/ha required to maintain production in a dry year. For mature trees, total crop water requirement is 11-12ML/ha. Irrigation required to supplement rainfall (usually about 3-5ML/ha)	A soybean crop achieving maximum production will used 600-800 mm of water. Irrigation demand in a dry year can range from 6-8ML per ha

Option	Beef	Macadamia	On-shore aquaculture	Avocado	Soybean
Available land	17,637ha	8,000ha	Commercial shed in Townsville area	8,000ha	36,000ha
Associated infrastructure requirements (on site)	Grain storage, grain mixing, steam flaking (if used), silage pits (if used), pen infrastructure (fences, bunks, troughs, shade (optional), hospital pens, staff amenities, office, effluent management, irrigation areas	Tractors, cultivation equipment, seeder/disc drills or row crop planters, boom sprayers, irrigation equipment, soil moisture monitoring, combine harvester, chaser bins, grain trucks, silos, de-husking/cracking machinery (if nuts to be sold at the farm gate), nut processor*	Hatchery*	Deep ripper, cultivator, irrigation system (unless dryland), herbicide and pesticide applicators, sprayers, soil moisture monitoring devices, harvesting equipment (ladders, hydraulic picking platforms, cherry pickers), field containers and transporters, packing shed*, post-harvest chemical treatment spray (for anthracnose and stem-end rot disease control)*, drying and polishing area and equipment*, sorting area*, cooling facility*, storage area*, ripening facility (if required)*	Combine harvester, chaser bins, storage facility (10 per cent, <13^{s}C), drying/aerating facility*, food grade transport containers*
Associated infrastructure requirements (off site)	Recommended: grain-fed abattoir required (at least 1,000 head facility), close to workforce, increased irrigated grain production in North Queensland, Improved Road access in rural areas General: Roads (b-triple road train), grain production area,	Recommended: drying and storage facility, no cracking of nuts required for export General: Nut processor*, roasting, flavouring, sorting facility,	Recommended: rock lobster hatchery in Townsville, storage facility for live fingerlings at airport/port, aquaculture ponds for adult production, close to workforce	General: packing shed*, post-harvest chemical treatment spray (for anthracnose and stem-end rot disease control)*, drying and polishing area and equipment*, sorting area*, cooling facility*, storage area*, ripening facility (if required)*, road, processing facility (for further	Recommended: Drying, storage and processing, use 20 per cent of current sugarcane land in rotation. *Note: need to contemplate broadacre cropping potential in/outside of the study area to ensure viability of infrastructure General: Buyer/Processor facility (eg HPP), drying

Option	Beef	Macadamia	On-shore aquaculture	Avocado	Soybean
	staff accommodation and facilities, processing facility			processing eg HPP), cold storage	facilities*, food grade transport containers
Key risks	Need a source of locally produced grain or grain transport costs can be excessive, need secure water supply, heat stress impacts on animal welfare, supply agreements (for incoming and outgoing cattle)	Cyclone damage, and low number of local advisors in the district	Very new and emerging market and little is known about farming in the tropics. New techniques for hatching are still being finalised.	Cyclone damage, and current lack of available rootstock. Also, low number of advisors in the district	Changes (upward) in sugar prices will result in growers turning away from rotation crops in general, however this appears unlikely in the short-medium term. Skilled advisors in the district are also required.

Sources: (DAF, 2018c https://www.daf.qld.gov.au/business-priorities/plants/fruit-and-vegetables/fruit-and-nuts/macadamia/macadamia-harvesting-yields-and-prices; DAF, 2016; Agrifutures Australia, 2017b; Australia, 2018; DEEDI, 2004; Agrifutures Australia, 2017c; Avocado Australia, Hort Innovation and Avocado Fund, 2018; Mace and Harris, 2012; DAF, 2018a; Queensland Government, NCEA and Growcom, 2018; http://www.qgso.qld.gov.au/products/tables/agriculture-yield-main-crop-qld/index.php; https://www.statista.com/statistics/631890/australia-soybean-yield).

Opportunities for greenfield development

In addition to the production areas considered within the capability assessment, the North Queensland region has significant potential to support large scale greenfield agricultural development. Major regional opportunities include:

- **Hells Gate Dam irrigation scheme:** The proposed scheme has the potential to irrigate up to 50,000ha and is suitable for production of a broad range of crops including perennial horticulture (avocado, citrus, table grapes), annual vegetables, and broadacre opportunities such as chickpeas, sugarcane, and cotton. A recent feasibility study by SMEC (2018) has shown the development to be technically viable, with the potential to create up to 4,000+ ongoing jobs and inject $1.3 billion in Gross Regional Product (GRP) annually to the North Queensland economy. The project is currently subject to a detailed business case, which will include the development of Big Rocks Weir. The Weir development will provide urban water security to the township of Charters Towers and potentially enable small scale irrigation and trial cropping.
- **Raising Burdekin Falls Dam:** SunWater is currently investigating the potential to raise Burdekin falls dam by 2 metres which would provide approximately 150,000 ML of additional annual irrigation allocations. This development has the potential to support expanded irrigation within the study catchment areas as well as to the key horticultural centre of Bowen to the south.

These large scale developments are subject to separate feasibility assessments, and given their complexity are not considered specifically within this study. However, these longer term developments provide the opportunity to develop expanded scale and alternative growing locations for the agricultural products identified within this study.

Scenario development

The following sections consider potential future industry scenarios for North Queensland based on the development of the five opportunity sectors identified in this study. The scenarios will be used to consider the potential returns to growers and economic development outcomes for the region associated with transitioning to the identified priority products against current production trends. The aim of the scenarios is not to prescribe specific crop options to growers, but to highlight a range of potential opportunities that are available to support the future development of the agricultural sector.

Neither should the scenarios be considered mutually exclusive, rather they focus on specific aspects and opportunities within the North Queensland agricultural industry. Each of the scenarios considers the requirements for change, including key changes in production/farm practices, land use, key infrastructure developments (on-farm and industry scale).

Scenario 1: Business as usual

The business as usual (BAU) scenario entails a continuation of current production trends with the industry's dominant crops of sugarcane and low intensity beef cattle production supported by small areas of annual horticulture. No significant growth is projected under the BAU scenario, however the agricultural sector remains a significant employer and driver of economic activity in the region, both on-farm and through the supply chain.

The business as usual scenario is designed to act as a benchmark against which results for other scenarios can be compared.

Key statistics relating to the BAU scenario are presented below.

Table 44: BaU production scenario

Input	2016-17
Agricultural gross production value	$1.1b
Employment (place of work)	3,352
Product mix (per cent of production value)	Sugarcane: 48.9 per cent Beef cattle: 35.3 per cent Vegetables: 9.9 per cent Other: 5.9 per cent
Dominant farm practices	Dryland and surface irrigated sugarcane Extensive cattle grazing
Key scenario risks	Weak demand outlook for sugar. High reliance on two core commodities.
Applicable LGA	All

Source: ABS (2017a,b).

Scenario 2: Beef cattle intensification

This scenario focuses on regional opportunities for intensification of North Queensland's beef cattle sector through the establishment of intensified production systems including feedlotting and potentially irrigated pasture. The scenario includes increased capacity of approximately 190,000 head turnoff per annum (36,000 head on feed at any one time). This level of production is considered viable to support increased regional meat processing capacity (DAF, 2014).

Intensifying production will generally occur on existing low intensity beef cattle areas, resulting in loss of current activity. Key regional changes under the beef cattle intensification scenario versus BAU are presented below.

Table 45: Beef cattle intensification scenario

Input	Beef cattle intensification
Land use change	17,637ha extensive grazing → Feedlotting
Production increase	190,000 head beef cattle p.a. (36,000 head capacity)
Production value ($m)	$228
Export value ($m)	$200 (approx. 70 per cent export propensity)
Value added ($m)	$83 direct
Employment	50 direct FTE (adapted from Deloitte, 2015 estimates)
Key scenario risks	High capital costs, access to affordable feedstock
Applicable LGA	Charters Towers

Source: RDA (2007), MLA (2017)

Scenario 3: Fallow cropping

This scenario focuses on the potential development of 20 per cent of existing sugarcane lands (based on a 1 in 5 year fallow) across the key Hinchinbrook and Burdekin production areas to a rotation of soybean (and potential other grain/pulse options) to created diversified income for growers and establish a new industry.

The new production will not impact upon existing sugarcane production, and in many cases will improve cane yields as a result of improved soil nitrogen provided by legume crops, and the transition from many years of monoculture sugarcane production.

Key regional changes under the fallow cropping scenario are presented below.

Table 46: Fallow cropping scenario

Input	Fallow cropping
Land use change	36,000ha fallow → Rotational soybean
Production increase	Approx. 96,000 tonnes soybean per annum
Production value ($m)	$46
Export value ($m)	$18 (approx. 40 per cent export propensity)
Value added ($m)	$27 direct
Employment	Will largely utilise existing sugarcane industry labour
Key scenario risks	Production risks during monsoon, commodity pricing
Applicable LGA	Charters Towers, Hinchinbrook, Burdekin

Source: DAF (2018), AEC.

Scenario 4: Diversification of sugarcane lands

This scenario focuses on the potential transition of 20 per cent of existing sugarcane lands across the key Hinchinbrook and Burdekin production areas to alternative cropping options, including extended fallow incorporating soybean (and potential other grain/pulse options) and the expansion of perennial horticultural production (avocado, macadamia) where land is suitable, and irrigation is available (available area has been reduced from 8,000 to 4,000ha to account for this).

Key aspects of this scenario include a focus on a transition of existing production lands (within the base case) to new cropping options rather than the development of greenfield sites. Therefore, production is not a net increase as it will replace irrigated sugarcane in the Burdekin and dryland cropping in Hinchinbrook.

This scenario will involve significant changes in practices and skills, particularly to transition to perennial, trickle irrigated horticultural production.

Key regional changes under the diversification of sugarcane lands scenario are presented below.

Table 47: Diversification of sugarcane lands scenario

Input	Diversification of sugarcane lands
Land use change	36,000ha sugarcane → rotational grains and pulses
	4,000ha extensive grazing → perennial horticulture
Production increase	+ Approx. 32,000 tonnes avocado
	+ Approx. 7,000 tonnes macadamia
	+ Approx. 48,000 tonnes soybean

Input	Diversification of sugarcane lands
	+ Approx. 108,000 tonnes sorghum + Approx. 98,000 tonnes chickpeas - Approx. 3m tonnes sugarcane
Production value ($m)	$213 net of lost sugarcane
Export value ($m)	$124 (approx. 35 per cent net export propensity)
Value added ($m)	$74 direct
Employment	Grain/pulse production will largely utilise existing sugarcane industry labour Estimated 800 perennial horticulture FTE jobs based on 1FTE/5ha
Key scenario risks	Production risks for perennial horticulture and grain cropping Viability of sugar milling infrastructure
Applicable LGA	All excluding Townsville

Source: DAF (2018c), AEC.

Scenario 5: Expansion of on-shore aquaculture

This scenario focuses on the expansion of land-based aquaculture, with 500ha of high-value aquaculture ponds developed across the region. Key regional changes under the expansion of on-shore aquaculture scenario are presented in the table below.

Table 48: Expansion of on-shore aquaculture scenario.

Input	Expansion of on-shore aquaculture
Land use change	500ha land-based aquaculture ponds
Production increase	Approx. 6,000 tonnes
Production value ($m)	$150 (est. @ $25/kg)
Export value ($m)	Production currently services the domestic market
Value added ($m)	$53 direct
Employment	Est. 300 FTE
Key scenario risks	Production and environmental risks from land-based aquaculture
Applicable LGA	Townsville

Source: DAF (2018c), AEC.

Financial analysis

The following sections consider the financial viability of key opportunity crops against current production options from an on-farm perspective. On-shore aquaculture has been excluded due to lack of available data.

Table 49: Key findings and relevant LGAs

LGA	Key findings
Hinchinbrook Burdekin	Incorporating rotational fallow crops such as soy beans provide modestly increased grower returns under dryland and irrigated production.
Hinchinbrook Burdekin	Transitioning from sugarcane completely in favour of a grain pulse/rotation improves returns under dryland cropping and irrigation. However, the increased in NPV needs to be weighed against the relative reliability of sugarcane production (particularly in the absence of irrigation).
Hinchinbrook Burdekin Palm Island	Transitioning to avocado production presents a strong potential return on investment, however macadamia provide a negative return due to the high upfront capital cost and long turnaround time for investment. Relative returns between these two crop options will change over time due to market supply dynamics, particularly for avocado, with strong increases in supply and some large producers projecting grower prices to fall from $9 to $4.50 per kg experienced in recent years (Delroy in ABC, 2018).
Charters Towers	Feedlotting of beef cattle is modelled to provide a modest return of investment of approximately (internal rate of return (IRR) 14 per cent over 15 years.

Source: KPMG, AEC

The analysis is based on available published benchmarks and should be considered indicative only, as the purpose of the analysis is to consider the incentives and barriers to change to gain insight into the future direction and possibilities for the North Queensland agricultural industry.

Specifications for each of the crops options is presented in the table below adapted from DAF (2018) and previous assessments by AEC. Capital cost estimates for grain/pulse crop options have been adapted from McKellar Et. Al. (2013) assuming a transition from existing sugarcane equipment to incorporate grain/pulse production. Capital costs for perennial horticulture have been adapted from Dee and Chose (2015).

Table 50: Financial Analysis Inputs.

Crop	Capital costs ($/ha)	Yield (t/ha)	Revenue ($/ha)	Variable costs ($/ha)	Fixed costs ($/ha)	Net margin ($/ha)
Existing crops						
Irrigated Sugarcane (existing)	N/A	120	$3,9261	$1,857 1	$650	$1,419
Dryland sugarcane (existing)	N/A	80	$2,6181	$1,2081	$500	$910
Grains/pulses						
Soybean (irrigated)	$1,000	3	$1,425	$558	$325	$542
Chickpeas (irrigated)		3.2	$2,880	$812	$325	$1,743
Sorghum (irrigated)		8	$2,400	$871	$325	$1,204
Soybean (dryland)	$1,000	2.2	$1,045	$318	$250	$470
Chickpeas (dryland)		2.2	$1,980	$542	$250	$1,188
Sorghum (dryland)		3	$900	$374	$250	$276

Crop	Capital costs ($/ha)	Yield (t/ha)	Revenue ($/ha)	Variable costs ($/ha)	Fixed costs ($/ha)	Net margin ($/ha)
Perennial horticulture[3]						
Avocado	$45,000	16	$79,200	$13,891	$2,000	$63,309
Macadamia	$45,000	3.5	$18,200	$6,646	$2,000	$9,554
Livestock	Capital costs ($/head throughput)	Kg gain (70 days)	Revenue ($/head)	Variable costs ($/head)	Fixed costs ($/head)	Margin ($/head)
Cattle feedlot	$200	90	$1,200	$1,163	$4	$33

1. Adjusted for 1 in 5 years fallow. 2. Additional overheads have not been included where soybean are used as a fallow rotational crop with sugarcane. 3. At full production, avocado trees typically reach full production after 8 years and macadamia after 11.

Source: DAF 2018; Dee and Chose (2015); AgriFutures Australia (2018); McKellar et al. (2013)

Returns have been assessed at a modest real discount rate of 7 per cent over 15 and 30 years reflecting different investment timeframes at an individual investor and broader community level (with capital costs incurred in year 1 and replacement capital costs equivalent to 50 per cent of initial expenditure in year 16), with the net present value (NPV) presented in the table below.

It should be noted that returns for crop options will vary significantly over time. Many production alternatives are also considered to have a higher crop risk profile compared to the established sugarcane and beef cattle sectors, for which regional production is considered relatively reliable.

A number of key risk factors will influence expected returns, including (but not limited to) weather events, market volatility and supply/demand movements, pests and diseases, and the cost structures and operating practices of individual organisations. Sensitivity analysis of potential risk factors is undertaken at a high level in the following section.

Despite these limitations, the analysis indicates that there exists a range of potential options for regional producers that are at least comparable to the established industries and feature a strong long-term market outlook.

Table 51: Financial Analysis Results

	NPV/ha 15 Years			NPV 200ha 15 years ($M)	NPV 200ha 30 years ($M)
Crop/Rotation	**4 per cent**	**7 per cent**	**10 per cent**	**7 per cent**	**7 per cent**
Existing crops					
Sugarcane (existing)	$15,777	$12,924	$10,793	$2.6	$3.5
Dryland sugarcane (existing)	$10,118	$8,288	$6,922	$1.7	$2.3
Grains/pulses					
Sugarcane plus fallow soybean (irrigated)	$17,791	$14,268	$11,655	$2.9	$3.8

Crop/Rotation	NPV/ha 15 Years			NPV 200ha 15 years ($M)	NPV 200ha 30 years ($M)
	4 per cent	7 per cent	10 per cent	7 per cent	7 per cent
Sugarcane plus fallow soybean (dryland)	$11,760	$9,394	$7,640	$1.9	$2.5
Grain pulse rotation (soybean/chickpeas/sorghum) two crops/annum (irrigated)	$27,872	$22,674	$18,793	$4.5	$6.3
Grain pulse rotation (soybean/chickpeas/sorghum) two crops/annum (dryland)	$16,510	$13,381	$11,050	$2.7	$3.5
Perennial horticulture					
Avocado	$392,179	$287,357	$211,991	$57.5	$97.8
Macadamia	-$35,774	-$40,854	-$43,567	-$8.2	-$3.3
Livestock					
Cattle feedlot (10,000 head/annum, $M)	$1.4	$0.8	$0.4	$0.8	$1.6

Source: AEC

Sensitivity testing

Sensitivity testing was undertaken using a Monte Carlo analysis, which assigns a probability distribution for each input parameter in the model and then examines multiple iterations. This distribution is then used to identify the effect of the input parameter on the decision criteria (i.e. NPV). It reflects the probability of achieving the key dependent output across the following key assumptions used in the analysis:

- capital costs
- operating costs (fixed plus variable)
- revenues (price and yield).

Each of the above assumptions was tested in isolation, with all other inputs maintained. The results were reported in terms of the modelled change in NPV resulting from the variance in the base assumptions at a discount rate of 7 per cent. The table below shows each assumption simultaneously to provide a 'combined' or overall sensitivity of the model findings to the assumptions used. The also outlines the distribution used, allowing for:

- A 90 per cent confidence interval, with the '5 per cent' and '95 per cent' representing a 90 per cent probability that the distribution and NPV will be within the range outlined in the table.

The ranges tested for each input variable are as follows:

- Costs reflect a maximum 40 per cent higher and 30 per cent lower than the base values.
- Broadacre cropping margins reflect a normal distribution with a standard deviation of 30 per cent.
- Horticultural and feedlot margins reflect a normal distribution with a standard deviation of 40 per cent.

Results of the Monte Carlo simulation indicate that grain pulse cropping options provide a higher variability in returns compared to sugarcane (due to the need for additional capital expenditure) while the higher risk profile of perennial horticulture and feedlotting present an even greater variation in returns.

Table 52: Monte Carlo simulation results (15 years, 7 per cent discount rate)

Crop/Rotation	NPV/ha ($'000)		per cent simulations >0
	5 per cent	95 per cent	
Existing crops			
Irrigated sugarcane (existing)	$2	$37	96.4 per cent
Dryland sugarcane (existing)	-$4	$20	85.8 per cent
Grains/pulses			
Sugarcane plus fallow soybean (irrigated)	-$11	$39	82.1 per cent
Sugarcane plus fallow soybean (dryland)	-$4	$22	87.9 per cent
Grain pulse rotation (soybean/sorghum/chickpeas) two crops/annum (irrigated)	$0.8	$45	95.7 per cent
Grain pulse rotation (soybean/sorghum /chickpeas) two crops/annum (dryland)	-$.2	$26	94.8 per cent
Perennial horticulture			
Avocado	-$13	$573	94.9 per cent
Macadamia	-$71	-$10	0.01 per cent
Livestock			
Cattle feedlot (10,000 head/annum) ($M)	-$69m	$66m	49.5 per cent

Source: AEC

Cost benefit analysis

The CBA provides an overview of the net economic costs and benefits associated with the future scenarios between the financial years ending 30 June 2020 and 30 June 2049.

All years presented in the CBA are for financial years ending in June. The costs and benefits have been assessed against three real discount rates (4 per cent, 7 per cent, and 10 per cent), with the focus primarily on the standard 7 per cent discount rate.

The geographical impact area is the Townsville Statistical Area Level 4. Costs and benefits assessed in this analysis relate to this catchment.

Decision criteria

The NPV and benefit-cost ratio (BCR) are the primary decision criteria for the economic appraisal. The NPV of a project expresses the difference between the present value (PV) of future benefits and PV of future costs, (i.e. NPV = PV benefits – PV costs). The BCR provides the ratio between the PV of benefits and PV of costs (i.e. BCR = PV benefits / PV costs).

Where the economic appraisal results in a:

- Positive NPV and BCR above 1, the project will be deemed as desirable
- NPV is equal to zero and BCR of 1, the project will be deemed neutral (i.e. neither desirable nor undesirable)
- Negative NPV and BCR below 1, the project will be deemed undesirable.

The IRR, which indicates the discount rate which would return an NPV of $0 and a BCR of 1, is also reported.

Scenarios compared in this assessment are as per those found in the body of the report:

- business as usual
- beef cattle intensification
- fallow cropping
- diversification of sugarcane
- expansion of aquaculture.

The CBA provides guidance on the net impact of the project cases against the base case. Additional details on the approach taken for this CBA are presented in Appendix 7.

Quantification of costs and benefits

Costs and benefits included in the assessment are presented in the table below. While the scenarios primarily focus upon on-farm changes, allowances within the CBA have been included to allow for significant value-adding/supply chain infrastructure requirements as follows:

- Beef cattle intensification (meat processing facility est. $60m (DAF (2013), GHD (2015)).
- Fallow cropping (grain storage and distribution est. $10m).
- Diversification of sugarcane lands (grain storage and distribution est. $25m).

For each of the scenarios, change in land use is assumed to occur over a period of 10 years.

Table 53: Cost benefit assessment inputs

Input	Beef cattle intensification	Fallow cropping	Diversification of sugarcane	Expansion of on-shore aquaculture
Change in land use (10 year transition)	17,637ha from extensive grazing to feed lotting	36,000ha to fallow soybean	36,000ha from sugarcane to rotational grains and pulses 8,000ha from sugarcane to perennial horticulture	500ha land based aquaculture ponds
Costs				
On-farm capital costs ($m)	$200/annual head throughput	$1,000/ha	Grains/pulses: $1,000	Est. $0.5 m/ha. Costs will vary depending on

Input	Beef cattle intensification	Fallow cropping	Diversification of sugarcane	Expansion of on-shore aquaculture
(renewal assumed after 15 years of operations @ 50 per cent of initial costs)			Perennial horticulture: $45,000/ha	hatchery requirements.
Other capital costs	Abattoir: $60m split over years 1-2	Grain storage: $10m year 1	Grain Storage: $25m year 1 Horticulture Processing $15m year 1	
Lost agricultural production (net margin)	Est. $25/ha (Building Queensland, 2017)		$1,419/ha irrigated sugarcane $910/ha dryland sugarcane	
Lost sugar milling production			Rising to $50m/annum from year 101	
Beef processing costs	$350/head			
Benefits				
Agricultural margins from new production	$33/head	Soybean (Irrigated): $542/ha Soybean (Dryland): $477/ha	Soybean (Irrigated): $542/ha Chickpeas (Irrigated): $1,743/ha Sorghum (Irrigated): $1,204/ha Soybean (Dryland): $477/ha Chickpeas (Dryland): $1,188/ha Sorghum (Dryland): $276/ha Avocado[2]: $50,657/ha Macadamia[2]: $9,554/ha	Est. $88,000/ha based on turnover adjusted to a value added estimate (50 per cent of wages included) using national transaction tables.
Manufacturing margins from beef processing	Processing costs plus 10 per cent margin			

1 based on the milling share of sugarcane revenue derived from the cane payment formula adjusted to a value added estimate using ABS national transaction tables. 2 At full production. Avocado returns reduced 20 per cent to allow for market impacts and potential falling prices.

Source: AEC

Costs and benefits not quantified

In addition to the costs and benefit identified above for inclusion in the CBA, a range of costs and benefits can be expected.

These include

- Environmental impacts to the Great Barrier Reef: Environmental impacts due to increased agricultural irrigation and aquaculture development – additional irrigated agriculture and on-shore aquaculture could increase the levels of agri-pollutants in the Great Barrier Reef and downstream catchments including the Bowling Green Bay Ramsar. These impacts could negatively affect the achievement of the Australian Government's Reef 2050 Long-Term Sustainability Plan.

- Improved sugarcane yields from rotational cropping. The move from monoculture of sugarcane towards rotational cropping presents significant soil health benefits, including increased resistance to disease and greater nitrogen levels. These benefits have not been modelled or quantified as part of this study.
- Additional supply chain costs and benefits. The CBA includes analysis of economic activity arising from direct operations only, while an allowance for meat processing has been included, numerous flow-on opportunities exist throughout the supply chain for each of the priority products.
- Additional employment opportunities. Intensification of North Queensland's agricultural production will create significant additional employment and wages (see section 4.4). These benefit streams have been conservatively excluded from the analysis.
- Potential decreased market prices for existing horticultural producers. Deep domestic and/or established export markets exist for the major broadacre crops included in this analysis (beef, grains/pulses/sugarcane). Horticultural production crops (including avocado and macadamia), however, have a strong reliance on supplying the domestic market. This is due to a range of factors, including trade barriers, the perishability of horticultural produce, and the intensity of production of these crops which decreases the advantage of the scale provided by Australia's available land compared to countries with lower operating costs. In the absence of sufficient growth in the domestic market or gaining greater access to international markets, new production may result in lower income for all producers.

Due to data limitations, these costs and benefits have been excluded from the analysis.

Cost benefit methodology

Step 1: Define the scope and boundary

To enable a robust determination of the net benefits of undertaking a given project, it is necessary to specify base case and alternative case scenarios. The base case scenario represents the 'without project' scenario and the alternative or 'with project' scenario examines the impact with the project in place.

The base case (without) scenario is represented by line NB1 (bc) over time T1 to T2 in the figure below. The investment in the project at time T1 is likely to generate a benefit, which is represented by line NB2 (bd). Therefore, the net benefit flowing from investment in the project is identified by calculating the area (bcd) between NB1 and NB2.

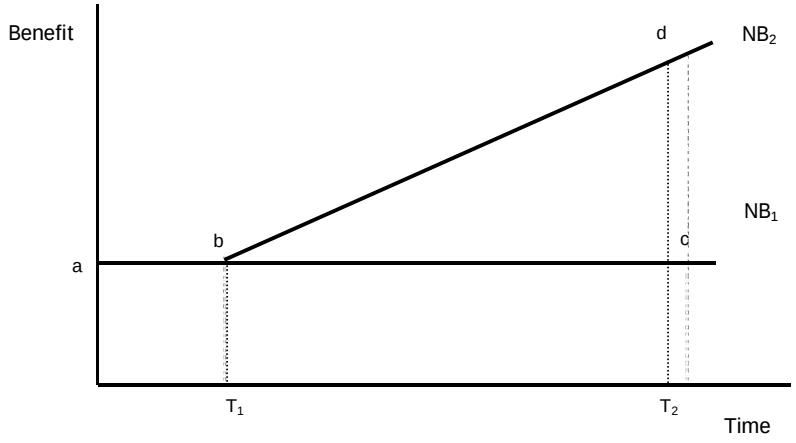


Figure 27: With and Without Scenarios

Source: AEC.

Step 2: Identify costs and benefits

A comprehensive quantitative specification of the benefits and costs included in the evaluation and their various timings is required and includes a clear outline of all major underlying assumptions. These impacts, both positive and negative, are then tabulated and where possible valued in dollar terms.

Some impacts may not be quantifiable. Where this occurs the impacts and their respective magnitudes will be examined qualitatively for consideration in the overall analysis.

Financing costs are not included in a CBA. As a method of project appraisal, CBA examines a project's profitability independently of the terms on which debt finance is arranged. This does not mean, however, that the cost of capital is not considered in CBA, as the capital expenses are included in the year in which the transaction occurs, and the discount rate (discussed below in Step 5) should be selected to provide a good indication of the opportunity cost of funds, as determined by the capital market.

Step 3: Quantify and value costs and benefits

CBA attempts to measure the value of all costs and benefits that are expected to result from the activity in economic terms. It includes estimating costs and benefits that are 'unpriced' and not the subject of normal market transactions but which nevertheless entail the use of real resources. These attributes are referred to as 'non-market' goods or impacts. In each of these cases, quantification of the effects in money terms is an important part of the evaluation.

However, projects frequently have non-market impacts that are difficult to quantify. Where the impact does not have a readily identifiable dollar value, proxies and other measures should be developed as these issues represent real costs and benefits.

One commonly used method of approximating values for non-market impacts is 'benefit transfer'. Benefit transfer (BT) means taking already calculated values from previously conducted studies and applying them to different study sites and situations. In light of the significant costs and technical skills needed in using the methodologies outlined in the table above, for many policy makers utilising BT techniques can provide an adequate solution.

Context is extremely important when deciding which values to transfer and from where. Factors such as population, number of households, and regional characteristics should be considered when undertaking benefit transfer. For example, as population density increases over time, individual households may value nearby open space and parks more highly. Other factors to be considered include, depending on the location of the original study, utilising foreign exchange rates, demographic data, and respective inflation rates.

Benefit transfer should only be regarded as an approximation. Transferring values from similar regions with similar markets is important, and results can be misleading if values are transferred between countries that have starkly different economies (for example a benefit transfer from the Solomon Islands to Vancouver would likely have only limited applicability). However, sometimes only an indicative value for environmental assets is all that is required.

Step 4: Tabulate annual costs and benefits

All identified and quantified benefits and costs are tabulated to identify where and how often they occur. Tabulation provides an easy method for checking that all the issues and outcomes identified have been addressed and provides a picture of the flow of costs, benefits and their sources.

Step 5: Calculate the net benefit in dollar terms

As costs and benefits are specified over time it is necessary to reduce the stream of benefits and costs to present values. The present value concept is based on the time value of money – the idea that a dollar received today is worth more than a dollar to be received in the future. The present value of a cash flow is the equivalent value of the future cashflow should the entire cashflow be received today. The time value of money is determined by the given discount rate to enable the comparison of options by a common measure.

The selection of appropriate discount rates is of particular importance because they apply to much of the decision criteria and consequently the interpretation of results. The higher the discount rate, the less weight or importance is placed on future cash flows.

The choice of discount rates should reflect the weighted average cost of capital (WACC). For this analysis, a base discount rate of 7 per cent has been used to represent the minimum rate of return, in line with Australian Government guidelines. As all values used in the CBA are in real terms, the discount rate does not incorporate inflation (i.e., it is a real discount rate, as opposed to a nominal discount rate).

To assess the sensitivity of the project to the discount rate used, discount rates either side of the base discount rate (7 per cent) have also been examined (4 per cent and 10 per cent).

The formula for determining the present value is:

$$PV = \frac{FV_n}{(1+r)^n}$$

Where:

PV = present value today

FV = future value n periods from now

r = discount rate per period

n = number of periods

Extending this to a series of cash flows the present value is calculated as:

$$PV = \frac{FV_1}{(1+r)^1} + \frac{FV_2}{(1+r)^2} + \mathrm{L} + \frac{FV_n}{(1+r)^n}$$

Once the stream of costs and benefits have been reduced to their present values the Net Present Value (NPV) can be calculated as the difference between the present value of benefits and present value of costs. If the present value of benefits is greater than the present value of costs then the option or project would have a net economic benefit.

In addition to the NPV, the internal rate of return (IRR) and benefit-cost ratio (BCR) can provide useful information regarding the attractiveness of a project. The IRR provides an estimate of the discount rate at which the NPV of the project equals zero, i.e., it represents the maximum WACC at which the project would be deemed desirable. However, in terms of whether a project is considered desirable or not, the IRR and BCR will always return the same result as the NPV decision criterion.

Step 6: Sensitivity analysis

Sensitivity analysis allows for the testing of the key assumptions and the identification of the critical variables within the analysis to gain greater insight into the drivers to the case being examined.

A series of Monte Carlo analyses has been conducted in order to test the sensitivity of the model outputs to changes in key variables. Monte Carlo simulation is a computerised technique that provides decision-makers with a range of possible outcomes and the probabilities they will occur for any choice of action. Monte Carlo simulation works by building models of possible results by substituting a range of values – the probability distribution – for any factor that has inherent uncertainty. It then calculates results over and over, each time using a different set of random values from the probability functions. The outputs from Monte Carlo simulation are distributions of possible outcome values.

During a Monte Carlo simulation, values are sampled at random from the input probability distributions. Each set of samples is called an iteration, and the resulting outcome from that sample is recorded. Monte Carlo simulation does this hundreds or thousands of times, and the result is a probability distribution of possible outcomes. In this way, Monte Carlo simulation provides a comprehensive view of what may happen. It describes what could happen and how likely it is to happen.

Cost benefit assessment

The table below outlines the present value (PV) of the identified costs and benefits between the financial year ending June 2020 and the financial year ending June 2049, at discount rates of 4 per cent, 7 per cent, and 10 per cent.

The CBA modelling at the discount rate of 7 per cent produced the following results:

- Intensification of beef cattle scenario – NPV of $26.5 million, BCR of 104, and IRR of 9.9 per cent.
- Fallow cropping scenario – NPV of $134.1 million, BCR of 4.20, and IRR of 39.6 per cent.
- Diversification of sugarcane scenario – NPV of $271.1 million, BCR of 1.25, and IRR of 14.1 per cent.
- Expansion of on-shore aquaculture scenario – NPV of $244.9 million, BCR of 2.83, and IRR of 16.6 per cent.

The CBA identified that, at a 7 per cent discount rate, the four scenarios would be deemed economically desirable (benefits outweigh costs). The fallow cropping, diversification of sugarcane, and expansion of on-shore aquaculture scenarios are estimated to be preferable to business as usual at discount rates between 4 per cent and 10 per cent, while the intensification of beef cattle scenario returns a negative NPV at a 10 per cent discount rate.

Table 54: Cost benefit analysis results

Real discount rate	PV costs ($M)	PV benefits ($M)	NPV ($M)	BCR
Intensification of beef cattle				
4 per cent	$1,031.3	$1,105.2	$73.9	1.07
7 per cent	**$726.3**	**$752.9**	**$26.5**	**1.04**
10 per cent	$541.5	$540.4	-$1.1	1.00
Fallow cropping				
4 per cent	$48.8	$258.5	$209.7	5.30
7 per cent	**$42.0**	**$176.1**	**$134.1**	**4.20** (Refer note below)
10 per cent	$37.2	$126.4	$89.2	3.39
Diversification of sugarcane				
4 per cent	$1,563.8	$2,126.4	$562.6	1.36
7 per cent	**$1,106.4**	**$1,377.6**	**$271.1**	**1.25**
10 per cent	$827.1	$939.1	$112.0	1.14
Expansion of on-shore aquaculture				
4 per cent	$319.4	$747.3	$427.9	2.34
7 per cent	**$295.3**	**$540.2**	**$244.9**	**1.83**

10 per cent	$279.9	$412.3	$132.3	1.47

Source: AEC.

Note: Applying a net agricultural margin benefit to the fallow cropping scenario (where there is a limited opportunity cost of production) greatly influences the BCR. The methodology has been retained to be consistent with the alternative scenarios. Replacing the net margin with production costs and revenues results in the 7% discount rate NPV remaining at $134.1 million but reduces the BCR to 1.45

Sensitivity testing

Sensitivity testing was undertaken using a Monte Carlo analysis, which assigns a probability distribution for each input parameter in the model and then examines multiple iterations. This distribution is then used to identify the effect of the input parameter on the decision criteria (i.e. NPV). It reflects the 'probability' of achieving the key dependent output across the following key assumptions used in the economic analysis:

- Costs:
  - capital costs (on-farm and supply chain)
  - lost agricultural production
  - lost sugar milling activity
  - beef processing costs
- Benefits:
  - net agricultural/aquaculture margins
  - net meat processing margins

Each of the above assumptions was tested in isolation, with all other inputs maintained. The results were reported in terms of the modelled change in NPV resulting from the variance in the base assumptions at a discount rate of 7 per cent. The table below shows each assumption simultaneously to provide a 'combined' or overall sensitivity of the model findings to the assumptions used. The also outlines the distribution used, allowing for:

- A 90 per cent confidence interval, with the '5 per cent' and '95 per cent' representing a 90 per cent probability that the distribution and NPV will be within the range outlined in the table.

The ranges tested for each input variable are as follows:

- Costs reflect a maximum 40 per cent higher and 30 per cent lower than the base values.
- Benefits reflect a normal distribution with a standard deviation of 30 per cent.

Results of the Monte Carlo simulation indicate:

- The intensification of beef cattle scenario is highly sensitive to the assumptions applied, returning a positive NPV on 52.6 per cent of iterations in the Monte Carlo simulation.
- The diversification of sugarcane scenario is moderately sensitive to the assumptions applied, returning a positive NPV on 85.1 per cent of iterations in the Monte Carlo simulation.
- The fallow cropping and expansion of aquaculture scenarios are shown to not be overly sensitive to the assumptions applied, returning a positive NPV on 99.3 per cent and 92.2 per cent of the 5,000 iterations in the Monte Carlo assessment respectively.

Table 55: Monte Carlo Simulation Results (7 per cent Discount Rate)

	NPV/ha ($'000)		
Scenario	**5 per cent**	**95 per cent**	**per cent simulations >0**
Intensification of beef cattle	-$353	$375	52.6 per cent
Fallow cropping	$46	$223	99.3 per cent
Diversification of sugarcane	-$143	$648	85.1 per cent
Expansion of aquaculture	-$39	$510	92.2 per cent

Farm budget estimates

Table 56: Farm Budgets

Avocado	**Year 8+**
Income ($/ha)	
Revenues @$4,800/t	*$79,200*
Variable Costs ($/ha)	
Pruning, mowing and operating	$1,097
Pest and disease control	$1,681
Fertiliser and testing	$2,064
Irrigation	$650
Harvest	$5,054
Management and consultant costs	$1,864
Other costs	$1,481
Total variable costs	**$13,891**
Gross margin	***$65,309***
Gross margin/ml	**-**
Beef feedlot	
Income $/head	
$400kg Beast @ $3/kg	*$1,200*
Costs	

Purchase of store beast (310 kg at $2.85/kg)	$884
Feed cost (748 kg at $300 per tonne)	$224
Running costs	
Cartage: saleyards to feedlot	$3.5
Health cost: vaccines, drenches etc.	$4.5
Losses: 1.0 per cent	$8.8
Fuel, repairs etc.	$11.0
Labour	$12.0
Cartage: feedlot to abattoir	$3.5
Selling costs (commission etc.)	$3.9
Transaction levy	$7.8
Total costs	**$1,163**
Margin ($/head)	**$37**
Soybean irrigated	
Income ($/ha)	
3 tonnes/ha @ $475/tonne	*$1,425*
Variable costs ($/ha)	
Fallow management	$54
Planting	$53
Nutrition	$45
Crop protection	$90
Irrigation	$240
Harvesting	$38
Post-harvest	$1
Other	$37
Total costs	**$558**
Gross margin	**$867**
Soybean dryland	

Income ($/ha)	
2.2 tonnes/ha @ $475/tonne	*$1,045*
Variable costs ($/ha)	
Fallow management	$54
Planting	$53
Nutrition	$45
Crop protection	$90
Harvesting	$38
Post-harvest	$1
Other	$37
Total costs	**$318**
Gross margin	**$727**
Chickpeas irrigated	
Income ($/ha)	
3.2 tonnes/ha @ $900/tonne	*$2,880*
Variable costs ($/ha)	
Fallow management	$215
Planting	$84
Nutrition	$44
Crop protection	$117
Irrigation	$240
Harvesting	$44
Post-harvest	$1
Other	$67
Total costs	**$812**
Gross margin	**$2,068**
Chickpeas dryland	
Income ($/ha)	

2.2 tonnes/ha @ $900/tonne	*$1,980*
Variable costs ($/ha)	
Fallow management	$215
Planting	$84
Nutrition	$44
Crop protection	$87
Harvesting	$44
Post-harvest	$1
Other	$67
Total costs	**$542**
Gross margin	**$1,438**
Sorghum Irrigated	
Income ($/ha)	
8t/ha @ $300/tonne	*$2,400*
Variable costs ($/ha)	
Fallow management	$35
Planting	$51
Nutrition	$338
Crop protection	$107
Irrigation	$240
Harvesting	$56
Post-harvest	$3
Other	$41
Total costs	**$871**
Gross margin	**$1,529**
Sorghum dryland	
Income ($/ha)	
3t/ha @ $300/tonne	*$900*

Variable costs ($/ha)	
Fallow management	$35
Planting	$51
Nutrition	$133
Crop protection	$55
Harvesting	$56
Post-harvest	$3
Other	$41
Total costs	**$374**
Gross margin	**$526**
Macadamia	**Year 11+**
Income ($/ha)	
3.5t/ha @ $5,200/t	*$18,200*
Variable costs ($/ha)	
Fertiliser	$1,060
Floor management	$530
Pest Control	$636
Canopy management	$530
Irrigation	$650
Harvesting	$800
Shed word (dehusking, sorting)	$270
Labour	$2,170
Total costs	**$6,646**
Gross margin	**$11,554**
Sugarcane (Irrigated)	**5 Year whole of cycle average**
Income @ 120t/ha	
Cane price ($/t)	*$3,926*
Variable costs	

Harvest, fuel, transport ($/t)	$797
Machinery operation (F.O.R.M) ($/ha)	$28
Planting ($/ha)	$168
Fertiliser ($/ha)	$363
Weed Control ($/ha)	$111
Insect Control ($/ha)	$3
Disease control ($/ha)	$2
Irrigation	$384
Total variable costs	**$1,857**
Gross margin	**$2,069**
Sugarcane (dryland)	**5 Year whole of cycle average**
Income @ 80t/ha	
Cane price ($/t)	*$2,618*
Variable costs	
Harvest, fuel, transport ($/t)	$531
Machinery operation (F.O.R.M) ($/ha)	$28
Planting ($/ha)	$168
Fertiliser ($/ha)	$363
Weed control ($/ha)	$111
Insect control ($/ha)	$3
Disease control ($/ha)	$2
Total variable costs	**$1,208**
Gross margin	**$1,410**

Note: For reference purposes only, costs and revenues will vary significantly across individual growers/farms and regions across North Queensland.

Appendix D: Case studies

Fonterra (NZ) – a case study on coordinated logistics and marketing

Highlights

New Zealand

What is it?

Fonterra (New Zealand) is a dairy cooperative that buys milk from its 10,000 farmer shareholders. Fonterra owns and processes, markets then sells milk – with 95 per cent being for export out of New Zealand – Fonterra comprises 30 per cent of total milk export globally.

Key industry focus?

- Dairy – milk export

Overview

Vision/Purpose

To provide the farming community with a marketing, distribution and processing network that delivers their nutritious dairy products in an environmentally sustainable and community friendly way.

Innovation types and achievements

- Efficient logistics collecting from multiple producers;
- Special vitamin processing plants (e.g. Lactoferrin plant at Hautapu);
- Developed value added products (e.g. spreadable butter);
- High quality milk protein concentrates (proprietary); and
- Farm Source website that enables efficient communication between farmers and Fonterra.

How does it work?

Fonterra (NZ) works with farmers to distribute and sell their dairy products. Fonterra buy's raw milk solids from farmers at a rate per Kg and then coordinate's delivery to market. Fonterra install a vat specifically fitted to their tankers for transportation from each farm. Frequency of collection is structured according to volume and rigorous quality protocols. Raw milk is transported by tankers to their processing plants across New Zealand. They will generally process this input into a variety of different products including cheese, milk and supplements. From there Fonterra has a large number of different brands that are sold in both locally (NZ and Australia) and further international markets with 40 per cent of all global sales coming from Asia. Fonterra's vast distribution network enables the farmer shareholders to sell to multiple markets by using its marketing and logistics expertise.

Key Lessons for NQMASCS

- A consistent buyer can mitigate the risk of seasonal peaks and troughs.
- Strategically located processing plants can ensure aggregated produce is collected and handled efficiently.
- Collective marketing and branding can add value to regional production.
- Cooperative model can provide opportunities for producer input in direction, dividends or investment in common infrastructure.
- Opportunities for development of value added products to improve profit margins.
- Development of quality parameters can enable consistent production.

Geraldton Fisherman's Co-operative – a case study on coordinated logistics and marketing

Highlights

Perth

What is it?

Geraldton Fishermen's Co-operative (GFC) is a collective that provides logistics and marketing support for fisherman in Western Australia. Their main product is rock lobsters that are provided to a worldwide customer base. They are the largest processor and exporter of rock lobsters in the world.

Key industry focus?

- Seafood
- Lobster

Overview

Vision/Purpose

To deliver the highest possible levels of service to its members and clients, to deliver the best premium quality lobster products in the world, and to create the maximum value from its unique resource.

Innovation types and achievements

- Established network of collection depots to live holding facilities, supplemented by a purpose built transportation fleet for efficient supply of products to market;
- Recirculating water system for transport of rock lobsters built in house; and
- World's largest rock lobster export facility.

How does it work?

GFC has 50 designated landing sites stretching across more than 1,000km of the WA coastline. GFC has a number of coastal facilities that run from the town in Mandurah to Kalbarri – which range from small depots for holding freshly landed catches for shorter periods, through to the 70 tonne receival and live holding facility in GFC's home port of Geraldton. All facilities have live holding tanks that are supplied with Indian Ocean seawater – keeping the current catches in optimal condition prior to collection and/or export. To transport these rock lobster, GFC has an established fleet of transportation in the form of trucks with recirculating seawater systems. These trucks also contain monitoring systems that record not only speed and direction, but also the conditions the lobsters are in throughout the duration of the journey. Finally, lobsters are delivered to the Welshpool Lobster Export Facility where they are stored 4km away from Perth International Airport – allowing for quick export to global markets.

Key lessons for NQMASCS

- Vertically integrated supply chain can reduce impact of seasonal demand for cooperative members.
- Shareholder status/ member status provides access to rebates, access to cooperative facilities and infrastructure as well as other key benefits.
- Quality infrastructure and transport methods ensure products are handled with the highest care (lower risk of accidents/defects, maintains quality).
- Pooled production provides a steady supply for export consumers.
- Close proximity to a major hub (Perth Airport) enables efficient access to export markets.
- Investment in technology improves supply chain efficiency and product quality.

Birchip Cropping Group – a case study in coordinated R&D and extension

Highlights

Wimmera and Mallee, Victoria

What is it?

Birchip Cropping Group Inc. (BCG) is a not-for-profit agricultural research and extension organisation established by geographically proximate farmers in Victoria. They conduct research and provide evidence, support and tools to improve farm management practices and profitability.

Key industry focus?

- Agriculture
- Broadacre cropping

Overview

Vision/Purpose

To provide a platform for researchers and industry to give advice to farmers, enabling them make better decisions that will ultimately result in prosperity of their farms and their respective rural communities.

Innovation types and achievements

- Setting up database / connected system with farmers pre-existing systems to collect weather data etc.
- Conduct large scale research papers with Universities (e.g. Melbourne University) to examine key issues.
- Implement new trials on climate change, weed and pest management and economic modelling.

How does it work?

BCG conducts research in a variety of ways. Firstly, by leveraging farmer member's data collection systems to consolidate large amounts of data in a centralised database. BCG manage trials across over 40 sites in the region (up to 230km from Birchip) which they use for primary research on topics such as agronomy, climate, plant nutrition and technology. They have a central laboratory and office in which they monitor research trials. BCG also run a number of information events to inform their communities of the issues and information that could be useful to them, as well as promote continued development of research projects and data collection networks.

Key Lessons for NQMASCS

- Centralised data accumulation and dissemination can inform future decision making and improve production outcomes.
- Coordination of geographical proximate producers increases relevance of data collected (e.g. soil, climate, and produce).
- Social and information sharing events provide a platform for greater community interaction.
- Investment in centralised infrastructure (e.g. laboratory and office) can reduce costs for cooperative members and provide additional benefits of data security.
- Cooperative contribution structure reduces cost of relevant research that may be unviable to conduct on an individual basis.

Foodbowl – a case study in R&D incubation and piloting on-site processing

Highlights

New Zealand

What is it?

Foodbowl is a facility that forms part of the New Zealand Food Innovation Network which provides in-depth knowledge of the food and beverage industry in NZ. In particular, Foodbowl focuses on providing companies with the opportunity to produce commercially viable volumes of new products for trial marketing, aiming to assist companies to capitalise on domestic and export opportunities.

Key industry focus?

- Food and beverage
- Processing

Overview

Vision/Purpose

Providing the 'next-step' for companies that want to release a new product line by reducing the cost and capital expenditure needed to successfully create a trial run of products and test them at market.

How does it work?

Foodbowl provide companies ranging from small start-ups to larger companies with access to their production facilities and staff expertise. Businesses wanting to break into new markets or utilise equipment they cannot currently access or afford utilise this service to prove conceptual products and business initiatives on a commercial scale. To access Foodbowl's facilities and expertise, prospective companies must first engage with Foodbowl and establish that they can satisfy a range of criteria such as innovation, use of natural ingredients, export focus etc.

Once a business passes this screening they are given access to the facilities that include processing, emulsifying and packaging etc. Facilities can be tailored to the specific needs of the product or business. While government subsidises exist, all product runs to a certain extent pay to use the facility regardless of their size. Callaghan Innovation pays for 70 per cent of the annual running costs, whilst the Auckland Tourism, Events and Economic Development pays for the remaining 30 per cent.

By the time a business gets to use one of the Foodbowl's processing and packaging facilities they will have completed the bulk of their packing and product design. Foodbowl staff provide their expertise to improve the processing by suggesting processing types or ingredients to further improve efficiency and the end product.

Foodbowl staff also have experience in product marketing. Foodbowl has an RMP (Risk Management Process) certification that allows the producers to sell products in local and international markets. Foodbowl also has staff with contacts in both domestic and international markets such as in Europe and China, who are able to act as a sales representative for the products produced at Foodbowl facilities.

Key Lessons for NQMASCS

- Provides a path to production for viable quantities of new or innovative products.
- Shares resources to reduce costs (production facilities, knowledge).
- Provides users with access to new markets (domestic and international).
- Reduces initial cost of regulation (certification) for new and innovative products.
- Provides users with the ability to add value by processing raw materials prior to export.

CSIRO Werribee – innovation incubator, pilot production

Highlights

Werribee, Victoria

What is it?

The CSIRO Food Innovation Centre (CFIC) Werribee provides a range of different services for agriculture and food businesses/producers. Some of these include innovation of food, beverage and ingredient manufacturing, as well as advanced separation technologies among others.

Key industry focus?

- Food and Beverage

Overview

Vision/Purpose

To allow both industry and research and development teams access to advanced technologies and state-of-the-art facilities in a pilot plant setting.

How does it work?

The CFIC is a 3000m^2, $50m facility that provides a range of services. These include separation technologies (extracting valuable components from agri-food), the food innovation pilot plant, commercial opportunities for the dairy industry, and assistance providing safety and quality with new technology. There are six self-contained 500 square metre modules providing secure and confidential operations. The six separate modules also provide an added benefit of being able to help different producers/businesses with entirely different problems. e.g. one client using the diary milk whilst the other uses separation technology.

An example of the CFIC's work involves specialists at the CSIRO helping producers and businesses in the dairy industry: CFIC helps develop technology and strategy in dairy products (particularly value-added products) through their thorough knowledge of the whole dairy value chain. They help develop new products by using novel technologies (e.g. high pressure processing, pulsed electric field, ultrasound etc.).

Key Lessons for NQMASCS

- Centralised of resources with an ability to house the development of complementary products.
- Co-location of industry and leading experts creates an environment that fosters innovation in production quality and efficiency.
- Centralised location can reduce (share) capital expenditure on high quality, value adding equipment.

Appendix E: Stakeholder consultation

The following table contains a list of stakeholders engaged to date, the purpose for engagement, and the date they were engaged.

Table 57: Overview of stakeholders engaged

Stakeholder	Engagement date	Purpose
CQU Delwar Akbar	22/6/2018	To understand similarities and differences between this TEL engagement and the work being undertaken by Delwar at CQU.
Horticulture Innovation Australia Jenny Vandemeeg	27/06/2018	To understand the export potential and demand sources for horticultural products that are already growing in the northern Queensland region, as well as any products that could be introduced. To gain insights into protocol considerations required for exported fruit and vegetables in identified markets.
Trade and Investment Queensland and Austrade Vic O'Keefe Glen Nunn Roger Kaus	28/06/2018	Discussion on markets that should be in-scope due to their emerging and increasing demand for Australian food products.
Australian Banana Growers Council Jim Pekin	9/07/2018	To understand the current production and future possible production of bananas, and any potential export opportunities from Townsville.
AusVeg Michael Coote	10/7/2018	To understand the export potential and demand sources for horticultural products that are already growing in the northern Queensland region, as well as any products that could be introduced.
Almonds Australia Ross Skinner	11/07/2018	To understand the current production and future possible production of almonds, and any potential export opportunities from Townsville.
Avocado Australia Joy Tang	11/07/2018	To understand the current production and future possible production of avocado, and any potential export opportunities from Townsville.
James Cook University Allan Dale	11/07/2018	To discuss the TEL project, possible in-scope markets and potential products to investigate in the study.
Table Grapes Australia Rowena Norris	11/07/2018	To understand the current production and future possible production of table grapes, and any potential export opportunities from Townsville.

Stakeholder	Engagement date	Purpose
Department of Agriculture and Fisheries Adam West Gareth Jones Peter Leach	24/7/2018 30/7/2018	Discussion on markets and products that should be in-scope due to their emerging and increasing demand for Australian food products. To gain an understanding of how protocol markets are accessed and any future markets that are expected to open in the short to medium term that may influence this study.
Citrus Australia David Daniels	27/7/2018	To understand the current production and future possible production of citrus, and any potential export opportunities from Townsville.
Macadamia Australia Joylan Burnett	27/7/2018	To understand the current production and future possible production of macadamia, and any potential export opportunities from Townsville.
Mangoes Australia Robert Gray	27/7/2018	To understand the current production and future possible production of mangoes, and any potential export opportunities from Townsville.
Academic Jan Diczbalis	30/7/2018	To understand the current production and future possible production of cocoa plantations, and any potential export opportunities from Townsville.
Meat and Livestock Australia Nigel Tomkins	30/7/2018	To understand the current production and future possible production of beef products, and any potential export opportunities from Townsville.
CQU University Jim Pekin	7/8/2018	Discussion on markets and products that should be in-scope due to their emerging and increasing demand for Australian food products. As well as to gain an understanding of any research the university has undertaken relevant to NQMASCS.
Fish Business (BTECH) Ben Pohlner	7/8/2018	To understand the current production and future possible production of aquaculture, and any potential export opportunities from Townsville.
Pacific Reef Jacinta Jackson	7/8/2018	To understand the production type and volume of Pacific Reef's on-shore pond and dam aquaculture and to gain insights on export potential and value-adding opportunities.
Charters Towers beef producer Blair Knuth	10/9/18	To understand the current production, future possible production diversification, supply chain constraints and any potential export opportunities from Charters Towers.
Charters Towers feedlot operator Peter Hammer	10/9/18	To understand the current production, future possible production diversification, supply chain constraints and any potential export opportunities from Charters Towers.
Charters Towers Mayor Liz Schmidt	10/9/18	To understand regional initiatives in place, supply chain constraints and any potential export opportunities from Charters Towers.
Charters Towers producer	10/9/18	To understand the current production, future possible production diversification, supply chain constraints and any potential export opportunities from Charters Towers.

Stakeholder	Engagement date	Purpose
Michael Penna		
Burdekin Council Lyn McLaughlin and council members	11/9/18	To understand regional initiatives in place, supply chain constraints and any potential export opportunities from the Burdekin.
Cane and soybean producer Kevin Fiamingo	11/9/18	To understand the current production, future possible production diversification, supply chain constraints and any potential export opportunities from the Burdekin.
Cane producer Mark Vass	11/9/18	To understand the current production, future possible production diversification, supply chain constraints and any potential export opportunities from the Burdekin.
Hinchinbrook Council Ramon Joyo and six cane producers	11/9/18	To understand the current production, future possible production diversification, supply chain constraints and any potential export opportunities from Hinchinbrook.
NQMASCS project leadership TEL Office	12/9/18	To brief the project leadership team and gather feedback on initial work completed to date.
Townsville Airport Cam Weller	12/9/18	To understand the supply chain and infrastructure constraints and any potential export opportunities at the airport.
Townsville Port Claudia Brumme-Smith and Alison Collier	12/9/18	To understand the supply chain and infrastructure constraints and any potential export opportunities at the port.
Palm Island Council representatives	27/9/18	To understand the current production, future possible production diversification, supply chain constraints and any potential export opportunities from Palm Island.

Appendix F: References

		Source
1	(AAC, 2015)	Agriculture and Agri-Food Canada, Inside Gulf Cooperation Council – the Fish and Seafood Trade, 2015.
2	(AAC, 2017)	Agriculture and Agri-Food Canada, Japan – Crustacean Trends, 2017.
3	(ABARES 2018a)	ABARES, About my region – Townsville, 2018.
4	(ABARES, 2017)	ABARES, Australian fisheries and aquaculture statistics 2016, 2017.
5	(ABARES, 2018b)	ABARES, Agricultural commodities: March quarter 2018, 2018.
6	(ABARES, 2018c)	ABARES, Australian fisheries outlook: March 2018, 2018.
7	(ABARES, 2018d)	ABARES, Australian crop report No. 186, 2018.
8	(ABFCA, n.d)	Abu Dhabi Food Control Authority, Food importers guide, n.d.
9	ABC (2018)	Avocado growers say prices have hit their peak while supply continues to skyrocket.
10	ABS (2017a)	Value of Agricultural commodities Produced, Australia 2015-16.
11	ABS (2017b)	Census of Population and Housing 2016.
12	(ABS, 2018)	Australian Bureau of Statistics, Value of Agricultural Commodities Produced, Australia – 2016-17, 2018
13	(ACCC, 2017)	Australian Competition and Consumer Commission, Cattle and beef market study, 2017.
14	(ADIRDC, 2018)	Australian Government Department of Infrastructure, Regional Development and Cities, Northern Australia Beef Roads Program, 2018 (accessed 21 January 2019)
15	(AEC for WAAC, 2016)	AEC for Western Australian Agriculture Authority, New and innovative beef supply chains in Thailand, 2016.
16	(AMS, 2014)	Australian Macadamia Society, China Consumer Research, 2014.
17	(AMS, 2016)	Australian Macadamia Society, Handbook, 2016.
18	(AOF, 2008)	Australian Oilseeds Foundation, Queensland Soybean Growers Guide, 2008.
19	(AOF, 2011)	Australian Oilseeds Foundation, Soybean in the Australian Global Market, 2011.
20	(ARC RHCD)	ARC Research Hub for Commercial Development, Rock Lobster culture systems, 2018.
21	(Austrade, 2017)	Austrade, Exporting to China – Guide to Australian food producers, 2017.

		Source
22	(Austrade, 2018a)	Austrade, Doing Business – Indonesia – Tariffs and Regulations, 2018.
23	(Austrade, 2018b)	Austrade, Doing Business – Republic of Korea, 2018.
24	(Austrade, 2018c)	Austrade, Doing Business – Japan - Tariffs and regulations, 2018.
25	(AVA, 2017)	Agri-Food and Veterinary Authority (Singapore), Veterinary conditions for importation of beef and beef products, 2017.
26	(Avocados Australia, 2014)	Avocados Australia, Export Development Plan, 2014.
27	(Avocados Australia, 2017)	Avocados Australia, Facts at a Glance, 2017.
28	(BQ, 2016)	Business Queensland, Aquaculture Establishment Costs, 2016.
29	(Bloomfield, 2014)	J. Bloomfield, AACo Beef Processing Facility, 2014, [website], https://cattleproducer.wordpress.com/tag/abattoir-construction/, (accessed 23 January 2019)
30	(BQ, 2017)	Nullinga Dam Preliminary Business Case.
31	(CB, 2019)	Central steel build, Shed Cost Per Square Metre, [website], http://www.centralbuild.com.au/blog/shed-cost-per-square-metre/, (accessed 22 January 2019)
32	(CBC, 2016)	CBC, New container will transport live lobster to foreign markets by sea, 2016.
33	(DAF, 2014)	Evaluating the commercial viability of a northern outback Queensland meat processing facility.
34	(DAF, 2018a)	DAF, Ag Trends – Queensland Agriculture Snapshot, 2018.
35	(DAF, 2018b)	DAF, Soybean – harvesting and drying, 2018.
36	(DAF, 2018c)	Agmargins Database
37	(DAWR, 2018a)	DAWR, 2018 end-of-month red meat export reports, 2018.
38	(DAWR, 2018b)	DAWR, Smashing Market Access for Hass Avos to Japan, 2018.
39	(Derry, 2011)	Derry, 'Bundaberg going nuts for macadamia', NewsMail, 12 February 2011, https://www.news-mail.com.au/news/bundaberg-going-nuts-macadamia-australia/767685/, (accessed 23 January 2019)
40	Dee, J., and Chose, A. (2015)	Comparative assessment of crops to use potential additional water resources in the Warren–Donnelly catchments
41	Deloitte (2015)	Regional Feedlot Investment Study, Report developed for Meat and Livestock Australia.
42	(DIRD, 2017)	Department of Infrastructure and Regional Development, Re: Inquiry into National Freight and Supply Chain Priorities Submission by Newcastle Airport, 2017.
43	(Everage, 2017)	J. Everage, Cold Storage Construction Cost Per Square Foot, 2017, [website], http://www.anccold.com/blog/cold-storage-construction-cost, (accessed 23 January 2019)

		Source
44	(Farm Tender, 2019)	Farm Tender, Tillage and Seeding Products, [website], https://www.farmtender.com.au/categories/machinery-equipment/sub_categories/tillage-and-seeding/listings?sort=highest, (accessed 23 January 2019)
45	(FAO, 2017)	FAO, The world lobster market, 2017.
46	(FEA, 2015)	Food Export Association, Hong Kong Seafood Market Profile, 2015.
47	(FRDC, 2018)	Fisheries Research and Development Corporation, Rock Lobster Exports, 2018.
48	(GHD, 2015)	Central Highlands Development Corporation Central Highlands Meat Processing Plant Feasibility Study
49	(GHKSAR, 2018)	Government of the Hong Kong Special Administrative Region, Import Control and Food Safety Guidelines – Guide to Game, Meat, Poultry and Eggs into Hong Kong, 2018.
50	(GSA, n.d.)	Government of South Australia, Functional and luxury foods opportunities for South Australia in Malaysia, n.d.
51	(Harvard, 2016)	Harvard Business Review, Global demand for food is rising – can we meet it?, 2016.
52	(HIA, 2016)	HIA, Macadamia Integrated Orchard Management Practice Guide, 2016.
53	(HIA, 2017)	HIA, Australian Tree Crop Rapid Response App, 2017.
54	(HIA, 2017b)	HIA, Australian Horticulture Statistics Handbook – Nuts 2015/2016, 2017.
55	(KPMG, 2018)	KPMG, Talking 2030: Growing agriculture into a $100 billion industry, 2018.
56	McKellar Et. Al. (2013)	Irrigation Costs and Benefits, 2013.
57	(MLA, 2015)	MLA, Thailand expands beef and cattle intake, 2015.
58	(MLA, 2017)	MLA, Market Snapshot – Beef, 2017.
59	(MLA, 2018)	MLA, Australian Livestock Exports – monthly trade summary – May 2018, 2018.
60	(MOH, 2017)	Ministry of Health – Malaysia, Health-Certificate Requirements, 2017.
61	(MPPD, 2011)	More Profit Per Drop, Centre Pivot/Lateral Move Irrigation, 2011, [website], http://www.moreprofitperdrop.com.au/wp-content/uploads/2011/11/cplm.pdf, (accessed 21 January 2019)
62	(NFF, 2018)	National Farmers' Federation, 2030 Roadmap, Australian Agriculture's Plan for a $100 Billion Industry, 2018
63	(Port of Townsville, 2018)	Port of Townsville, About Townsville Port – Trade Statistics, 2018.
64	(Preshafruit, 2019)	Preshafood Pty Ltd, HPP Toll Processing, [website], http://preshafruit.com.au/hpp-toll-processing, (accessed 23 January 2019)
65	(QLD Country Life, 2017)	M. Bunyard, 'Take a look at Kerwee Feedlot's $8m expansion', Queensland Country Life, 4 November 2017, https://www.queenslandcountrylife.com.au/story/5034229/kerwee-feedlots-big-unveiling/, (accessed 21 January 2019)
66	(QLD DPI, 2004)	Queensland Department of Primary Industries (now DAF), An ecological assessment of Queensland's Tropical East Coast Rock Lobster Fishery, 2004.

		Source
67	(SCMP, 2016)	South China Morning Post, China's massive soybean imports eating into record US bean crop, 2016.
68	(SMEC, 2018)	Hells Gate Dam Feasibility Study
69	(Smith, 2018)	Michael Smith, Australian Financial Review: Why Australia is not making the most of its China seafood opportunity, 2018.
70	(TEL, 2019)	Townsville Enterprise Limited (Economic Development Team) (with REMPLAN), Economy Profile, 2019.
71	(USDA, 2014)	United States Department of Agriculture, Global Agricultural Information Network – UAE Food and Agricultural Import Regulations and Standards, 2014.
72	(USDA, 2017)	USDA, Seafood Report – Singapore, 2017.
73	(USDA, 2017b)	USDA, Oilseeds – Hong Kong, 2017.
74	(USDA, 2018)	USDA, Seafood Report- Bangkok, 2018.
75	(USDA, 2018b)	USDA, Oilseeds – Seoul, 2018.
76	(USDA, 2018c)	USDA, Oilseeds – Malaysia, 2018.
77	(USDA, 2018d)	USDA, Oilseeds – Bangkok, 2018.
78	(USSEC, 2012)	US Soybean Export Council, Japanese Trading Companies and the Asia-bound Grain Trade, 2012.
79	(WA, 2017)	Western Australia Government, Co-op scheme boost for rock lobster exports, [website], 2017, https://www.mediastatements.wa.gov.au/Pages/Barnett/2017/01/Co-op-scheme-boost-for-rock-lobster-exports.aspx, (accessed 24 January 2019)
80	(WTO, 2013)	World Trade Organisation, Trade Policy Review – Indonesia, 2013.
81	(Wiley, 2019)	Wiley, Heinz Golden Circle fruit and vegetable processing facility, 2015, [website], https://www.wiley.com.au/wp-content/uploads/Project_Profile_-_Heinz_Golden_Circle_-_Fruit_and_vegetable_processing_facility.pdf, (accessed 22 January 2019)

Contact us

Robert Poole
Partner, National Food & Agribusiness Lead, KPMG
+61 3 9288 6209
robertpoole@kpmg.com.au

Michael McMillan
Director, Policy and Investment
Townsville Enterprise Limited
+ 61 7 4726 2728
michael.mcmillan@tel.com.au

townsville enterprise KPMG Premise AEC OUTCOME DRIVEN