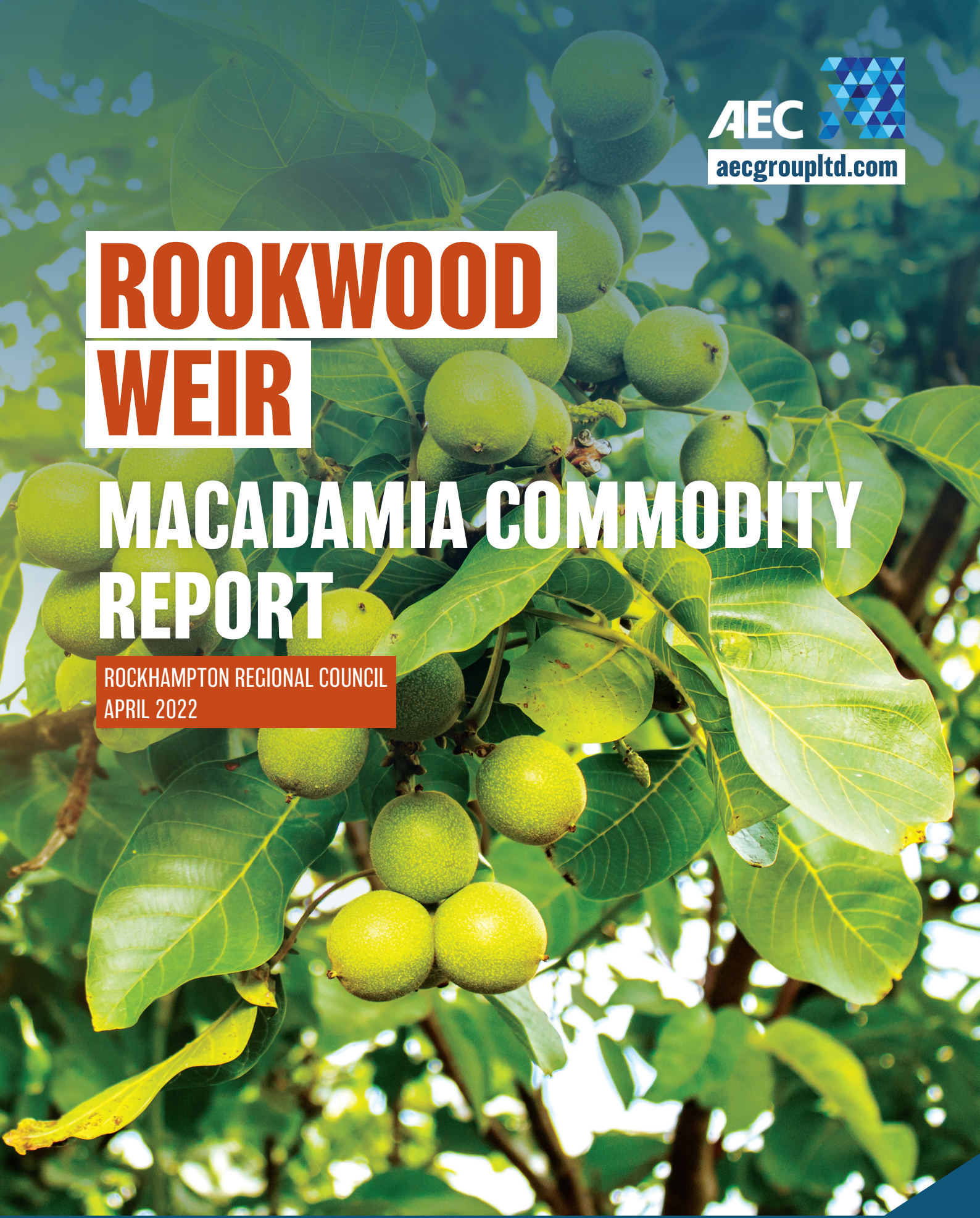

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ROOKWOOD WEIR

MACADAMIA COMMODITY REPORT

ROCKHAMPTON REGIONAL COUNCIL
APRIL 2022

THE ROOKWOOD WEIR LANDHOLDER SUPPORT AND GRANTS PROGRAM IS PROUDLY FUNDED BY SUNWATER WITH COORDINATION PROVIDED BY ADVANCE ROCKHAMPTON

ADVANCE ROCKHAMPTON
Rockhampton Regional Council

sunwater

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DISCLAIMER

The document contents form part of the explanatory materials for use in the Rockwood Weir Commodity and Farm Enterprise business case preparation and analysis. It does not purport to be a comprehensive nor complete record of every decision variable used by any party in the running any agricultural operation. The driver tree variables contained herein may be aggregated and/or excluded from any financial modelling used in the broader project. This document only provides a discussion tool to elicit information from potential stakeholders who may participate in the Project.

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EXECUTIVE SUMMARY

BACKGROUND AND PURPOSE

Rookwood Weir is a landmark project that will capture water in the lower Fitzroy River for use across the Region. Rockhampton Regional Council and Advance Rockhampton are co-ordinating the Rookwood Weir Grants Program (RWGP), which focuses on providing support to eligible landholders in the Lower Fitzroy region to prepare for the second tranche of water sales from the Rookwood Weir Supply Scheme (7,500ML in 2022). Rookwood Weir will provide existing landholders with the opportunity to significantly increase the net return derived from their land by increasing the water accessible for agricultural production in the area.

This report provides an in-depth analysis of the global market for macadamias and assesses the potential agribusiness opportunities for production of macadamia crops within the Rookwood Weir Catchment Area. The market outlook presented is based on research of historical and forecast information, and engagement with key stakeholders and industry associations. The analysis also includes commentary on the growing conditions and requirements for commercial macadamia crops in the Australian environment, including soil suitability, water availability, orchard management, pest and weed control, infrastructure and equipment.

COMMODITY OUTLOOK

GLOBAL PRODUCTION

From 1995 to 2021, the global macadamia NIS production increased at an average of 5.9% per annum. Macadamia nut-in shell (NIS) production has more than quadrupled over the period of 25 years, reaching an estimated 246,735 tonnes in 2021. The World Macadamia Organisation (WMO) estimate that from 2020 to 2030, macadamia production will triple to reach around 600,000 tonnes of macadamia NIS (Fresh Plaza, 2021 a). The Australian macadamia industry has seen a rapid and aggressive expansion which has seen Australian production quintuple over the period from 10,000 tonnes in 1990 to over 51,000 tonnes in 2021 (approximately 21.4% of global production), with the Australian industry NIS production expected to exceed 55,000 tonnes in 2022.

The largest long-term producer of macadamia's has been South Africa, with production experiencing an average annual increase of 13.5% per annum from 1991 to 2021. South African production per hectare is estimated to decline over 2019 and 2020 as new non-bearing hectares are established. These newly planted hectares will not begin to yield for the next four years. Global production growth is expected to accelerate over the next eight years with the 2030 NIS production estimate expected to exceed 600,000 tonnes by 2030, reflecting an average annual growth rate of approximately 10.4% over the period.

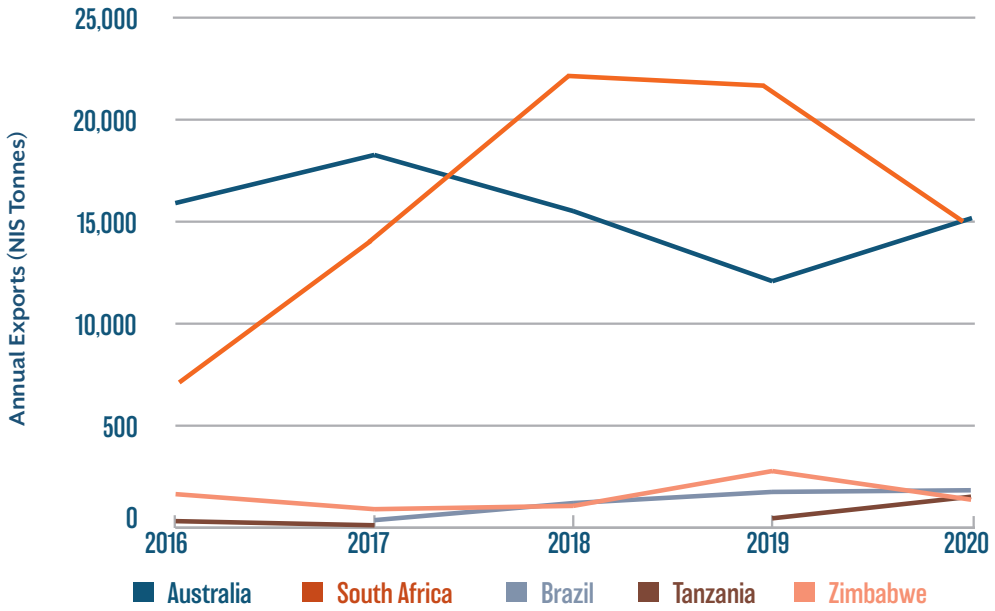
Australia's share of global production is expected fall to 11.7% (2030) from approximately 21% (2021), reflecting new entrants and non-bearing trees reaching maturity over the next eight years based on the expected growth of competitor supply. The rapidly increasing production area and volume from China's domestic production provides a real and present danger to current supply arrangements for the industry, with China expected to become the dominant producer of macadamias by 2030.

MAJOR EXPORTERS AND IMPORTERS

Australia and South Africa are the world's largest exporters of macadamia. In 2020, Australia was the largest exporter of macadamias NIS with exports estimated to total 14,960 tonnes, while South Africa exports totalled an estimated 14,868 tonnes.

Australia's 2020 export volume was the lowest experienced over the four-year period, with exports decreasing by an average annual rate of 1.5% per annum from 2016 to 2020. NIS macadamia exports from South Africa have experienced significant growth in South Africa over the past four years, nearly doubling in volume.

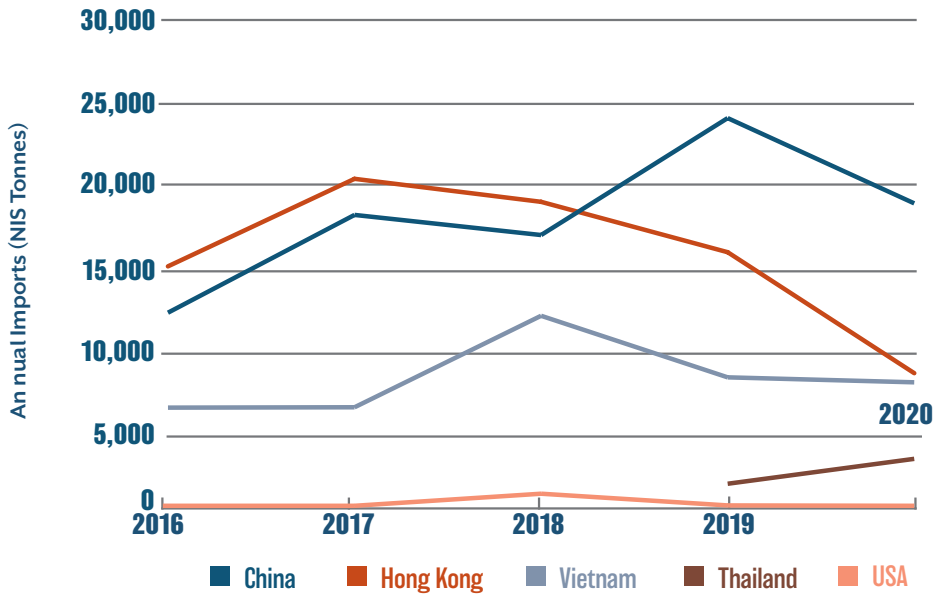
Figure ES. 1. Top Five Export Countries in 2020 (Macadamia NIS), 2016 to 2020



Note: Fresh Logic does not present data for Tanzania and Brazil every year.
Source: Fresh Logic (2022).

In 2020, China was the largest importer of macadamia NIS with imports totalling over 18,600 tonnes. China largely sources its' NIS from Australia (which holds majority of the market) and South Africa. The second largest importer of macadamias NIS in 2020 was Hong Kong, with imports estimated to total 8,169 tonnes. In 2020, Hong Kong largely sourced its macadamia imports from South Africa (88% of total imports) and Mozambique (6.3% of total imports).

Figure ES. 2. Top Five Major Importers, NIS (tonnes) 2016 to 2020

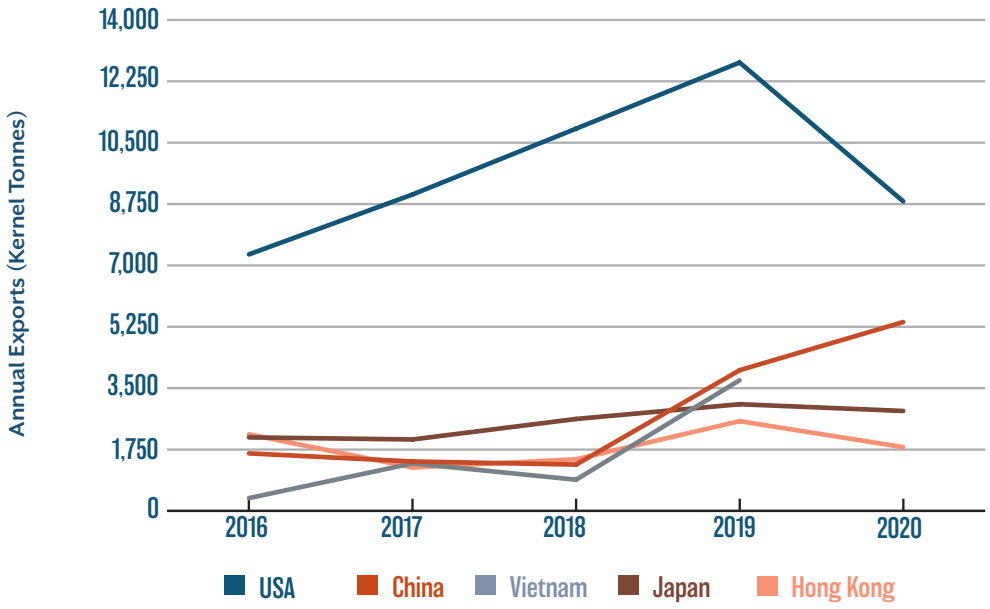


Note: Data for Thailand is not available on fresh logic from 2016 to 2019.
Source: Fresh Logic (2022).

In 2020, the US was the largest importer of macadamia kernels, with imports totalling an estimated 8,826 tonnes. Approximately 42% of these imports originated from South Africa (Fresh Logic, 2022). The Australian Macadamia Society (2021) have identified that since the impacts of COVID-19, macadamia kernel imports to the US have slightly decrease. This is largely due to an increase in domestic consumption of the Hawaiian crop (Australian Macadamia Society, 2021).

The second largest importer of macadamia kernels was China, with imports estimated at 5,391 tonnes. China's demand for macadamia kernels have experienced an increase since 2018, growing by an average annual rate of 102% per annum over a two-year period.

Figure ES. 3. Top Five Major Importers, Kernels (Tonnes) 2016 to 2020



Source: Fresh Logic (2022).

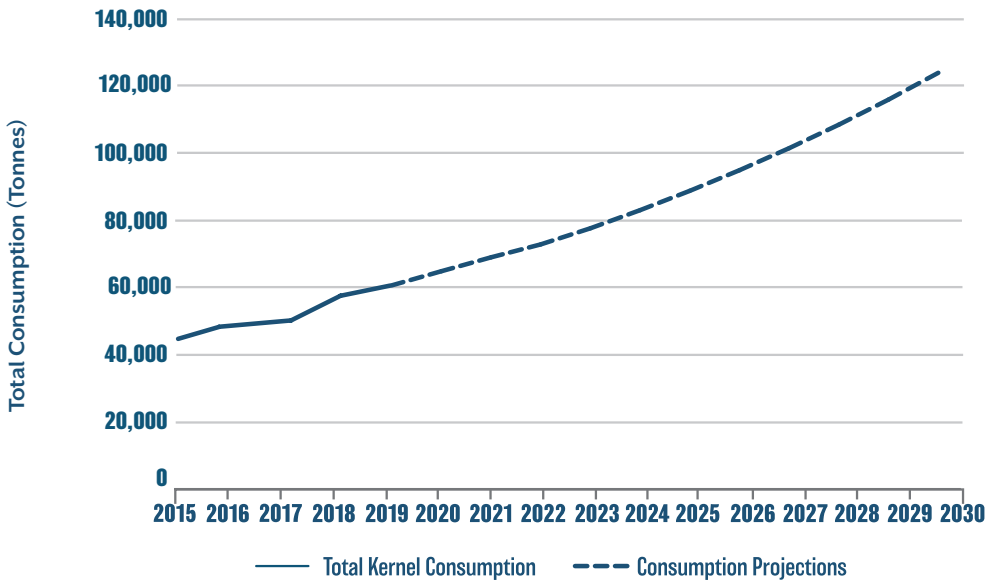
GLOBAL CONSUMPTION AND DEMAND

A key emerging market for future demand is Europe, with long-term demand projected to experience stable growth (CBI, 2021). Over the next five years, it is reported that demand for macadamia nuts in Europe will increase by an average annual rate of between 3% and 6% (CBI, 2021).

From 2015 to 2019, consumption per capita has increased by approximately 6% on average over the four-year period. In 2019, consumption per capita was estimated to total eight grams, growing to an estimated 15 grams per capita in 2030. It has been assumed that consumption will continue to increase in line with historical growth as demand is currently strong, largely driven by a rising demand for healthier snacking options.

Projections to 2030 identify global macadamia kernel consumption has the potential to increase to approximately 127,460 tonnes.

Figure ES. 4. Global Macadamia Kernel Consumption (Tonnes), 2015 to 2030



Source: INC (2021a), IMF (2022), OECD (2022), AEC.

Another growing market for macadamias on the global scene is South Korea. Marquis Macadamia's, which is the world's largest macadamia processing company, have highlighted sales to Korea doubled over the year to 2021 (ABC, 2021). Marquis have identified that the macadamia market in Korea is rapidly maturing, with demand stemming from the inclusion of macadamias in a wider variety of products (ABC, 2021).

AUSTRALIAN INDUSTRY

Australia has maintained a consistent yield and solid kernel recovery percentage of between 32% and 35% from 2013 to 2020 (Australia Macadamia Society, 2020). South Africa have been able to achieve similar kernel recovery rates, estimated at around 32% in 2021 (INC, 2021b). In contrast, the kernel recovery rate in the US was estimated to total 22% in 2021 (INC, 2021b). This productivity differential reflects a number of competitive advantages that Australian producers have enjoyed including (Australian Macadamia Society, 2017):

- Internationally recognised genetics and varietal development
- An industry which can demonstrate over 20 years of full compliance with all relevant standards
- A younger average age of tree across the industry
- The industry has a strong representative body, driving industry and export development
- Management and operational learnings from 2008-2011 on pest, disease and crop management including development of class leading integrated orchard management systems.

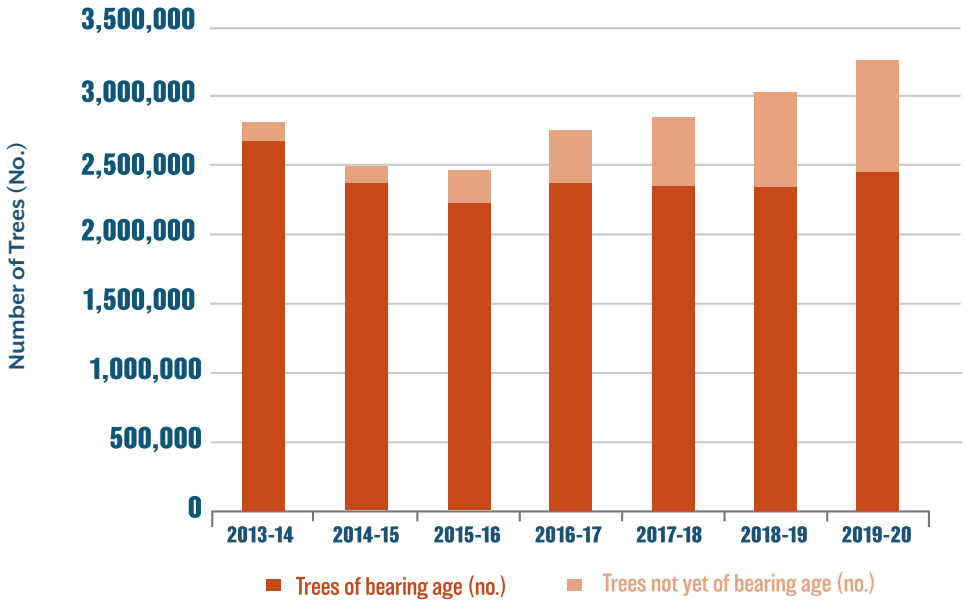
In Australia there are 6.4 million macadamia trees, with the majority concentrated in Queensland and New South Wales as stated above. Of the total macadamia trees, approximately 1.2 million are not yet of bearing age (22% of Queensland's total trees and 13% of New South Wales's total trees).

New planting areas are experiencing significant growth with the establishment of greenfield sites in Queensland and the Clarence Valley in addition to growers maximising their holdings (Australian Macadamia Society, 2021a). The future of the macadamia industry in Australia has a positive outlook with around one quarter of the trees under cultivation yet to reach full production (Australian Macadamia Society, 2021a).

Although Bundaberg is the main growing region within Central Queensland, Rockhampton is also home to several macadamia farms. According to the Macadamia Industry Benchmark Report (Queensland Government, 2021b), Central Queensland has the youngest average tree age of 15 years, compared to the other major growing regions highlighted in the study. Central Queensland also includes some young farms which are yet to reach full maturity. This highlights that macadamia production in the Central Queensland region is likely to increase in the near future, with more tress beginning to mature.

Macadamia production is prominent throughout the broader Central Queensland region with approximately 2.4 million trees of bearing age and an additional 812,906 trees which are not yet of bearing age.

Figure ES. 5. Number of Macadamia Trees in Central Queensland



Notes:

- Bearing = 6 years and over
- Non-bearing = under 6 years

Source: ABS (2021, 2020, 2019, 2018a & b, 2016, 2015).

Australian macadamia farms yield, on average, up to 2.97 tonnes per Ha (refer to Table 3.4 on page 22 for details, Section 3.4). However, Central Queensland is a highly productive region for macadamia production. Despite having a relatively young average age of trees (15 years old), yield on a per Ha basis is well above the national average of 2.72 (refer to Table 7.3). In modelling the average farm in the Rookwood Weir Catchment Area, the Australian average has conservatively been applied.

Table ES. 1. Regional Yield Summary

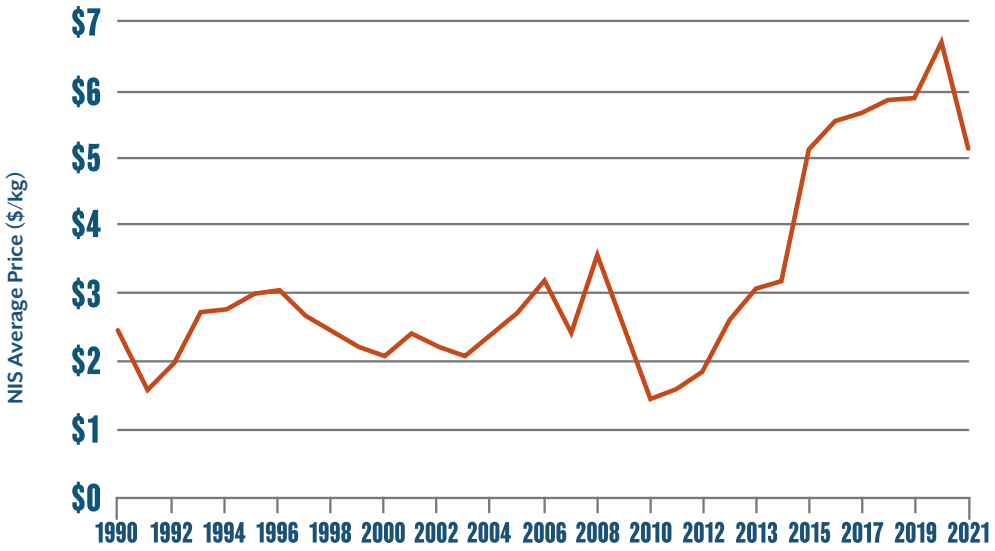
Year	Average Age of Tree	Total Ha Planted	Total NIS Produced	Average NIS yield/ha
Central Queensland	15	5,616	16,666	2.97
South-East Queensland	26	1,514	3,713	2.45
Northern Rivers	25	3,297	8,102	2.46
Mid North Coast	21	423	983	2.32
Australia	20	10,851	29,464	2.72

Source: Queensland Government (2021).

For the 2019-20 season, it was estimated that macadamia prices averaged approximately $6.65 per kilogram. From 1990 to 2010 prices were relatively low, increasing from 2010 onwards which displays a distinct and positive growth trajectory.

However, the short-term price outlook is negative with transport costs and further devaluation of the exchange rate expected to place downward pressure on prices over the next 12 months as the supply impacts associated with the pandemic continue and the interest cycle in the US, Europe and Asia are likely to lead similar increases in Australia.

Figure ES. 6. Average Price, $/kg (Macadamia NIS)



Notes:

- The prices are reflective of macadamias at 10% moisture. This average price does not include contract processed.
- From 1990 to 2012 prices are indicative based on 33% sounds kernel recovery.
- 2021 price estimates exclude bonuses/freight subsidies (including quality bonus for reject recovery)

Source: Australian Macadamia Society (2020), Marquis Macadamias (2021).

Although 2021 prices are expected to be lower than the peak in 2020, these prices still provide the grower with the ability to make a profit (ABC, 2021). These prices are above the long-term average of $3.20 per kilogram over the 33-year historical period.

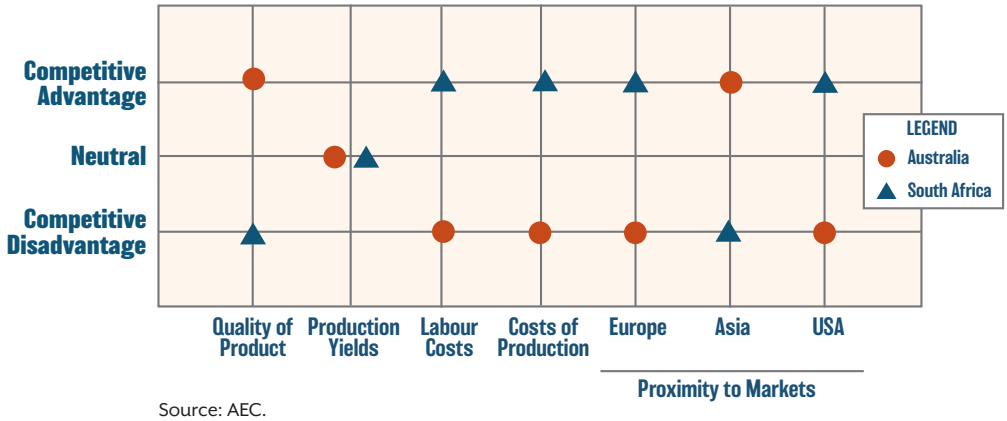
AUSTRALIAN COMPETITIVE ADVANTAGE

Australia has a competitive advantage in proximity to market for China, Japan and South Korea, which is reflected in the greater proportion of supply. South Africa on the other hand has travel time advantages to supply the US market, as well as the European market. Other competitive advantages South Africa has include lower labour costs and costs of production, however, the quality of Australia's macadamia products are generally higher due to more established compliance and quality standards.

SOUTH AFRICA

Australia has a competitive advantage in proximity to market for China, Japan and South Korea, which is reflected in the greater proportion of supply. South Africa on the other hand has travel time advantages to supply the US market, as well as the European market. Other competitive advantages South Africa has include lower labour costs and costs of production, however, the quality of Australia's macadamia products are generally higher due to more established compliance and quality standards.

Figure ES. 7. Competitive Advantage Comparison, Australia vs South Africa



Source: AEC.

CHINA

The expansion of macadamia production in China may see a shift in the international export market with majority of the demand able to be realised domestically. Currently, China's yield per hectare is relatively low compared to that of both Australia and South Africa due to the significant volume of production area and smaller volume of yielding trees.

If realised, China will increase their supply of macadamia nuts by an average 94% per annum from 2021 to 2025, significantly increasing the supply of a country who are currently a net importer of the commodity. China largely imports macadamias from Australia, particularly NIS, sourcing 97.3% of NIS from Australia in 2020 (see section 3.6)

FUTURE MARKETS

Japan represents a growth market for Australian macadamias. Japan is largely a market for kernels, with value adding being undertaken domestically including chocolate coating, roasting, and flavour adding (Deloitte, 2017). Vietnam is another potential growth market for Australia macadamias, with Australian imports accounting for approximately 42% of the country's total imports in 2020 (3,190 tonnes). Vietnam was the third largest importer of macadamias in 2020 (both NIS and kernel), with the country also sitting as the eight largest producer of the commodity in 2021, highlighting the strong domestic demand for macadamias.

SUPPLY CHAIN GAPS

The macadamia industry in Central Queensland is supported by four post-production processing facilities – two in Bundaberg (operated by Marquis Macadamias and Macadamias Australia), and two in Gympie (operated by Suncoast Gold Macadamias and CL Macs). Another facility exists in the Sunshine Coast (operated by Nutworks), servicing the South-East Queensland region.

There are currently no processing facilities in the Rookwood Weir Catchment Area or the Rockhampton region. If macadamias were selected as commodity for the Rookwood Weir Catchment Area, harvested nuts will need to be shipped to a processing plant in Bundaberg, which could be up to 500km from the Rookwood Weir Catchment Area.

Depending on the scale of macadamia cultivation in the region, a new macadamia processing plant may be required within the catchment. The current levels of production in the Rockhampton area are insufficient to justify the high upfront capital costs for a macadamia processor to establish new operations within the region.

FINANCIAL AND COMMERCIAL ANALYSIS

The Rookwood Weir Scheme allows for a maximum 500ML water allocation for agricultural landholders. Under the assumption this water is provided with a conservative 80% reliability and macadamias require an estimated 5.0ML per ha per year (DAF, 2004), the maximum growing area in the Rookwood Weir Catchment Area is 80ha.

The key guiding outcomes of the financial analysis for an 80ha farm are:

- The anticipated initial capital investment for a macadamia orchard is $4.5 million – including, land, land clearing, infrastructure and equipment, water entitlements, and planting
- The first commercial harvest is not expected to occur until the seventh year of growing, when the trees will yield, on average, 1.88 tonnes per Ha. The farm will be operating at a loss for the first nine years the orchard is planted
- The break-even point (at current market price of $5.21 NIS) is May 2030, however, the first full year of operating at a profit is predicted to be FY2033, with the plants being planted in FY2024
- With consideration to the capital investment and the operating position, the discounted cash flow will be positive by FY2033
- The long-term growth rate for agricultural farmland values is 8.8%, with a net present value (NPV) of the farm at $0 the implied internal rate of return is 9.52%. The terminal value of the macadamia farm at the conclusion of the analysis (FY2041) is $38.65 million.

The orchard revenue consists of the operating income associated with the sale of NIS. The price point is determined by the quality of the saleable kernel and the rate of recovery from the NIS. The estimated total price per kilogram used in modelling the example farm is $5.21. This total price includes both the base price and the additional price (associated with the quality of the kernel).

The assumed macadamia orchard in the Rookwood Weir Catchment Area would be anticipated to reach a positive annual operating position, that is, a positive net profit after tax (NPAT) ten years after orchard establishment, that is FY2033. The positive operating position is estimated to be held for a couple of years before increases in depreciation and asset write-offs increase and undermine the operating position. FY2035 is the year the biological asset write-off (that is, the trees in the orchard) begin being incurred.

By FY2041 the NPAT of the orchard is estimated to exceed $33 thousand. The NPAT profile over the FY2022 to FY2041 shows a stepped increased in profitability, which indicates the operating profit is directly correlated to and driven by the assumed yield. Additionally, the depreciation and asset write-off expense places a burden on the NPAT achievable by the farm.

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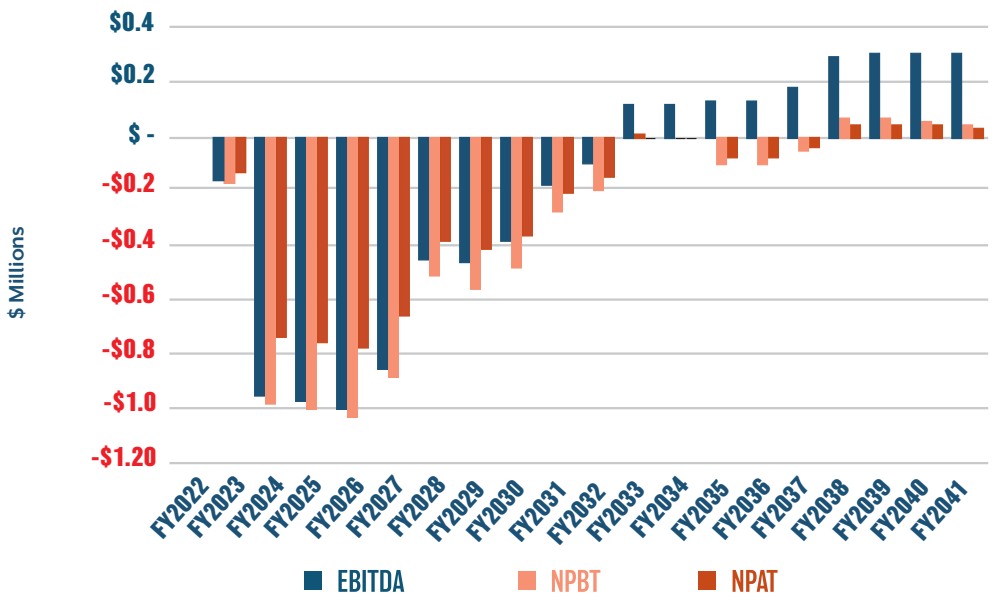
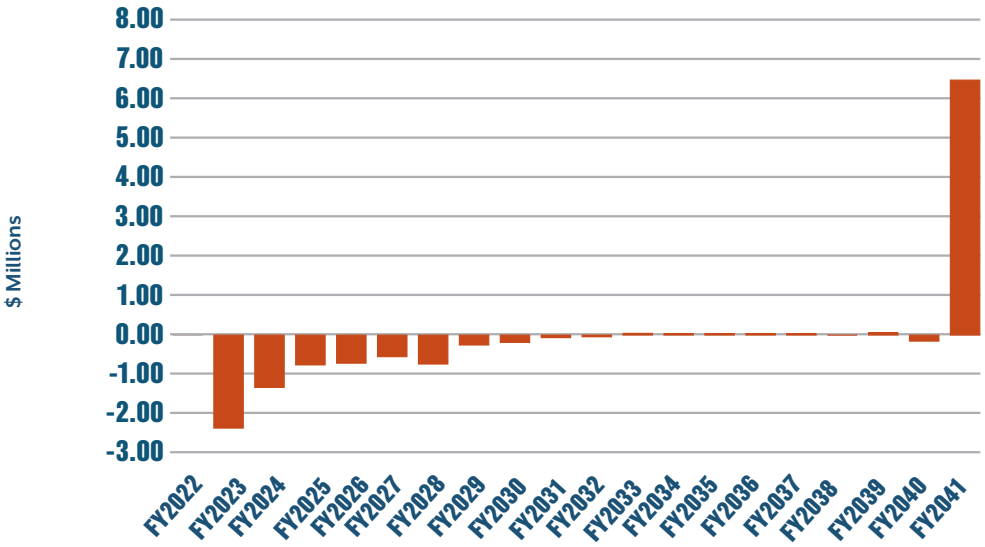
Figure ES. 8. Orchard Operating Profit (FY2022 - FY2041)



Source: AEC (2022).

To understand the value of the orchard investment, a discounted cash flow (DCF) has been calculated. This is shown below in Figure ES.9 By FY2035 the orchard will begin to see positive discounted cashflows. However, given the large capital investment, and the periods of no returns (which ultimately increases the required capital investment), the cumulative discounted cash flows do not return a net positive income in the 20-year analysis.

Figure ES. 9. Discounted Cashflows, Including Excluding Terminal Value (FY2022 – FY2041)



Note: Discounted cashflows have been estimated on a 9.52% post-tax discount rate, which is the implied internal rate of return.Source: AEC (2022).

ECONOMIC IMPACT

Initial capital investment of the orchard is anticipated to cost approximately $3.09 million, not including the purchase of land or the purchase of water entitlements (both of which are not contributing factors of the economic impact). Capital investment and operation of the orchard is anticipated to directly contribute to $2.7million in industry output (i.e. revenues) to local businesses within the Rockhampton LGA.

A further $1.9 million in industry output is estimated to be supported in the catchment's economy through flow-on activity, including $1.2 million in production induced (i.e. supply chain) activity and $0.7 million through household consumption induced activity (i.e. expenditure of households within the local economy as a result of a lift in household incomes).

This level of industry activity is estimated to support the following within the Rockhampton LGA:

- A $2.0 million contribution to GRP including $1.1 million directly
- 17 FTE jobs (including 10 FTE jobs directly), paying a total of $1.4 million in wages and salaries ($0.8million directly).

Table ES. 2. Economic Activity Supported by a Macadamia Orchard Enterprise, Rockhampton LGA

Impact	Output ($M)	Gross Regional Product ($m)	Incomes ($M)	Employment (FTEs)
Direct	$2.7	$1.1	$0.8	10
Production Induced	$1.2	$0.5	$0.3	4
Consumption Induced	$0.7	$0.4	$0.2	3
Total	**$4.7**	**$2.0**	**$1.4**	**17**

Note: Figures may not add due to rounding.
Source: ABS (2012), ABS (2017), ABS (2020a, b, c and d), AEC.

GLOSSARY

TERM	DEFINITION
AEC	AEC Group Pty Ltd
CAGR	Compund annual growth rate
DAF	Department of Agriculture and Fisheries
EBIT	Earnings before interest and tax
FTA	Free Trade Agreement
FTE	Full-time Equivalent
FY	Financial year
GRP	Gross Regional Product
HA (HA)	Hectares
HTW	Herron Todd White
KM	Kilometres
LGA	Local Government Area
ML	Megaliters
NIS	Nut in-shell
NPAT	Net Profit After Tax
NPBT	Net Profit Before Tax
NSW	New South Wales
QLD	Queensland
RFM	Rural Funds Management
RKR	Rejected kernel recovery
ROCE	Return on Capital Employed
RWGP	Rookwood Weir Grants Program
SKR	Saleable kernel recovery
TKR	Total kernel recovery
WMO	World Macadamia Organisation

TABLE OF CONTENTS

1. INTRODUCTION

1.1 BACKGROUND

Rookwood Weir is a landmark project that will capture water in the lower Fitzroy River for use across the Region. The project comprises of the construction of the weir, and enabling works that will upgrade existing infrastructure to support both the construction of the weir and its operation, which includes:

- Upgrading and widening 16.2 kilometres (km) of Thirsty Creek Road
- Installing a new intersection on the Capricorn Highway and upgrading Second Street and Third Street through to the railway crossing at Gogango
- Building a 21-metre high, 260 metre long bridge at Riverslea to replace the existing crossing and up to 300m of new road on the approaches to the bridge, connecting to the existing road.

The $367 million project is jointly funded by the Australian and Queensland governments, and is expected to be completed and operational in 2023. Early works commenced in late 2020, and as of January 2022, the progress on the construction of the weir is approximately at 50% (Sunwater, 2022).

Once complete, Rookwood Weir will be the largest weir operated by Sunwater in regional Queensland. Subject to final design, the weir's planned volume will be 74,325 megalitres (ML), which is estimated to potentially yield up to 86,000ML of medium priority water. This valuable new water source will bring much-needed water security as well as economic growth and jobs for Central Queenslanders.

Rockhampton Regional Council and Advance Rockhampton are co-ordinating the Rookwood Weir Grants Program (RWGP), which focuses on providing support to eligible landholders in the Lower Fitzroy region to prepare for the second tranche of water sales from the Rookwood Weir Supply Scheme (7,500ML in 2022). Rookwood Weir will provide existing landholders with the opportunity to significantly increase the net return derived from their land by transitioning to intensive irrigated crop production. A range of crops have been identified as suitable for production within the Rookwood Weir Catchment Area, including macadamias, mandarins and mangoes.

AEC Group Pty Ltd (AEC) and Herron Todd White (HTW) have been commissioned to undertake Business Case Studies to provide an in-depth analysis of potential agribusiness opportunities aligned with irrigation in the Rookwood Weir Catchment Area. This Study will assist local growers prioritise crop options given available water allocations.

1.2 PURPOSE OF THIS REPORT

The purpose of this report is to provide an in-depth analysis of the global market for macadamias and assess the potential agribusiness opportunities for production of macadamia crops within the region. This study will inform landholders in the Lower Fitzroy region that are considering options for potential crops that could be grown utilising water that will be available for tender through the Rookwood Weir Water Supply Scheme.

The market outlook presented is based on research of historical and forecast information, and engagement with key stakeholders and industry associations. The analysis also includes commentary on the growing conditions and requirements for commercial macadamia crops in the Australian environment, including soil suitability, water availability, orchard management, pest and weed control, infrastructure and equipment. The report and analysis presents an informed base for a financial model to assess the potential production feasibility and profitability at an individual farm level.

The broader research program will see this report is as one of nine commodity reports to inform growers of the potential opportunity and viability of accessing addition water to expand production and productivity. A financial assessment has been undertaken for each potential crop based on a greenfield farm development to test size, returns and value prioritisation. The financial analysis aims to provide potential growers with an overview of the costs, timing and potential returns from operating a farm in the region to enable a more detailed, customised analysis based on their individual circumstances.

The analysis presented in this is report is structured as follows:

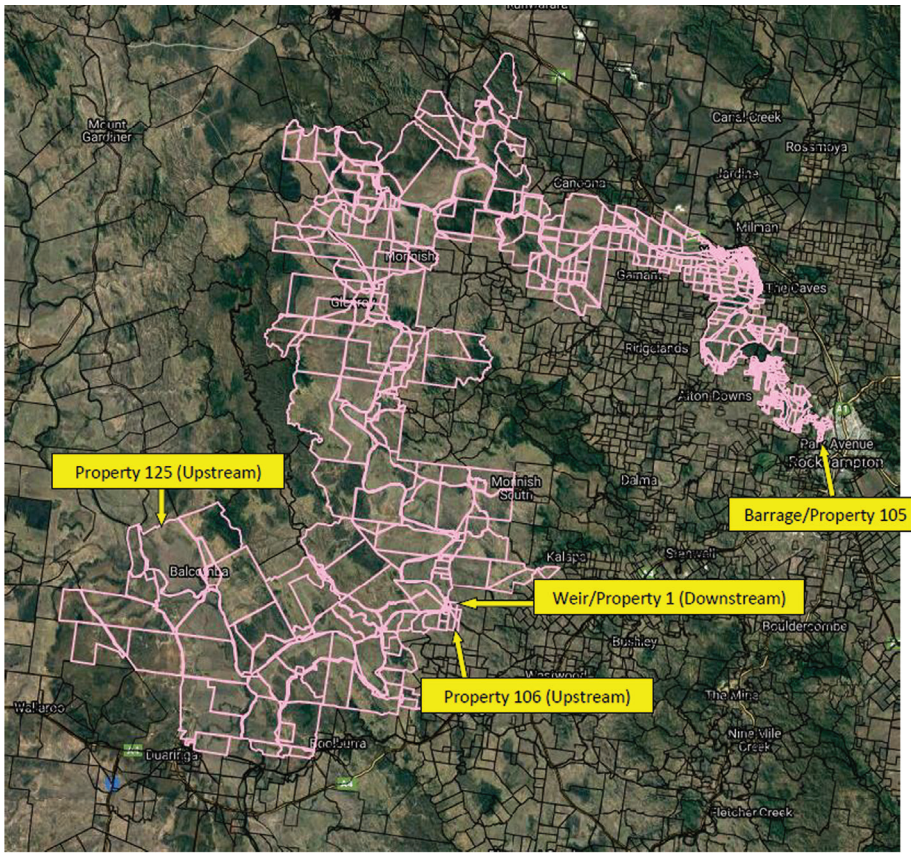
Source: AEC.

1.3 ROOKWOOD WEIR CATCHMENT AREA

The Rookwood Weir is located north-east of Duaringa, on the Fitzroy River within the Fitzroy Basin in Central Queensland and is approximately 66km south-west of Rockhampton.

The Rookwood Weir Catchment Area, for the purpose of our assessment, has been defined as the property holdings approximately within five kilometres of either side of the Fitzroy River, and can be potentially suitable for irrigated crops.

Figure 1.1. Rookwood Weir Catchment Area



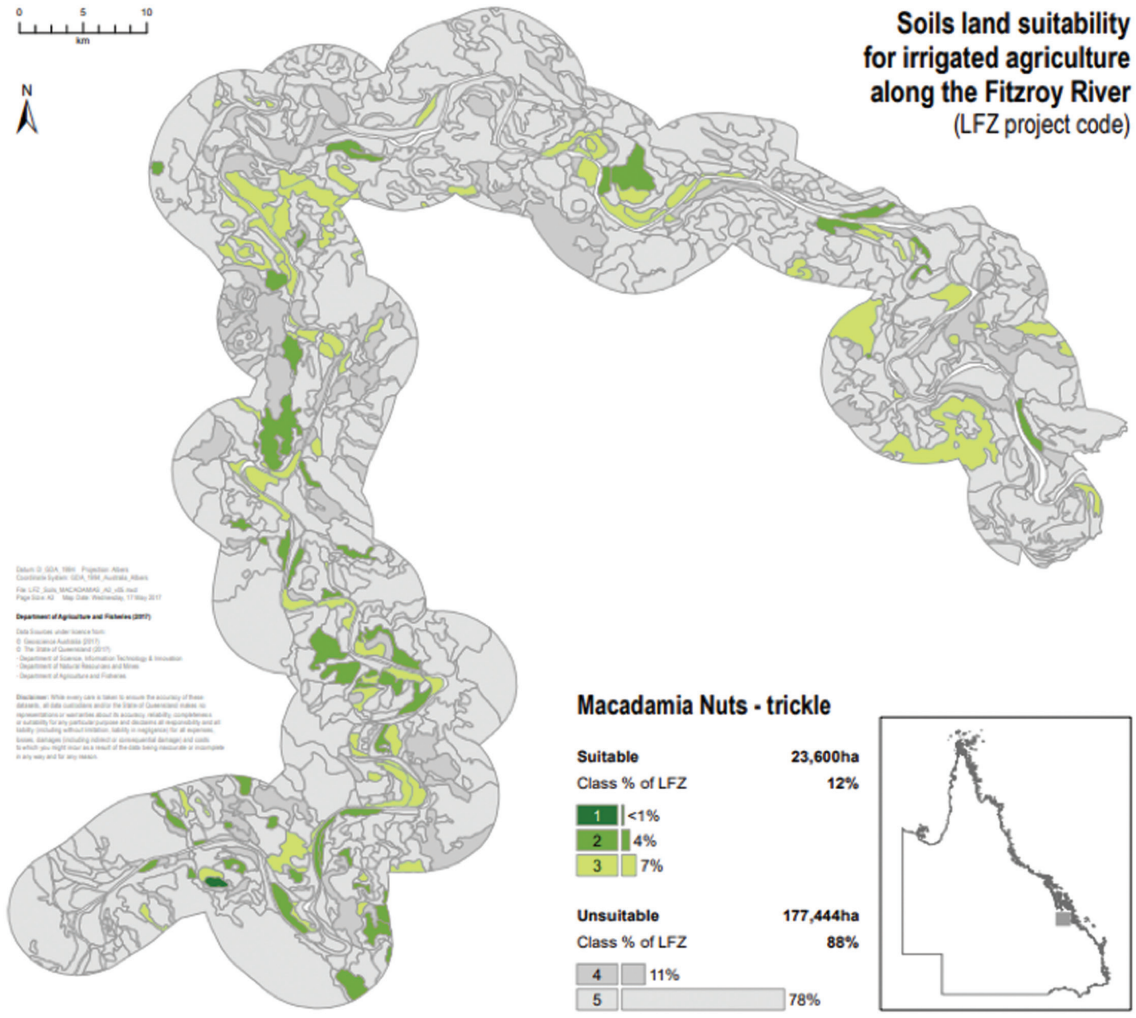
Source: HTW.

1.3.1 LAND SUITABILITY FOR MACADAMIA PRODUCTION

The Rookwood Weir project has worked with Queensland Department of Agriculture and Fisheries (DAF or the Department) and Sunwater to develop a crop suitability tool to assess individual landholder area suitability for different crops.

The following map highlights the land areas in the study area that could be used to grow Macadamias in the Fitzroy River region based on the DAF soil suitability tool.

Figure 1.2. Land Suitability Fitzroy River



Source: Queensland Government (2021a).

Based on the identified area, the maximum suitable land area that could be used to produce macadamia's is 23,600ha which would produce approximately 70,000 tonnes of NIS macadamias by 2035 (22,400 tonnes of kernels based on 5 year recovery rate of 32%) valued at approximately $364.4 million based on current regional price of $5.21 per kg.

However, when taking into account the land's slope, another critical element in assessing macadamia suitability, the total land available for macadamia's reduces to approximately 18,690ha – which would equate to $288.5 million over the same time period.

2. OVERVIEW OF THE GLOBAL MARKET

2.1 INTRODUCTION

The macadamia nut is Australia's only native tree nut to become an internationally produced and traded commodity. There are two primary varieties that are able to be grown and sold commercially for both domestic and export consumption, namely, *M. integrifolia* and *Macadamia tetraphylla* varieties and their hybrid derivatives (Marquis, 2021b).

Despite its native roots and the first establishment in the 1870s, commercially feasible domestic operations only succeeded once grafting techniques and mechanical processing were developed in the 1950s and 1960s (Australian Macadamia Society, undated a). In contrast, the first commercial orchard in Hawaii was established in the 1920s.

Despite this slow start, the Australian macadamia industry has seen a rapid and aggressive expansion over the past 32 years. This has seen Australian production quintuple over the period from 10,000 tonnes in 1990 to over 51,000 tonnes in 2021 (approximately 21.4% of global production), with the Australian industry nut in-shell (hereinafter referred to as 'NIS') production expected to exceed 55,000 tonnes in 2022.

The growth in production has reflected strong consumer demand for Macadamia Nuts (both NIS and kernels) over the same period, with demand growing at an average annual growth rate of 7.8% from 2010 to 2021. This production growth is expected to accelerate over the next eight years with the 2030 NIS production estimate expected to exceed 600,000 tonnes by 2030, reflecting an average annual growth rate of approximately 10.4% over the period. Consumer demand has been underpinned by three primary factors:

1. Growth in alternative protein demand
2. Growth in health snack demand particularly with the millennial market segment
3. Rising demand in beauty therapy and processed food/drink categories.

With a farmgate value of over $275 million in 2020 for Australia and a sector export value (NIS, kernel and processed products) in excess of $233.9 million, macadamia's have become Australia's fourth most important horticultural export (Hort Innovation, 2021a).

Australia's share of global production is expected fall to 11.7% (2030) from approximately 21% (2021) over the same period, reflecting new entrants and non-bearing trees reaching maturity over the next eight years based on the expected growth of competitor supply.

In addition, the short-term price outlook is negative with transport costs and further devaluation of the exchange rate expected to place downward pressure on prices over the next 12 months as the supply impacts associated with the pandemic continue and the interest cycle in the US, Europe and Asia are likely to lead similar increases in Australia.

The rapidly increasing production area and volume from China's domestic production provides a real and present danger to current supply arrangements for the industry, with China expected to become the dominant producer of macadamias by 2030. Development of new markets in Europe and other Asian countries, as well as improvements in production efficiency and kernel recovery rates will be critical for maintaining Australia's premium market space and the financial performance of individual operators.

Despite these short-term issues, prices are expected to remain above the 10-year average for the industry. With growth in the industry expected to continue over the medium term, new orchard establishments being developed now will begin to yield in the first four years and reach maturity in 12 to 16 years' time. As these trees begin to mature, the global market will be competitive, particularly with the projected increase in China's production. This will place long-term pressure on Australia's position in the global market.

[1] Average annual growth rates throughout the report refers to the compound annual growth rate (CAGR).

2.2 GLOBAL PRODUCTION

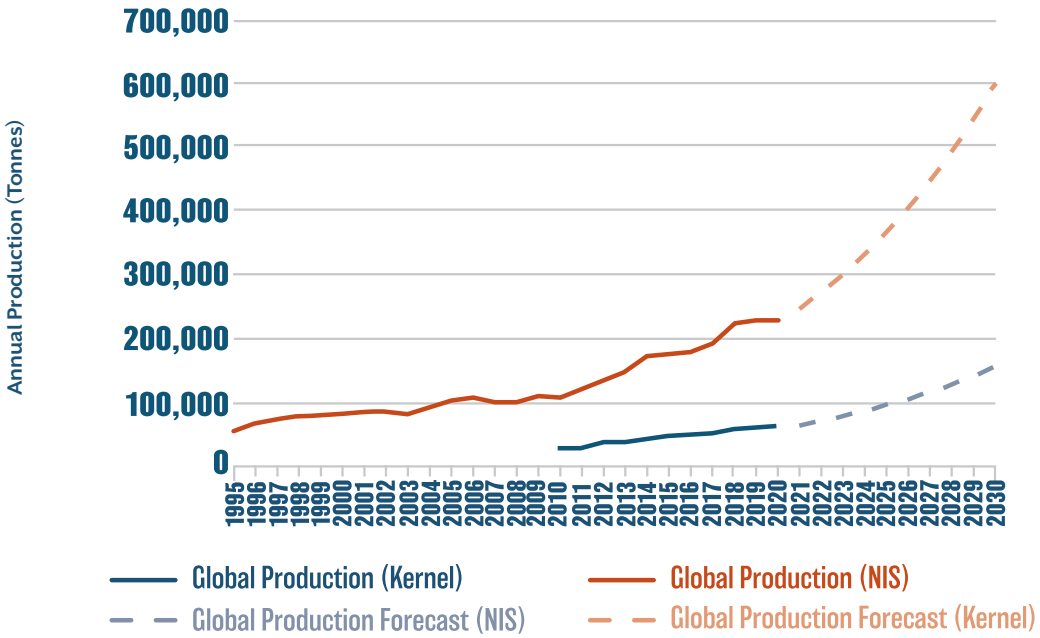
From 1995 to 2021, the global macadamia NIS production increased at an average of 5.9% per annum. Macadamia NIS production has more than quadrupled over the period of 25 years, reaching an estimated 246,735 tonnes in 2021. This production volume of macadamias NIS was estimated to equate to a total of 68,911 tonnes of macadamia kernels (with an average kernel recovery rate of 28%).

Global macadamia production has experienced stronger growth from 2010 to 2021, increasing by an average annual rate of 7.8% per annum.

The World Macadamia Organisation (WMO) estimate that from 2020 to 2030, macadamia production will triple to reach around 600,000 tonnes of macadamia NIS (Fresh Plaza, 2021a).

The figure below provides an indication of the estimated growth over 2021 to 2030, which equates to an average annual growth rate of 10.4% over the nine-year period.

Figure 2.1. Global Production, Tonnes (Macadamias)



Note:

- Kernel production value is only available from 2010 with publicly available INC data. Forecast data have been estimated based on the average annual rate of recovery from 2010 to 2020.
- To estimate the production volumes between 2020 to 2030, the average annual growth of 10.2% has been applied.

Source: SAMAC (2020), INC (2021a, b), Fresh Plaza (2021a)

2.3 MAJOR PRODUCERS

Combined, Australia and South Africa represent nearly half of global macadamia production. Australia has not always been the largest producer of macadamias on the global scale.

Based on the average annual production over five years to 2020, South Africa has been the largest producer of macadamias. Over the next five years, macadamia production in South Africa is estimated to represent approximately 27% of total global production.

Table 2.1. Top 10 Macadamia Producers (NIS), Tonnes

Country	2020		2021	
	NIS	Proportion	NIS	Proportion
Australia	46,900	21%	51,500	21%
South Africa	48,925	22%	53,585	22%
China	30,400	13%	32,000	13%
Kenya	37,000	16%	42,250	17%
USA	15,300	7%	15,000	6%
Guatemala	14,200	6%	16,000	6%
Vietnam	5,300	2%	6,700	3%
Malawi	6,000	3%	6,900	3%
Brazil	5,500	2%	5,500	2%
Columbia	1,300	1%	1,300	1%
Others	16,000	7%	16,000	6%
Total	**226,825**	**100%**	**246,735**	**100%**

Notes:

- 3.5% moisture content
- 2021 kernel production forecasts are based on the estimated recovery rates highlighted by INC (2021b).

Source: INC (2021a, b).

Table 2.2. Top 10 Macadamia Producers (Macadamia Kernel), Tonnes

Country	2020		2021	
	NIS	Proportion	NIS	Proportion
Australia	15,840	25%	17,397	25%
South Africa	15,700	25%	17,169	25%
China	8,800	14%	9,600	14%
Kenya	7,400	12%	8,450	12%
USA	3,400	5%	3,300	5%
Guatemala	2,850	5%	3,500	5%
Vietnam	1,590	3%	2,000	3%
Malawi	1,500	2%	1,700	2%
Brazil	1,375	2%	1,375	2%
Columbia	260	0%	260	0%
Others	4,160	7%	4,160	6%
Total	**62,685**	**100%**	**68,911**	**100%**

Notes:

- 3.5% moisture content
- 2021 kernel production forecasts are based on the estimated recovery rates highlighted by INC (2021b).

Source: INC (2021a, b).

Table 2.3. Macadamia Production, Five Year Average to 2020, Kernel Equivalent (Tonnes)

Country	Five Year Average	Proportion
South Africa	15,118	27%
Australia	14,600	26%
Kenya	6,852	12%
China	5,369	10%
USA	3,446	6%
Guatemala	2,380	4%
Malawi	1,587	3%
Brazil	1,475	3%
Others	4,957	9%
Total	**226,825**	**100%**

Notes: 3.5% moisture content
Source: INC (2021a).

2.3.1 AUSTRALIA

Australia experienced a production decline from 2008 to 2011, which was primarily driven by (Australian Macadamia Society, 2017):

- Poor weather conditions
- Emerging pests
- Orchard management responses to challenging conditions.

The industry developed methods to manage the issues impacting macadamia production, which is evident in sustained production growth from 2011 onwards. These management and operational learnings have seen production increase to total a crop of 51,500 tonnes of NIS (Australian Macadamia Society, 2021b). This increase in crop production is a result of improved management practices and strong growth in Queensland and production from new plantings, which are reaching 5-10 years old in Bundaberg (Australian Macadamia Society, 2021b).

The 2020 macadamia production was a near record crop even through the battles of the COVID-19 pandemic and weather challenges. It is estimated that one third of the farms located in South-East Queensland (mostly in the Glass House Mountain area) and a large portion of the farms in both Northern Rivers and Mid North Coast of New South Wales are reliant on rainfall and not irrigation (Queensland Government, 2021b). From 2017 to 2019 there were multi-year rainfall deficiencies in much of northern New South Wales and southern Queensland, which were expected to impact on macadamia production throughout the 2020 production season, however, the crop performed stronger than expected.

Demand for Australian production remained strong throughout the COVID-19 pandemic, which impacted food service channels and disruptions to the supply chain (Australian Macadamia Society, 2020c). The COVID-19 related impacts only caused minor disruptions to international shipping, with sales in the third quarter of 2020 improving (Australian Macadamia Society, 2020c).

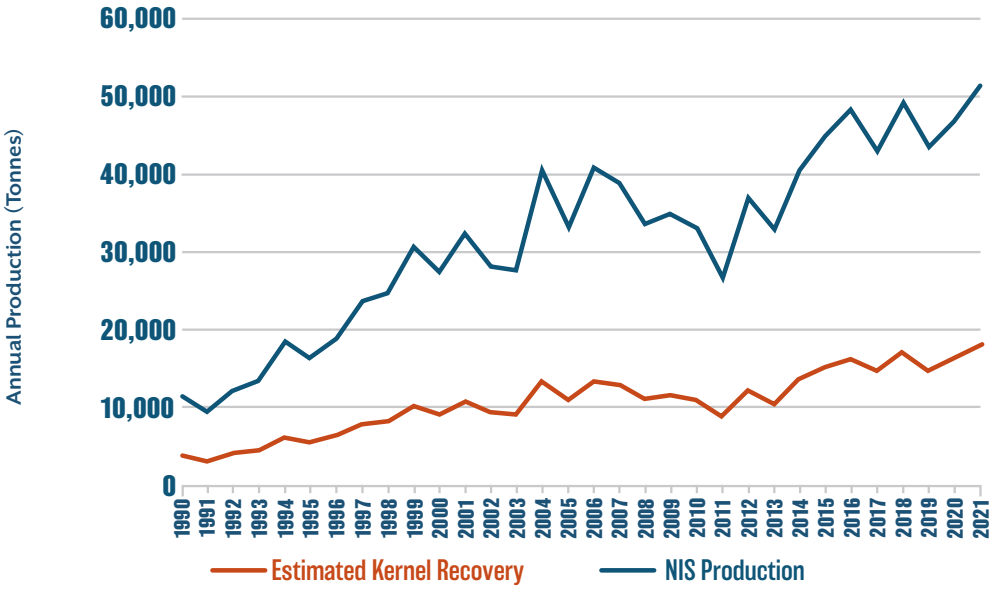
In 2021, it is forecast the farm gate price in Australia will deliver a crop value of $275 million, equating to an estimated $855 million at retail value (Australian Macadamia Society, 2021a).

There are approximately 36,000 hectares (Ha) of macadamia plantings in Australia, with 78% of this area currently bearing (Australian Macadamia Society, 2021a). It is estimated that there will be around 46,000ha under planting by 2025, equating to a 10,000ha increase in macadamia plantings (Australian Macadamia Society, 2021a).

New planting areas are experiencing significant growth currently with the establishment of greenfield sites in Queensland and the Clarence Valley in addition to growers maximising their holdings (Australian Macadamia Society, 2021a). The future of the macadamia industry in Australia has a positive outlook with around one quarter of the trees under cultivation yet to reach full production (Australian Macadamia Society, 2021a).

[3] Based on 3.5% moisture.

Figure 2.2. Australian Macadamia Production, 1990 to 2021 (Tonnes)



Note:

- Kernel production has been estimated sound kernel recovery rates. From 1990 to 2012, sounds kernel rates are assumed to be 33%.
- Australian Macadamia Handlers Association (AMHA) represent more than 90% of production.
- The ratio between production at 3.5% moisture and 10% moisture in 2021 has been applied to NIS production at 10% moisture content from 1990 to 2020 to estimate the tonnes at 3.5% moisture.

Source: AMHA as cited in Australian Macadamia Society (2020a), Australian Macadamia Society (2021b).

2.3.2 SOUTH AFRICA

The largest long-term producer of macadamia's has been South Africa, with production experiencing an average annual increase of 13.5% per annum from 1991 to 2021.

The 2020 crop in South Africa was down by approximately 17% on the 2019 crop, equating to a decrease of over 10,000 tonnes of NIS (SAMAC, 2020). The decrease was attributed to a number of factors including challenging weather conditions (unseasonably heavy rain) during flowering and early nut development, mature orchards, a lack of pruning and insects and diseases (INC, 2021b). The heavy rainfall significantly impacted higher density plantings, with the trees remaining wet for longer periods of time (SAMAC, 2020). This drop in production pushed Australia into the number one production position in 2020, with the position expected to be recaptured by South Africa based on the 2021 crop estimates.

Although macadamia production was down in South Africa in 2020, the 2021 production estimate was 10% higher than the previous year (SAMAC, 2020). The 2021 South African production totalled 53,585 tonnes of NIS.

The 2017 agricultural census in South Africa highlighted macadamia plantings increased three-fold over a ten-year period, from 11,567ha in 2007 to 34,431ha in 2017 (Statistics South Africa, 2020). Data provided by Macadamias South Africa highlighted there has been an estimated 11,313ha increase in macadamia area from the agricultural census in 2017. This suggests that macadamia production in South Africa will continue increase over the next four to five year as new plantings begin bearing.

The estimated production per hectare listed in the table below is based on total area planted and production estimates provided by Macadamias South Africa. The production per hectare is estimated to decline over 2019 and 2020 as new non-bearing hectares are established. These newly planted hectares will not begin to yield for the next four years.

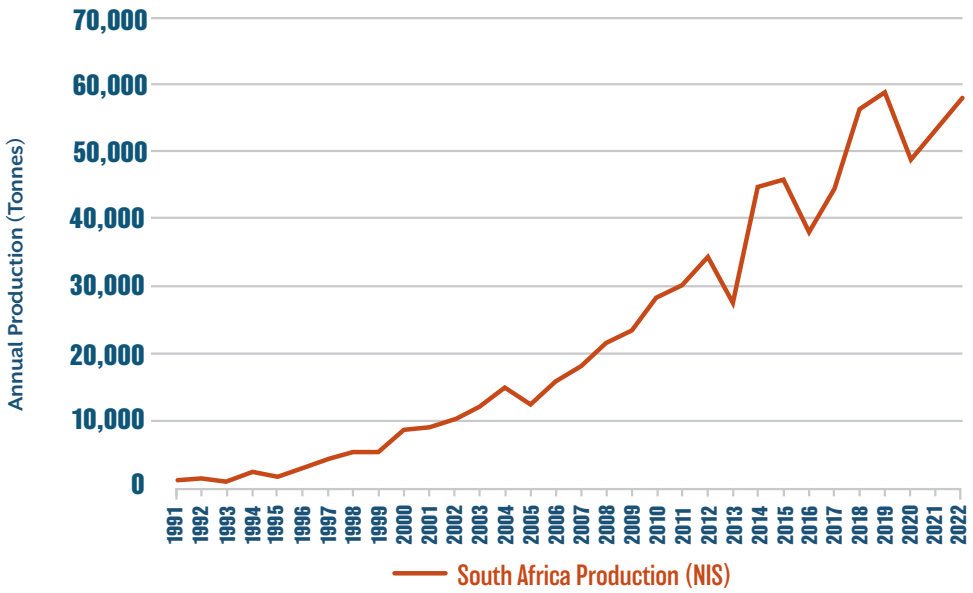
The agricultural census highlighted that at the end of September in 2018, the macadamia bearing trees totalled 6.28 million while non-bearing trees totalled 3.60 million.

Table 2.4. South Africa Macadamia Area Planted

Area Planted	2007	2017	2018	2019	2020
Area Planted	11,567	34,432	38,820	44,782	50,133
Additional Planted Area	-	-	-	5,692	5,351
Production	18,232	44,610	56,550	59,050	48,925
Estimated Production p/ha (tonnes)	1.6	1.3	1.5	1.3	1.0

Notes: 2018 and 2019 macadamia hectares have been estimated based on the reported macadamia land in 2020 and the growth in planted hectares over 2019 and 2020.
Source: SAMAC (2020), Statistics South Africa (2020).

Figure 2.3. South Africa Macadamia Production, 1991 to 2021 (Tonnes) (1.5% Moisture)



Source: SAMAC (2020).

2.3.3 CHINA

China emerged as a relatively small producer of macadamias on the global scale, with production totalling an estimated 10,000 tonnes of NIS in 2016 (Hot Innovation, 2021b). In 2016, this represented approximately 3% of the global market (Hort Innovation, 2021b). Over the period of four years (from 2016 to 2020), macadamia production has increased threefold, with China now standing as the third most prominent producer of macadamias.

There are two main production regions in China, with most of the production concentrated in Yunnan followed by Guangxi. A key challenge for production in Yunnan is the climate, with an elevation of around 700 to 1,200 meters (ABC, 2014). This provides difficulties in a number of aspects, particularly machinery on the mountainous terrain and lack of drainage system (Produce Report, 2017; Zhao, X., et al., 2019).

The mountainous region in China is opposite to the rather flat or gentle slope growing conditions in both Australia and South Africa. As a result, many of the macadamia production guides, which are applicable for production in Australia are not suitable for China (Zhao, X., et al., 2019). In China, "...the agronomic management of macadamia, especially nutrient management, is lacking effective guidance because of a poor understanding of biological characteristics of nutrient uptake and demand and root growth and rhizosphere dynamics of the plant species" (Zhao, X., et al., p.604, 2019).

This has resulted in actual production failing to meet projections over the period. Should these issues be addressed, China is expected to become the dominant global producer, which may result in its status as a net importer changing to a net exporter. This in turn may put pressure on those countries currently supplying the Chinese market to find alternative markets or potentially see margins eroded through increased in country competition with a comparative advantage in transport and labour costs. The figure below provides an example of the mountainous conditions which are located throughout Yunnan.

Figure 2.4. Macadamia Plantings near Yunnan

Note: Macadamia nut plantation in Daxue Shan Township, Yongde Country, city of Lincang, southwest China's Yunnan Province, September 2018.
Source: Yongde Country as cited in Xinhua (2019).

China now has the largest planting area in the world for macadamias, but only represents 13% of total global NIS production in 2021 (INC, 2021b; Zhao, X., et al., 2019). In 2012, it was estimated that China had approximately 16,513ha allocated for macadamias, growing to an estimated 240,000ha in 2020 (Farm Online 2012; USDA 2020).
Over the period of eight years, this equated to an increase of approximately 223,487ha. Therefore, a significant portion of China's macadamia crop is in the early stages of bearing and will mature over the coming years, increasing productivity per hectare.

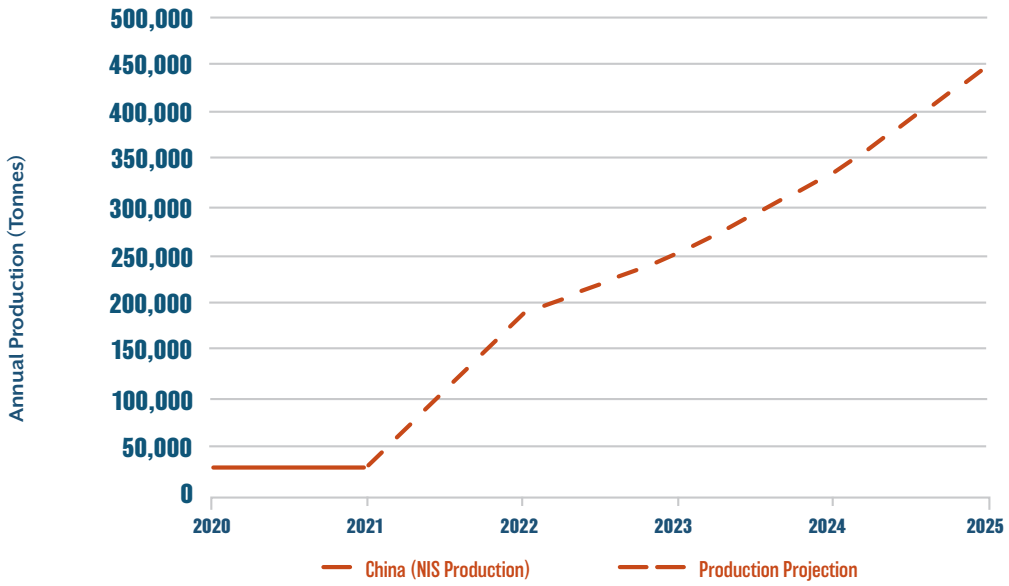
The significant growth in planting area is only expected to increase, with estimates suggesting that China will increase macadamia plantings to 300,000ha by 2030 (Pacific Nut Producer, 2020). China is already holding the world's largest planting area, with this only expected to increase.

As new plantings begin to bear macadamias, it is estimated China will increase production to 190,000 tonnes of macadamia NIS in 2022 (USDA, 2018). At the International Macadamia Symposium hosted in China in 2018, China highlighted macadamia production is projected to further grow to 450,000 tonnes of NIS in 2025 (Green and Gold Macadamias, 2018).

Yield per hectare is currently estimated to total 0.13 tonnes, which is significantly lower compared to both Australia and South Africa. For China to meet the projected increase in macadamia production, there needs to be a structural shift in farm management and productivity to achieve its full potential.

[4] Based on 240,000 hectares in 2020 and 30,400 tonnes of macadamia NIS production

Figure 2.5. China Macadamia Production Forecast, 2020 to 2025 (Tonnes)



Note: Assuming average annual growth of 33.3% from 2022 to 2025.
Source: USDA (2018), Green and Gold Macadamias (2018).

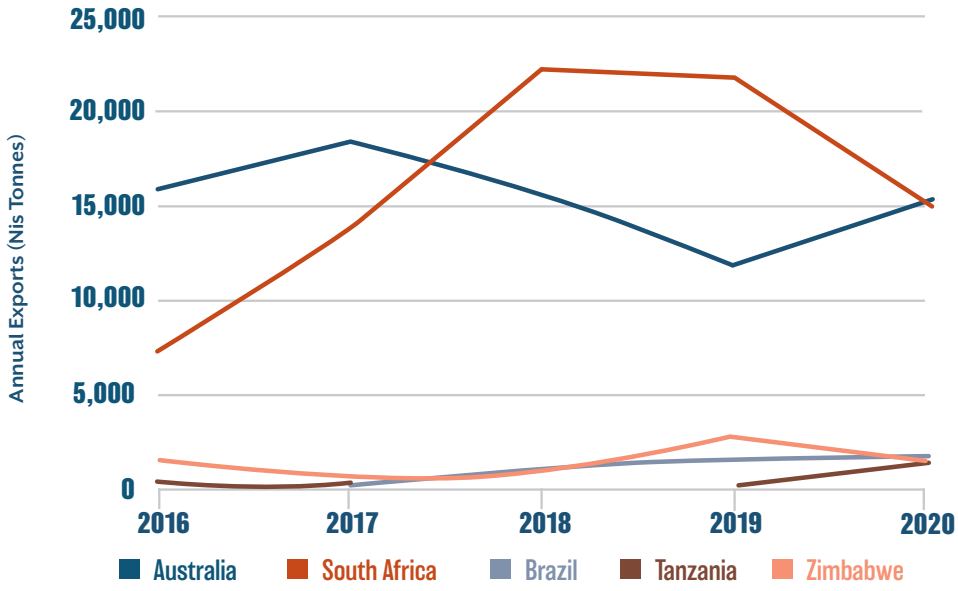
2.4 MAJOR EXPORTERS

2.4.1 NIS MACADAMIA EXPORTS

In 2020, Australia was the largest exporter of macadamias NIS with exports estimated to total 14,960 tonnes. This export volume is the lowest experienced over the four-year period, with exports decreasing by an average annual rate of 1.5% per annum from 2016 to 2020. Australia largely exports macadamias to Asia with key markets including China and Japan.

South Africa was the second largest exporter of macadamias NIS in 2020, with exports totalling an estimated 14,868 tonnes. NIS macadamia exports have experienced significant growth in South Africa over the past four years, nearly doubling in volume. This is reflective of strong macadamia production in South Africa, which experienced an average annual growth rate of 7.3% per annum from 2016 to 2021 (for NIS).

Figure 2.6. Top Five Export Countries in 2020 (Macadamia NIS), 2016 to 2020



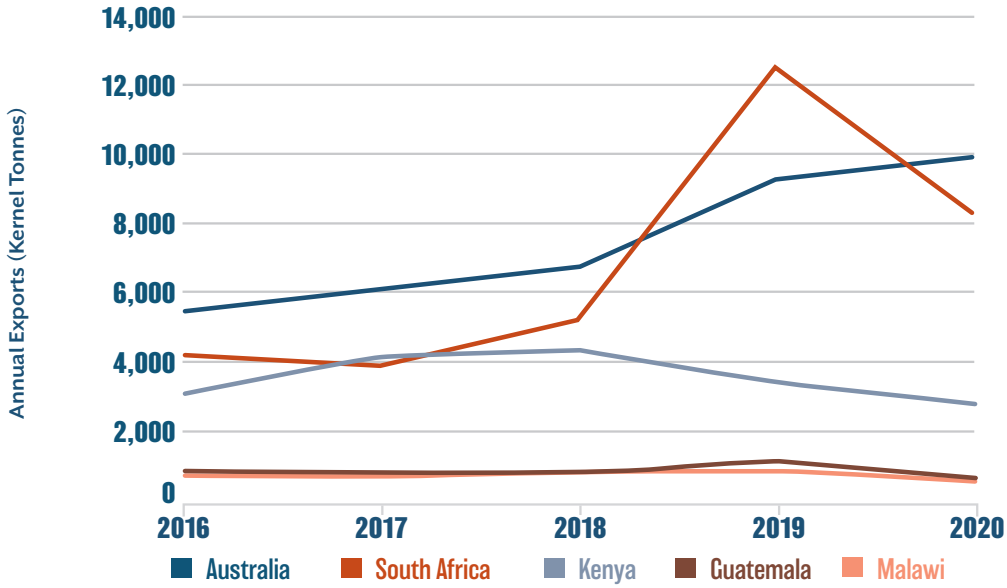
Note: Fresh Logic does not present data for Tanzania and Brazil every year.
Source: Fresh Logic (2022).

2.4.2 MACADAMIA KERNEL EXPORTS

Similar to macadamia NIS exports, Australia was the largest exporter of macadamia kernels in 2020. Australian macadamia kernel exports were estimated to total 9,896 tonnes in 2020, growing by an average annual rate of 15.8% per annum from 2016 to 2020.

The second largest exporter of macadamia kernels in 2020 was South Africa, exporting an estimated 8,334 tonnes.

Figure 2.7. Top Five Export Countries in 2020 (Macadamia Kernel), 2016 to 2020



Source: Fresh Logic (2022).

2.4.B MAJOR IMPORTERS

2.4.B.1 NIS MACADAMIA IMPORTS

In 2020, China was the largest importer of macadamia NIS with imports totalling over 18,600 tonnes. China has historically been a market for NIS, with kernel use in China still low in comparison; 95% usage of NIS, compared to 5% usage of kernel with China expected to increase kernel usage over the coming years (Australian Macadamia Society, 2021). China largely sources its' NIS from Australia (which holds majority of the market) and South Africa (see section 3.6 below for China's largest markets for macadamias).

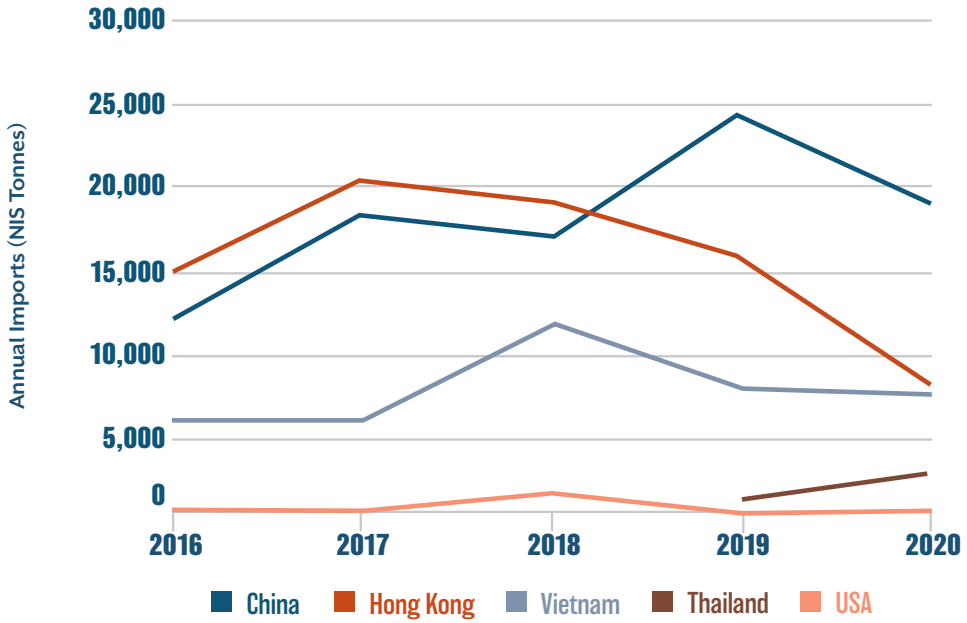
The second largest importer of macadamias NIS in 2020 was Hong Kong, with imports estimated to total 8,169 tonnes. In 2020, Hong Kong largely sourced its macadamia imports from South Africa (88% of total imports) and Mozambique (6.3% of total imports). Macadamia NIS imports to Hong Kong have been declining since 2017, decreasing by an average annual rate of 26% per annum over the three years to 2020.

Table 2.5. Largest Importers & Their Key Suppliers (2020)

Top 3 Largest Importers	Largest Supplier	Second Largest Supplier
China	Australia	South Africa
Hongkong	South Africa	Mozambique
Vietnam	South Africa	Australia

Source: Fresh Logic (2022).

Figure 2.8. Top Five Major Importers, NIS (Tonnes), 2016 to 2020



Note: Data for Thailand is not available on fresh logic from 2016 to 2019.
Source: Fresh Logic (2022).

2.4.B.2 MACADAMIA KERNEL IMPORTS

In 2020, the US was the largest importer of macadamia kernels, with imports totalling an estimated 8,826 tonnes. Approximately 42% of these imports originated from South Africa (Fresh Logic, 2022). From 2019 to 2020, macadamia kernel imports in the US declined by a little over 7,500 tonnes. Approximately 30% of this decline was attributed to the decrease in imports from South Africa over the year (2,382 tonne decline in imports from South Africa from 2019 to 2020). The Australian Macadamia Society (2021) have identified that since the impacts of COVID-19, macadamia kernel imports to the US have slightly decrease. This is largely due to an increase in domestic consumption of the Hawaiian crop (Australian Macadamia Society, 2021).

Macadamia nuts in the husk or shell are prohibited importation into the US, unless the macadamia nuts were produced in and imports from St Eustatius (DAWE, 2021), which impacts/lifts their consumption of kernel.

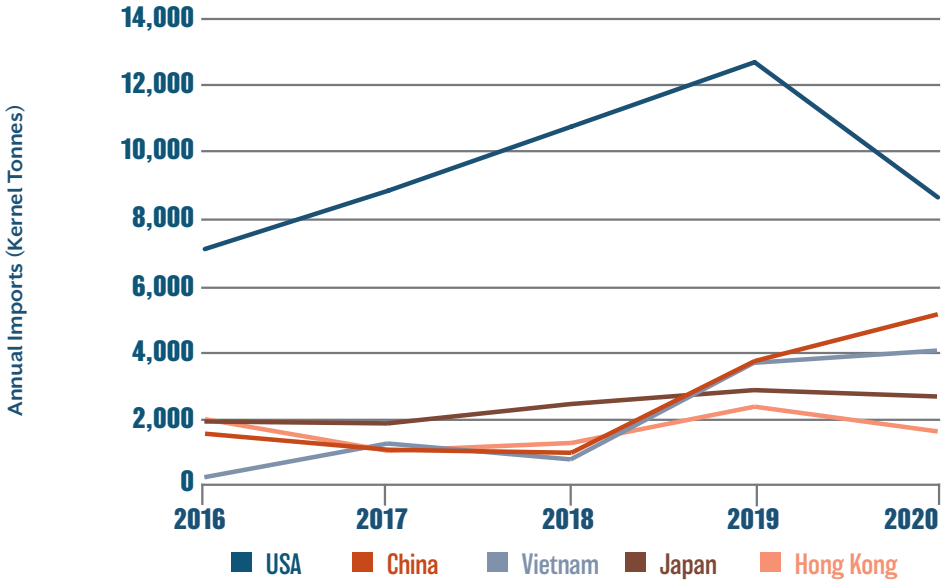
The second largest importer of macadamia kernels was China, with imports estimated at 5,391 tonnes. China's demand for macadamia kernels have experienced an increase since 2018, growing by an average annual rate of 102% per annum over a two-year period.

Table 2.6. Largest Importers & Their Key Suppliers (2020)

Top 3 Largest Importers	Largest Supplier	Second Largest Supplier
USA	South Africa	Kenya
China	Australia	South Africa
Vietnam	Uganda	South Africa

Source: Fresh Logic (2022).

Figure 2.9. Top Five Major Importers, Kernel (Tonnes), 2016 to 2020



Source: Fresh Logic (2022).

2.5 GLOBAL CONSUMPTION

In 2019, the US was the largest consumers of macadamia kernels, with total consumption estimated at 15,426 tonnes. This represented approximately 25% of total global consumption for the year.

Overall, global consumption was estimated grow by approximately 7.1% on average per annum from 2015 to reach 60,627 tonnes in 2019.

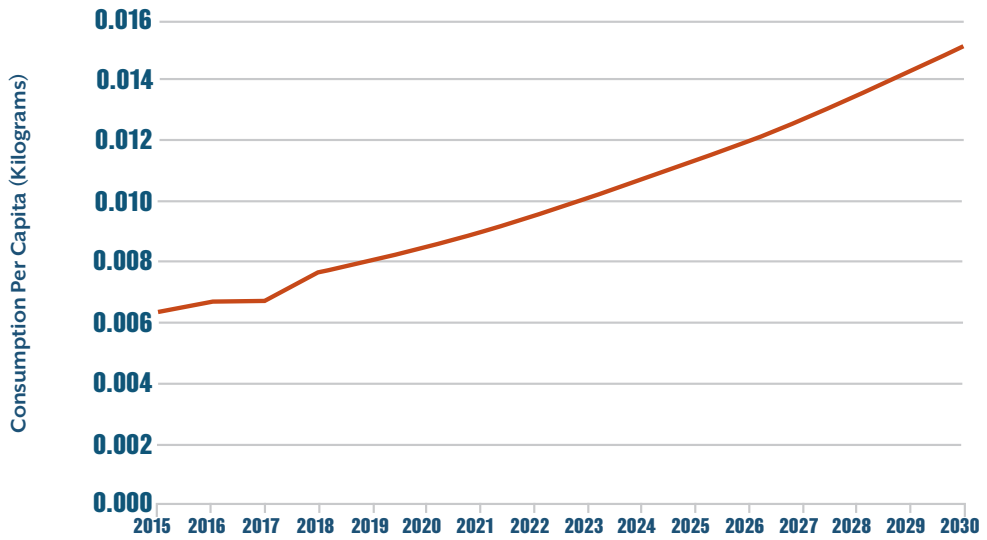
Table 2.7. Top Five Global Macadamia Kernel Consumers in 2019 (Tonnes)

Area Planted	2015	2016	2017	2018	2019
USA	12,026	8,007	10,676	13,788	15,426
China	2,186	4,055	4,131	6,455	11,033
Australia	3,255	3,374	3,204	3,999	3,448
Japan	2,331	3,233	3,116	2,772	3,160
Global Consumption	**46,038**	**49,071**	**49,914**	**57,504**	**60,627**

Source: INC (2021a).

Based on historical population and global consumption of macadamia kernels, consumption per capita has been estimated. From 2015 to 2019, consumption per capita has increased by approximately 6% on average over the four-year period. In 2019, consumption per capita was estimated to total eight grams, growing to an estimated 15 grams per capita in 2030. It has been assumed that consumption will continue to increase in line with historical growth as demand is currently strong, largely driven by a rising demand for healthier snacking options.

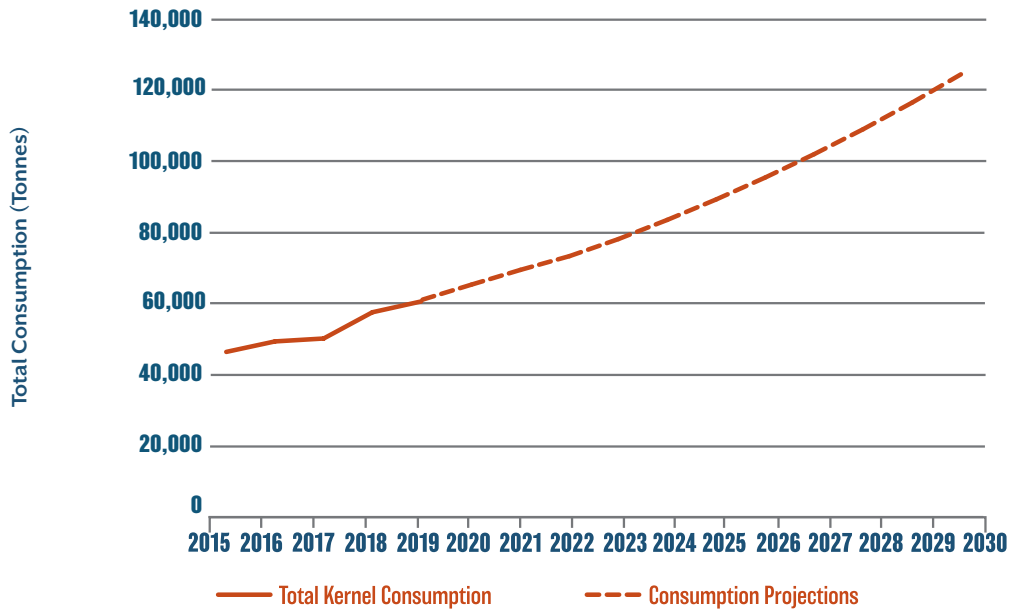
Figure 2.10. Macadamia Kernel Consumption Per Capita, 2015 to 2030



Note: The average annual growth rate from 2015 to 2019 has been applied to 2019 estimate of consumption per capita identified by INC to identify potential macadamia kernel consumption into the future.
Source: INC (2021a), IMF (2022), OECD (2022), AEC.

Projections to 2030 identify global macadamia kernel consumption has the potential to increase to approximately 124,000 tonnes.

Figure 2.11. Global Macadamia Kernel Consumption (Tonnes), 2015 to 2030



Source: INC (2021a), IMF (2022), OECD (2022), AEC.

2.6 GROWTH MARKET FOR MACADAMIAS

A key emerging market for future demand is Europe, with long-term demand projected to experience stable growth (CBI, 2021). Over the next five years, it is reported that demand for macadamia nuts in Europe will increase by an average annual rate of between 3% and 6% (CBI, 2021). The drivers of demand for macadamia are stemming from (CBI, 2021):

- A rising demand for healthier snacking options
- A demand for new experiences in consumption
- Demand from food processors for ingredient use (particularly in the use of ice cream toppings, fruit and nut bars and cereal and protein bars).

Key countries identified in the European market include Germany, Spain, United Kingdom, Italy, France, Switzerland and the Netherlands (CBI, 2021). Germany is Europe's largest importer of macadamia nuts and provides opportunities for organically certified macadamias (CBI, 2021). Together, Germany and the Netherlands represent significant transit countries for other European markets. Reports suggest that there is a shift to importing directly from production countries, with a decline in transit country imports (CBI, 2021).

Another growing market for macadamias on the global scene is South Korea. Marquis Macadamia's, which is the world's largest macadamia processing company, have highlighted sales to Korea doubled over the year to 2021 (ABC, 2021). Marquis have identified that the macadamia market in Korea is rapidly maturing, with demand stemming from the inclusion of macadamias in a wider variety of products (ABC, 2021).

3. THE AUSTRALIAN MACADAMIA INDUSTRY

3.1 CULTIVARS

According to DAF, there are in excess of 20 varieties of the two core types currently in commercial use and/or available for commercial scale developments. Each type has unique attributes, yield expectations and planting densities.

Table 3.1. Largest Importers & Their Key Suppliers (2020)

Variety	Tree Size	Nut Drop Periods
HV A4	Medium	May to August
HV A16	Small	May to November
HV A29	Large	May to July
HV A38	Medium	May to August
HV A203	Medium	Early[1]
HV A268	Medium	April to July
HAES 246	Large	May to August
HAES 344	Medium-Large	April to July in QLD; May to September in NSW
HAES 660	Medium-Large	May to June
HAES 705	Medium-Large	Very Late
HAES 741	Large	April to June
HAES 781	Very Large	Not yet Determined
HAES 783	Medium-Large	June to September
HAES 816	Medium-Large	March to June
HAES 835	Large	Early[1]
HAES 842	Medium-Large	April to September
HAES 849	Medium-Large	May to October
Daddow	Medium-Large	May to September

[1]Early, exact timing not determined.
Source: DAF (2004 c).

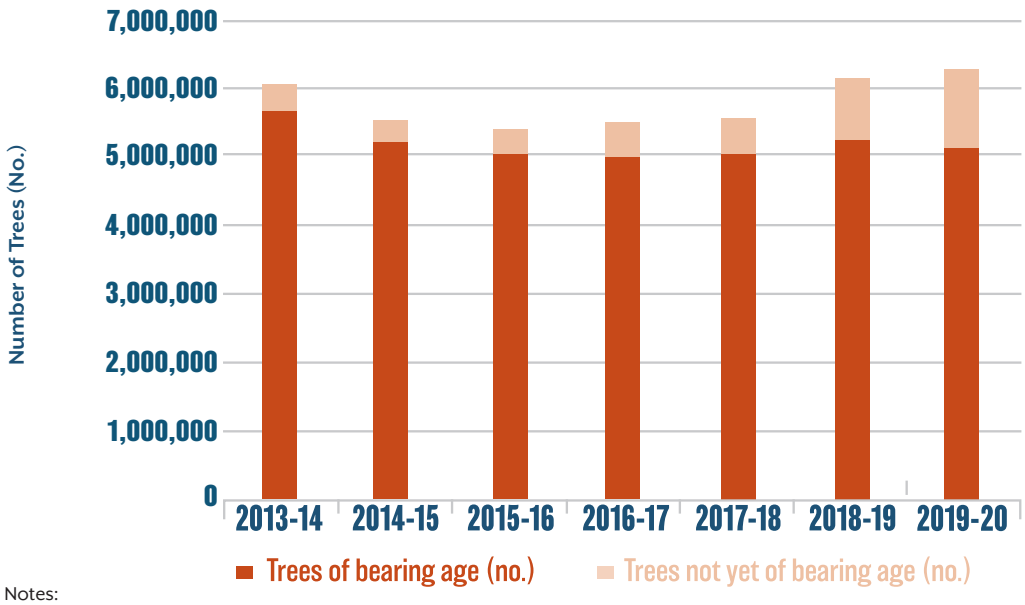
Macadamia Innovation is the industry body that delivers new varieties targeting greater sustainability and efficiency in farming yields. Australia has a strong competitive advantage in terms of its genetic research platform to improve industry productivity following significant production challenges from 2008 to 2011 as the industry adapted to emerging pest, weather and orchard management issues.

A detailed breakdown of identifying different Macadamia varieties can be found through the Queensland Department of Agriculture (DAF, 2004c).

3.2 AUSTRALIAN MACADAMIA TREES & COMPETITIVE POSITION

Over the years, Australia's macadamias have been impacted by a number of factors including pests, crop management and drought. These impacts are reflected in the figure below which highlights the estimated number of bearing and non-bearing trees in Australia over financial year 2013-14 (FY2014) to FY2020. In FY2020, the number of trees that are not yet of bearing age reached 1.2 million, which is the highest number over the seven-year analysis period.

Figure 3.1. Number of Macadamia Trees, Australia (FY2014 to FY2020)



Notes:

- Bearing = 6 yeard and over
- Non-bearing = under 6 years

Source: ABS (2021, 2020, 2019, 2018a & b, 2016, 2015).

New planting areas are experiencing significant growth with the establishment of greenfield sites in Queensland and the Clarence Valley in addition to growers maximising their holdings (Australian Macadamia Society, 2021a). The future of the macadamia industry in Australia has a positive outlook with around one quarter of the trees under cultivation yet to reach full production (Australian Macadamia Society, 2021a).

Australia has maintained a consistent yield and solid kernel recovery percentage of between 32% and 35% from 2013 to 2020 (Australia Macadamia Society, 2020). South Africa have been able to achieve similar kernel recovery rates, estimated at around 32% in 2021 (INC, 2021b). In contrast, the kernel recovery rate in the US was estimated to total 22% in 2021 (INC, 2021b). This productivity differential reflects a number of competitive advantages that Australian producers have enjoyed including (Australian Macadamia Society, 2017):

- Internationally recognised genetics and varietal development
- An industry which can demonstrate over 20 years of full compliance with all relevant standards
- A younger average age of tree across the industry
- The industry has a strong representative body, driving industry and export development
- Management and operational learnings from 2008-2011 on pest, disease and crop management including development of class leading integrated orchard management systems.

3.3 KEY GROWING AREAS

In Australia there are 6.4 million macadamia trees, with the majority concentrated in Queensland and New South Wales as stated above. Of the total macadamia trees, approximately 1.2 million are not yet of bearing age (22% of Queensland's total trees and 13% of New South Wales's total trees).

It is estimated that one third of the farms located in South-East Queensland (mostly in the Glass House Mountain areas) and a substantial portion of the farms in both Northern Rivers and Mid North Coast of New South Wales are reliant on rainfall and not irrigation (Queensland Government, 2021b). Northern New South Wales is rather volatile in production numbers compared to Queensland, due to the large number of orchards which operate as dryland.

Table 3.2. Australian Macadamia Production, 2019-20

	NSW	VIC	QLD	WA	TOTAL
Total Trees (no.)	2,519,895	17	3,833,653	250	6,353,815
Trees not yet of bearing age (no.)	321,824	4	836,153	-	1,157,980
Trees of bearing age (no,)	2,198,072	13	2,997,500	250	5,195,835
Production (t)	16,497	0[1]	26,552	0	43,048
Yield (kg/tree)	7.5	0.0	8.9	0.0	-

Notes:

- [1] ABS do not have production volumes for Victoria in 2019-20
- Bearing = 6 years and over ·
- Non-bearing = under 6 years
- Production recorded at 10% moisture content.

Source: ABS (2021).

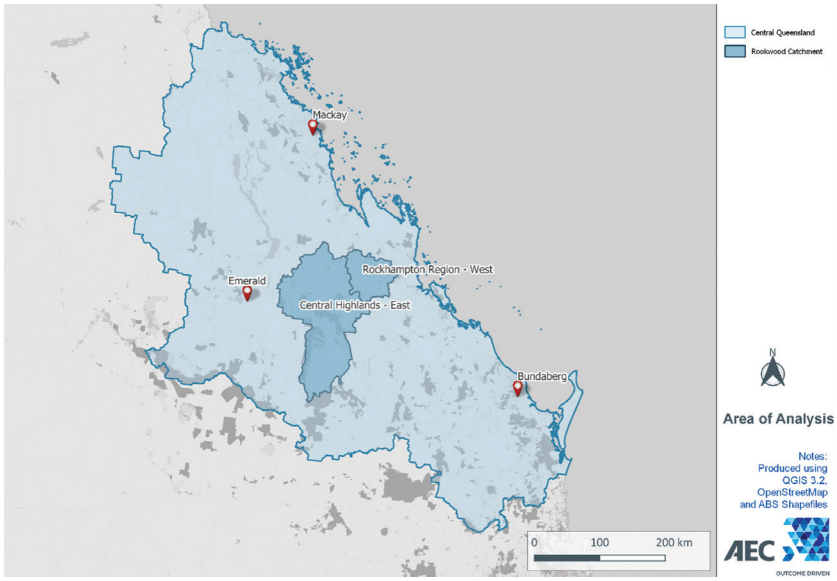
3.3.1 CENTRAL QUEENSLAND MACADAMIA PRODUCTION

Within Central Queensland, macadamias are largely grown in the Bundaberg region. Bundaberg provides key macadamia growing conditions including temperature, good soil, flat land, and good water availability (Bundaberg Today, 2021). Although Bundaberg is the main growing region within Central Queensland, Rockhampton is also home to several macadamia farms. The map below highlights the Rookwood Weir Catchment Area and the Central Queensland region, which stretches as far north as Whitsunday and as far south as Gympie.

According to the Macadamia Industry Benchmark Report (Queensland Government, 2021b), Central Queensland has the youngest average tree age of 15 years, compared to the other major growing regions highlighted in the study. Central Queensland also includes some young farms which are yet to reach full maturity. This highlights that macadamia production in the Central Queensland region is likely to increase in the near future, with more tress beginning to mature. Due to the young trees, the region has an opportunity to grow yield productivity in the coming years, supporting domestic production and export quantities.

Throughout the coming years, Central Queensland may provide a key hotspot for macadamia production. Rockhampton is a suitable growing region with agricultural communities, affordable land, and suitable soil conditions (CQ Today, 2021).

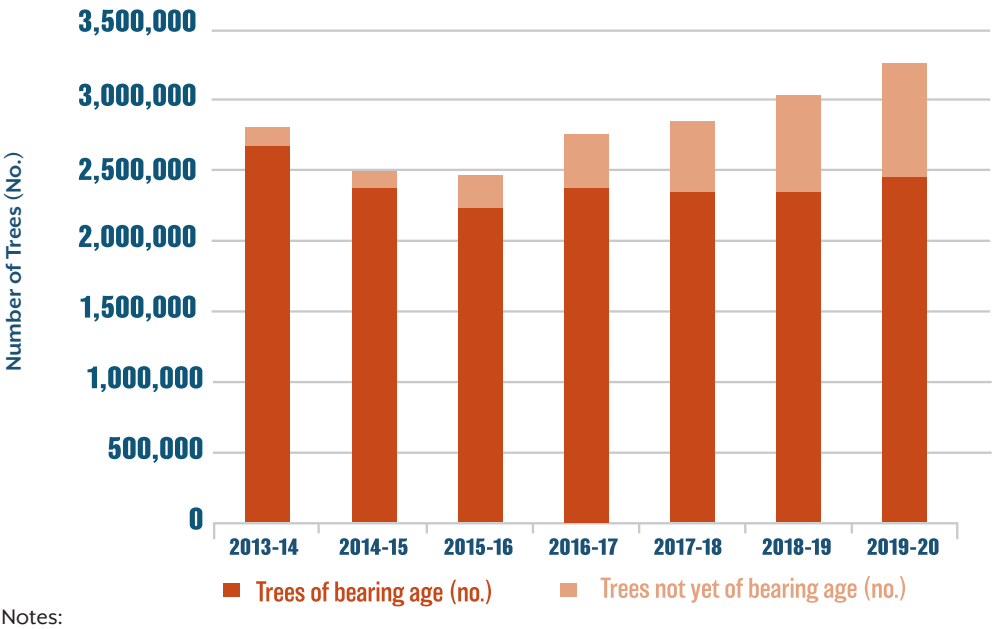
Figure 3.2. Rookwood Weir Catchment Area and Central Queensland



Source: AEC

Macadamia production is prominent throughout the broader Central Queensland region with approximately 2.4 million trees of bearing age and an additional 812,906 trees which are not yet of bearing age.

Figure 3.3. Number of Macadamia Trees in Central Queensland



Notes:

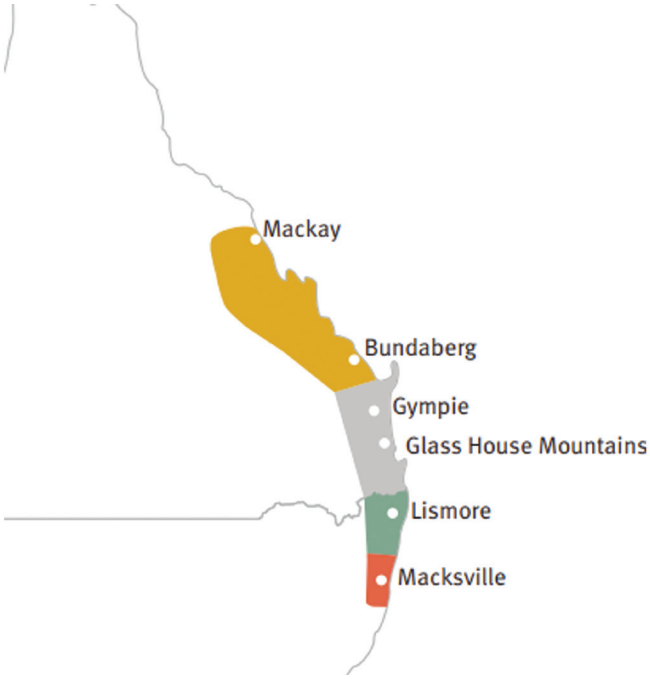
- Bearing = 6 years and over
- Non-bearing = under 6 years

Source: ABS (2021, 2020, 2019, 2018a & b, 2016, 2015).

3.4 FUTURE PRODUCTION

A macadamia industry benchmark report released by the Queensland Government (2021), provides benchmark data including yield, quality and planting information for Central Queensland, South-East Queensland, Northern Rivers (NSW) and Mid North Coast (NSW). These production regions have been highlighted in the figure below.

Figure 3.4. Benchmark Data Regions



Source: Queensland Government (2021b).

Based on information provided by DAF (highlighted in the table below), it is estimated that the benchmark region (identified in Figure 3.4) has approximately 11,386ha of macadamias in 2021 (including 457 hectares with trees aged 40 years and over). The total hectares by tree age have been utilised in forecasting Australia's future production of macadamias to the year 2030. Projections were first developed for the benchmark region, then extrapolated to include Australia wide production.

As trees begin to age and mature, there are changes in yield volumes and productivity (as shown in Table 3.4). DAF have highlighted that the average life of a macadamia tree is 30 years, however, consultation with the Department has identified trees can provide yield for a longer period. Extending orchard life largely comes down to orchard management practices, such as pruning to ensure a sufficient volume of light is reaching the orchard.

Due to consultation with DAF and industry benchmarks, it has been assumed that from year 40 onwards, macadamia trees have been identified as being unproductive and are assumed to not provide yield. The productive hectares which are at 39 years, are assumed to be replanted in following year to replace the older non-bearing hectares. However, depending on orchard management practices, new replacement plantings may occur at an earlier age (approximately four years before the end of useful life) to ensure there are an appropriate number of bearing hectares to replace the older, non-yielding hectares.

Over the analysis period until 2030, it has been assumed that 1,424ha will be listed as unproductive and subsequently will be replanted within the benchmark region, resulting in an unchanged volume of total hectares from 2021 to 2030. Although hectares are assumed to remain unchanged, there will be variances in yield productivity as trees begin to mature. Yield productivity by hectare and tree age are presented in Table 3.4 below, highlighting an increase in yield as trees mature. This yield productivity by hectare and age grouping has been applied to the volume of hectares by age listed in Table 3.3 below. This provides an estimate of macadamia production in the benchmark region.

Table 3.3. Benchmark Regions Macadamia Production Area (Ha), 2021 to 2030

Tree Age	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
0	805	142	132	62	130	82	62	76	251	488
1	821	805	142	132	62	130	82	62	76	251
2	326	821	805	142	132	62	130	82	62	76
3	522	326	821	805	142	132	62	130	82	62
4	342	522	326	821	805	142	132	62	130	82
5	239	342	522	326	821	805	142	132	62	130
6	125	239	342	522	326	821	805	142	132	62
7	129	125	239	342	522	326	821	805	142	132
8	35	129	125	239	342	522	326	821	805	142
9	54	35	129	125	239	342	522	326	821	805
10	41	54	35	129	125	239	342	522	326	821
11	43	41	54	35	129	125	239	342	522	326
12	409	43	41	54	35	129	125	239	342	522
13	397	409	43	41	54	35	129	125	239	342
14	678	397	409	43	41	54	35	129	125	239
15	564	678	397	409	43	41	54	35	129	125
16	725	564	678	397	409	43	41	54	35	129
17	326	725	564	678	397	409	43	41	54	35
18	206	326	725	564	678	397	409	43	41	54
19	211	206	326	725	564	678	397	409	43	41
20	245	211	206	326	725	564	678	397	409	43
21	276	245	211	206	326	725	564	678	397	409
22	357	276	245	211	206	326	725	564	678	397
23	347	357	276	245	211	206	326	725	564	678
24	130	347	357	276	245	211	206	326	725	564
25	174	130	347	357	276	245	211	206	326	725
26	131	174	130	347	357	276	245	211	206	326
27	117	131	174	130	347	357	276	245	211	206
28	472	117	131	174	130	347	357	276	245	211
29	192	472	117	131	174	130	347	357	276	245
30	64	192	472	117	131	174	130	347	357	276
31	488	64	192	472	117	131	174	130	347	357
32	251	488	64	192	472	117	131	174	130	347
33	76	251	488	64	192	472	117	131	174	130
34	62	76	251	488	64	192	472	117	131	174
35	82	62	76	251	488	64	192	472	117	131
36	130	82	62	76	251	488	64	192	472	117
37	62	130	82	62	76	251	488	64	192	472
38	132	62	130	82	62	76	251	488	64	192
39	142	132	62	130	82	62	76	251	488	64
Total	**10,929**	**10,929**	**10,929**	**10,929**	**10,929**	**10,929**	**10,929**	**10,929**	**10,929**	**10,929**

Source: DAF (unpublished), AEC.

Table 3.4. Benchmark Regions Macadamia Production Area (Ha), 2021 to 2030

Year	Tonnes (NIS)
5-7	1.27
8-9	1.88
10-14	2.43
15-19	2.65
20-24	2.83
25-29	2.94
30-34	2.97
35+	2.85

Source: Queensland Government (2021b).

The proportion of production by tree age for the benchmark region in 2021 was applied to the total production volumes in Australia (51,500 tonnes) to extrapolate the benchmark data for an estimate of total Australian production by tree age. The average production growth rate by tree age for the benchmark region was then applied to the estimated 2021 Australian figures resulting in an estimated future production volume from 2022 to 2030 (as highlighted in the table below).

Macadamia production is projected to increase year on year from 2021 to 2029, decreasing slightly in 2030 to total an estimated 63,198 tonnes. This decrease is reflective of productive hectares reaching the end of their useful life and being replaced by younger trees with lower yield.

Macadamia Society Australia have provided an indication that macadamia production in 2030 is estimated to total around 70,000 tonnes (Queensland Country Life, 2021a). Based on the industry forecast (in Table 3.5 below) and 5–7-year age profile of the trees, Australia would require an additional 5,356ha of macadamia orchards developed within the next 24 months.

The industry forecast estimate provided below does not include the additional 5,000ha, which are proposed to be planted by Rural Funds Management as part of their expansion program (RFM, 2021). If these additional hectares of macadamia orchards are developed, production is estimated to increase by 6,350 tonnes in 2030. This would equate to a total estimated production volume in 2030 approximately 70,000 tonnes. This production could potentially double if the available land in the Rookwood Weir was fully utilised, but this volume is unlikely to contribute to any increase in production volumes prior to 2030.

Table 3.5 Australia Macadamia NIS Production by Tree Age (Tonnes), 2021 to 2030

Tree Age (Years)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
0	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-
5	731	1,046	1,597	998	2,513	2,463	434	404	189	396
6	381	731	1,046	1,597	998	2,513	2,463	434	404	189
7	396	381	731	1,046	1,597	998	2,513	2,463	434	404
8	158	586	564	1,083	1,548	2,364	1,477	3,719	3,646	642
9	243	158	586	564	1,083	1,548	2,364	1,477	3,719	3,646
10	239	315	205	758	729	1,399	2,001	3,056	1,909	4,808
11	254	239	315	205	758	729	1,399	2,001	3,056	1,909
12	2,395	254	239	315	205	758	729	1,399	2,001	3,056
13	2,322	2,395	254	239	315	205	758	729	1,399	2,001
14	3,972	2,322	2,395	254	239	315	205	758	729	1,399
15	3,601	4,332	2,532	2,611	277	261	343	223	826	795
16	4,630	3,601	4,332	2,532	2,611	277	261	343	223	826
17	2,084	4,630	3,601	4,332	2,532	2,611	277	261	343	223
18	1,314	2,084	4,630	3,601	4,332	2,532	2,611	277	261	343
19	1,348	1,314	2,084	4,630	3,601	4,332	2,532	2,611	277	261
20	1,672	1,440	1,403	2,226	4,945	3,846	4,626	2,704	2,789	295
21	1,878	1,672	1,440	1,403	2,226	4,945	3,846	4,626	2,704	2,789
22	2,437	1,878	1,672	1,440	1,403	2,226	4,945	3,846	4,626	2,704
23	2,367	2,437	1,878	1,672	1,440	1,403	2,226	4,945	3,846	4,626
24	889	2,367	2,437	1,878	1,672	1,440	1,403	2,226	4,945	3,846
25	1,236	924	2,459	2,532	1,951	1,737	1,496	1,458	2,312	5,137
26	927	1,236	924	2,459	2,532	1,951	1,737	1,496	1,458	2,312
27	831	927	1,236	924	2,459	2,532	1,951	1,737	1,496	1,458
28	3,342	831	927	1,236	924	2,459	2,532	1,951	1,737	1,496
29	1,363	3,342	831	927	1,236	924	2,459	2,532	1,951	1,737
30	457	1,377	3,376	840	937	1,249	933	2,484	2,558	1,971
31	3,493	457	1,377	3,376	840	937	1,249	933	2,484	2,558
32	1,795	3,493	457	1,377	3,376	840	937	1,249	933	2,484
33	544	1,795	3,493	457	1,377	3,376	840	937	1,249	933
34	445	544	1,795	3,493	457	1,377	3,376	840	937	1,249
35	560	427	522	1,723	3,351	439	1,321	3,240	806	899
36	890	560	427	522	1,723	3,351	439	1,321	3,240	806
37	425	890	560	427	522	1,723	3,351	439	1,321	3,240
38	906	425	890	560	427	522	1,723	3,351	439	1,321
39	974	906	425	890	560	427	522	1,723	3,351	439
Total Production	**51,500**	**52,315**	**53,640**	**55,125**	**57,694**	**61,006**	**62,278**	**64,191**	**64,597**	**63,198**
Production Change		**+815**	**+1,324**	**+1,485**	**+2,569**	**+3,312**	**+1,272**	**+1,913**	**+406**	**-1,399**

Source: Queensland Government (2021b), DAF (unpublished), AEC.

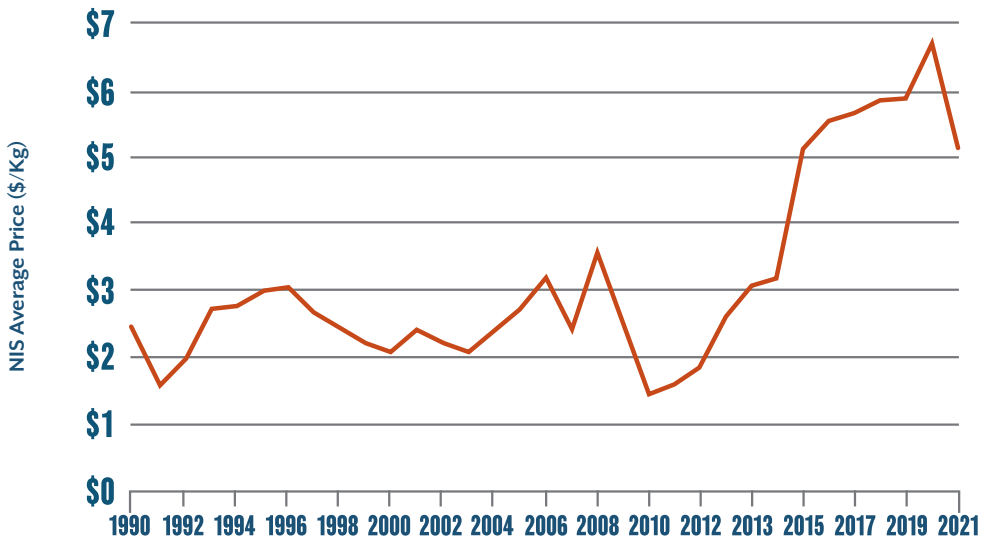
3.5 MACADAMIA PRICES IN AUSTRALIA

The prices in the figure below are based on shell receipts supplied by the Australian Macadamia Handlers Association, which represents 90% of production in Australia (Australian Macadamia Society, 2020). The prices reflect the average NIS price paid to growers, based on the total amount paid to purchase NIS, excluding GST but including all subsidies/ bonuses and freight (Australian Macadamia Society, 2020).

For the 2019-20 season, it was estimated that macadamia prices averaged approximately $6.65 per kilogram. From 1990 to 2010 prices were relatively low, increasing from 2010 onwards which displays a distinct and positive growth trajectory.

Information from Marquis Macadamias suggest that at a 33% total kernel recovery (TKR), NIS prices are estimated to total $5.10 per kilogram. This price is not inclusive of bonuses/freight subsidies, which are estimated to total $0.03 per kilogram NIS for a 0-50km radius from depot, growing to $0.06 per kilogram of NIS for a 100km+ radius from depot. This price also does not include quality bonus for reject recovery, which is estimated to total $0.24 per kilogram at 3% reject kernel recovery (RKR).

Figure 3.5. Average Price, $/kg (Macadamia NIS)



Note:

- The prices are reflective of macadamias at 10% moisture. This average price does not include contract processed.
- From 1990 to 2012 prices are indicative based on 33% sounds kernel recovery.
- 2021 price estimates exclude bonuses/freight subsidies (including quality bonus for reject recovery).

Source: Australian Macadamia Society (2020), Marquis Macadamias (2021).

Although 2021 prices are expected to be lower than the peak in 2020, these prices still provide the grower with the ability to make a profit (ABC, 2021). These prices are above the long-term average of $3.20 per kilogram over the 33-year historical period.

The price outlook for 2022 season is lower as result of exchange rate movements and transport costs with the expected final price being between in the range of $5.10 to $5.42 including incentive payments. For the Central Queensland region, prices will be lower with the range being between $4.95 and $5.21 as a result of historically lower than target kernel recovery ratio and higher than target rejection rates.

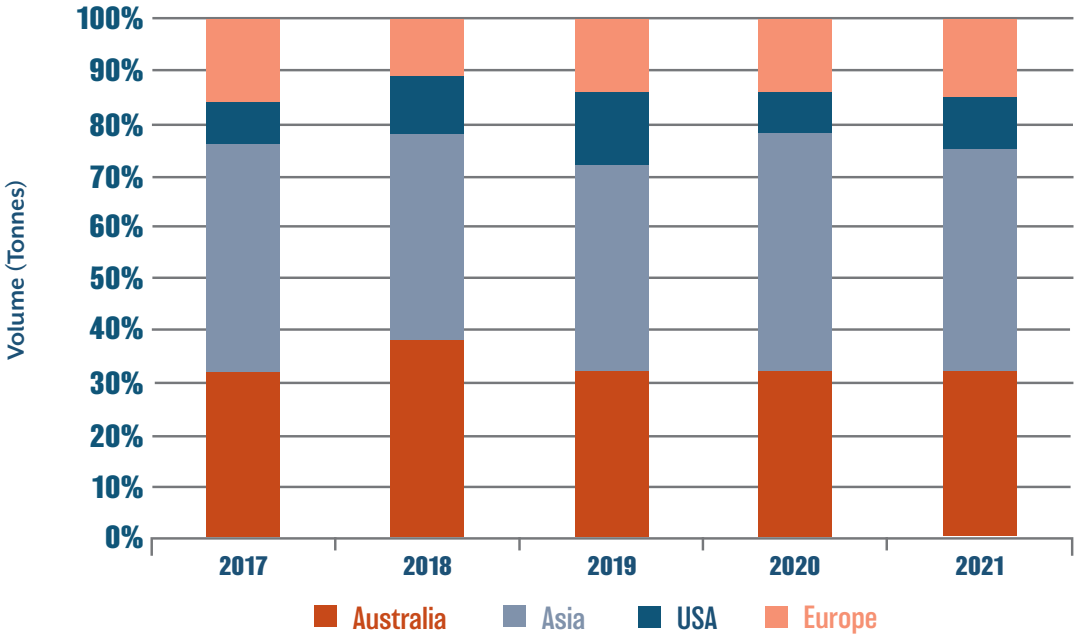
The US Federal Reserve are preparing to raise interest rates over the coming years resulting in a lower exchange rate, with Australia largely 12-18 months behind major advanced economies (Financial Review, 2022). As a result, it is likely there will be increased price pressure in Australia due to the falling exchange rates (due to interest rate differentials) until interest rates equalise.

The financial analysis contained in section 7 provides more detail on price expectations for the Central Queensland region.

3.6 AUSTRALIA'S KEY MARKETS

Domestic consumption of Australian macadamia's has remained relatively steady from 2019 to 2021, with 32% of domestic production destined for the domestic market. Asia has historically been Australia's largest export market for macadamias, accounting for 43% of Australia's total kernel sales by volume in 2021. This was followed by the USA, which accounted for approximately 10% of Australia's total kernel sales.

Figure 3.6. Australian Kernel Sales Distribution by Area (Volume)



Note: Financial Year.
Source: Australian Macadamias Society (2021).

Table 3.6 highlights a breakdown of Australia's top three largest export markets for macadamia's (both kernel and NIS) in 2020. China was Australia's largest market for macadamias, largely importing macadamias NIS from Australia.

Table 3.6. Australia's Top 3 Key Export Markets in 2020

Country	2020	Proportion of Exports (%)	Value of Exports ($M)
Macadamia Kernels			
China	5,247	50%	$34.9
Japan	1,889	18%	$12.6
USA	961	9%	$6.4
Macadamia (NIS)			
China	11,634	78%	$77.4
Vietnam	3,190	21%	$21.2
Hong Kong	100	1%	$0.7

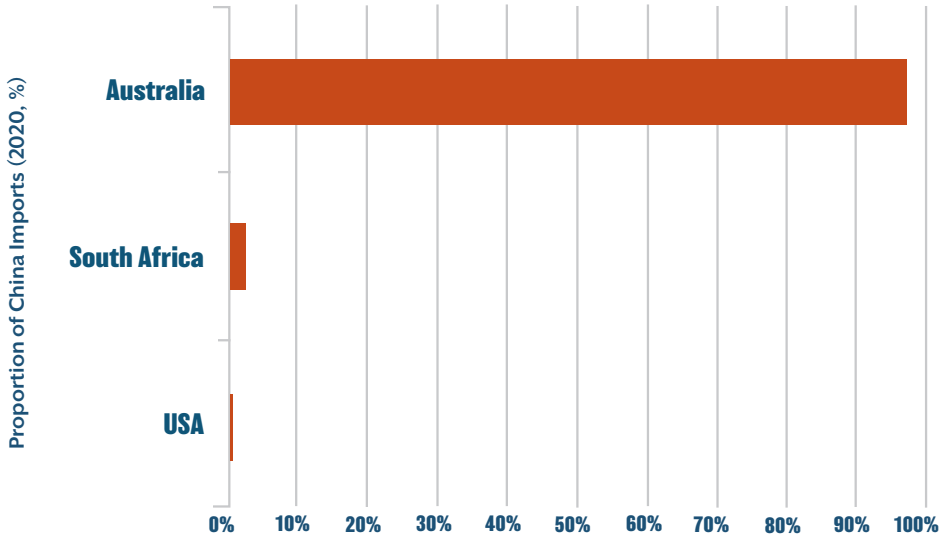
Note: Value of exports were estimated based on 2020 pricing of $6.65 per kilogram.
Source: Fresh Logic (2022).

3.6.1 CHINA

Both Australia and China are reliant on each other for macadamia trade. China is Australia's largest export market and Australia is China's largest import market (for both kernels and NIS). For macadamia kernel imports into China, Australia was by far the largest supplier, supplying 97.3% of total imports in 2020.

The second largest source of macadamia kernels in China were from South Africa, accounting for 2.3% of total imports in 2020.

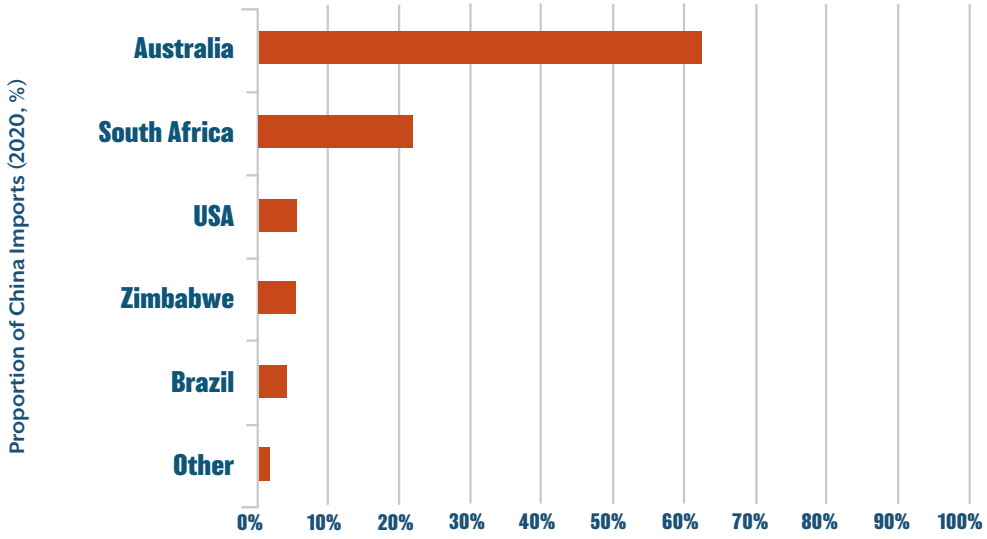
Figure 3.7. Macadamia Kernel Imports to China, 2020



Source: Fresh Logic (2022).

Figure 3.8 highlights China's macadamia NIS imports in 2020. China is largely reliant on Australia for the import of NIS, accounting for 66.3% of their total imports in 2020. China's second largest source for NIS was South Africa, accounting for 22.0% of imports in 2020.

Figure 3.8. Macadamia NIS Imports to China, 2020

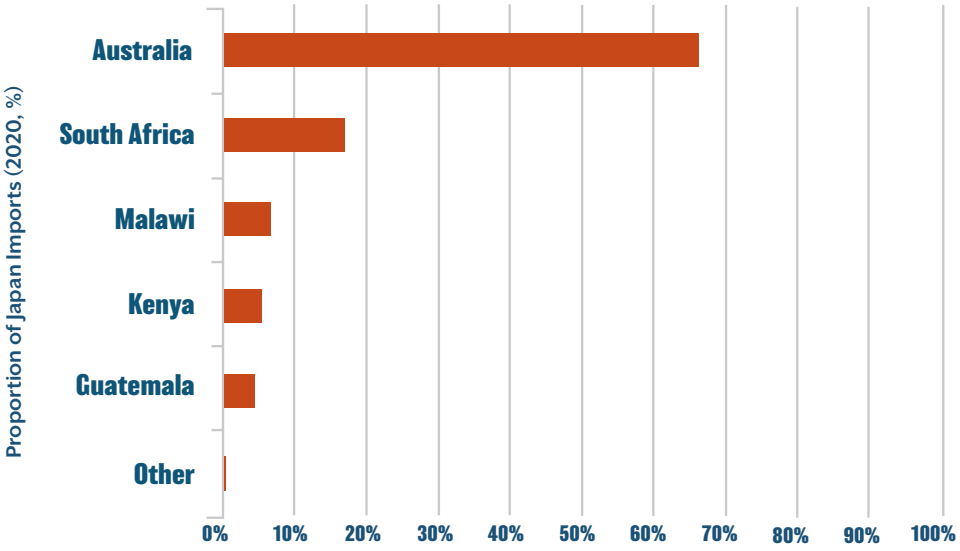


Source: Fresh Logic (2022).

3.6.2 JAPAN

In 2020, Australia exported approximately 1,889 tonnes of macadamia kernels to Japan. The figure below identifies that Japan is largely reliant on Australia for the import of macadamia kernels. In 2020, it was estimated that Australian macadamia kernel imports to Japan accounted for approximately 66.2% of the country's total macadamia kernel imports.

Figure 3.9. Macadamia Kernel Imports to Japan, 2020

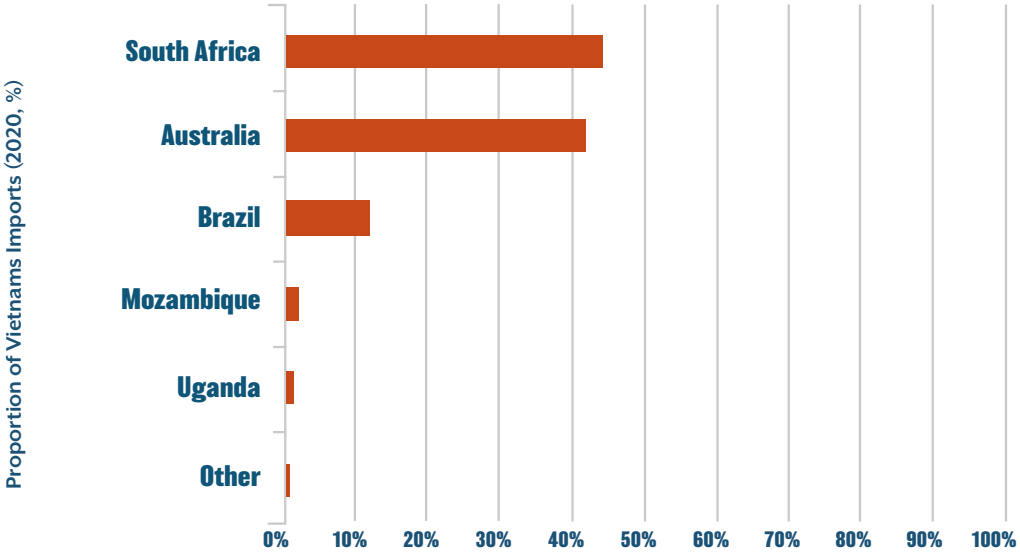


Source: Fresh Logic (2022).

3.6.3 VIETNAM

In 2020, Australia exported approximately 3,190 tonnes of macadamia NIS to Vietnam. In 2020, the largest import market for macadamia NIS to Vietnam was South Africa, accounting for approximately 43% of all macadamia NIS imports. In 2020, Australian NIS imports to Vietnam accounted for approximately 42% of the country's total NIS imports.

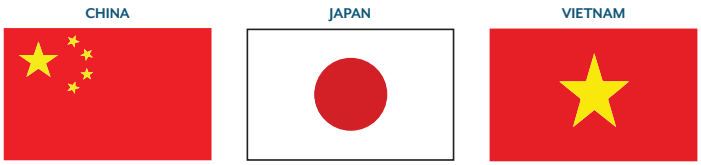
Figure 3.10. Macadamia NIS Imports to Vietnam, 2020



Source: Fresh Logic (2022).

4. MARKET VIABILITY ANALYSIS

The three key markets for Australia that were identified in section 3.6 above include:



This following section provides a snapshot of each key market that has been identified for Macadamias. This snapshot includes:

- Market depth and maturity
- Market access considerations (access to Free Trade Agreements)
- Production seasonality and import competition
- Economic strength, market growth and consumer capacity to pay.

4.1 CHINA

China has historically been Australia's largest market for macadamia exports, with Australia exporting 5,247 tonnes of macadamia kernels and 11,634 tonnes of NIS in 2020. Currently, China is a market for NIS macadamias, with usage of kernels at 5% and usage of NIS at 95% (Australian Macadamia Society, 2021). Although kernel use in China is relatively low, this market is expected to increase over the coming years (Australian Macadamia Society, 2021).

Population & 2050 Forecast

2021: 1.44 billion
2050: 1.40 billion

GDP

2020: $10,4511 per capita (USD)
2026: $17,493 per capita (USD)

Macadamia Production Area & Forecast

2020: 240,000ha
2030: 300,000ha

Macadamia Production & Forecast (NIS)

2020: 30,400 tonnes
2025: 450,000 tonnes

Source: OECD (2022), Pacific Nut Producer (2020), (Green and Gold Macadamias, 2018), INC (2021a & b) World Bank (2022), Statista (2022).

MARKET ACCESS CONSIDERATION

- China and Australia have been trading partners for a number of years and have established agreements for many commodities. Free trade agreements (FTAs), which have eliminated tariffs for macadamia imports include ChAFTA and more recently RCEP
- China has established supply chains due to its significant volume of global trade
- China has a 24% tariff for shelled macadamias imported from both South Africa and the US. Shelled macadamia tariffs do not exist for Australia under the FTA, presenting a key future market for Australia
- Like the US, China has the capacity to weaponise trade issues including market access when in dispute with a country. Recent regional disagreements between Australia and China have seen the beef, wine and wellness industries impacted by either increased costs or removal of market access. Often this action is focused on industries where a cost-effective alternative supply opportunity is available.

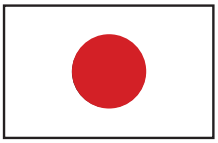
PRODUCTION SEASONALITY AND IMPORT COMPETITION

In 2020 Australia was the dominant supplier of macadamias to China, followed by South Africa and the US. Both Australia and South Africa have similar growing season, spanning from around February/March to August (Agrifutures undated; Fresh Plaza 2021b). The US, in particular Hawaii, has different supply windows for macadamias. In Hawaii, macadamias are harvest from July to March each year (AGMARC, undated). Australia has a competitive advantage in China for the supply of macadamia nuts, largely due to proximity to market and subsequently transport cost advantages.

Currently China is the third largest producer of macadamias with production totaling an estimated 32,000 tonnes of NIS. China is also the largest importer of macadamias, with domestic demand exceeding current domestic productionThe USDA (2019) have identified that China will soon become a net exporter of macadamia nuts. China is Australia's largest export market for macadamias and the country is largest reliant on Australian imports to meet domestic demand. However, if the projected growth in macadamia production throughout China is realised (which is largely concentrated in the Yunnan province) and production quality improves, then Australian macadamia demand in China will most likely fall in the future and alternative markets will need to be developed.

Trade Stability	Unfavorable		Favorable
Wage Growth	Unfavorable		Favorable
Macadamia Demand & Import Risk	Unfavorable		Favorable

4.2 JAPAN



In 2020, Japan was the fifth largest importer of macadamia kernels with Australia being the primary supply market to satisfy demand. Unlike China, Japan is largely a market for macadamia kernel with a significant volume of value-adding being undertaken domestically (Deloitte, 2017). Historically, Japan has mostly utilised macadamias as an ingredient (for example in ice-cream and chocolate confectionary) (Australian Macadamia Society, 2021). However, over recent years, Japan has expanded into snacking particularly with premium nut mixes and increased use in bakery products (Australian Macadamia Society, 2021).

Population & 2050 Forecast

2021: 124.8 million
2050: 101.9 million

GDP

2020: $40,087 per capita (USD)
2026: $51,797 per capita (USD)

Macadamia Kernel Usage

Snack: 50%
Ingredient: 40%
Food Service: 10%

In 2020, Australian macadamia kernel imports to Japan accounted for approximately 66.2% of the total macadamia kernel imports.

Source: OECD (2022), Australian Macadamia Society (2021), World Bank (2022), Statista (2022).

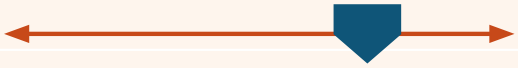
MARKET ACCESS CONSIDERATION

- Japan and Australia have been trading partners for a number of years and have established agreements for many commodities. FTAs, which have eliminated tariffs for macadamia imports, include CPTPP, JAEPA and RCEP
- The section below identifies Japan's top five largest markets for macadamia kernel supply. Tariff implications for the top suppliers are as follows:
  - Australia: 0%
  - South Africa: 2.5%
  - Malawi: 0%
  - Kenya: 2.5%
  - Guatemala: 2.5%

PRODUCTION SEASONALITY AND IMPORT COMPETITION

In 2020 Australia was the dominant supplier of macadamias to Japan, followed by South Africa. Both Australia and South Africa have similar growing season, spanning from around February/March to August (Agrifutures undated; Fresh Plaza 2021b). Australia has a competitive advantage in Japan for the supply of macadamia nuts, largely due to proximity to market and subsequently transport cost advantages. Another key advantage for Australia is the benefit of no import tariffs, while its second biggest competitor, South Africa, is subject to tariffs.

In 2019, Japan was Australia's second largest two-way trading partner (DFAT, 2020). Australia's competitive position in Japan has increased significantly over the years with the introduction of FTAs, eliminating all tariffs on many commodities including macadamia nuts. Japan is solely reliant on macadamia imports, with Australia being in a strong position to continue supplying quality macadamia nuts to Japan into the future.

Trade Stability	Unfavorable		Favorable
Wage Growth	Unfavorable		Favorable
Macadamia Demand & Import Risk	Unfavorable		Favorable

4.3 VIETNAM

Vietnam is the world's eighth largest producer of macadamias in 2021, producing an estimated 6,700 tonnes of macadamias NIS. Vietnam is seeking to expand their current production of macadamias, increasing the total planted area to 50,000ha in 2025 and 100,000 hectares by 2030 (Reuters, 2020).

In 2020, NIS imports from South Africa accounted for approximately 43% of Vietnam's total imports for the year. This was followed by Australia who accounted for approximately 42% of Vietnams total imports for the year. This was estimated to total an export value of $21.2 million for Australia, representing a significant market in global trade.

Population & 2050 Forecast

2021: 98.3 million
2050: 107.5 million

GDP

2020: $3,523 per capita (USD)
2026: $6,149 per capita (USD)

Income Growth Aims:

2025: Middle-income country
2030: Upper-income country
2045: High income country

Macadamia Production Area

2025: 50,000ha
2030: 100,000ha

Note: Population forecasts have been estimated based on population projections by IMF and OECD.
Source: IMF (2022), OECD (2022), Reuters (2020), Statista (2022), GOV UK (2021).

MARKET ACCESS CONSIDERATION

- Under the RCEP FTA, which entered into force on the 1st of January 2022, tariffs for Australian macadamia NIS will see a decrease over the years. The current tariff stands at 27% and is expected to decrease by 3 percentage points each year to reach 0% from 2031 onwards.
- South Africa, which is one of Vietnams largest sources of macadamias, does not have an FTA in place with Vietnam for macadamia trade. South Africa is classified as a most favoured nation, in which a 30% tariff applies.

PRODUCTION SEASONALITY AND IMPORT COMPETITION

In 2020 South Africa was the dominant supplier of NIS to Vietnam, followed by Australia. Uganda and South Africa were the biggest suppliers of macadamia kernels to Vietnam in 2020.Both Australia and South Africa have similar growing season, spanning from around February/March to August (Agrifutures undated; Fresh Plaza 2021b).

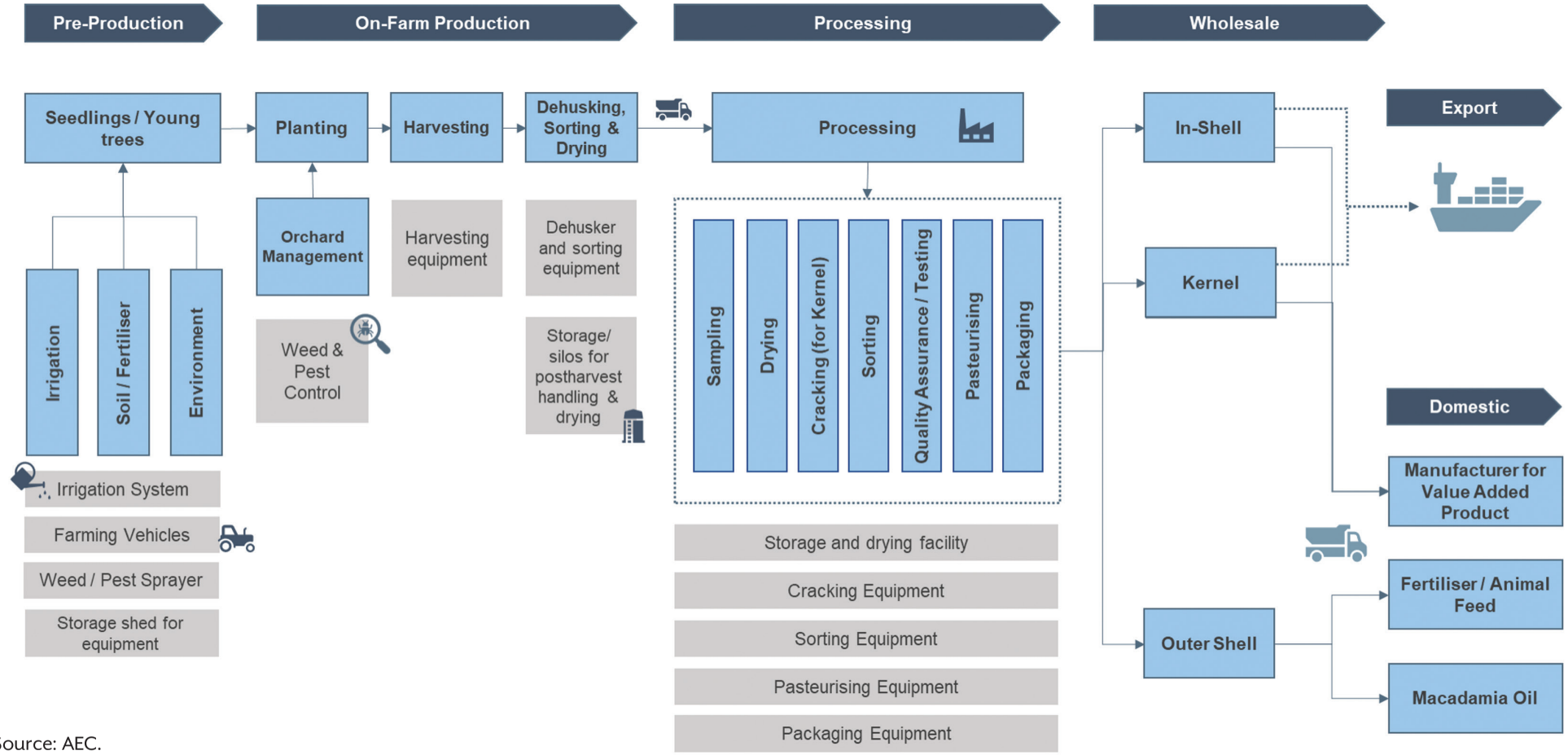
Australia has a cost advantage due to proximity to market, with lower transport costs compared to South Africa. Another competitive advantage for Australia is the cost savings associated with the proposed decline in tariff rates over the coming years. Australia's position as the second largest market for macadamias NIS and the decreasing tariff rate under the FTA, places Australia in a strong position to become the favoured macadamia supplier into Vietnam.

Trade Stability	Unfavorable		Favorable
Wage Growth	Unfavorable		Favorable
Macadamia Demand & Import Risk	Unfavorable		Favorable

5. MACADAMIA SUPPLY CHAIN ANALYSIS

The figure below introduces a high-level supply chain analysis to investigate the activities and processes used to supply macadamias within the Central Queensland region (refer to Figure 5.1). It is important to understand this process to identify potential industry constraints or opportunities for the region at each point of the supply chain.

Figure 5.1. Macadamia Macadamias - High-Level Supply Chain



Source: AEC.

At the end of the supply chain, three major products are produced for wholesale. These are NIS, kernel or value add products like macadamia nut oil.

The below analysis will focus on the infrastructure and equipment requirements required at each point of along the supply chain. Growing conditions and orchard management practices are outlined in Appendix A.

PRE-PRODUCTION

- Pre-production refers to the tasks and infrastructure associated with orchard establishment, prior to the planting of macadamias trees. According to the Queensland Government's Macadamia grower's handbook (2004), essential infrastructure and equipment to set up a macadamia orchard include:
- An irrigation system including a dam, piping and under-tree sprinklers
- Soil and fertiliser (and fertiliser spreader)
- Weed and pest sprayers, and safety equipment
- Storage shed for farm chemicals
- Farming vehicles, which includes a large tractor to operate spray (and harvesting) equipment, and a heavy duty trailer.

While the majority of activities will not generally require Council approval if the land is zoned for rural activities and agriculture, Council approval for the clearing of land and the construction of buildings for on-farm operations (such as a storage and production facilities) may be required.

ON-FARM PRODUCTION

Once planted, macadamia trees generally start to bear after four to five years. Macadamias are ripe when their husks begin to dry out, and gradually change from green to brown. Fully grown nuts will drop to the ground when they are ready for harvest. The figure below highlights the macadamia lifecycle from tree to kernel.

Figure 5.2. Macadamia Life Cycle

Source: Australian Macadamia Society (2021c).

Growers will then harvest macadamias using harvesters (refer to Figure 5.3), generally attached to tractors and contain finger wheels to collect the nuts from the ground.

Figure 5.3. Macadamia Harvesters

Source: Lismore Engineering.

Queensland's harvest season begins in February and spans to July, with August being the latest month to harvest. The harvest in New South Wales begins slightly later in March and spanning to August, with the end of the harvest season generally September.

Table 5.1. Macadamia Harvest Season by State (Kernel)

State	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
NSW	H	H	E						H	H	H	H
QLD	H	E						H	H	H	H	H
WA	E						H	H	H	H	H	H

H = Harvest
E = End of Harvest
Source: Hort Innovation (2021a).

Harvested nuts are generally still enclosed in a husk, which should be removed within 24 hours of harvesting to prevent deterioration of kernel quality. Mechanical dehuskers will sort and separate the NIS from the excess husks. The fibrous husk material is usually recycled as organic mulch.

The raw NIS are then stored and dried, commonly in aerated silos, prior to being delivered for processing. INC (2018) notes that it is recommended to have a larger number of small silos than fewer larger ones, as this allows nuts to be separated into different batches according to variety, storage time, humidity etc. Silos should have adequate airflow and a bed depth of lower than three metres.

PROCESSING

Macadamias are generally delivered to processors deshusked, but still in their shells. They are then weighed, graded, and cracked, depending on the processor.

Marquis, the largest macadamia processor in Australia and globally, outlines the following process related to post-harvest activities:

- Sampling – On arriving at the local processors, samples are taken to assess the moisture content and quality of the nuts. This informs the prices paid for the consignment.
- Drying – The macadamias are transferred via a series of conveyors to a state-of-the-art drying facility to remove excess moisture, powered by the burning of macadamia shells. The drying process also shrinks the kernel away from the inside of the shell which results in minimal damage to the kernel during the cracking process. In this step, the goal is to reduce kernel moisture content to below 1.5% (nut inshell moisture content of 3.5%).
- Cracking – To produce macadamia kernels, the nuts are mechanically cracked and separated from the shells.
- Sorting – In order to meet requirements of quality standards, mechanical equipment for sorting and manual inspection for sorting NIS and kernels according to size, colour, and the presence of any defects.
- Testing – Quality assurance process to ensure macadamia kernels and nuts meet the required standards and specifications.
- Pasteurising – Marquis utilises the Napasol pasteurisation process to treat the macadamias to ensure food safety. This process involves pasteurising with saturated steam at low temperatures in a partial vacuum, which has been validated to provide a reduction of salmonella and other potentially pathogenic micro-organisms that may be present.
- Packaging – Finished product is vacuum sealed in nitrogen-flushed foil pouches within cardboard cartons to ensure freshness. The cartons are labelled and stored in storage facilities, ready for dispatchment.

Infrastructure for drying, cracking, sorting, pasteurising, packaging, and storage is required during this process.

The three products at the end of the processing step in the supply chain are typically macadamia NIS, kernels and potentially the outer shells of the nuts.

WHOLESALE & SALES (EXPORT & DOMESTIC)

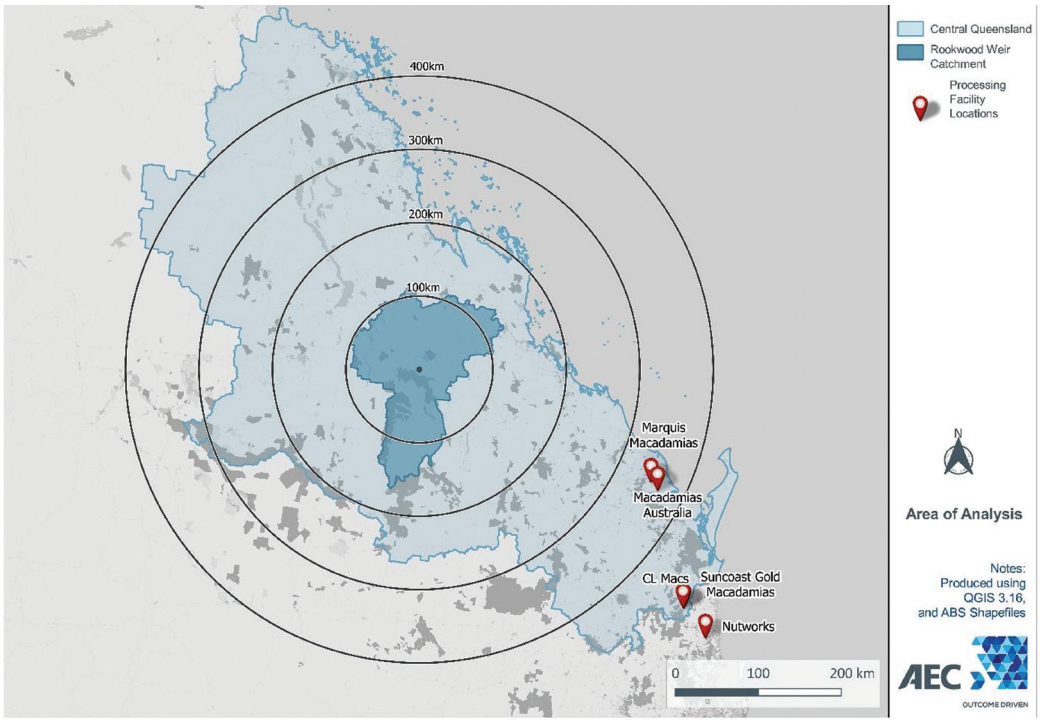
The final forms from macadamia processing (i.e. NIS, kernel or outer shell) are then sold in bulk, either exported internationally (outer shell not usually exported) or sold domestically. These products may be further manufactured into value-add products such as snacks and other foods, nut oils, beauty products, animal feed and fertiliser.

Macadamias Australia indicates that "99% of the 20,000 tonnes of macadamias are exported and are transported by sea freight from Port of Brisbane" (Deloitte, 2018). It is assumed that any macadamia exports from the processing facilities in and around the Central Queensland region will be from the Port of Brisbane.

5.1 INFRASTRUCTURE REQUIREMENTS AND GAPS IN CENTRAL QUEENSLAND

The macadamia industry in Central Queensland is supported by four post-production processing facilities – two in Bundaberg (operated by Marquis Macadamias and Macadamias Australia), and two in Gympie (operated by Suncoast Gold Macadamias and CL Macs). Another facility exists in the Sunshine Coast (operated by Nutworks), servicing the South-East Queensland region. These processing facilities are illustrated in Figure 5.4.

Figure 5.4. Macadamia Processing Facilities, Rookwood Weir Catchment Area



Source: AEC.

There are currently no processing facilities in the Rookwood Weir Catchment Area or the Rockhampton region. If macadamias were selected as commodity for the Rookwood Weir Catchment Area, harvested nuts will need to be shipped to a processing plant in Bundaberg, which could be up to 500km from the Rookwood Weir Catchment Area.

Depending on the scale of macadamia cultivation in the region, a new macadamia processing plant may be required within the catchment. The current levels of production in the Rockhampton area are insufficient to justify the high upfront capital costs for a macadamia processor to establish new operations within the region. An indicative range between 2,000 – 5,000 tonnes of NIS macadamia production in the region may be sufficient to justify the establishment of a new plant (CQ Today, 2021). The viability of establishing a new processing facility will need to be investigated to determine whether there is a net benefit to the region.

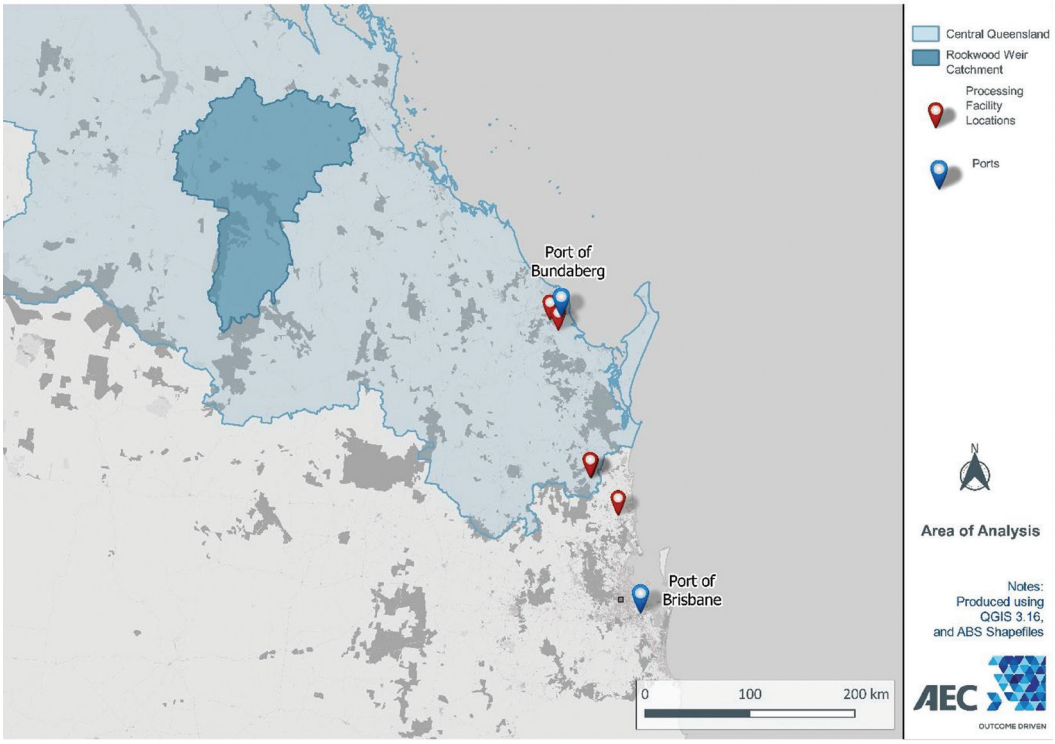
Marquis Macadamias has received development approval for its multi-million expansion of their processing facility in Bundaberg. Stage 1 will include a new delivery area as well as increased drying and storage for an additional 4,800 tonnes of NIS product (Queensland Country Life, 2021b).

According to the development application submitted to Bundaberg Regional Council, the expansion will enable the increase in production from 10,213 tonnes to 30,000 tonnes of macadamia NIS with 10% moisture content. Marquis estimates the expansion of all three stages will cost up to $40 million. The expansion is expected to significantly increase Marquis' processing and export capabilities, catering to the demand for macadamia products globally.

As most macadamia processors purchase macadamias which have already been husked, on-farm dehusking equipment is generally required. If growers within the Rookwood Weird Catchment Area do not wish to purchase dehusking equipment for their farms, both processing facilities in Bundaberg offer a dehusking service at an additional cost. However, given it is recommended that husks be removed within 24 hours after harvest, certain growers within the catchment may find it difficult to deliver their products to the processor to be dehusked within this timeframe. A centralised but local dehusking facility may be viable in this instance if production volumes in the region increases, however the capital costs associated with dehusking equipment are relatively low compared to the cost of establishing a facility specifically for dehusking. If a new processing plant were to be established in the region, the inclusion of a dehusking service should be considered.

Macadamia exports are currently transported from the Port of Brisbane. A port is also located at Burnett River, the Port of Bundaberg, owned by Gladstone Ports Corporation Limited, which is closer to the Rookwood Weir Catchment Area. However, macadamias are not identified as a primary export at this port. The two main wharves, Sir Thomas Hiley Wharf and John T. Fisher Wharf handles sugar, gypsum, wood pellets, bulk liquids, molasses and silica sand. Macadamia Australia has previously indicated that if the Port of Bundaberg were to be used instead of the Port of Brisbane, it would save them approximately $2.2 million of road transport costs (currently paying $70 per pallet to transport produce to Port of Brisbane via road freight) (Deloitte, 2018). The current port infrastructure at the Port of Bundaberg is not suitable for macadamia exports. Although agribusiness is identified as an important industry in the Precinct Outlook for Port of Bundaberg (GPC, 2019), it not listed specifically as a 'future trade of the port', which includes dry bulk commodities (minerals), general cargo and bulk liquids. It is expected that the Port of Brisbane will continue to service the macadamia processing facilities in the Central Queensland region.

Figure 5.5. Ports, Rookwood Weir Catchment Area



Source: AEC.

6. COMPETITIVE ANALYSIS & MARKET OUTLOOK

Australia is positioned to remain a key competitive producer on the international scale. Australia has a number of competitive advantages for macadamia production, including (Australian Macadamia Society, 2017):

- Internationally recognised genetics and varietal development
- An industry which can demonstrate over 20 years of full compliance with all relevant standards
- A younger average age of tree across the industry
- Management and operational learnings from 2008 -2011 on pest, disease and crop management including development of class leading integrated orchard management systems.

The largest threats to demand for Australia's macadamia product is South Africa, given they are the second largest exporter in the world (for both macadamia NIS and kernel), and China, being Australia's primary export location and potentially an emerging net exporter of macadamias.

Figure 6.1. Major Importers and Exporters of Macadamia

Source: AEC.

SOUTH AFRICA

Key export markets for South Africa include Hong Kong, Vietnam and China for macadamia NIS, and the US for macadamia kernels (Agriculture, Forestry and Fisheries, 2019). South Africa is the leading supplier of macadamia nuts to Europe, with kernel exports totalling an estimated 3,735 tonnes in 2020 (CBI, 2021). Of the South African exports to Europe in 2020, approximately 30% was destined for Germany, 24% for the Netherlands, 18% for France and 12% for Spain (CBI, 2021). Key competitors for South Africa in the European market are currently Kenya and Australia (CBI, 2021).

South Africa and Australia are the largest producers of macadamias on the global scale and are key competitors in international trade. Both Australia and South Africa supply a range of markets based on a number of key factors including proximity to market. The table below provides Australia's top export markets and the proportion of supply from Australia and South Africa to these respective markets.

Table 6.1. Australia's Largest Export Markets in 2020

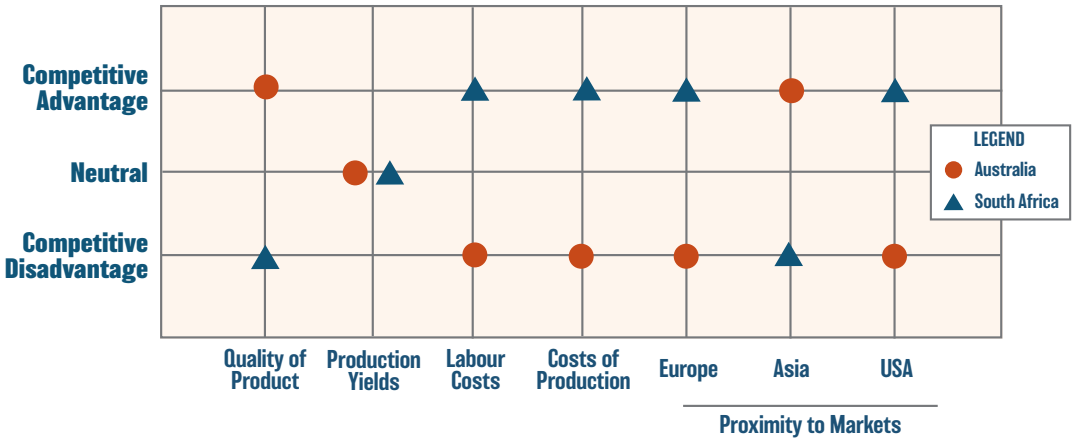
Australia's Top Export Markets	Australia Supply	South Africa Supply
Macadamia Kernel		
China	97.3%	2.3%
Japan	66.2%	17.0%
US	10.9%	42.3%
South Korea	99.9%	0.0%
Macadamia NIS		
China	62.3%	22.0%
Vietnam	41.8%	43.3%
Hong Kong	1.2%	88.3%

Source: Fresh Logic (2022).

Australia has a competitive advantage in proximity to market for China, Japan and South Korea, which is reflected in the greater proportion of supply. South Africa on the other hand has travel time advantages to supply the US market, as well as the European market. Other competitive advantages South Africa has include lower labour costs and costs of production, however, the quality of Australia's macadamia products are generally higher due to more established compliance and quality standards.

A comparison of the two countries against export factors is illustrated in Figure 6.2 below.

Figure 6.2. Competitive Advantage Comparison, Australia vs. South Africa



Source: AEC (2022).

CHINA

The expansion of macadamia production in China may see a shift in the international export market with majority of the demand able to be realised domestically. Currently, China's yield per hectare is relatively low compared to that of both Australia and South Africa due to the significant volume of production area and smaller volume of yielding trees. As trees begin to mature and bear macadamias, it is expected that macadamia production in China will increase significantly. It is estimated that production will reach a total of 190,000 tonnes in 2022 with production reaching 450,000 tonnes in 2025.

If realised, China will increase their supply of macadamia nuts by an average 94% per annum from 2021 to 2025, significantly increasing the supply of a country who are currently a net importer of the commodity. China largely imports macadamias from Australia, particularly NIS, sourcing 97.3% of NIS from Australia in 2020 (see section 3.6). This was followed by South Africa, where China was estimated to source 2.3% of their total NIS imports from.

The projected increase in production from China will result in a trade shift, with China moving from a net importer to a net exporter. China will have a number of key advantages to trade in the international market, including significant volumes of production and proximity to key markets. The proximity to key markets will provide China with significant efficiencies for transport, including travel time and lower costs for transport. China will be in a position to capture the growing macadamia demand in Europe due to significant increase in supply, transport efficiencies, free trade agreements (i.e., China European free trade agreement) and most favoured nation tariff regime. South Africa is also in a position to capture the macadamia demand in Europe, and is currently a key supplier for a number of European countries including Germany, the Netherland, France and Spain (CBI, 2021).

If the projected increase in macadamia production is realised, China will be able to satisfy their future domestic demand with domestic production. Should this occur, there will be no demand from and as a result, access to, the domestic market in China, resulting in significant implications for future global trade. China's demand for Australian macadamias will decrease (if not stop completely), providing Australia with no other alternative but to look for another key market for export.

FUTURE GROWTH MARKETS FOR AUSTRALIA

Japan represents a growth market for Australian macadamias. Japan is largely a market for kernels, with value adding being undertaken domestically including chocolate coating, roasting, and flavour adding (Deloitte, 2017). Although reports suggest that there will be no significant increase in the demand for macadamia nuts in Japan, there could be opportunities for new applications (Deloitte, 2017).

Vietnam is another potential growth market for Australia macadamias, with Australian imports accounting for approximately 42% of the country's total imports in 2020 (3,190 tonnes). Vietnam was the third largest importer of macadamias in 2020 (both NIS and kernel), with the country also sitting as the eight largest producer of the commodity in 2021, highlighting the strong domestic demand for macadamias. Vietnam, however, is seeking to expand their current production of macadamias, increasing the total planted area to 50,000 hectares in 2025 and 100,000 hectares by 2030 (Reuters, 2020). With the projected increase in macadamia production in Vietnam, there is a risk that they will be able to satisfy domestic demand with domestic production in the future.

If China has macadamia supply which surpasses its domestic demand, there is the risk that this excess supply is distributed to other Asian markets (with lower associated transport costs), potentially reducing the demand for Australia's macadamia products.

Table 6.2 outlines the strengths, weaknesses, opportunities and threats of the Australian macadamia industry which may be of relevance to potential growers of macadamia crops in the Rookwood Wier Catchment Area.

Table 6.2. SWOT Analysis – Australian Macadamia Production

Strengths	Weaknesses
• Management and operational learnings from 2008-11 on pest, disease and crop management. • Over 20 years of full compliance with all relevant standards. • Relatively young tree age across the industry, with production expected to increase as trees begin to mature. • A number of Free Trade Agreements with key markets, reducing costs to supply macadamias internationally. • Australia's industry is already export-focused. • Close proximity to Asia, with lower transportation costs compared to some key competitors. • Expansion of process facilities, particularly with Marquis Macadamias in Bundaberg. Leading to an increase capacity for processing. • Strong levy-funded industry programs. • Attractive investment due to high gross margins and returns on investment. • Australia holds the only natural germplasm resources for macadamias and has invested over $10 million throughout the last 10 years on a comprehensive breeding program (Australian Macadamia Society, 2017).	• Difficult to respond quickly to market signals due to long lead time to increase production. • No local macadamia processing facility, with the closest facilities being in Bundaberg. Added time constraints associated with transport, potentially impacting quality of NIS product. • High logistics costs associated with transport to Port of Brisbane for export after processing. • Increased price pressure in Australia due to falling exchange rates, until interest rates equalise.
Opportunities	**Threats**
• Global demand for macadamias surpasses existing production. • Increase the kernel market segment, particularly in China if future domestic production is not realised. • Local macadamia processing facility to be established (if production grows in the region). • Regional production is significantly more efficient than production in other Australian regions. • Strong underlying consumer demand driving new and emerging market opportunities such as Korea and Germany.	• Logistic challenges due to the impact of COVID-19. • Increasing competition if China make structural changes and increase land productivity to be the world's largest producer. • If China realises production forecasts, Australia will be required to find an alternative market for supply. • Potential for South Africa to increase production and service key growing markets such as Europe. • Trade disputes between China and Australia may impact future supply to the market. • United States, is turning towards domestic production to meet domestic demand.

Source: AEC.

Currently, demand for macadamias on the global scale exceeds the supply, however, global production is estimated to increase by three-fold by 2030 to reach a total of approximately 600,000 tonnes of NIS. The rising awareness of macadamia as a healthy snack is a key driver propelling the growth of the macadamia nut on the international market. There are widespread applications for macadamia nut usage, particularly as an ingredient in baked goods and popular as an ice-cream topping (KBV Research, 2021). There is an increasing trend to shifting diets to plant based, where macadamias are highly demand as they provide a good source of plant-based protein (KBV Research, 2021).

Whilst the short to medium outlook for the industry through to 2030 remains strong, it can be expected that with a negative outlook on exchange rates and continued COVID driven logistics challenges that the short-term price outlook may soften further over the next two years.

In addition, the rapid production growth in key export such as China and Vietnam will place longer term pressure on the industry to develop new markets such as Korea that can provide an alternative market opportunity in the event the current export destinations become self-reliant.

Growth in per capita consumption will enable the development of new markets as the consumer trends and supply access improves. However, reductions in inputs costs such as transport and yield improvements will be critical in protecting industry margins and Australia's overall competitiveness in this commodity.

As result, the outlook for the industry remains positive, with prices expected to remain above the lows of 2007 which was below the cost of production.

7. FINANCIAL AND COMMERCIAL ANALYSIS

ROOKWOOD WEIR FINANCIAL FEASIBILITY - KEY ASSUMPTIONS & FINDINGS

- The average land available on a typical Rookwood Weir land lot which is suitable for macadamia production is 160ha. With water entitlement restrictions, the total sustainable land available for orchard development (i.e. planted area) is restricted to 80ha.
- The anticipated initial capital investment for a macadamia orchard is $4.5 million – including, land, land clearing, infrastructure and equipment, water entitlements, and planting.
- The first commercial harvest is not expected to occur until the seventh year of growing, when the trees will yield, on average, 1.88 tonnes per Ha. The farm will be operating at a loss for the first nine years the orchard is planted.
- The break-even point (at current market price of $5.21 NIS) is May 2030, however, the first year of operating at a profit is predicted to be FY2033, with the plants being planted in FY2024.
- With consideration to the capital investment and the operating position, the discounted cash flow will be positive by FY2033.
- The long-term growth rate for agricultural farmland values is 8.8%, with a net present value (NPV) of the farm at $0 the implied internal rate of return is 9.52%. The terminal value of the macadamia farm at the conclusion of the analysis (FY2041) is $38.65 million.

7.1 APPROACH

The commercial and financial feasibility of an average macadamia orchard in the Rookwood Weir Catchment Area has been evaluated on a discounted cash flow basis over a twenty-year evaluation period. This analysis assumes a greenfield farm establishment in the region, and includes the cost of land, capital investment required, operating costs, and the anticipated revenue over the 20-year time frame. The following sections detail the following:

- Orchard establishment
- Orchard operations
- Sources of funding
- Financial Feasibility (including sensitivity analysis).

7.2 ROOKWOOD WEIR WATER AVAILABILITY

The Rookwood Weir Scheme allows for a maximum 500ML water allocation for agricultural landholders. Under the assumption this water is provided with a conservative 80% reliability and macadamias require an estimated 5.0ML per ha per year (DAF, 2004), the maximum growing area in the Rookwood Weir Catchment Area is 80ha. This presents a much larger than average Australian macadamia farm. The median macadamia farm size across Australia is 19.8ha and 58.8ha in Central Queensland (Queensland Government, 2021a). However, approximately 58.3% of macadamia farms in Central Queensland are greater the 50ha and 32.1% are greater than 100ha. Sensitivity has been conducted at 60% and 100% water reliability as well as without the water allocation cap. The total land available for horticulture under each scenario is shown in Table 7.1.

Table 7.1. Land Availability

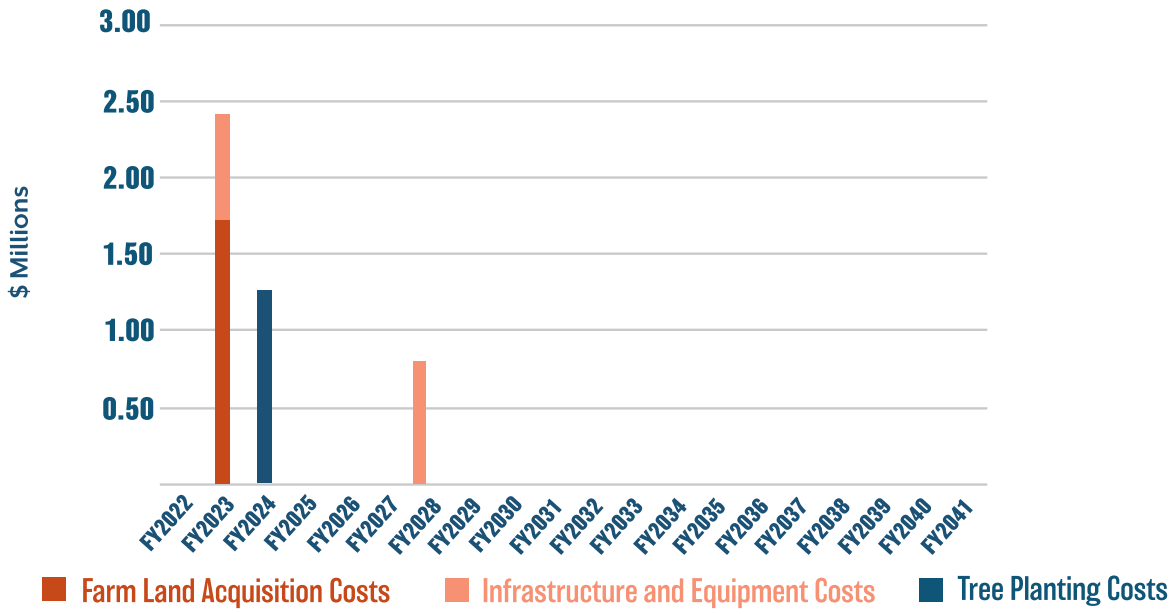
	60% Reliability	80% Reliability	100% Reliability	No Water Allocation Cap
Land Availability	60 ha	80 ha	100 ha	160 ha

Source: Queensland Treasury (2021)

7.3 ORCHARD CAPITAL INVESTMENT
7. 3.1 ORCHARD ESTABLISHMENT

Macadamia orchard establishment requires three key capital investments, the land, the on-farm infrastructure and associated equipment and the trees. For the purpose of analysis, it is assumed the majority of the initial investment occurs across four months, starting 1 January 2023. A secondary investment, that of harvesting and processing equipment, is anticipated to incur in the fourth year of growing (FY2027). Overall, for the 80ha farm, the initial capital investment is $4.5million ($56,133/ha).

Figure 7.1. Total Orchard Establishment Costs (FY2022 – FY2041)



Source: AEC (2022), HTW (2022).

FARMLAND AND ACQUISITION COSTS

Farmland and acquisition costs include the price of land, the cost of land clearing, and the water entitlements. Total farmland and acquisition costs per farm are estimated to be $1.7 million. Land suitability analysis shows each property within the Rookwood Weir Catchment Area has on average 160 available Ha suitable for growing macadamias. At value of $3,810/ha in FY2021 terms (on advice from HTW) the total estimated land price for a typical allotment which has macadamia suitable land is approximately $626,715 in nominal terms.

Secondary capital costs associated with the land include the water entitlements. Water entitlements from the Rookwood Weir are priced at $1,500/ML (RFM, 2020), at a total allocation of 500ML the water entitlement cost for landholders will be approximately $771,056 thousand in nominal terms. Given the typical current land use within the catchment, it is assumed the land, upon purchase, will need to be cleared and prepared for orchard establishment. In cases where land requires clearing, an additional 12 months is typically added to the establishment timeline to allow for soil rehabilitation (DAF, 2004c). Based on anecdotal evidence from HTW and other key regional producers, and the typical terrain of the Rookwood Weir Catchment Area, the per hectare cost of clearing land would be approximately $4,000.

The orchard establishment does not include costs related to establishing wind breaks for the orchard for two key reasons. The varieties typically planted within Central Queensland are typically spreading or moderately upright varieties and are not as susceptible to wind damage as the upright varieties (DAF, 2004c). Secondly, wind breaks are typically recommended for high wind risk areas, it is assumed the average property within the Rookwood Weir Catchment Area does not fall within this category.

INFRASTRUCTURE AND EQUIPMENT COSTS

On-farm infrastructure includes storage facilities, require a capital investment to establish facilities such as irrigation, storage and processing facilities, and farming equipment. The infrastructure and equipment investment are considered in two parts, those necessary to begin and undertaking planting and growing and those required for harvesting. To plant and grow macadamias on an 80ha farm, the necessary infrastructure and equipment will cost an estimated $690,566. This includes irrigation installation which, according to The Australian Macadamia Society (2017), would cost about $2,128/ha (in FY2021 terms). It is noted, however, that this is an indicative estimate, the cost to landholders will vary depending on their location along the weir scheme and their distance from the river. Harvesting and processing equipment are assumed to be purchased in the year of the first harvest (2027). This equipment includes the harvest, dehusker, sorter and processing equipment and will cost approximately $8,805/ha of bearable trees (DAF, 2004a). For the example farm, this will cost an estimated $806,621.

TREE PLANTING COSTS

Planting costs are incurred across May and June (refer to Table 7.2 for the modelled seasonal breakdown). It is assumed macadamia saplings will be planted across both May and June of 2024, and as such the capital investment associated with planting will be incurred across this time period. Based on anecdotal advice, the planting cost will total $1.3 million at an estimated $50 per tree.

Table 7.2. Modelled Macadamia Seasons

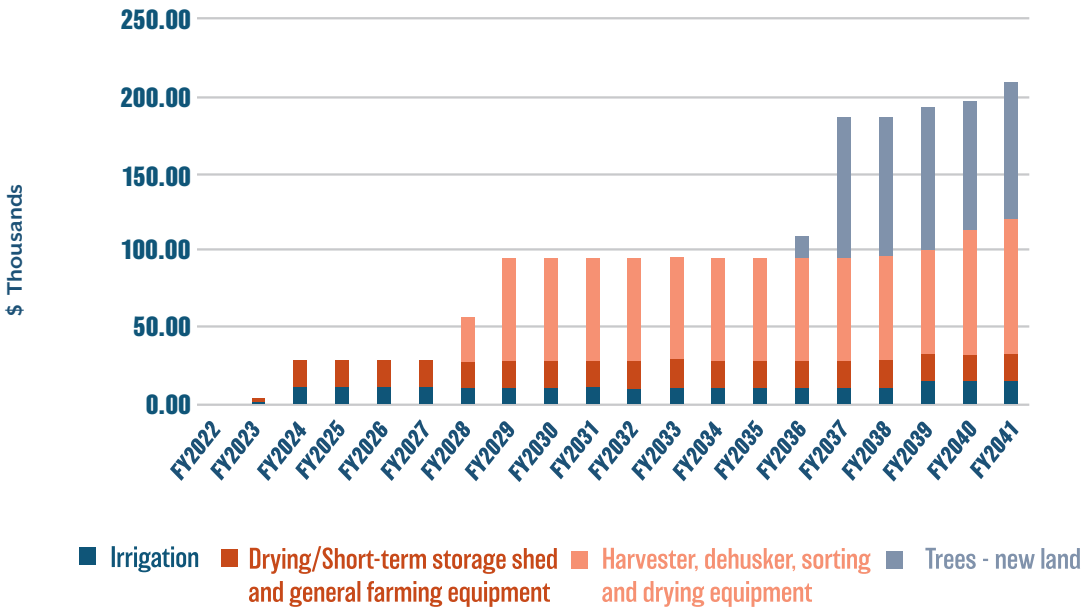
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Planting											■	■
Pollinating		■	■									
Growing				■	■	■	■					
Harvesting	■	■						■	■	■	■	■

Source: The Australian Macadamia Society (2021a).

7. 3.2 DEPRECIATION AND AMORTISATION OF ASSETS

The capital investment required to establish the orchard form the depreciable asset base of the farm. The total depreciation and asset write-off expense over the evaluation period is shown in Figure 7.2.

Figure 7.2. Total Depreciation Expense (FY2022 – FY2041)

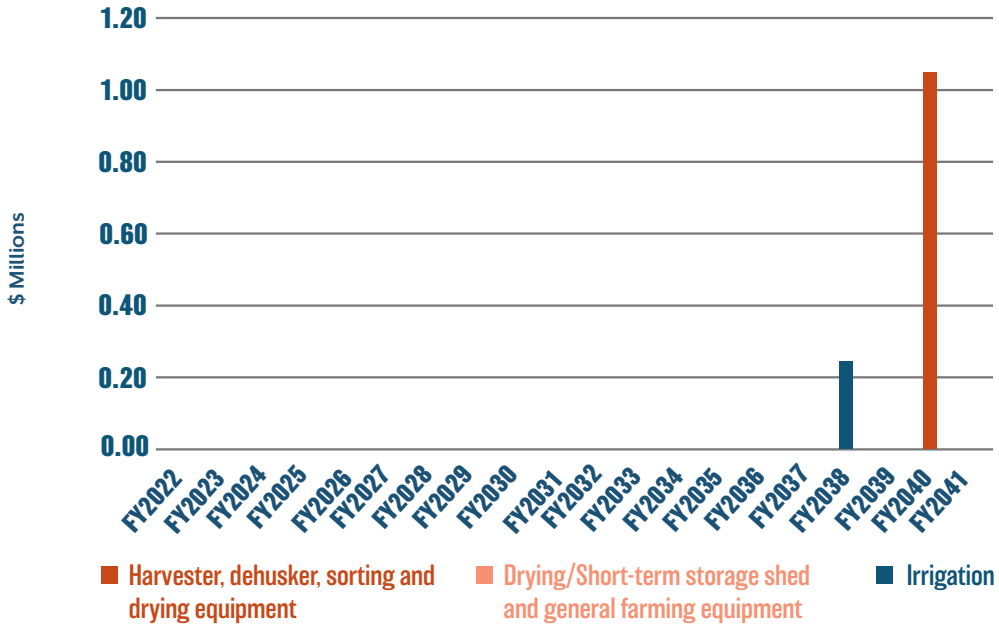


Source: AEC (2022).
Treatment of each asset type is outlined in Appendix B.

7.3.3 ASSET RENEWAL

As the on-farm infrastructure, general equipment, and the harvesting equipment all have useful lives less than the less than the evaluation period, they will be replaced at the expiration of their useful lives. The replace capital expense is assumed to be consistent with the cost structure and drivers the initial investment. There is an anticipated additional $1.3 million required to maintain operational farm assets over the evaluation period. This expense is show in Figure 7.3.

Figure 7.3. Total Asset Renewal (FY2022 – FY2041)



Source: AEC (2022).

7.4 ORCHARD OPERATIONS

7.4.1 ORCHARD REQUIREMENTS

There are a number of overarching operational assumptions which define the parameters of the financial analysis, including the tree population, ownership structure, and yield assumptions.

TREE POPULATION

There is a range of tree density within which macadamias can be farmed, all of which present unique array of benefits and costs. In modelling an average farm of the Rookwood Weir Catchment Area, the mid-range of a medium density has been assumed, which is 300 trees planted per ha (The Macadamia Society, 2017). For an 80ha farm, this leads to a tree population of 24,000.

Key assumptions underlying the modelling include:

- There are no supply chain or regional capacity constraints in accessing and planting the saplings, that is, 24,000 will be able to be sourced and planted during orchard establishment
- There are zero on-farm tree losses throughout the evaluation period. Macadamia farms will experience tree loss due to a range of factors such as pests, disease, and weather and climatic events. Without defined loss rates across the region or industry at large, the loss rate modelled is nil. This presents a downside risk to potential macadamia farmers.

OWNERSHIP STRUCTURE

Modelling of the operations of the example farm assumes the farm will be owner-operated. Labour operating costs of a manager farm will incur a might higher average labour cost. An owner-operated farm spends approximately $2,600/ha on labour, whereas a managed farm can cost an additional 50% on labour costs (Queensland Government, 2021) given the increased salary expense for farm management.

In this analysis it is assumed that the farm manager (the owner) will pay themselves a notional salary on an ongoing basis at an additional 30% of labour costs. Additionally, all positive net profit after tax (NPAT) positions are assumed to be paid out as a dividend to the farm owner (as the farm is an owner-operated enterprise). These dividends are paid out on an annual basis at the end of the financial year.

YIELD

Australian macadamia farms yield, on average, up to 2.97 tonnes per Ha (refer to Table 3.4 on page 25 for details, Section 3.4). However, Central Queensland is a highly productive region for macadamia production. Despite having a relatively young average age of trees (15 years old), yield on a per Ha basis is well above the national average of 2.72 (refer to Table 7.3). In modelling the average farm in the Rookwood Weir Catchment Area, the Australian average has conservatively been applied.

Table 7.3. Regional Yield Summary

Year	Average Age of Tree	Total Ha Planted	Total NIS Produced	Average NIS yield/ha
Central Queensland	15	5,616	16,666	2.97
South-East Queensland	26	1,514	3,713	2.45
Northern Rivers	25	3,297	8,102	2.46
Mid North Coast	21	423	983	2.32
Australia	20	10,851	29,464	2.72

Source: Queensland Government (2021).

The product sold by the farms to processors are the NIS. The price paid the NIS are determined by the recoverable kernel rate. With the total NIS weight including the shell and any potential debris in the produced bins, the saleable kernel recovery (SKR) rate is typically around 30-32% and the RKR is usually around 1%. The SKR is distinguished by quality and identified as either commercial grade or premium grade. Total kernel recovery modelled is shown in Table 7.4.

Table 7.4. Modelled Kernel Recovery

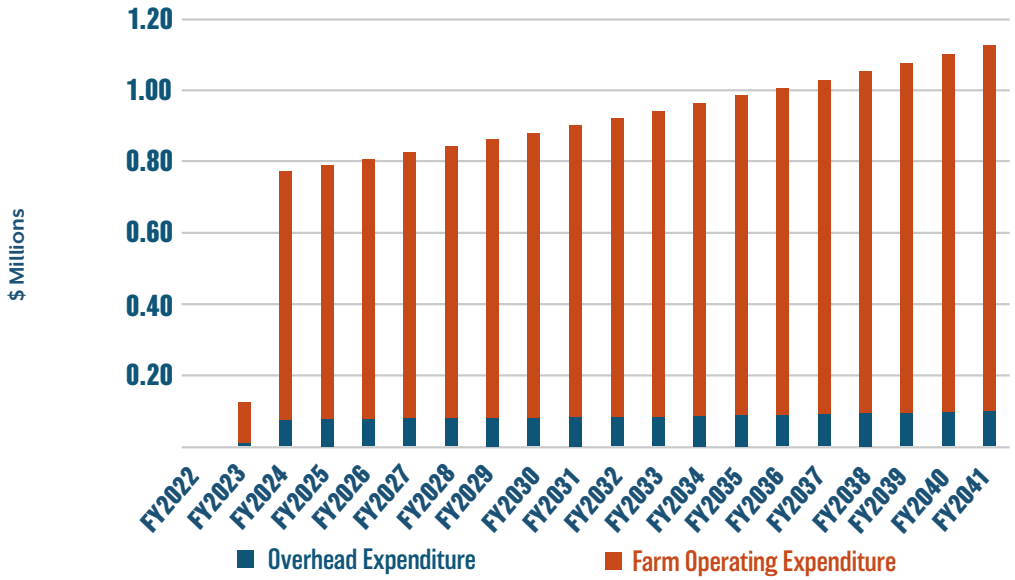
Grade	
Premium Kernel Recovery	30.2%
Commercial Kernel Recovery	1.8%
Rejected and/or Spoilage	68.0%

Source: Australian Macadamia Society (2017), Marquis (2021b).

7.4.2 ORCHARD OPERATING COSTS

Orchard operating costs have been estimated on the basis of labour, non-labour, and overhead costs. Non-labour and overhead costs are escalated using the consumer price index, while the labour costs are escalated using the wage price index. Total operating cost forecast is presented in Figure 7.4 below.

Figure 7.4. Total Operating Costs (FY2022 – FY2041)



Source: AEC (2022).

Each operating cost is forecast based on a set of potential cost drivers – per hectare, per planted hectare, per ML of water used, per tonne produced, or an annual fixed cost. Each operating cost and their cost driver is listed in the following table.

Table 7.5. Operating Costs

Operating Costs	Cost Driver	Cost per Driver (Real $FY 2021)
Non-Labour Operating Costs		
Crop nutrition	Planted ha	$1,450
Repairs and maintenance - plant	Planted ha	$650
Contractors	Planted ha	$520
Crop protection	Planted ha	$500
Fuel and oil	Planted ha	$420
Hire	Planted ha	$400
Irrigation	Planted ha	$360
R&M Imp	Planted ha	$270
Utilities	Planted ha	$250
Consultants	Planted ha	$120
Freight	Tonne	$34
Labour Operating Costs		
Employment	Planted ha	$2,600
Farm Manger	Planted ha	$780
Overhead Operating Costs		
Administration	Planted ha	$500
Leases	Planted ha	$420
Management	Planted ha	$350
Government Charges	Planted ha	$150
Levies	Tonne	$0.25
Freight Subsidy	Tonne	-$60

Source: Australian Macadamia Society (2017), Marquis (2021a), AEC (2022).

The freight subsidy is a common subsidy provided on top of the price received for the NIS by the processor based on the distance the farm transports the produce to the processor. This cost is classified as a negative operating cost (as opposed to an additional revenue) for the purpose of offsetting the freight costs. The subsidy assumed for this example farm is $0.06 per kilogram of NIS at 10% moisture content.

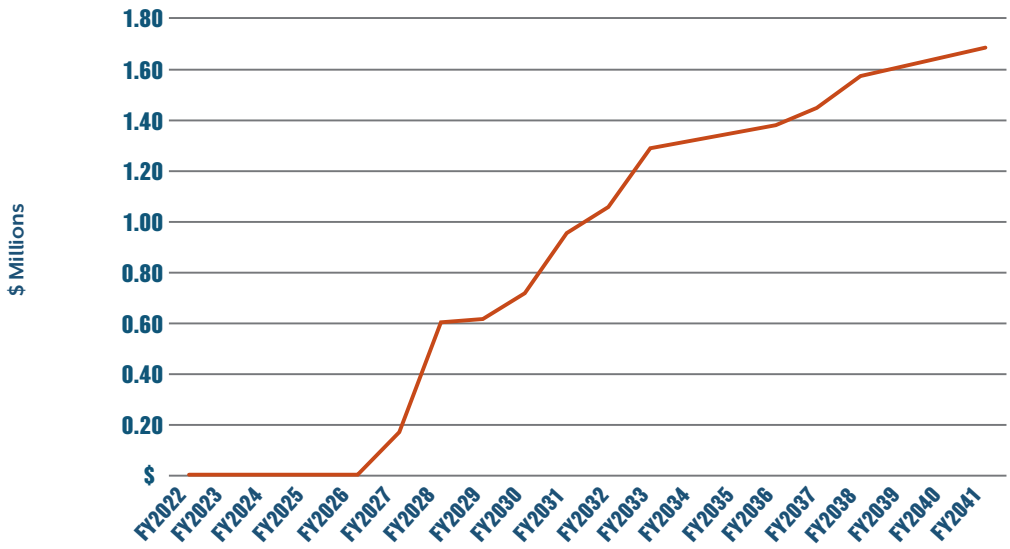
7.4.3 ORCHARD REVENUE

The orchard revenue consists of the operating income associated with the sale of NIS. The price point is determined by the quality of the saleable kernel and the rate of recovery from the NIS. The estimated total price per kilogram used in modelling the example farm is $5.21. This total price includes both the base price and the additional price (associated with the quality of the kernel).

The base price applied is $4.945 per kilogram of NIS at 10% moister content and a 32% recoverable rate. Based on the Marquis Notional Price Table (2021a) both premium and commercial grade macadamias are purchased at the same price. The additional payment is a quality bonus, which at the 6-year average of $0.32 per kilogram has been added to the base price.

The macadamia orchard will not receive operating revenue until the fifth year of operation, and at a yield of only 1.27tonne/ha, the farm will continue to operate at a loss. The step changes shown in Figure 7.5 below are reflective of the increase in yield as the average age of the trees increase over time. The forecast presented below does not consider price changes over time, refer to section 7.6.1 for price sensitivity analysis.

Figure 7.5. 20-year Revenue Forecast (FY2022 – FY2041)



Source: AEC (2022).

The modelled revenue does not consider potential price structures adopted by the buyers. For example, Marquis, the largest processer in Australia (and globally) structure their purchases on a 30% upfront purchase for the season, with volumetric and quality adjustments across the harvesting season (Marquis, 2021b). For the purpose of analysis, all revenue has been accounted for in the month after which the nuts are harvested. Landholders will likely experience a different cash flow profile, depending on the terms and conditions of the processor to which they sell.

7.5 SOURCES OF INVESTMENT

Establishment of the macadamia orchard require significant investment to cover the capital requirements and the operating shortfall until the trees start bearing harvestable produce. There are number of high-level assumptions which guide the investment sources as a part of this analysis.

1. The capital investment is assumed to be funded at a notional gearing ratio of 40%. The total capital investment of $4.5million, $1.8million is debt funded. This gearing level is the upper band of the target gearing level in the agricultural sector, which usually target between 30% and 40%.
2. Debt repayment can be structed as either interest only or principal and interest, in all outputs present, interest only repayment structure has been assumed.
3. The debt facility only services the initial capital investment (that is, the land and acquisition costs, on-farm infrastructure and equipment and the cost of planting). The debt facility does not cover any operational cash flow shortfall (this is assumed to be covered by equity), nor does it cover any lifecycle capital replacement costs.

   As the debt facility is assumed to not cover any operating cost shortfalls over the evaluation period, these shortfalls are funded through additional equity injections, which increases the total equity invested and decreases the overall gearing ratio of the enterprise.
4. The debt facility is entirely drawn down in the first period of the capital investment. As such, interest is incurred from the first period of development. Interest is assumed to be incurred and paid on a monthly basis.

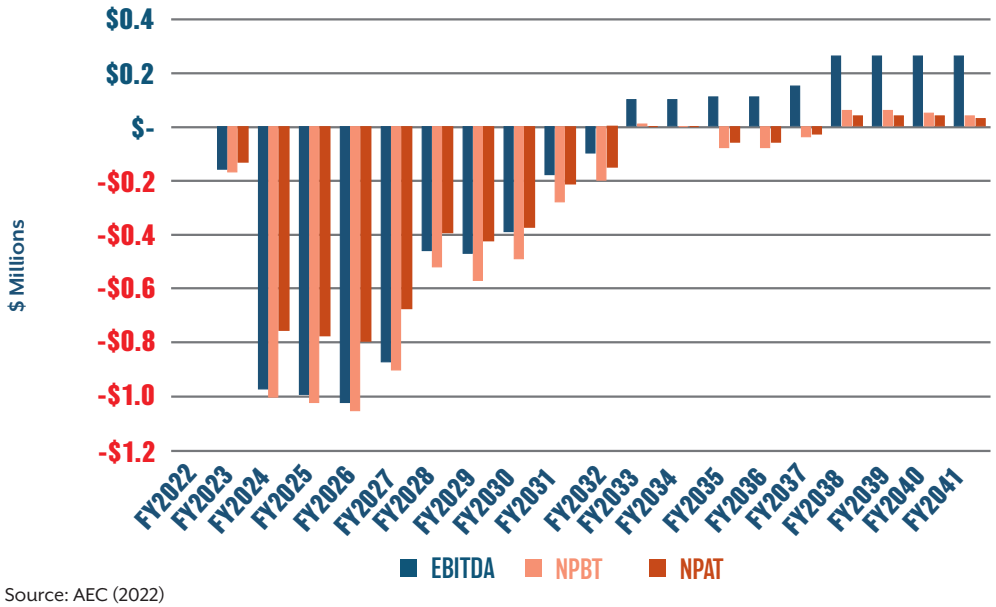
7.6 FINANCIAL FEASIBILITY

The assumed macadamia orchard in the Rookwood Weir Catchment Area would be anticipated to reach a positive annual operating position, that is, a positive NPAT ten years after orchard establishment, that is FY2033. The positive operating position is estimated to be held for a couple of years before increases in depreciation and asset write-offs increase and undermine the operating position. FY2035 is the year the biological asset write-off (that is, the trees in the orchard) begin being incurred.

The operating breakeven month for the example farm orchard modelled is May 2030 when the average age of the trees is eight years old.

By FY2041 the NPAT of the orchard is estimated to exceed $33 thousand. The NPAT profile over the FY2022 to FY2041 shows a stepped increased in profitability, which indicates the operating profit is directly correlated to and driven by the assumed yield. Additionally, the depreciation and asset write-off expense places a burden on the NPAT achievable by the farm.

Figure 7.6. Orchard Operating Profit (FY2022 – FY2041)



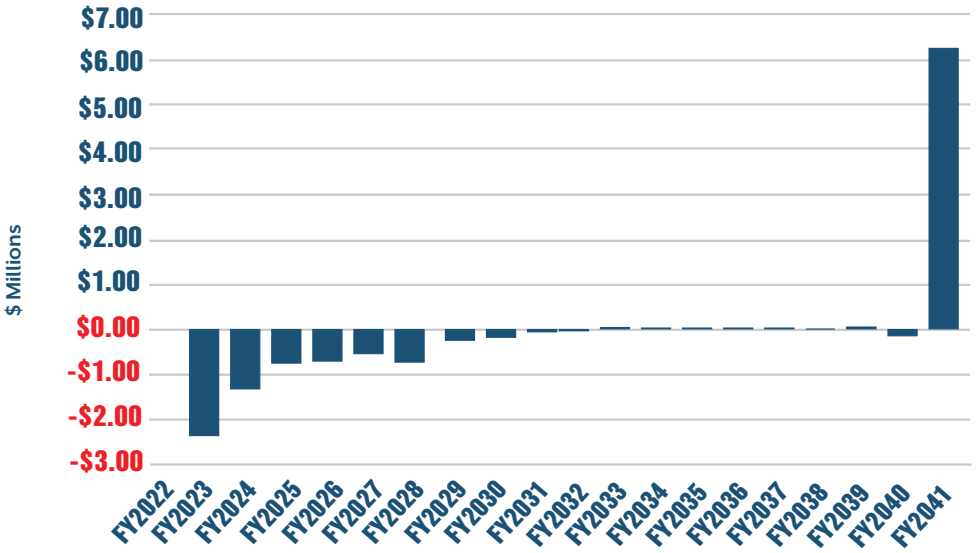
Source: AEC (2022)

Total asset investment over the evaluation timeline shows that while there is significant up-front investment and quite a few years of negative cashflow before an operating profit can be made, a macadamia orchard establishment in the Rookwood Weir Catchment Area will ultimately provide a positive financial return to investors. However, this is a long-term investment.

To understand the value of the orchard investment, a discounted cash flow (DCF) has been calculated. This is shown below in Figure 7.7. The discounted cash flows include the terminal value of the farm in the final year of analysis (FY2041). The terminal value represents the value of the business past the evaluation period and is estimated based on the long-term historical growth rate of farmland in Queensland, which is 8.8% (Rural Bank, 2021).

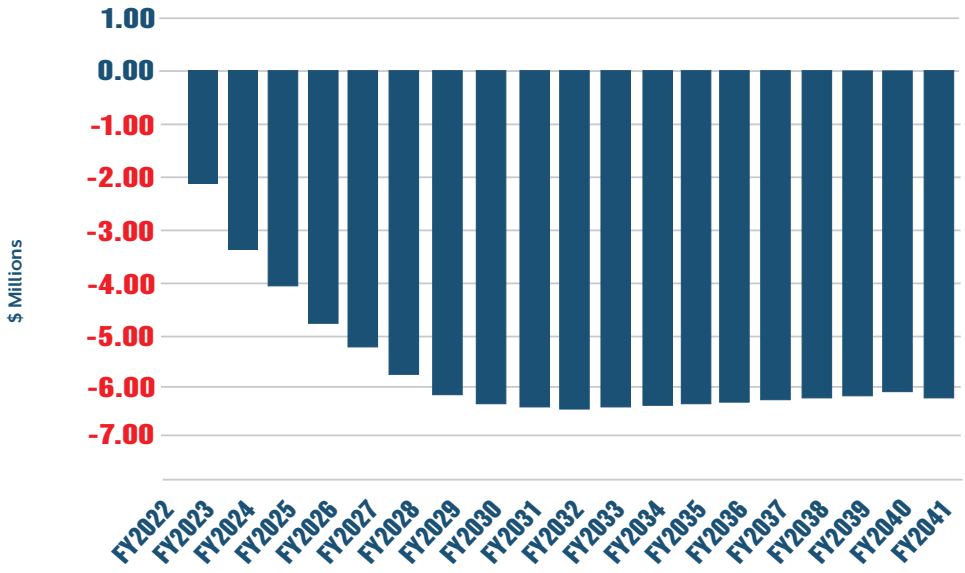
Given the large capital investment, and the periods of no returns (which ultimately increases the required capital investment), the cumulative discounted cash flows do not return a net positive income in the 20-year analysis, refer to Figure 7.8 below. Rather, the NPV for the investment is set at $0 to understand the implied internal rate of return, which is estimated to be 9.5%.

Figure 7.7. Discounted Cashflows Including Terminal Value (FY2022 – FY2041)



Source: AEC (2022).
Note: Discounted cashflows have been estimated on a 9.52% post-tax discount rate, which is the implied internal rate of return.

Figure 7.8. Cumulative Discounted Cashflows Including Terminal Value (FY2022 – FY2041)



Source: AEC (2022).
Note: Discounted cashflows have been estimated on a 9.52% post-tax discount rate, which is the implied internal rate of return.

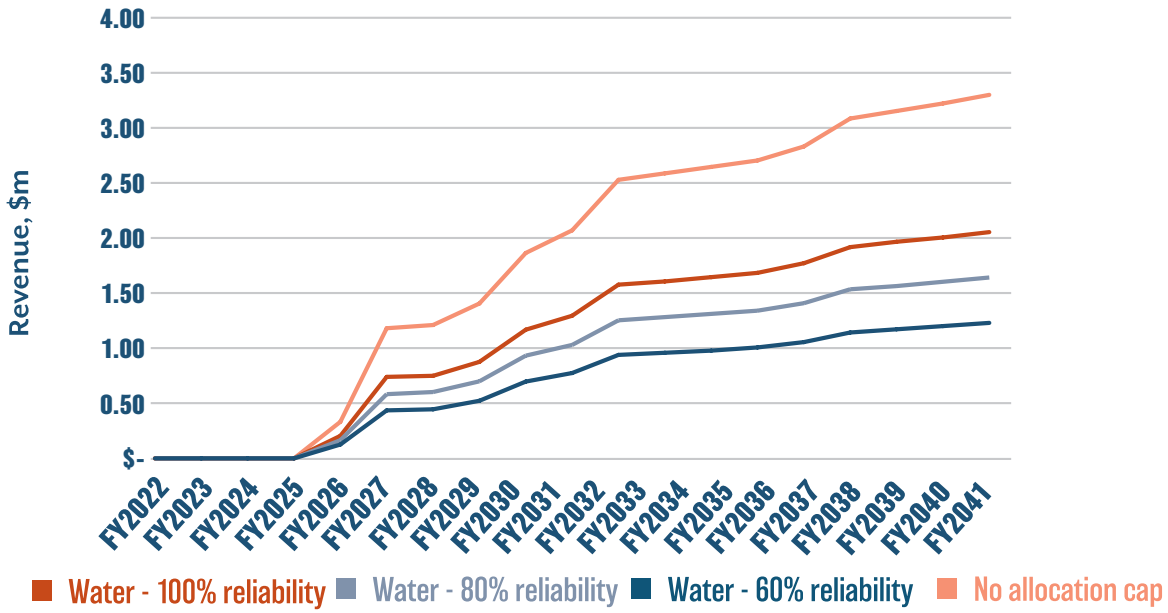
7.6.1 SENSITIVITY ANALYSIS

WATER SENSITIVITY

Water availability has a relatively linear relationship with the profitability of the example orchard modelled. This is because the majority of operating parameters are contingent on the land available to farm. There are very few operating costs which are not driven by the planted area, which means that as the land available for planting increases, so do does the operating expenses. Similarly, there is a direct relationship between land planted and yield of the macadamia trees.

The variance in revenue is presented in the figure below.

Figure 7.9. Water Availability Impact on Revenue (FY2022 – FY2041)



Source: AEC (2022).

The upfront capital costs will change, with changes to water availability. Any changes to the reliability of water will impact the irrigation, planting, and equipment costs. Whereas changes to the quantity of water available will impact both the irrigation, planting and equipment costs, and the water entitlement costs.

A key limitation in understanding the variation of revenue which could be achieved is there is no assumed loss in orchard establishment timing. In practice, by doubling the available land (such as under the No allocation cap scenario) there will be an increased time required to establish the orchard. This timing will impact the timing of when the trees are planted (and how quickly they are planted) which will ultimately impact yield. This timing is not considered in the sensitivity analysis and would likely result in a lower long term revenue profile as the orchard would have a younger average age of trees.

PRICE SENSITIVITY

With the global production profile and volumes expected to change significantly in the next 10 years, the impact on domestic and global prices are unknown and dependent on a number of factors. The domestic prices will be influenced by factors such as whether the supply forecasts are realised, the potential impact of major weather events around the world, and changes in consumer purchasing activity.

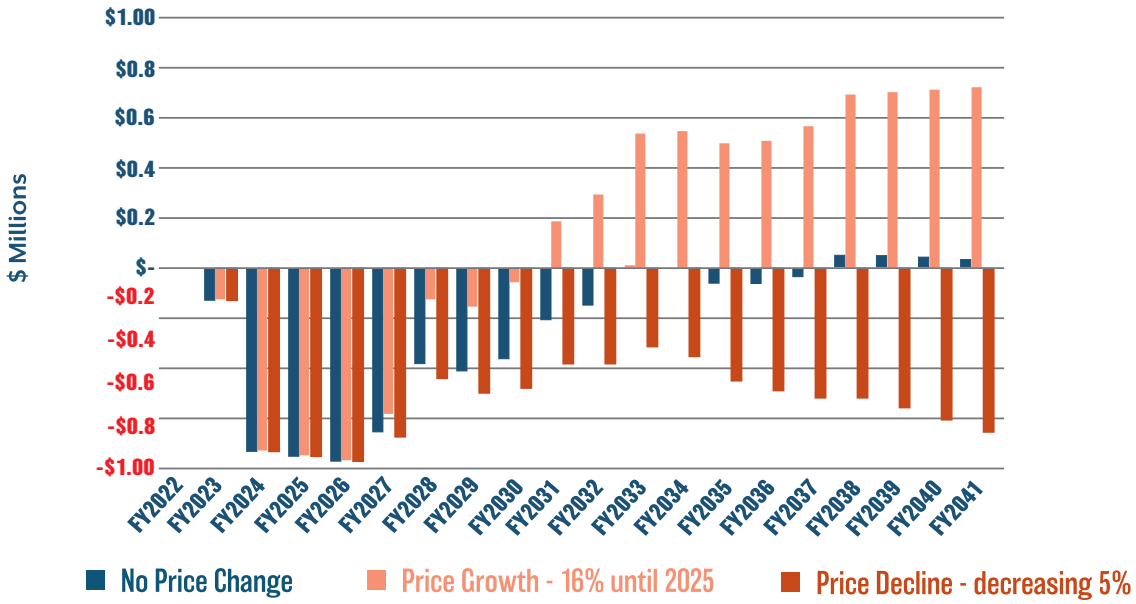
Global production increased by a factor of four over the past 25 years, to reach over 247,000 tonnes. Current projections show total global production is expected increase fourfold in the next 10 years to reach approximately 600,000 by 2030. This is largely driven by production in China, who are reporting to increase the number of macadamias planted to 300,000 trees by 2030. China anticipates their production will increase from 32,000 tonnes in 2021 to 190,000 tonnes in 2022 and again to 450,000 tonnes by 2025.

Although production growth to date has been significant it has not been enough to meet current demand as prices have grown at a 16% annualised rate over the last 20 years. Price sensitivity has been conducted for three scenarios:

- Scenario One: No price change from current levels. This is based on the assumption the relationship between global demand and global production remains at the current state over the forecast years and will not impact future price changes.
- Scenario Two: Growth continues at current levels (16% annually) until China reaches 450,000 tonnes of production in 2025 and then no price changes for from 2026 to the end of the forecast period. The underlying assumption is that while production ramps up in China there is a similar strong growth in global demand until production rate plateau.
- Scenario Three: No price growth until 2025 and then an annual 5% decline in prices over the forecast period. Under this scenario, the global demand does not continue to increase, rather it would stay stable while production increases. The scenario emulates a flooding of the macadamia market and would have an associated decreasing price.

Giving the multitude of variables, their relationship with one another, and the number of independent variables, these scenarios are set to provide a range of potential revenue impacts, rather than a set of real-world outcomes. Figure 7.10 shows the total impact of the price change is significant over the 20-year forecast period. The long-term impact of price changes is significant, with the difference in NPAT reaching $1.42 million by FY2041.

Figure 7.10. Price Sensitivity Impact on NPAT (FY2022 – FY2041)



Source: AEC (2022).

[5] Both Type I and Type II flow-on impacts have been presented in this report. Refer to Appendix C for a description of each type of flow-on impact.

7.7 ECONOMIC IMPACT

Investment in a macadamia enterprise will have an economic contribution to Fitzroy region, and more broadly Central Queensland. Economic modelling in this section estimates the economic activity supported by the orchard establishment and operations of the farm.

Input-Output modelling is used to examine the direct and flow-on activity expected to be supported within the Rockhampton local government area (LGA). A description of the Input-Output modelling framework used is provided in Appendix C.

Input-output modelling describes economic activity by examining four types of impacts:

- **Output** – Refers to the gross value of goods and services transacted, including the costs of goods and services used in the development and provision of the final product. Output typically overstates the economic impacts as it counts all goods and services used in one stage of production as an input to later stages of production, hence counting their contribution more than once.
- **Gross product** – Refers to the value of output after deducting the cost of goods and services inputs in the production process. Gross product (e.g., Gross Regional Product (GRP)) defines a true net economic contribution and is subsequently the preferred measure for assessing economic impacts.
- **Income** – Measures the level of wages and salaries paid to employees of the industry under consideration and to other industries benefiting from the project.
- **Employment** – Refers to the part-time and full-time employment positions generated by the economic stimulus, both directly and indirectly through flow-on activity, expressed in full time equivalent (FTE) positions. 6

The economic contribution of a macadamia orchard enterprise in the Rookwood Weir Catchment Area is presented in Table 7.6.

Initial capital investment of the orchard is anticipated to cost approximately $3.09 million, not including the purchase of land or the purchase of water entitlements (both of which are not contributing factors of the economic impact). Capital investment and operation of the orchard is anticipated to directly contribute to $2.7 million in industry output (i.e. revenues) to local businesses within the Rockhampton LGA.

A further $1.9 million in industry output is estimated to be supported in the catchment's economy through flow-on activity, including $1.2 million in production induced (i.e. supply chain) activity and $0.8 million through household consumption induced activity (i.e. expenditure of households within the local economy as a result of a lift in household incomes).

This level of industry activity is estimated to support the following within the Rockhampton LGA:

- A $2.0 million contribution to GRP including $1.1 million directly
- 17 FTE jobs (including 11 FTE jobs directly), paying a total of $1.4 million in wages and salaries ($0.8 million directly).

Table 7.6. Economic Activity Supported by a Macadamia Orchard Enterprise, Rockhampton LGA

Impact	Output (SM)	Gross Regional Product ($m)	Incomes ($M)	Employment (FTES)
Direct	$2.7	$1.1	$0.8	10
Production Induced	$1.2	$0.5	$0.3	4
Consumption Induced	$0.7	$0.4	$0.2	3
Total	**$4.7**	**$2.0**	**$1.4**	**17**

Note: Figures may not add due to rounding.
Source: ABS (2012), ABS (2017), ABS (2020a, b, c and d), AEC.

[6] Where one FTE is equivalent to one person working full time for a period of one year.

8. CONCLUSION

The Rookwood Weir Catchment Area provides the region with a unique opportunity to structurally shift farm incomes and employment.

Based on an analysis of 2021 sales data (HTW, unpublished), the estimated average land value is approximately $3,800 per hectare (ha). In contrast, moving from non-irrigated land to irrigated agriculture could see value uplift range between $6,200/ha and $16,200/ha, depending on the commodity and quality of the land and infrastructure. This value improvement provides the foundation for existing regional growers to consider alternative land uses that are either supplementary or complementary to existing operations.

Macadamia orchards are a long-term investment, taking up to 10 years to break-even operationally depending on maturity and productivity of the trees. This lag between commitment and sustainable profitability makes the long-term industry outlook a critical issue in any investment decision.

There is no doubt macadamia crops are an attractive investment opportunity, with a gross margin exceeding 50%. However, whilst the outlook for the industry remains positive, there are number of challenges emerging across the international market.

Short-term prices are expected to remain softer than the five-year average, as exchange rates and COVID related supply chain issues impact on both revenue and cost. In addition, increased domestic production in China and Vietnam will place pressure on Australia's exports to those countries. Further, the continued political fallout on market access between China and Australia as each country jostles for regional influence may also be adverse. These two countries combine reflect 43% of Australia's total production, and as a result create a strategic need to develop other market opportunities in emerging growth markets such as Korea and Germany.

Despite these challenges, the outlook for the industry remains positive, with global consumption expected to exceed supply for the foreseeable future, making the sector a viable long-term opportunity for the region. Australia's share of the global market is expected to fall over the next 10 years as production in other areas increase. Australia's production is forecasted to grow to over 63,000 tonnes by 2030 based on its existing planted area.

Central Queensland is Australia's fastest growing region for Macadamia production and its position is expected to strengthen as the orchards mature and yields improve. This position will improve further if production meets sector benchmarks in yield and quality. This will increase farmgate income and overall value to the region.

The Rookwood Weir Catchment Area has no local processing capability at present, which imposes a significant transport cost for the growers to transport their output to the nearest facility in Bundaberg. However, this can be addressed in the future as the production volumes from the region increase to levels which can justify the capital costs associated with the establishment of a new processing facility.

The Rookwood Weir Catchment Area has the potential to grow up over 18,000ha of macadamia's based on constraints imposed by various production factors including slope and soil suitability. The expected allocation of 7,500ML under this phase of scheme allocations will restrict the total land able to be converted to macadamia production. As a result of water availability, optimal farm size would be larger than the median for the Central Queensland region at 80ha and would be largest average farm size in Australia, presenting opportunities for capital efficiency, but also presenting risk.

This area would produce in excess of 43,000 tonnes of macadamia NIS, which would increase Australia's total production when mature at around 10 years of age (2.4 tonnes per ha) by around 80%, resulting in a potential farm-gate value of over $200m. Whilst it is improbable that the whole area will be planted with macadamia crops, it underscores the potential value creation derived from the Rookwood Weir Water Scheme.

Water rights have been estimated to range between $1,500 and $2,500, with the recent purchase of 21,600ML by Rural Funds Group, suggesting a price of $1,500 per ML to acquire the permanent entitlement. Details on expected access costs were unavailable at the time of publication, but based on comparable water access charges for the macadamia sector, the annual access price is expected to be $360 per Ha (i.e. $72 per ML). Actual water demand will be phased and really ramp up after the saplings are planted in the orchard. At 5ML per hectare, efficient water infrastructure and minimising the lift distance will be critical in managing this input cost.

Overall, the analysis demonstrates that macadamia orchards are an attractive, high-value opportunity for the region's landholders.

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APPENDIX A: MACADAMIA GROWING CONDITIONS

GROWING CONDITIONS

ORCHARD ESTABLISHMENT

Establishing a macadamia orchard takes careful planning and design to ensure that the final development maximises yield at an efficient cost. Establishing an irrigated orchard has been broken down into five core components:

- Land Selection – soil type, slope and proximity to water sources
- Environment – Temperature variation, rainfall and adverse weather events
- Infrastructure and Service Support – access to support services such as agronomic advisors, inputs and supply chain infrastructure (i.e. processors, transport etc.)
- Nursery access – plantings will be dependent on access to grafted seedlings
- Capital Funding – Macadamia trees only start bearing nuts after 4 years and reach maturity between 12 and 16 years. Funding the establishment phase until maturity is critical for commercial success and enabling a replacement program to be developed to replace the trees at the end of the 30-year life (i.e. 20 years of full of production) is the key to sustainability of any investment. Consultation with DAF provided an indication that macadamia orchards can still provide relatively strong yields after a 30-year lifespan, depending on orchard management practices such as canopy management.

ENVIRONMENT

Environmental considerations are equally important as land suitability. Macadamias are a sub-tropical rainforest tree, where they thrive the best under wet and dry periods (Planting Seeds, 2019). This should give a good idea of the climate requirements for the cultivars, which is similar to areas where avocados, papayas, and bananas grow well.

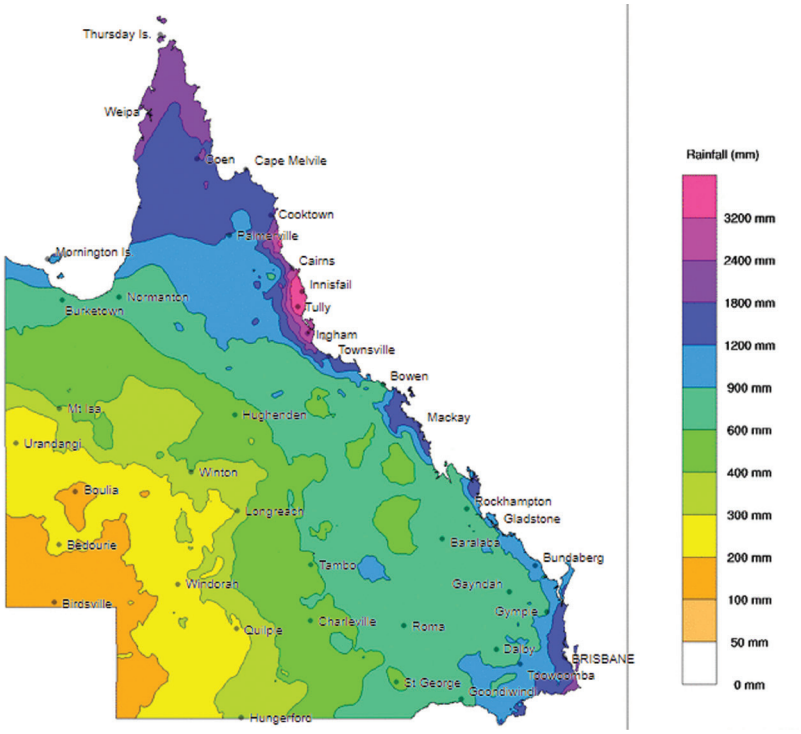
When choosing a site for a macadamia orchard, the maximum and minimum temperatures should considered as well as the altitude and humidity. High humidity can enhance tree vigour, sap flow, fruit set and high-quality kernel. Low humidity can increase 'stress' in the tree with negative results that could result in nut drop, low oil, and bad kernel quality. Frost is also a challenge with trees subjected to low temperatures dying or suffering damage.

For macadamia production, it is important to avoid sites where temperatures regularly exceed 35 degree Celsius (DAF, 2004a). These high temperatures negatively affect the crop in a number of ways including, reduce vegetation growth, may cause leaf burn, increase premature nut drop and impact the macadamia growth and oil accumulation (DAF, 2004a). It is also important to avoid sites where temperatures are regularly lower than 15 degree Celsius (DAF, 2004a). Optimal growth occurs when the temperature is between 20-25 degrees Celsius (DAF, 2024c).

ROOKWOOD WEIR CATCHMENT AREA

Throughout 2021, it was estimated that the Rockhampton region and more specifically, the Rookwood Weir Catchment Area, has experienced approximately 600mm of rainfall (refer to the figure below). This volume is in line with the 30-year average annual rainfall for the region, spanning from 1981 to 2010.

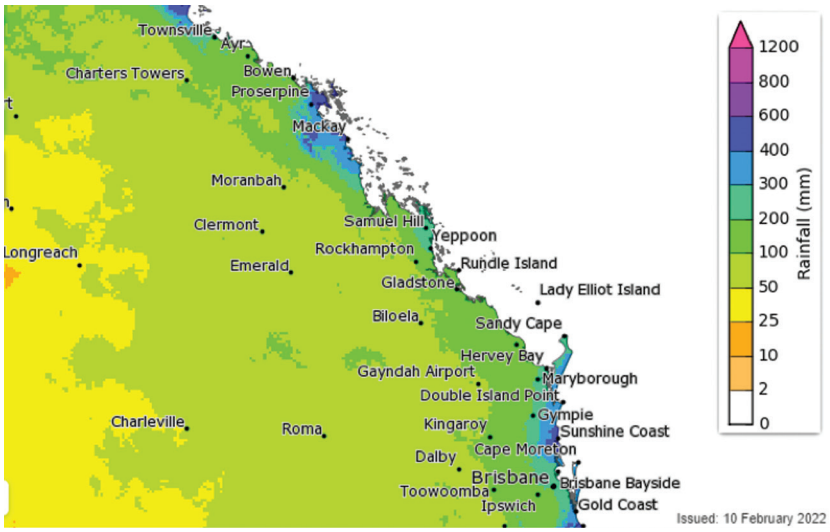
Figure A. 1. Rainfall Map Queensland, 2021



Note: Map highlights the rainfall totals for 12 months from January 2021 to December 2021.
Source: BOM (2022a).

Looking at the future rainfall forecast from the Bureau of Meteorology, the Rockhampton region is expected to receive around 100mm of rainfall between the months of March to May 2022. The figure below provides an indication on the outlook for the region.

Figure A. 2. Climate Outlook, March to May 2022



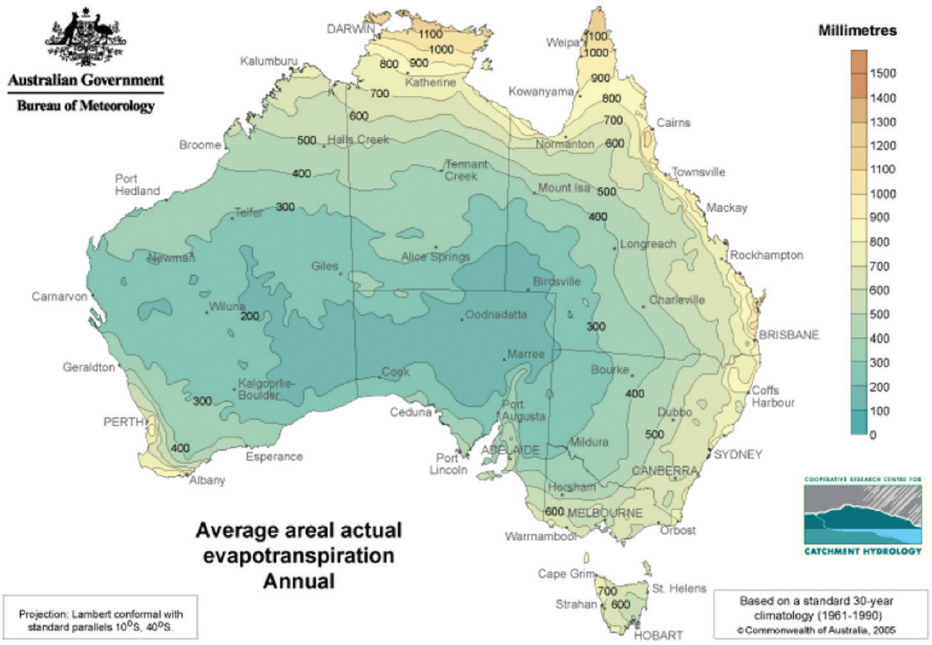
Note: Totals that have a 75% chance of occurring for March to May.
Source: BOM (2022b)

WATER REQUIREMENTS

When considering a site for macadamia production, DAF have highlighted that a location with either rainfall less than 1,200mm or unevenly distributed rainfall is ideal (DAF, 2004a). Where there are extended periods of dry conditions, it is important to consider orchard irrigation. On mature trees, water requirements may be up to 5ML per hectare per year (DAF, 2004a).

The average annual evapotranspiration in the Rockhampton region is approximately 900 millimetres per year. Comparing Figure A. 1 and Figure A. 3, Rockhampton (on average) may experience a net rainfall deficit. This indicates that the available water from irrigation maybe lower than expected and reserves or production sizing may need to be structured to enable continuous production.

Figure A. 3. Average Annual Evapotranspiration



Source: BOM (2005).

PLANTING

Macadamias are a long-term venture, with production only commencing around the fifth year of tree development and not maturing until about 12 to 15 years after planting (DAF, 2004a).

It is estimated that a well-managed orchard with 312 trees per hectare are expected to achieve 3.5 to 4 tonnes of NIS per hectare (at 10% moisture content)
(DAF, 2004a). The table below provides a breakdown on classification of planting densities. Higher density orchards have an earlier return but will also have earlier canopy crowding problems and medium density plantings have similar issues but at a later stage.

Table A. 1 Planting Densities

Planting Densities	Classification
High Density	Greater than 350 trees per hectare
Medium Density	250 to 350 trees per hectare
Low Density	Less than 250 trees per hectare

Source: Australian Macadamia Society (2017).

ORCHARD MANAGEMENT

In the first four years of the macadamia tree, there are six important operations to develop a strong tree for future production. These important operations include, protecting trees from frost and other damage, fertilising, watering, training and pruning, weed control and mulching and pest disease management (DAF, 2004c). After trees begin to bear the management changes into building a healthy tree for maximum yield and quality. This process includes fertilising, watering, canopy management, weed control and mulching, management of pests, diseases, disorders and rats, pollination management, windbreak maintenance and fire protection (DAF, 2004c). It is also key to develop a quality management system to satisfy the customer demand and provide efficient operations.

A more detailed step of orchard management during the critical first four years and onwards is provided below.

Table A.2. Managing Macadamia Trees

Stage	Description
First Four Years	
Protection from frost & other damage	If the site location is impacted by frost during winter, it is important to wrap (loosely) the trunks of young trees to above the graft. It is also important to prune the leaves below the graft and provide a form of insulation around the trunk.
Fertiliser	Depending on soil perpetrating activities, fertiliser may not be required for the first few months. After which, a small amount of fertiliser should be applied every eight weeks during the growing season (spring to autumn). Fertigation is the best method, if available.
Watering	For the first few weeks of establishment, it is important to irrigate regularly (up to two to three times per week in extremely hot weather). In the first year up to 40L per tree per week should be applied, growing to up to 150L per tree per week by the fourth year (during hot dry spells).
Training & pruning	Trees should be trained to a central leader, which will minimise breakage from intense winds in the future. During the first two years, it is important to inspect the tree regularly (particularly in summary and autumn) and prune the tree as necessary.
Weed control and mulching	Week control is crucial for newly planted trees. These weeds can be controlled by grassed inter-row areas and mulching along the tree rows.
Pest & disease management	Major pests which are likely to cause problems include macadamia felted coccid, scale insects, macadamia twig-girdler, macadamia leafminer, redshouldered leaf beetle, hares, and kangaroos/wallabies. A major disease could be trunk canker.
Bearing Macadamias Onwards	
Fertilising	Monitoring both leaf and soil nutrient is essential to understand the requirements from the land of the tree itself. Again, fertigation is the recommended application process where irrigation is installed.
Watering	It is important to ensure water stress is avoided from flowering nut to maturity, when rainfall is low and evaporation is high.
Canopy management	There are three main canopy management operations including skirting, trimming, and hedging.
Weed control and mulching	There are two key options for week control. The first being a grassed inter-row with mulching and herbicides under the tree. The second is growing a permanent, living ground cover throughout the orchard (recommended sweet smother grass).
Management of pests, diseases, disorders, and rats	Major insect pests include flower caterpillar, spotting bugs and nutborer. In Southeastern Queensland flowering caterpillar is a problem during July to September (flowering period) while spotting bugs are largely a problem during young nut stages (October to December). For developing nuts during December to February, nutborer is mainly the problem. Some key diseases include blossom blight (mainly in New South Wales), husk spot (premature drop) and trunk canker (problematic in wetter areas). It is also important to monitor tree decline and rats.
Pollination management	Honeybees are beneficial in the orchard for improving nut set. It is recommended to have 2-3 double hives per hectare, with honeybees travelling about 200m.
Windbreak maintenance	Rip lines should be undertaken even two years, between the macadamia trees and the windbreak trees.
Fire protection	It is important to ensure suitable practices are in place to protect the orchard from fire risk by maintaining an effective firebreak around the orchard.

Source: DAF (2004c).

HARVESTING

The first key step in harvesting, is preparing for the harvest itself. The ground in the orchard should be cleared to allow for efficient harvesting and collection. It is also important to ensure any weeds are under control and the ground has an even soil surface.

It is important that picking up macadamia nuts from the ground is as efficient as possibly to avoid nuts being left of the ground until the next harvest round (DAF, 2004c), as this has significant quality implications. Harvest rounds should occur at least every four weeks to support a higher kernel quality.

POST-HARVEST PROCESSING ACTIVITIES

Processors largely purchase the nut from farmers without the husk, requiring on-farm facilities to first dehusk the macadamia (DAF, 2004c). Some processors will accept macadamia nuts which have not been dehusked, including Marquis Macadamia's approved dehusking facilities (Marquis, 2021b). If the nut is delivered to the processor with a husk, there will be a dehusking and/or sorting charge to the grower (Marquis, 2021b).

The fibrous outer husk is required to be removed within the first 24 hours of harvest, which supports to prevention of deterioration through reducing heat respiration. After the dehusking process, it is crucial to dry the macadamia to reduce the moisture content. The moisture content of macadamias may be as high as 30% NIS (Australian Macadamia Society, 2021c). NIS at 10% moisture can only be stored for around two weeks at 25 degrees Celsius before the shelf life is impacted (Australian Macadamia Society, undated b).

APPENDIX B: FINANCIAL MODELLING CONVENTIONS

The key modelling conventions used as a part of this analysis are detailed below. These conventions have been adopted to ensure consistency of treatment across all commodities evaluated.

EVALUATION TIMELINE

The financial and commercial evaluation spans a period of 20 financial years, starting from financial year (FY) 2021-22. All base cost assumptions used in the financial model are in Real FY2022 terms and have been escalated accordingly, across the timeline. The macadamia farm modelling assumes the farm establishment (after award of Rookwood Weir water allocation) will begin from 1 January 2023.

ESCALATION

A number of guiding financial assumptions underpin the financial analysis, such as the Consumer Price Index (CPI) and Wage Price Index (WPI). These assumptions are detailed in Table B. 1. All costs presented in the following sections are in nominal terms (i.e., accounts for inflation), unless otherwise stated.

Table B.1 Escalation Rates

	Assumptions	
Consumer Price Index	1.75%	FY2021-22
	1.75%	FY2022-23
	2.00%	FY2023-24
	2.25%	Long-term Rate
Wage Price Index	2.25%	FY2021-22
	2.25%	FY2022-23
	2.50%	FY2023-24
	2.50%	Long-term Rate

Source: Queensland Treasury (2021)

DEPRECIATION AND AMORTISATION OF ASSETS

The depreciation/amortisation treatment of each asset type is as follows:

- Land and water entitlements – These assets are non-depreciable assets (ATO, 2021b). Water entitlements, as with land values, can appreciate or decline in value over time. The appreciation of water entitlements is dependent on a number of factors, such as seasonal and whether events. Any changes in the value of land or water entitlements have not been considered in the financial analysis and may provide an upside benefit to landholders.
- Irrigation system – The irrigation system is treated as a single asset in this analysis. It is depreciated on a straight-line basis, with a useful life of 15 years and a residual value of zero. The useful life applied is blended useful life of irrigation and pump systems pursuant to the ATO (2022) guidelines. This asset is depreciated in the first period after the completion of installation, that is, the first instance of depreciation for the irrigation system is May 2023.
- Storage and general farm equipment – These assets are not distinguished on a cost basis between built infrastructure and purchased machinery and equipment. In modelling the depreciation of this asset group, the total asset value has been depreciated on a straight-line basis with a residual value of zero. A notional 30-year useful life has been applied, to factor in the longer useful lives of built infrastructure (such as the sheds) and the shorter useful lives of mechanical machinery and equipment. The first incurrence of deprecation of this asset group is May 2023.
- A key defining feature of this group of assets is that without distinct asset list, the entire asset group is depreciated. This means any individual assets within this group which would fall within the taxable write-off threshold of $150,000 (assuming the 2021 taxation rules are the status quo for the forecast years) have been ignored (ATO, 2021a).
- Harvesting and processing equipment – This asset group is also depreciated on a straight-line basis with a residual value of zero. The useful life applied 12 years, as a blended useful life for harvesting, picking, and processing asset within the fruit and tree nut growing agricultural assets (ATO, 2022). As these assets are not acquired until the year of first harvest, the depreciation expense is first incurred in February 2027.

- Trees – As a horticultural asset, trees decline in value over their effective life (ATO, 2016). The declining value applies only to the capitalise value of establishing the plant, meaning the land, and the process of clearing land are not included in the asset value. The effective life of a horticultural plant typically begins at maturity and lasts until decline. For macadamia trees, this effective life for tax purposes is typically 24 years. The ATO provides a schedule of annual write-off value, as a percentage of capitalised value. With an effective life of 24 years, the annual write off for a macadamia tree is 7%.

Some required assets can be depreciated at an accelerated rate for tax purposes. In this analysis, a straight-line depreciation rate has been applied and any consideration to asset write-offs or accelerated depreciation has not been considered. This places a limitation on the interpretation of the financial outlook and may not be reflective of individual circumstances.

APPENDIX C: INPUT-OUTPUT METHODOLOGY

INPUT-OUTPUT MODEL OVERVIEW

Input-Output analysis demonstrates inter-industry relationships in an economy, depicting how the output of one industry is purchased by other industries, households, the government and external parties (i.e. exports), as well as expenditure on other factors of production such as labour, capital and imports. Input-Output analysis shows the direct and indirect (flow-on) effects of one sector on other sectors and the general economy. As such, Input-Output modelling can be used to demonstrate the economic contribution of a sector on the overall economy and how much the economy relies on this sector or to examine a change in final demand of any one sector and the resultant change in activity of its supporting sectors.

The economic contribution can be traced through the economic system via:

- Initial stimulus (direct) impacts, which represent the economic activity of the industry directly experiencing the stimulus.
- Flow-on impacts, which are disaggregated to:
  - Production induced effects (type I flow-on), which comprise the effects from:
    - Direct expenditure on goods and services by the industry experiencing the stimulus direct suppliers to the industry), known as the first round or direct requirements effects.
    - The second and subsequent round effects of increased purchases by suppliers in response to increased sales, known as the industry support effects.
  - Household consumption effects (type II flow-on), which represent the consumption induced activity from additional household expenditure on goods and services resulting from additional wages and salaries being paid within the economic system.

These effects can be identified through the examination of four types of impacts:

- **Output** – Refers to the gross value of goods and services transacted, including the costs of goods and services used in the development and provision of the final product. Output typically overstates the economic impacts as it counts all goods and services used in one stage of production as an input to later stages of production, hence counting their contribution more than once.
- **Gross product** – Refers to the value of output after deducting the cost of goods and services inputs in the production process. Gross product (e.g., GRP) defines a true net economic contribution and is subsequently the preferred measure for assessing economic impacts.
- **Income** – Measures the level of wages and salaries paid to employees of the industry under consideration and to other industries benefiting from the project.
- **Employment** – Refers to the part-time and full-time employment positions generated by the economic shock, both directly and indirectly through flow-on activity, and is expressed in terms of FTE positions.

Input-Output multipliers can be derived from open (Type I) Input-Output models or closed (Type II) models. Open models show the direct effects of spending in a particular industry as well as the indirect or flow-on (industrial support) effects of additional activities undertaken by industries increasing their activity in response to the direct spending.

Closed models re-circulate the labour income earned as a result of the initial spending through other industry and commodity groups to estimate consumption induced effects (or impacts from increased household consumption).

MODEL DEVELOPMENT

Multipliers used in this assessment are derived from sub-regional transaction tables developed specifically for this project. The process of developing a sub-regional transaction table involves developing regional estimates of gross production and purchasing patterns based on a parent table, in this case, the 2018-19 Australian transaction table (ABS, 2021a). Estimates of gross production (by industry) in the study areas were developed based on the percent contribution to employment (by place of work) of the study areas to the Australian economy (ABS, 2012; ABS, 2017; ABS, 2021b; DoESE, 2021), and applied to Australian gross output identified in the 2018-19 Australian table. Industry purchasing patterns within the study area were estimated using a process of cross industry location quotients and demand-supply pool production functions as described in West (1993). Employment estimates were rebased from 2018-19 (as used in the Australian national Input-Output transaction tables) to current year values using the Wage Price Index (ABS, 2021c).

MODELLING ASSUMPTIONS

The key assumptions and limitations of Input-Output analysis include:

- **Lack of supply-side constraints** – The most significant limitation of economic impact analysis using Input-Output multipliers is the implicit assumption that the economy has no supply-side constraints so the supply of each good is perfectly elastic. That is, it is assumed that extra output can be produced in one area without taking resources away from other activities, thus overstating economic impacts. The actual impact is likely to be dependent on the extent to which the economy is operating at or near capacity.
- **Fixed prices** – Constraints on the availability of inputs, such as skilled labour, require prices to act as a rationing device. In assessments using Input-Output multipliers, where factors of production are assumed to be limitless, this rationing response is assumed not to occur. The system is in equilibrium at given prices, and prices are assumed to be unaffected by policy and any crowding out effects are not captured. This is not the case in an economic system subject to external influences.
- **Fixed ratios for intermediate inputs and production** (linear production function) – Economic impact analysis using Input-Output multipliers implicitly assumes that there is a fixed input structure in each industry and fixed ratios for production. That is, the input function is generally assumed linear and homogenous of degree one (which implies constant returns to scale and no substitution between inputs). As such, impact analysis using Input-Output multipliers can be seen to describe average effects, not marginal effects. For example, increased demand for a product is assumed to imply an equal increase in production for that product. In reality, however, it may be more efficient to increase imports or divert some exports to local consumption rather than increasing local production by the full amount. Further, it is assumed each commodity (or group of commodities) is supplied by a single industry or sector of production. This implies there is only one method used to produce each commodity and that each sector has only one primary output.
- **No allowance for economies of scope** – The total effect of carrying on several types of production is the sum of the separate effects. This rules out external economies and diseconomies and is known simply as the "additivity assumption". This generally does not reflect real world operations.
- **No allowance for purchasers' marginal responses to change** – Economic impact analysis using multipliers assumes that households consume goods and services in exact proportions to their initial budget shares. For example, the household budget share of some goods might increase as household income increases. This equally applies to industrial consumption of intermediate inputs and factors of production.
- **Absence of budget constraints** – Assessments of economic impacts using multipliers that consider consumption induced effects (type two multipliers) implicitly assume that household and government consumption is not subject to budget constraints.

Despite these limitations, Input-Output techniques provide a solid approach for taking account of the inter-relationships between the various sectors of the economy in the short-term and provide useful insight into the quantum of final demand for goods and services, both directly and indirectly, likely to be generated by a project.

In addition to the general limitations of Input-Output analysis, there are two other factors that need to be considered when assessing the outputs of sub-regional transaction table developed using this approach, namely:

- It is assumed the sub-region has similar technology and demand/ consumption patterns as the parent (Australia) table (e.g. the ratio of employee compensation to employees for each industry is held constant).
- Intra-regional cross-industry purchasing patterns for a given sector vary from the national tables depending on the prominence of the sector in the regional economy compared to its input sectors. Typically, sectors that are more prominent in the region (compared to the national economy) will be assessed as purchasing a higher proportion of imports from input sectors than at the national level, and vice versa.

THE ROOKWOOD WEIR LANDHOLDER SUPPORT AND GRANTS PROGRAM IS PROUDLY FUNDED BY SUNWATER WITH COORDINATION PROVIDED BY ADVANCE ROCKHAMPTON

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