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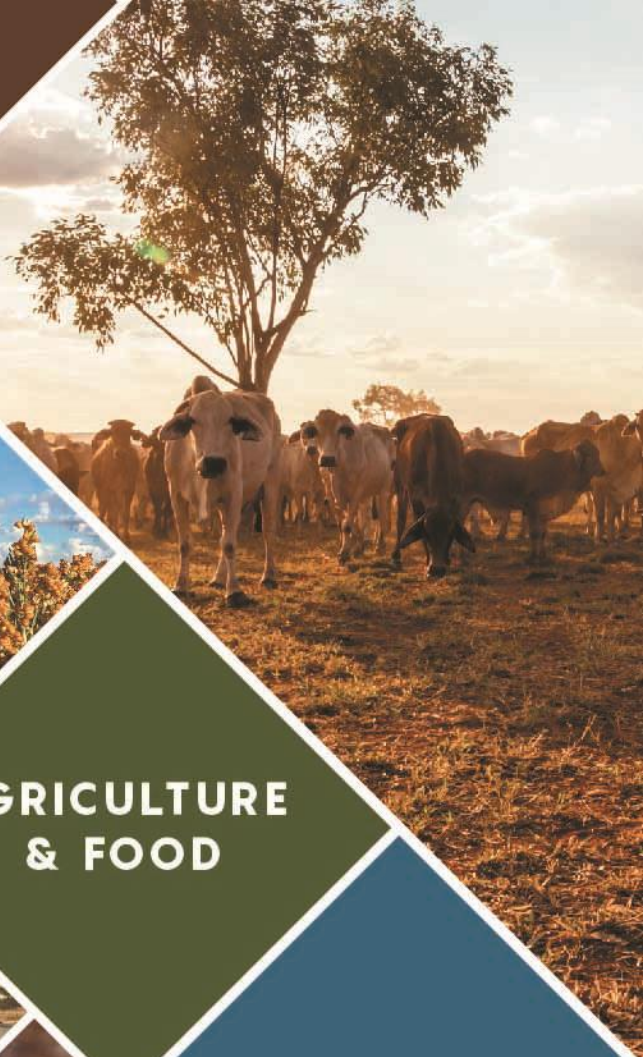

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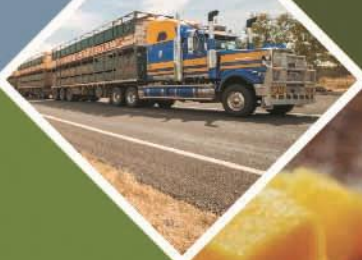

Current and potential High Value Perishable Agricultural Commodities (HVPACs) that have demand in Asian countries

A Case Study of Central Queensland

Akbar, D., Rahman, A., Rolfe, J., Kinnear, S., Bhattarai, S.

CRCNA
DEVELOPING NORTHERN AUSTRALIA

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The CRCNA recognises the value of knowledge exchange and the importance of objective peer review. It is committed to encouraging and supporting its research teams in this regard. The milestone report of project A.1.1718097: Exporting perishable commodities to Asia: Developing a stakeholder collaboration model, has been reviewed by the external reviewer Prof. Hurriyet Babacan from James Cook University.

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Abbreviations

ABS	Australian Bureau of Statistics
ABC	Australian Broadcasting Corporation
CQ	Central Queensland
CQU	Central Queensland University (also known as CQUniversity Australia)
DSDIP	Queensland Department of State Development, Infrastructure and Planning
DAF	Queensland Department of Agriculture and Fisheries
DFAT	Australian Department of Foreign Affairs and Trade
FAO	Food and Agricultural Organisation
HPP	High pressure processing
HVPAC	High value perishable agricultural commodity(ies)
LGA(s)	Local Government Authority(ies)
MLA	Meat and Livestock Australia
Qld	Queensland
RRC	Rockhampton Regional Council

Executive Summary

Northern Australia is an emerging economic region in Australia, and central Queensland (CQ) is one of the most prosperous economic regions within Northern Australia. CQ accounts for nearly 21 billion dollars in the Queensland state economy, including huge volumes of agricultural production. Within central Queensland, perennial horticultural land is underutilised because of low domestic demand for perishable agricultural commodities. This low-demand situation often results in an oversupply of some commodities, resulting in low prices and poor profitability. Exporting high value perishable agricultural commodities (HVPACs) to Asian markets, therefore, offers significant potential for positive economic activity in CQ. An understanding of the demand for, and supply of, HVPACs is an important starting point for planning and development of HVPAC exports from the region. This report provides an assessment of the potential HVPACs from the CQ region that are expected to have high export value in Asian markets.

The research approach is based on a literature review on the types and volumes of perishable agricultural commodities in central Queensland that have high value in the Asian markets. Secondary data were used to estimate the current activity in international trade of perishable commodities. In some instances, quantitative data have been presented in percentage format, whereas in other instances, data have been converted to graphical format for better readability and interpretation.

The key findings of this study are:

- Chilled beef meat, mango, table grapes, avocado, lychee, blueberries, passion fruits, fig, citrus and culinary herbs are the dominant types of perishable commodities currently grown in the CQ region, and which have high demand and high value in targeted Asian markets such as in China, the Middle East and South-East Asian countries. The CQ region also produces fresh pineapple which has high demand in Asian countries, but it is a low-value commodity. The countries listed above are currently importing high-value food commodities from alternative markets in South America, Africa, South Asia countries as well as some from Australia.
- Some HVPACs such as mango, lychee and avocado have counter-seasonal advantages to enter the Asian markets if they produced from the CQ region. In contrast, some HVPACs such as figs and table grapes can grow year-round in Emerald in central Queensland.
- A skilled labour force is readily available in CQ to increase the production of HVPACs.
- The beef industry in CQ is well matured, with forwarding linkages to processing industries and capability to handle higher demands from international markets, compared with what is currently being provided.
- Current trade agreements among Australia, China, South Korea, Japan, Singapore and Thailand means that produces of perishable commodities can access to these Asian markets with a better competitive price.

Some key priorities identified in this study include:

- Securing natural resources of agriculture sectors, including water availability and access to the priority agricultural areas (PAA) as outlined in the CQ regional development plan (DSDIP, 2013).
- Identifying potential market (both domestic and international) for the high value perishable agricultural commodities.
- Acquiring market access to the targeted market.
- Scale up the production gradually to meet the forecasted demand for high value perishable agricultural commodities in the targeted markets.
- Development of horizontal and vertical collaboration in high value perishable agricultural commodities supply chain to increase efficiency.

- Extend the collaboration with local and state government and with industry bodies to smooth out the market access process.

1. Introduction

Northern Australia is an emerging economic region, which includes the central and northern parts of Queensland (QLD), all the Northern Territory (NT) and the northern part of Western Australia (WA). Northern Australia possesses huge agricultural, mining and tourism potential, yet only about 1.3 million inhabitants out of the national population of 25.4 million people live in the Northern Australia region (Austrade 2014; RDA 2014, DIIS, 2016, Australian Government, 2015).

Central Queensland (CQ) is a major economic region within northern Australia, accounting for nearly 21.97 billion dollars in the Queensland state economy during the 2018-19 fiscal year (REMPLAN, 2021, DSDIP, 2013). CQ is a diverse agricultural region which produces beef, sugar, cotton, grains and a range of horticultural commodities. The latter includes many varieties of cucurbits, vegetables, citrus, table grapes, avocadoes, mangoes, lychees and other tropical fruits, which are mostly perishable goods and have a maximum shelf-life of only about one week (DAF, 2013). Agriculture in central Queensland contributes about 25% of the state's total exports (TIQ, 2018). CQ region exports about 80% of the total agricultural products (predominantly beef) to Asian countries, including China Japan and Korea (DFAT, 2018). Therefore, increase the export of high-value agricultural commodities to the Asian markets may be a significant economic focus in central Queensland to maintain the economic dynamics within the region.

Many rapidly developing Asian nations such as China and India are experiencing rapidly growing populations and the emergence of a wealthier middles class (EIU, 2014, p.3). In 2016, about 46% of Chinese households were considered as "middle class" families, yet this figure was predicted to grow to 60% by 2020 (MAGI, 2016). Many Asian countries are confronting difficulties in the use of local resources to fulfil the demands of population growth and therefore, are increasingly using global imports to satisfy demand (EIU, 2014). World demand for agricultural commodities is expected to increase about 77% by 2050 because of global population increase, growth in per capita incomes and increasing urbanisation, especially in Asia (Ash et al., 2014). Consumption of fresh fruits and vegetables is also projected to increase significantly (Ash et al., 2014). Despite these strong growth indicators, the potential for exporting HVPACs from central Queensland is yet to be examined in terms of its supply and market size, labour markets, land and water availability to increase the production, external economies and diseconomies and immobile factors.

This report aims to assess potential HVPACs that have high export value in the Asian markets, and the information has been organised under six sections. The first section forms the introduction. Section 2 describes the methods undertaken, followed by a brief background of the study area, including the regional socio-demographic profile in Section 3. Section 4 describes the available HVPACs in the central Queensland region. Section 5 presents the estimated demand for HVPACs in Asian markets. The report concludes with Section 6.

2. Methodology

The research approach in this project is a mix of desktop study and quantitative analysis on types and volumes of perishable agricultural commodities in central Queensland, with a specific focus on those that have high value in Asian markets.

Data sources included Australian Bureau of Agricultural and Resource Economics (ABARES), Australian Bureau of Statistics (ABS), Queensland Land Survey (QLS), Queensland Department of Agriculture and Fisheries (DAF) and Meat & Livestock Australia (MLA). The potential demand data of perishable commodities in Asian markets have been collected from the statistical database of different countries, international trade information, Food and Agriculture Organisation (FAO) of the United Nations, Australian Government Department of Foreign Affairs and Trade (DFAT) and relevant scholarly articles on business and trade of the selected regions.

Secondary data were used to estimate the current international trade volumes and value in perishable commodities. In some cases, the quantitative data were converted in the percentage form; for other cases, data were converted into a graphical format to provide a better understanding of the current trends. Based on the analysed data, several outcomes have been revealed and some key recommendations are made on exporting HVPACs from CQ.

3. Socio-economic profile of central Queensland

Central Queensland is a Level 4 Statistical Area of within Queensland (ABS, 2017a). This region includes six local government areas (LGA):

- Banana Shire Council,
- Central Highlands Regional Council,
- Gladstone Regional Council,
- Livingstone Shire Council,
- Rockhampton Regional Council and
- Woorabinda Aboriginal Shire Council.

The CQ region has a sub-tropical climate with moist and warm summer together with a dry winter. Central Queensland covers a range of landforms including beaches, plain lands, gem fields, highlands and mountains. The landmass of the region comprises rural and urban holdings, agricultural production areas, resource industries and mine sites, and some protected areas (DSDIP, 2013).

3.1 Location and area

Central Queensland is in the central west of Queensland, surrounded by Mackay Isaac Whitsunday region in the north, the Darling Downs-Maranoa and Wide Bay in the south, the Queensland Outback in west and Pacific Ocean in the east (Figure 1). Central Queensland has a total land area of 117,588 km^2, which represents nearly 6.8% of Queensland (ABS, 2017a). According to the land area data of countries published by United Nations (UN, 2007), the landmass of central Queensland is greater than about 125 independent countries of the world, which signifies the importance of the region and this research study.

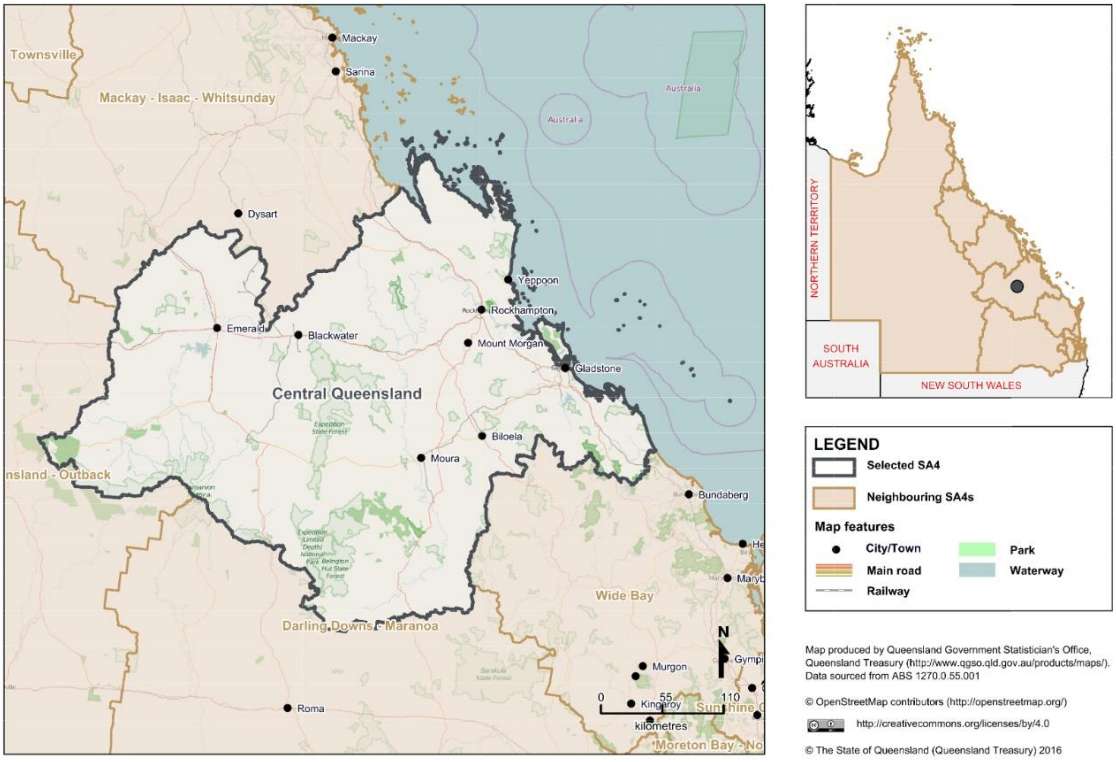


Figure 1: Queensland Statistical Area, Level 4 (SA 4) - Central Queensland (ASGS code 308)

3.2 Land and climate

According to a recent land audit, about 81% of the land area of CQ is used for agriculture, with 74% used for grazing (DAF, 2013). The average annual temperature of central Queensland is 21°C. In season, the base summer average temperature is 27°C while during winter, the same is 15°C (DEHP, 2016). The average rainfall of the CQ region is 707mm per annum (DEHP, 2016). However, the average rainfall is significantly varied across the region and between the years, which affects dryland crop production. Extreme weather events such as major and minor floods, storm surges, cyclones, bushfire and heatwaves occur in Queensland almost every year; however, cyclone or tropical lows in the CQ region are comparatively less than other regions in Queensland (BoM, 2018). Due to the tropical environment and water availability, the major industries of the region are agriculture and extractive resources (primarily thermal coal).

3.3 Water

The Fitzroy River basin is the primary water source in CQ along with Calliope River basin and Boyne River basin. The Fitzroy River basin is the largest catchment in Queensland and the second-largest water basin in Australia (DAF, 2013). Given the variability of rainfall and streamflow in the region, catchments are routinely impounded to provide more consistent and reliable water supplies. Several large dams (e.g. Awoonga Dam, Fairbairn Dam, Callide Dam) plus numerous weirs provide about 2.5 million mega-litres of water storage across the region (DAF, 2013). In recent years, further development plans have been explored to increase the region's freshwater availability, particularly for consumption in the agricultural sector. The Lower Fitzroy River Infrastructure Project (LFRIP, 2017a) involves raising of the existing Eden Bann Weir and establishing a new weir at Rookwood on the Fitzroy River. This project will enable about 76,000 mega-litres of additional water for agricultural production at CQ (LFRIP, 2017b). The project is expected to commence during the 2019 dry season, with a targeted completion date during the 2021 wet season (LFRIP, 2017a). A map of water resources planning for this region can be found in appendix (Figure A5)

3.4 Demographic profile

The population profile of central Queensland with a breakdown by local government areas (LGAs), are summarised in Table 1.

Table 1: Estimated resident population of central Queensland (SA4) and Queensland

LGA/SA4 / State	**As at 30 June**			**Average annual growth rate 2008-2018**	**Average household size**
	2008	**2013**	**2018**		
	Number			(%)	Persons
Central Queensland SA4	**206,990**	**224,898**	**225,625**	**0.9**	**2.6**
Banana (S)	14,880	14,948	14,291	-0.4	2.6
Central Highlands (R)	28,090	29,782	28,645	0.2	2.7
Gladstone (R)	55,425	62,158	62,979	1.3	2.6
Livingstone (S)	31,407	35,279	37,638	1.8	2.5
Rockhampton (R)	76,272	81,745	81,067	0.6	2.5
Woorabinda (S)	916	986	1,005	0.9	3.5
Queensland	**4,219,505**	**4,652,824**	**5,011,216**	**1.7**	**2.6**

Source: ABS 3218.0, Regional Population Growth, Australia, ABS, Census of Population and Housing, 2019

The resident population of central Queensland as of 30 June 2018 was 225,625 persons (ABS 2019a). About 64% of the population live in the cities of Rockhampton and Gladstone. The annual population growth rate of central Queensland is 0.9% which is much lower than the state average. However, Livingstone Shire Council had experienced similar growth rate like QLD for the period 2008 to 2018. The household size of central Queensland is comparative with the Queensland average.

In central Queensland, amongst the persons attending educational institutions, 30.0% were in primary school, 21.7% in secondary school and 12.7% in a tertiary or technical institution (Table 2). Despite the higher enrolment trends in primary and secondary school compared with Queensland and Australia (Table 2); the residents of central Queensland are lagging on acquiring technical and higher degrees. In 2016, only 12.6% of CQ residents had the higher education and/or technical education in contrast to 20.1% in QLD and 22% in Australia (Table 2). Lack of technical or higher education of residents may lead to the inadequate skilled labour force to grow the various industry sectors.

Table 2: Education Profile of central Queensland residents, as of 30 June 2016

Education	Central Queensland	%	Queensland	%	Australia	%
Preschool	2,458	3.6	56,639	3.9	347,621	4.8
Primary	20,549	30	400,514	28	1,926,881	27
Secondary	14,880	22	298,145	21	1,446,507	20
Technical or further education institution	3,111	4.5	76,992	5.3	424,869	5.9
University or tertiary institution	5,574	8.1	213,221	14.8	1,160,626	16.1
Other	1,478	2.2	37,517	2.6	198,383	2.8
Not stated	20,505	29.9	360,888	25.0	1,707,023	23.7

Source: ABS, 2017a

3.5 Employment, labour force and industry statistics

Labour force is one of the key parameters in describing the economic profile of a region. Recent data indicates that during the last decade, the resident labour force has changed slightly, with CQ now being almost identical to that of the broader state (Table 3). The unemployment rate in central Queensland rose from 2.9% to 5.4% from 2011 to 2016 Table 3), which is broadly like the trends recorded for the state.

Table 3: Labour force Percentage CQ vs QLD

Year / Job Status (%)	2006		2011		2016	
	CQ	QLD	CQ	QLD	CQ	QLD
Employed	60.1	58.9	61.5	59	56.4	56.4
Unemployed	2.9	2.9	2.8	3.8	5.4	4.6
Labour force	63	61.8	64.3	62.8	61.8	61.0
Not in labour force	29.8	31.4	28	31.2	29.5	31.8
Not Stated	7.2	6.8	7.7	6	8.7	7.2

Source: ABS, Census of Population and Housing, 2016, Time Series Profile - T33

The distribution of the labour force in a region indicates areas of prospective strength in terms of skilled workers available for different industries. Figure 2 compares the workforce distribution across various industries for the CQ region and the state average. Employment in the Agriculture, Mining and Manufacturing industries sector is higher in CQ compared with Queensland (Figure 2).

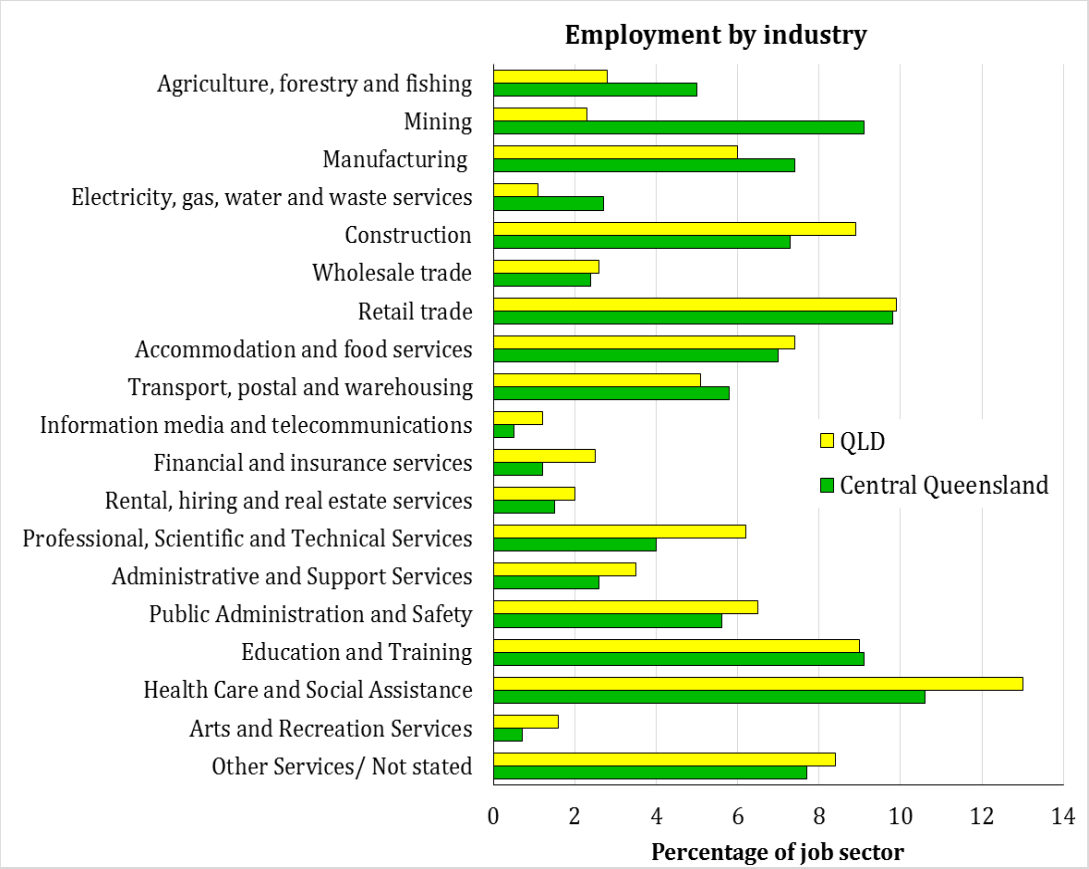


Figure 2: Employment by industry, central Queensland SA4 and Queensland, 2016
Source: ABS, Census of Population and Housing, 2016, Working Population Profile - W09 (place of work)

The transportation and warehousing industry is another strong sector for CQ, with employment figures that are marginally higher than the employment percentage for Queensland. The strengths in agriculture and transportation sector are notable as these can act as a pull factor when creating new economic dynamics for developing HVPACs for the Asian export market.

Employment of the CQ labour force by their occupations is summarised in Table 4. Current data indicates that in CQ, about 24% of the labour force hold positions of managers and professionals (see appendix Table A1), which required highly skilled personnel.

Table 4: Industry of employment by occupation in percentage: central Queensland (2016)

Industry	Managers	Professionals	Technicians and Trades Workers	Service personnel	Labourers	Inadequately described
Primary Industry (Agriculture, Forestry, Mining)	24.1	5.4	54.4	5.4	9.9	1.0
Secondary Industry (Manufacturing and construction)	9.7	4.4	52.9	13.7	18.3	0.9
Tertiary Industry (Service providers)	11.4	10.2	22.0	43.2	12.4	0.8
Quaternary Sector (Education, Health Care and Social Assistance)	5.2	44.1	3.9	41.1	5.2	0.5
Other services/ not stated	7.3	5.9	41.3	24.4	11.6	9.5

Source: Based on ABS, 2016 Census of Population and Housing, central Queensland

About 4.5% of the CQ region labour force is currently engaged with the agriculture, forestry and fishing industry, while another 6% are working in the transport and warehouse industries. Among the labour force of the primary industry sectors in CQ, some 54% are technical and trade workers. The proportion of skilled employees in these two sectors enhance the opportunity of the CQ region to become a potential economic base and business hub based on a strong agricultural industry.

3.6 Summary

The annual population growth rate of central Queensland is currently lower than that of Queensland overall but is higher than some other locations such as the Cairns and Townsville regions (QGSO, 2016). Though the primary and secondary schooling levels in CQ are like the state and national levels, the region is lagging in higher and technical education. Although historically CQ's unemployment rate is lower than the Queensland average, a recent downturn in the mining sector has been attributed to an increase in the region's unemployment rate. Further diversification of the industry representation in CQ and strengthening the primary and processing industries may offer benefits for positive economic dynamics in the CQ region.

About 21% of the CQ labour force is working in the agriculture, mining and manufacturing industries, which is much higher than that of the state's average. About 11% of the CQ workforce are highly skilled employees (e.g., manager, professional or technicians) in the primary industries (agriculture, forestry and mining). Another 11% of the CQ workforce consists of unskilled labour who can contribute to growth in the primary industry sectors, especially in agriculture. The existing and future planned water storages can meet the needs of irrigated and intensive agriculture in the CQ region. Furthermore, some areas of western CQ region may use underground water to meet their irrigation demand. This region also has an advantage with growing counter-seasonal (to Asian countries) high-value tropical fruits as well as comparative advantage of geographic proximity to Asian markets. Therefore, the central Queensland has the potential to grow the HVPACs sector.

4. Perishable commodities and processing in the central Queensland region

A 'perishable commodity' refers to an unpreserved commodity that has a limited shelf time (about seven (7) days) after initial processing or harvesting. Most horticulture commodities and meats are perishable. The CQ region currently produces a range of perishable commodities including chilled beef, vegetables, fruits and herbs. This section describes key perishable commodities of the CQ region in terms of annual production, and the available processing industries to support export chains.

4.1. Perishable commodities

4.1.1 Beef

Beef is the predominant agricultural commodity in central Queensland, as well in the State of Queensland. In 2017-18, Australia produced approximately 2.24 million tonnes carcass weight (cwt) of beef, of which almost half (48.1%) came from Queensland (MLA, 2018). Central Queensland produced about 33% of the total beef production in Queensland (TIQ, 2016). Rockhampton, the key population centre of central Queensland, is also known as the "Beef Capital of Australia", and has an extensive beef breeding, producing and processing capacity.

4.1.2 Pineapple

Queensland is the largest producer of Australian pineapple. In 2018, central Queensland produced about 17 thousand tonnes of pineapple, which represents about 19% of Queensland's pineapple production (ABS, 2018). Pineapple is one of the high demand fruits in China, with the main market suppliers being the Philippines and Malaysia. Currently, Australia exports a negligible volume of raw pineapple (Growcom, 2016). Still, Australia has the potential to enter China's pineapple market by increasing the quality of pineapple, pineapple juice and other (fresh) pineapple products.

4.1.3 Melons

Australia produces three different types of melon, namely watermelon, rockmelon and honeydew melon. The tropical climate of the CQ region is very suitable for growing all varieties of melons. About 33% of Australian melons are produced in Queensland, of which central Queensland contributes about 3.6% (Table 5). The Australian Melon Association is the peak industry body for the melon industry in Australia. There are about 300 Australian melon growers (AMAI, 2018) but eleven commercial watermelon farms are in the CQ region. The main export destinations of Australian melons are the United Arab Emirates, Singapore and New Zealand.

4.1.4 Fresh vegetables and herbs

Queensland is a major producer of several fresh vegetables in Australia including tomatoes, lettuces, capsicums, cabbages, broccoli, herbs and sweet potatoes. A substantial amount, about 4.5 thousand tonnes, of these vegetables are exported to South-East Asian and Middle Eastern countries (Hort Innovation, 2016). However, most of the central Queensland production is destined for domestic consumers. Central Queensland also grows herbs and condiment crops which account for 7% of the total state production, and mostly was used for domestic consumption (ABS, 2018). However, some herb farmers have processed their products, including tubes or bottles packaging for export to fifteen countries (Canlderwood, 2014).

4.1.5 Banana

Banana is considered the world's favourite fruit and dominantly grows in tropical climates. Australia produces about 365,000 tonnes of banana each year and over 95% of this is produced in the far north Queensland. Some local farmers in CQ grow banana for local consumers only. The CQ region has the potential to grow further volumes of banana, but this would be sensible only where there is export demand to do so, as the Australian domestic market is currently oversupplied. Banana has high demand in China and Japan; these nations import banana from South American countries and the Philippines. Australia could take advantages over the South American countries on exporting bananas in China and Japan's niche markets due to geographical proximity which will allow Australian producers to supply fresh banana in a shorter time.

4.1.6 Mandarin

Mandarin is one of the members of citrus fruits which grows in tropical and subtropical regions. Almost 60% of Australian mandarin is produced in Queensland (ABS, 2018). The three main varieties of mandarin are Imperial, Murcott and Afoure. Each year, Australia exports about 35,000 tonnes of mandarins, mostly in China and South-East Asian countries. The CQ region produces 8.6% of the state's mandarin production (RDAFCW, 2013).

4.1.7 Mangoes

In Australia, mangoes are commercially cultivated in tropical and subtropical areas. The Northern Territory and Queensland are accountable for about 95% of total mango production in Australia (AMIA, 2017). About 7,000 ha of mangoes are commercially grown in Queensland (DAF, 2014). However, only 10% of Australian mangoes are exported overseas (AMIA, 2017). The main varieties of mangoes are Kensington Pride, Calypso, R2E2, Honey Gold and Keitt (DAF, 2014). CQ produced about 3.7 per cent of Queensland mangoes in 2017 (ABS, 2018). The two main mango-producing regions, the Burdekin and Bundaberg, are close to the CQ region. The aggregated volume of mangoes from this region supplies major share in the domestic market, and the production can be increased for potential export from these regions.

4.1.8 Lychees

Lychees are a tropical fruit in Australia that grown mostly in central and northern Queensland. Australia produces about 3,000 tonnes of lychees per annum with a farm gate value of AUD 20 million. About 20% to 35% of this production is exported (ALGA, 2017). Recent communication with Australian Lychee Growers Association (ALGA) revealed that about 1,000 tonnes of lychees are produced in Rockhampton and Bundaberg region (roughly 95 per cent of Queensland's production). Lychee trees produce only a single crop annually, but the production season may linger from late October to late March (DAF, 2014), the longest period in the world.

4.1.9 Others

Central Queensland also produces some other perishable commodities which have high value in the international markets such as strawberries, avocado, table grapes, fig and passionfruit, but these typically occur in only small quantities. Some of these fruits, like figs, may be grown in greenhouse environments to allow perennial supply throughout the year (ABC, 2018). A small amount of barramundi and freshwater prawns are grown in the aquaculture systems in central Queensland which can also be exported as perishable goods. Table 5 summarises the production volume of the perishable commodities of Queensland along with the fraction produced in central Queensland.

Table 5: Major perishable commodities of Queensland that have high demand in Asian markets

Perishable commodities	Queensland Production (tonne)	Production volume (tonne) in CQ/Fitzroy	Percentage of QLD
Beef [a, b]	1,110,816	366,570	33%
Fresh Vegetable (tomato, lettuces, capsicum, cabbages, broccoli) [c]	167,090	57	0.034%
Melons [c]	89,438	3,200	3.6%
Mango [c]	34,871	1,290	3.7%
Pineapple [c]	87,497	16,784	19.2%
Mandarin [c]	70,280	453	0.64%
Avocado [c]	33,785	45	0.13%
Strawberry [c]	31,962	3.5	<0.01%
Table grapes [c]	7,704	3,368	43.7%
Lychee[d]	3,000	600	20%
Fresh herbs (parsley, coriander, basil, mint, chives) [c]	4,640	1,546	33.3%
Citrus (excluding Mandarin) [c]	52,341	148	0.5%
Barramundi and Prawn (Aquaculture) [e,f]	7, 882	80.8	1.02%
Mung bean [g]	101,813	31,690	31.1%
Chickpeas [g]	370,580	46,757	12.5%
Banana [c]	363,315	Not reported	Not reported

Source: a: MLA, 2018, Beef fast fact 2018, Online version accessed July, 2019 https://www.mla.com.au/globalassets/mla-corporate/prices--markets/documents/trends--analysis/fast-facts--maps/mla_beef-fast-facts-2018.pdf.; **b:** Market Profile Central Queensland, Trade and Investment Queensland, 2016, available online, https://www.tiq.qld.gov.au/files/tiq-16-1249-regional-overview_rockhampton_final-pdf/ ; **c:** ABS, (2018), 71210DO001_201718 Agricultural Commodities, Australia, 2017-18; **d**: ALGA, 2017, Personal communication, **e:** Savage, J 2015, Australian fisheries and aquaculture statistics 2015, Fisheries Research and Development Corporation project 2016-246. ABARES, Canberra, December 2016; **f:** Heidenreich, M., 2016, Ross Lobegeiger Report to farmers: Aquaculture production summary for Queensland 2015-16. Queensland Department of Agriculture and Fisheries. **g:** ABS), (2017). 71210DO001_201516 Agricultural Commodities, Australia- 2015-16

4.2 Perishable commodities processing industry

4.2.1 Meat processing

Central Queensland is a major beef meat processing region. Three major meat processing facilities are in this region: two in Rockhampton and one in Biloela. Tey's Rockhampton Processor has a slaughtering capacity of 1,731 head per day while JBS Swift's Rockhampton can handle 676 head of beef per day. At Biloela, Teys Ltd has another meat processing facility with a daily slaughtering capacity of 703 head. Because of these meat processing facilities, the beef industry of central Queensland is very productive and contributes significantly to the export value and local economy. In addition to these abattoirs, the central Highlands Regional Council has announced the establishment of a new meat processing plant near Emerald with the capacity to process over 100,000 head per annum (CHDC, 2017). It is assumed that on commissioning this facility, a competitive advantage in transport costs of over AUD 40 per head could be achieved over the existing meat processing facilities in southern Queensland (CHDC, 2017). Also, a meat processing plant near Moranbah is waiting for approval and finance. This plant would be able to process up to 50,000 head per year and employ 90 staff (Bunyard, 2018).

4.2.2 High-pressure processing

High-pressure processing (HPP) is a non-thermal food preservation process, which uses high pressure in a confined vessel to eliminate or inactivate food spoilage microorganisms effectively. HPP allows the food to be preserved without any thermal sterilisation or chemical preservation, and to retain the desirable taste, texture and nutrition characteristics. Crucially, HPP extends the shelf-life of perishable commodities. HPP uses a pressure range from 100 to 800 MPa on foods irrespective of size, shape, composition and packaging. Currently, only a few (about 9) HPP plants are in operation in Australia with none in central Queensland. However, one plant (i.e., Austchillie- a private company owned farm) exists in Bundaberg, which is very close to the central Queensland region. Building a HPP plant directly in the region could allow the local growers and exporters to enhance the supply chain of chilled beef and horticultural products to international markets. The main advantages of using HPP to preserve food are:

- to meet consumer demand concerning freshness and minimal processing;
- avoid the use of chemical additives or involvement of high temperatures;
- extended shelf-life;
- less processing time without any by-product;
- energy efficiencies;
- minimal interference with food taste, texture and nutritional content; and
- processing can be done on final packaging to avoid post-processing contamination.

A range of food can be processed by HPP including dry-cured meat or cooked meat, cheeses, fish & seafood, fruits, vegetables, dairy products and fruit juices. The only concern of HPP is the processing cost which might cause potential market intolerance with the increased sale price.

4.2.3 Cold storage

Cold storage facilities are one of the most vital parts of the supply chain of perishable commodities. It is recommended to hold perishable goods at 5^{o}C or below for the entire period of processing and transportation. On average, foods are moved in and out of refrigeration control 14 times before consumption (AFGC, 2017). Hence, it is essential to maintain an effective cold chain to ensure the safety, shelf-life and quality of perishable commodities. Central Queensland has several cold storage

facilities, although none are dedicated to exporting perishable commodities, except for purpose-built facilities in the meat processing factories.

Along with the cold storage facilities, a dedicated transportation network is required for perishable commodities. Specialised vehicles and equipment are needed to ensure food safety and product quality for the entire transportation time. These protocols require not only simple refrigeration but also supporting features like a corrugated floor, even air circulation, door seals and insulated walls. Further development of the logistics and supply chain infrastructure is prerequisite for exporting perishable commodities to Asian markets, from the CQ region.

4.3 Key challenges and opportunities

The biophysical environment is critical for optimal agricultural yield. Most common biophysical factors are land availability, favourable climate condition, soil quality and water access. In the CQ region, a significant part of potentially productive land is within the mine closure (mainly coal), which lead to a conflict in the land usages (DSDIP, 2013). The potential for future land usage to cultivate annual and perennial horticulture is vast (see appendix Figure A3 an A4). However, the ongoing conflict on the usage of land needs to be resolved to ensure the consistent growth of the horticulture sector. The water availability of the CQ region is moderate and mostly relies on the Fitzroy catchment area. Some recent developments in increasing access to water will unlock the great future for the horticulture industry (QG, 2018).

The horticulture industry in CQ could achieve higher economic growth through the specialization in producing high-value horticulture products. One of the key challenges is the infrastructure for such economic development. Ongoing infrastructure development to secure the water access will help the horticulture industry to grow. Exporting high-value horticulture products could add value to regional economic development. However, the existing three strategic airports of this region need to be upgraded to facilitate the direct export channel from this region. The regional Port of Gladstone is currently focused on coal and other mineral exports and have some facilities in exporting horticultural products. For the economic benefit of this region, the horticulture industry will also need investment from domestic and international investors.

Market access is one of the significant challenges for the CQ horticulture industry. Currently, CQ region exports beef and some other agricultural products to the Asian markets. However, the market access becomes a challenge for CQ exporters due to the increasing food safety measure and export regulation. Government support is required for the local producers to meet the export regulation criteria and to send their products to the international markets.

Technology for producing value added product is another avenue of opportunities for horticulture sectors of CQ. Some development is currently going on in the Livingstone Shire Council to establish an HPP facility for horticulture products of this region. Through processing, the shelf life of several horticulture products could be extended. Digital technologies for market access could be another sector for future development. Development in the genetics allows the local producers to produce new improved varieties of horticulture that has more tolerance with the changing climate of this region.

The supply chain of horticulture produces, especially the perishable horticulture produces, need to be controlled to ensure that high-quality produce is always delivered to the consumers. Therefore, meeting high quality standards by the producers and the processors is a challenge and on the other hand, it is an opportunity for them accessing to the international markets. A further investigation on HVPACs' supply chain logistics and enabling infrastructure is required to increase the efficiency of the current

supply chains as well as on multi-party and sectoral collaboration in using such improved logistics and enabling infrastructure.

4.4 Summary

Processed beef is a well-developed industry among the perishable commodities in central Queensland with three processing centres currently operating and an additional two progressing through the planning and development stages. Pineapple, melons and mangoes are produced in CQ but mostly for domestic consumption. Almost one-third of Queensland's lychees production occurs in CQ and some of these lychees are currently exported to Asian markets. Fresh herbs are also one of the high-value perishable commodities of CQ, with about 1,500 tonnes of fresh herbs being produced in the region, and some of these being exported to one of fifteen different countries. By comparison, the production volume of fresh vegetables in CQ is low and these are mostly grown for domestic consumption. Some of the high-value fruits grown in CQ in small quantities include avocado, strawberry, figs, table grape, citrus, and passionfruit; some these fruits such as figs and table grapes can be grown under Greenhouse round the year.

HPP facilities could be an effective way to process and value add to the perishable commodities of CQ and to attract foreign buyers. However, currently CQ does not have such facilities. Cold storage and dedicated transportation facilities are required for an operational export supply chain of perishable commodities. CQ needs to enhance such facilities for future growth.

5. Demand for perishable commodities in the Asian markets

The current world population is about 7.6 billion people, of which 58% live in Asian countries. About 36% of world's population lives in China or India (FAO, 2017) and the remaining 22% of the Asian populous live in the south, south-east Asia, central and Middle Eastern regions (FAO, 2017). To meet the demands of their rapidly growing populations, these countries import grains, fruits, vegetables, herbs, meat and livestock from other countries. Australia's location near these regions gives Australia substantial opportunities to dominate the international food market by exporting quality perishable commodities. However, with a few exceptions, Australia's food producers and processors have not been very successful in exporting HVPACs compared with other countries. This section aims to identify demand for the perishable commodities of central Queensland in China, South-East Asian and Middle Eastern countries.

5.1 Profile of targeted Asian market

Chinese consumption is one of the main drivers of growth in the global economy (Morrison, 2019). South-East Asian countries and the Middle East also contribute significantly to international market consumption (Gary, 2017). The population growth of these countries is expected to rise over the next 20 years and could exceed 2.5 billion by the year 2030 (FAO, 2017) (see Figure 3). According to FAO (2017), some South-East Asian countries such as Brunei Darussalam, Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam are currently importing HVPACs from other countries. Meanwhile, countries such as Bahrain, Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, the United Arab Emirates (UAE) and Yemen are also currently importing some HVPACs from other countries. A summary of the exporting countries and exporting HVPACs are discussed in the next section.

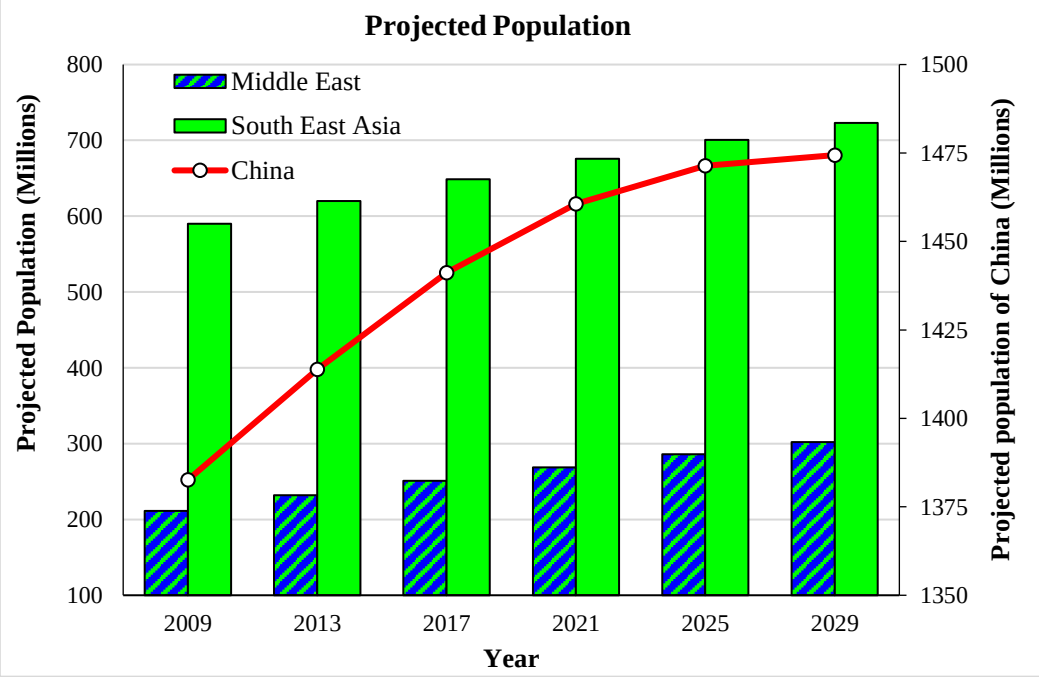
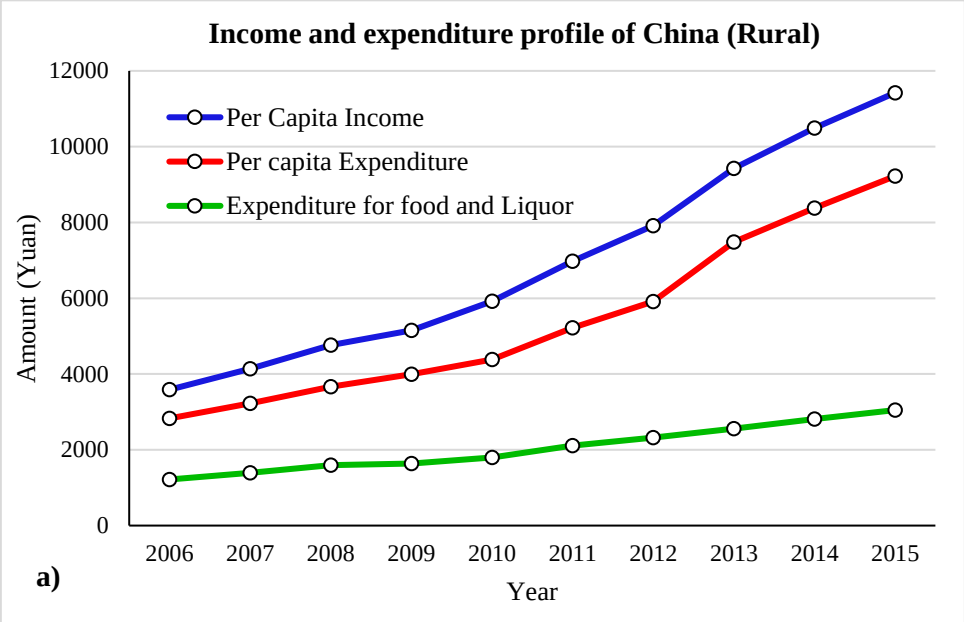


Figure 3: Projected population of China, South East Asia and Middle East

Source: FAO, 2017

In these regions, population growth together with increasing per capita income leads to a higher demand for HVPACs. Figure 4a and 4b indicate the current trend of the per capita income and expenditure of the people of China, both in urban and rural contexts.



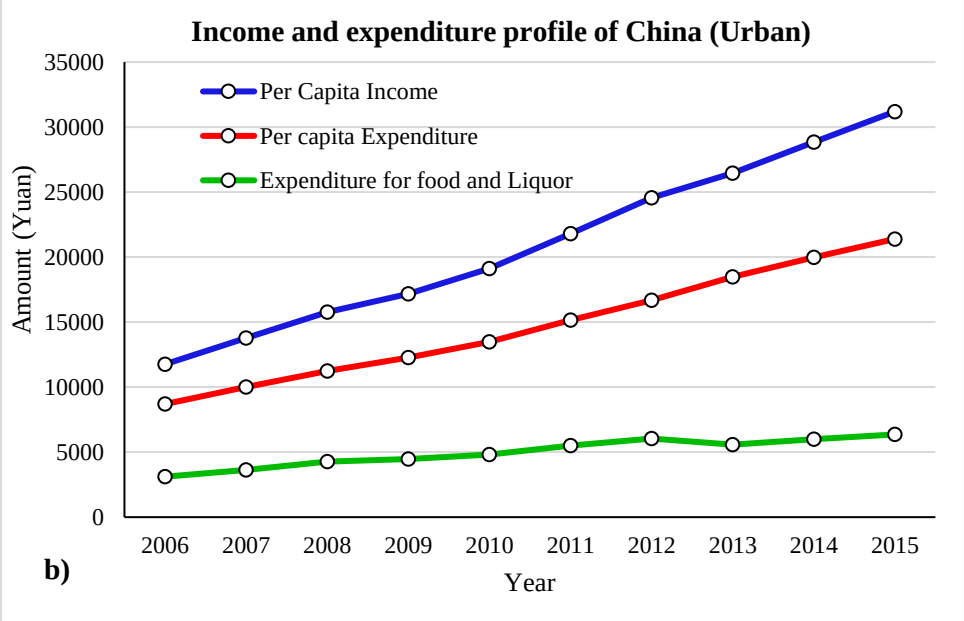


Figure 4: Income and expenditure profile of China – (a) Urban, (b) Rural
Source: FAO, 2017

In a recent study, it was predicted that the growth in food consumption in China would be higher for dairy product, meat and sugar whereas South-East Asian countries are expected to consume fruits and vegetables at a rate significantly higher compared with current consumption (Ash et al., 2014). From 2000 to 2013, per capita consumption of vegetables increased by about 45% while the same for fruits and beef are 115% and 34% respectively (Figure 5). The trend of growing per capita food consumption is predicted to continue until 2030.

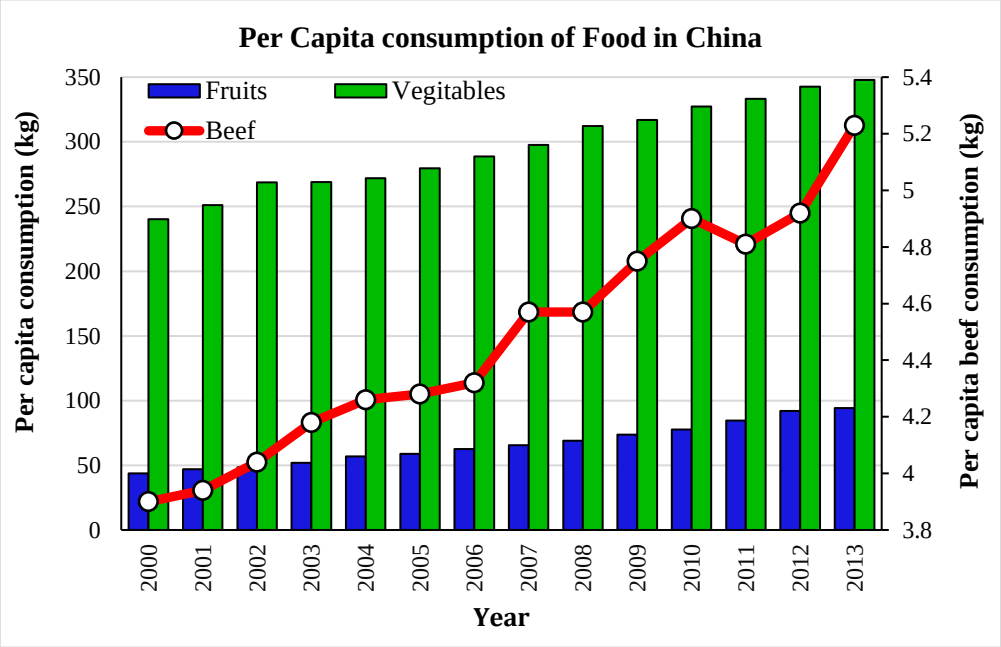


Figure 5: Per capita food consumptions in China
Source: FAO, 2017

China also offers a broad range of opportunities for Australian businesses exporting HVPACs, including the perishable commodities. The 2015 China-Australia Free Trade Agreement (ChAFTA) opened the gates of competitive advantage to Australian exporters wishing to access the emerging Chinese market. A vast range of Australian products including beef, horticultural products and processed food, will benefit from this agreement and the regional producers and exporters should take the opportunity of ChAFTA to increase the export quantities.

5.2 Estimated demand in the targeted Asian markets

The demand for Australian perishable commodities is high in the Asian markets. The demand data and current import trends for individual countries was collected from the literature as well as from respective government websites and integrated in Table 6. Table 6 summarises the estimated demand for perishable goods in the Asian markets. Most of these countries specially China and South-East Asian countries would be good candidates for air freight services from Queensland, given the location proximity. The data presented in Table 6 indicate that the current suppliers of the selected perishable commodities in the Asian market are from various regions of the world. The table 6 also suggests that among the selected perishable commodities, Australia only exports beef in large quantities with some minor amount of pineapple, mangoes, mandarin, avocado and grapes. Recent trade agreements and the possibility of a local airport upgrade may motivate local farmers and tradespeople to develop a supply chain of perishable commodities form central Queensland to targeted Asian markets.

Table 6: Estimated demand of perishable goods in Asian market.

Product	Demand in Asian market (Countries)	Potential Demand (in tonne approx.)	Current suppliers
Beef	China, Indonesia, Japan, South Korea	720,000 (CCS, 2017; MLA, 2016, 2017)	Australia, USA, Uruguay, Brazil
Fresh Vegetable	China, Singapore, Indonesia, Japan and UAE	250,000 (CCS, 2017; Fonsah et.al. 2008; ITC, 2015)	Malaysia, Thailand
Melons	Singapore, UAE and Hong Kong	75,000 (ITC, 2015)	Brazil, South Africa
Mango	Hong Kong and Singapore, China and UAE	150,000 (UNCTAD, 2016)	India, Thailand, Pakistan
Pineapple	China, Singapore and Hong Kong	40,000 (PMA, 2016)	Philippine, Taiwan, Malaysia
Mandarin	Singapore, Indonesia, Thailand and UAE	250,000 (USDA,2017)	China, South Korea, Egypt
Avocado	Japan, China	80,000 (PISA, 2014]	Mexico, Peru, New Zealand, Chile
Strawberry	Saudi Arabia, UAE, China, Hong Kong, Japan, Singapore Malaysia,	31,180 (CCS, 2017; PISA, 2014)	Spain, USA, Mexico
Grapes	China, Hong Kong, Thailand, Korea, UAE, Saudi Arabia	590,301 (CCS, 2017)	Chile, USA
Fresh herbs	Singapore, Thailand	DNF	India, Israel
Citrus (excluding Mandarin)	UAE, Japan, China	1,177,000 (CCS, 2017; CFS, 2015; PISA, 2014)	South Africa, Spain, Turkey
Barramundi and Prawn (Aquaculture)	Vietnam, Japan, Hong Kong, China	DNF	Indonesia, Thailand, Vietnam
Mung bean*	India, Indonesia, Vietnam, Thailand, Japan	DNF	Myanmar,
Chickpeas*	India, Bangladesh, UAE	845,098 (FAO, 2016)	Australia, Mexico, Argentina, USA
Banana	China, Japan	170,000 (CCS, 2017; FAO 2016)	Ecuador, Costa Rica, Philippian

Note: DNF- Data not found**; ***These are not perishable commodities but have listed here as emerging high value agricultural commodities in CQ

5.3 Summary

Population growth, increase in per capita income and the rising middle class of China, South-East Asia and Middle East will increase the demand for HVPACs over the next 20 years. For example, the expenditure on food and liquor doubled in China between 2006 and 2015 because of rapid growth of Chinese middle class. Between 2000 to 2013, per capita beef, vegetables and fruits consumption in China has increased about 34%, 45% and 115% respectively. Apart from Australia, targeted Asian markets import beef from the USA, Uruguay and Brazil, which are far away from the Asian markets, compared with Australia. Mangoes, melon, table-grapes, avocado and the citrus fruits producers have an advantage over the producers of other contending exporting countries due to short air distance to the targeted Asian markets. Counter seasonal production is another competitive advantage of the Australian producers.

6. Conclusion and future priorities

Central Queensland is a planning region of Queensland, is rich in agricultural assets. Central Queensland already has the market access for international trade for some perishable commodities like beef, horticulture fruits and herbs. For this study, the targeted region for (international) trade is Asian markets, especially China, where the demand for HVPACs is increasing. Employment in the agriculture sector of central Queensland is higher than the state average, confirming CQ has both skilled and unskilled labour force in the primary industries and agriculture sectors. Beef, pineapple, mangoes and lychees are the primary perishable commodities grown in the CQ region, and they have high demand in targeted Asian markets such as in China, Middle Eastern and other South-East Asian countries. China, Japan, Korea, Thailand, Vietnam and UAE are currently importing those commodities from South America, African, South Asian countries and some from Australia.

Chilled beef meat, mangoes, table grapes, avocado, lychee, blueberries, passion fruits, fig, citrus and herbs are the main perishable commodities currently grown in CQ region. All these products have high demand and high value in targeted Asian markets such as in China, Middle East and South East Asian countries. These countries currently are importing those commodities from South American, African, South Asian countries and some from Australia. Some of the HVPACs such as mango, lychee and avocado have counter-seasonal advantages to enter the Asian markets. Some HVPCAs such table grapes can grow year-round in Emerald in central Queensland, and it has high-value across most of the Asian countries. A skilled labour force is readily available in CQ to increase the production of HVPACs. The beef industry of CQ is mature with forward linkages to processing industries with the capability to handle the demand of the international markets. Current trade agreements between Australia, China, South Korea, Japan, Singapore and Thailand offer the chance to supply perishable commodities into these Asian markets at a more competitive price.

The following key priorities have been identified as being crucial for the future growth of perishable horticulture industry of CQ:

- Securing natural resources of agriculture sectors, including water availability and access to the priority agricultural areas (PAA) as outlined in the CQ regional development plan (DSDIP, 2013).
- Identifying potential market (both domestic and international) for the high-value perishable agricultural commodities.
- Acquiring market access to the targeted Asian markets.
- Increase use of technology is required to achieve market access and to increase the supply chain efficiency.
- Scale up the production gradually to meet the forecasted demand for HPVACs in the targeted markets.
- Development of horizontal and vertical collaboration in HPVACs supply chain to increase efficiency.
- Extend the collaboration with local and state governments and with industry bodies to smooth out the market access process.

A collaborative effort from the growers and other relevant stakeholders will ensure the future growth of the agricultural sector in CQ. However, the nature of collaboration and the mechanism of the collaboration are yet to be identified. A detailed description of various collaborative models will be given in the Milestone 11-13 Report. One of the key objectives of these models would be improve farmers' return on investment in the short and medium term by cross regional and multi-party collaboration. Therefore, both drivers and barriers for collaboration among different actors in the supply chain is further investigated in the final *Stakeholder Collaboration Models for Exporting Perishable Agricultural*

Commodities in Asia report, ensuring the effectiveness of collaboration. It is to be noted some horizontal collaboration (collaboration among the growers) exists in the horticulture industry of CQ, but only for limited commodities. In the next stage of this study, the research team will conduct a focus group workshop to investigate the factors for collaboration to enhance the supply chain efficiency.

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Appendices

Table A1: Industry of employment by occupation (Count of employed persons aged 15 years and over)

	Managers	Professionals	Technicians and Trades Workers	Community and Personal Service Workers	Clerical and Administrative Workers	Sales Workers	Machinery Operators and Drivers	Labourers	Inadequately described/ Not stated	Total
Agriculture, Forestry and Fishing	2,509	72	152	8	193	36	183	944	31	4,125
Mining	501	599	2,659	41	388	12	3,810	297	89	8,387
Manufacturing	567	355	1,815	67	456	221	981	1,255	54	5,768
Electricity, Gas, Water and Waste Services	164	297	786	15	437	30	282	151	33	2,192
Construction	625	183	2,817	16	866	68	908	1,006	61	6,555
Wholesale Trade	291	137	440	12	318	452	372	184	20	2,217
Retail Trade	1,304	203	661	79	508	5,393	275	949	35	9,410
Accommodation and Food Services	1,138	45	782	1,631	311	919	105	1,610	27	6,570
Transport, Postal and Warehousing	460	404	596	151	1,000	154	2,322	356	68	5,516
Information Media and Telecommunications	64	125	142	3	62	123	15	31	3	563
Financial and Insurance Services	144	299	21	3	709	111	5	7	16	1,324
Rental, Hiring and Real Estate Services	167	74	130	25	301	596	83	70	18	1,465
Professional, Scientific and Technical Services	285	1,365	744	12	877	39	106	218	23	3,666
Administrative and Support Services	163	198	234	160	436	31	123	1,077	18	2,442
Public Administration and Safety	433	985	491	1,212	1,400	39	268	388	57	5,274
Education and Training	548	4,480	275	1,681	853	23	46	445	44	8,404
Health Care and Social Assistance	468	4,126	359	3,784	1,624	60	83	562	57	11,121
Arts and Recreation Services	120	88	100	201	85	28	17	68	8	720
Other Services	233	234	1,906	460	442	70	70	364	24	3,799
Inadequately described/Not stated	287	188	646	178	346	243	316	462	655	3,322
Total	**10,478**	**14,450**	**15,753**	**9,739**	**11,613**	**8,657**	**10,370**	**10,440**	**1,344**	**92,845**

Source: ABS, 2016 Census of Population and Housing, central Queensland, W12 (place of work)

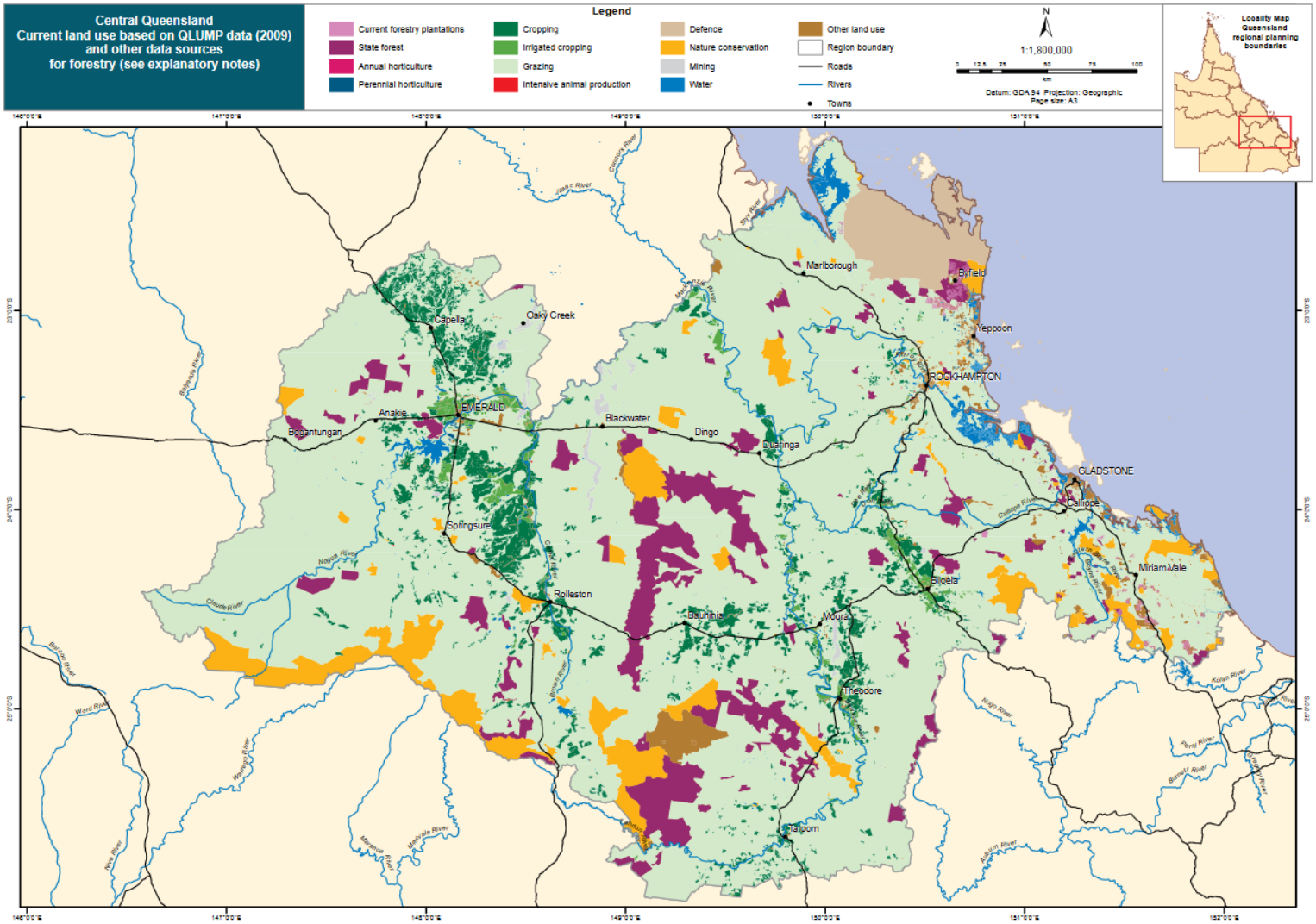

Figure A1: CQ land use based on QLUMP data (2009)

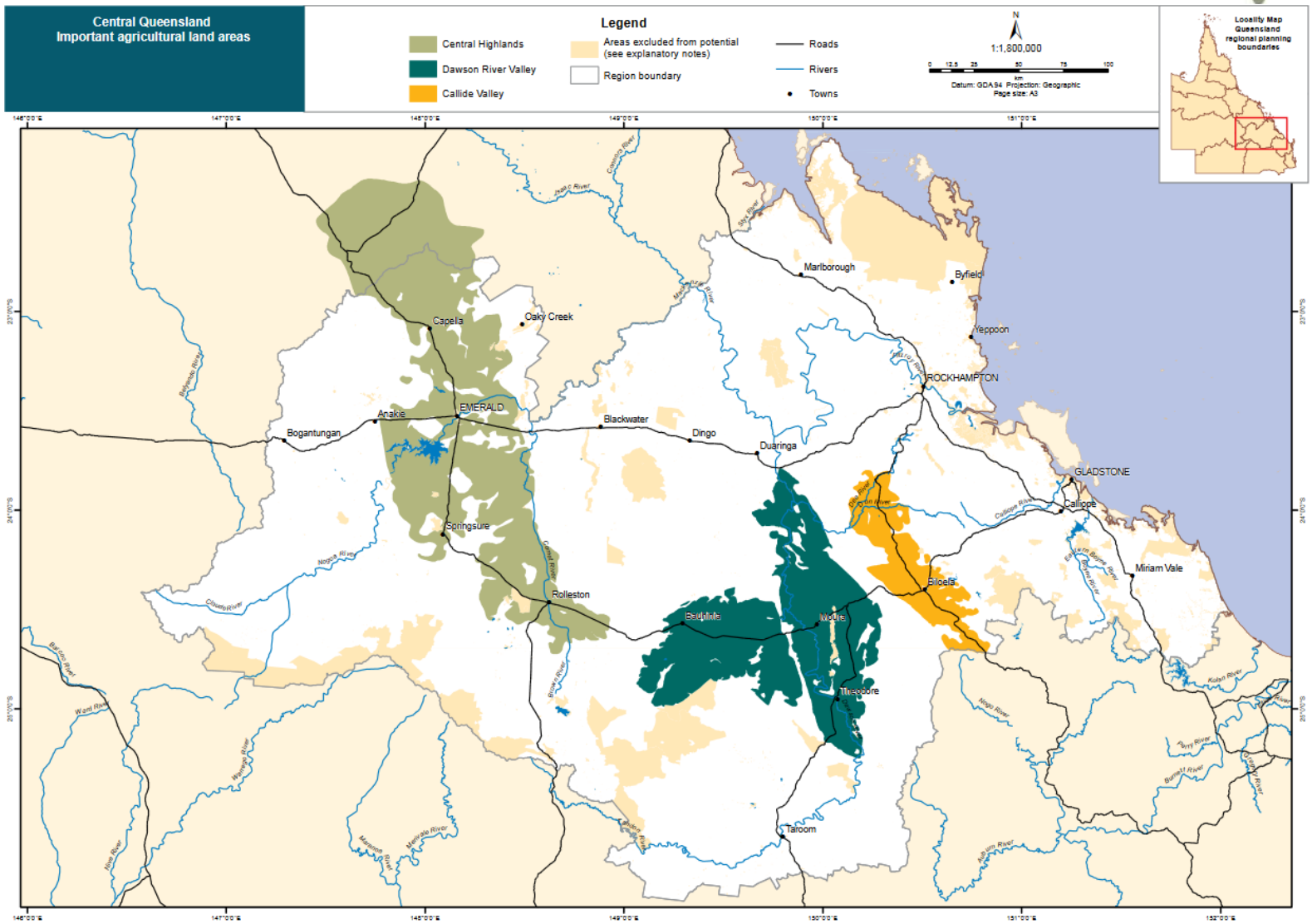

Figure A2: CQ important agricultural land area

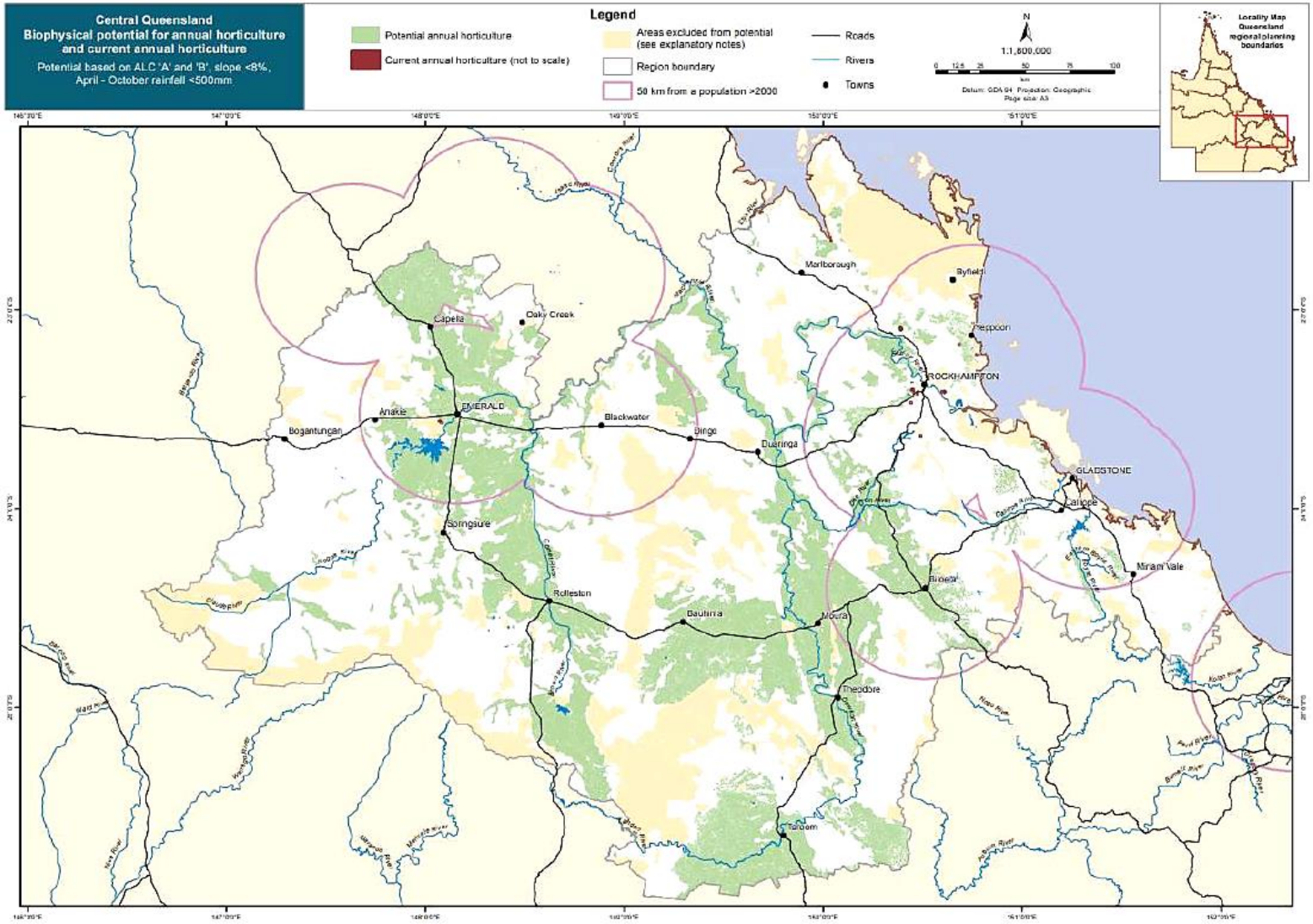

Figure A3: Current and potential biophysical for annual horticulture of CQ (ACIL Allen, 2019)

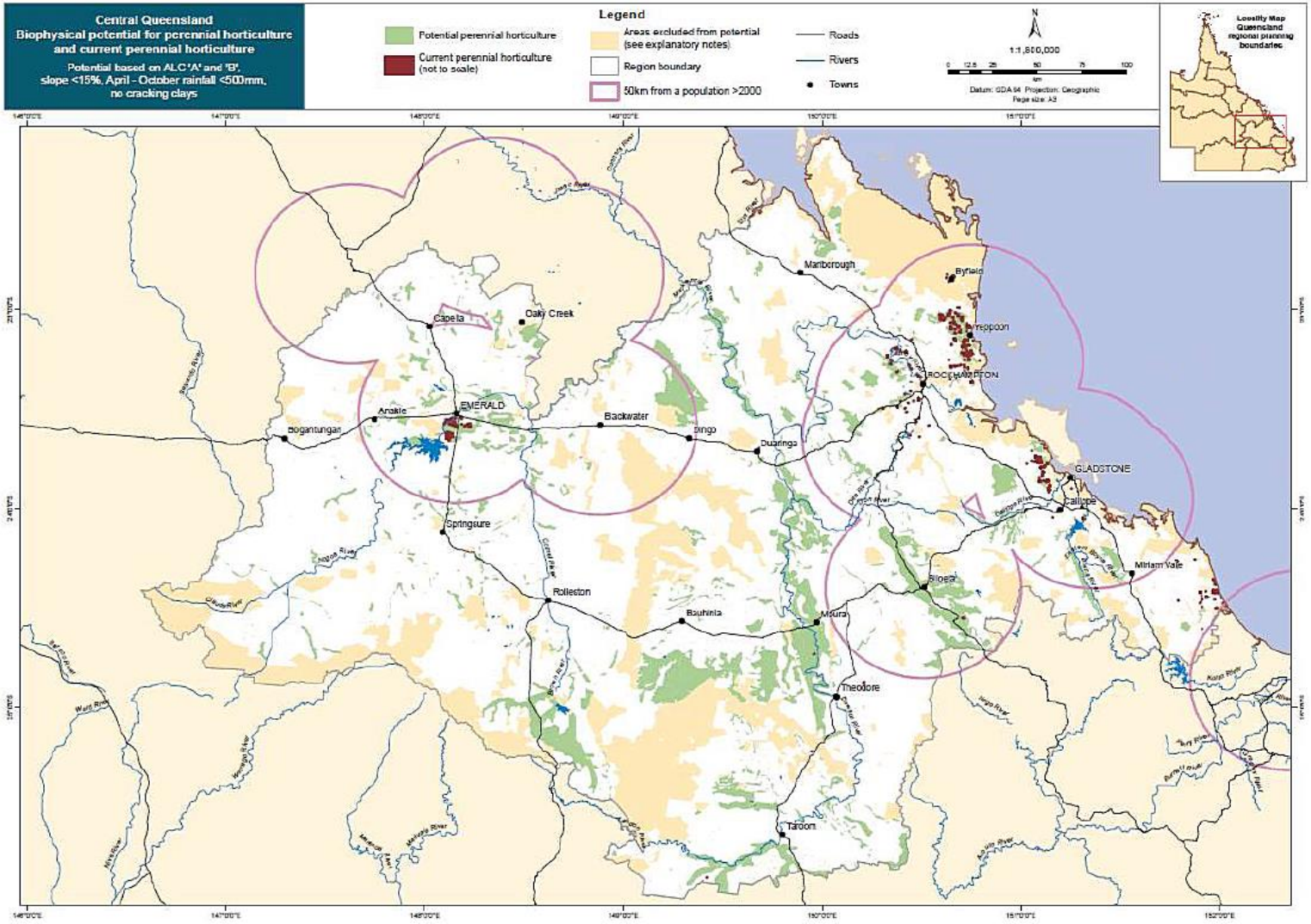

Figure A4: Current and biophysical potential for perennial horticulture of CQ (ACIL Allen, 2019)

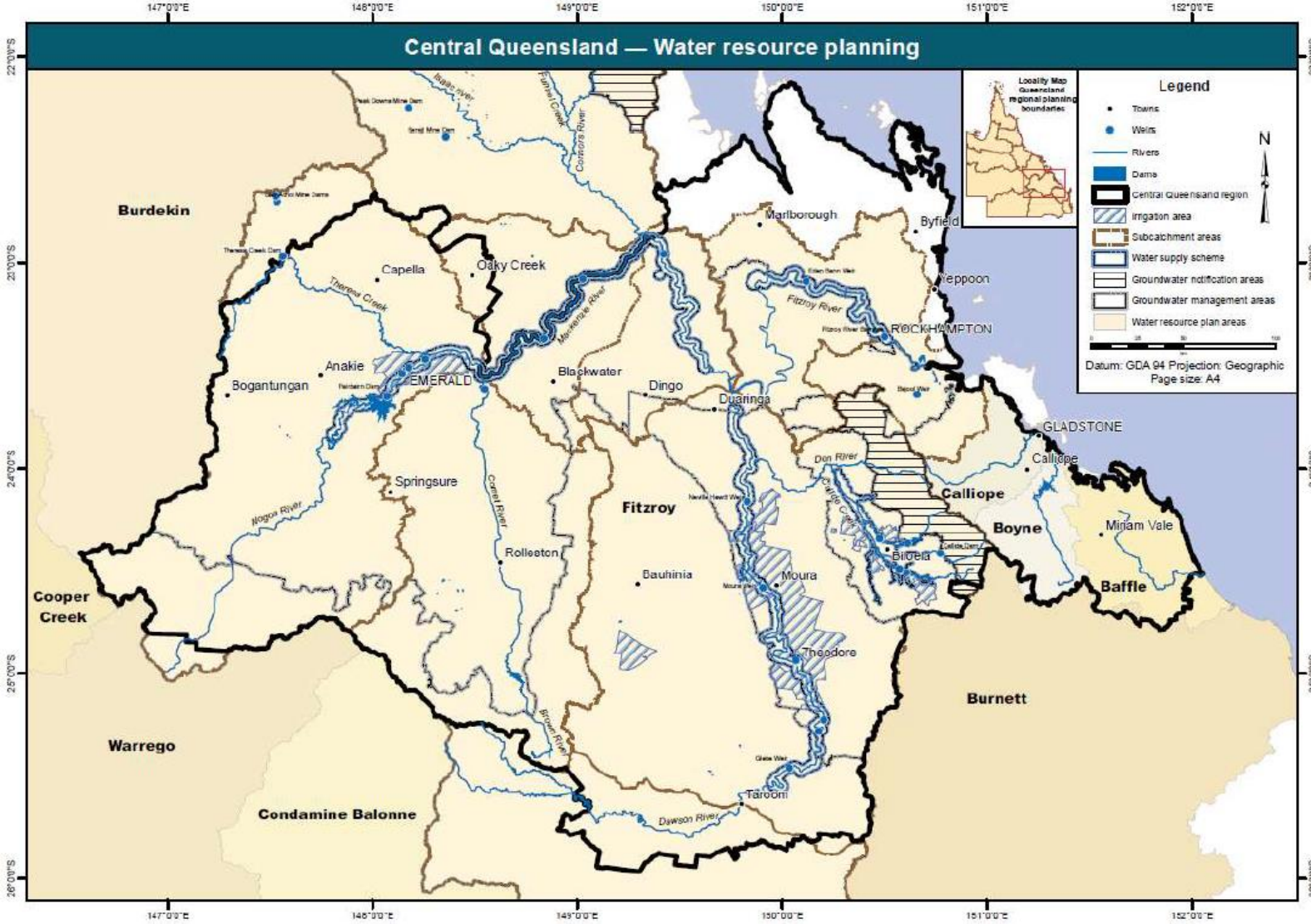

Figure A5: Water resources planning of CQ region