

ANZRSAI Conference 2019

Every community wants an airfreight facility: Is this a viable regional agricultural supply chain development option for central Queensland in Australia?

Azad Rahman*, Delwar Akbar, John Rolfe

School of Business and Law, Central Queensland University

*Corresponding author: a.rahman2@cqu.edu.au

ANZRSI Conference 2019

Every community wants an airfreight facility: Is this a viable regional agricultural supply chain development option for central Queensland in Australia?

Abstract: Central Queensland (CQ) is one of the agriculture intensive regions in Queensland. This region produces a range of perishable agricultural commodities, which have high demand in the Asian markets. Perishable commodities require a well-developed cold supply chain with air freight facilities for transporting fresh commodities to international markets. This paper examines the viability of developing air freight facilities in central Queensland for exporting perishable commodities to Asian markets. A mixed methodology consisting of a literature review, a stakeholder workshop, and qualitative and quantitative data analysis was used for this research. This study found that 71% and 18% of the total production of beef and horticultural products respectively are currently exported overseas from Australia. Some potential issues, including the risk of inconsistent supply, lack of locally based processing and packaging centres, and lack of enabling supply chain infrastructure were identified during the stakeholder workshop. Most participants were looking for improvement of the existing airport into an export-oriented business hub, which could provide local producers with better access to international markets. However, the supply data analysis indicates that the existing supply of horticultural products of CQ is insufficient to develop export facilities in the current airport(s) in the CQ region. It was suggested that the development of inter-regional horizontal collaboration among producers would enable CQ to be a potential perishable agricultural commodity exporting zone. However, another option would be to develop an air freight network with the existing export-oriented airports.

Keywords: Perishable agricultural commodities, horizontal collaboration, inter-air freight network, export, Asian markets.

Every community wants an airfreight facility: Is this a viable regional agricultural supply chain development option for central Queensland in Australia?

Abstract: Central Queensland (CQ) is one of the agriculture intensive regions in Queensland. This region produces a range of perishable agricultural commodities, which have high demand in the Asian markets. Perishable commodities require a well-developed cold supply chain with air freight facilities for transporting fresh commodities to international markets. This paper examines the viability of developing air freight facilities in central Queensland for exporting perishable commodities to Asian markets. A mixed methodology consisting of a literature review, a stakeholder workshop, and qualitative and quantitative data analysis was used for this research. This study found that 71% and 18% of the total production of beef and horticultural products respectively are currently exported overseas from Australia. Some potential issues, including the risk of inconsistent supply, lack of locally based processing and packaging centres, and lack of enabling supply chain infrastructure were identified during the stakeholder workshop. Most participants were looking for improvement of the existing airport into an export-oriented business hub, which could provide local producers with better access to international markets. However, the supply data analysis indicates that the existing supply of horticultural products of CQ is insufficient to develop export facilities in the current airport(s) in the CQ region. It was suggested that the development of inter-regional horizontal collaboration among producers would enable CQ to be a potential perishable agricultural commodity exporting zone. However, another option would be to develop an air freight network with the existing export-oriented airports.

Keywords: Perishable agricultural commodities, horizontal collaboration, inter-air freight network, export, Asian markets.

1. INTRODUCTION

Many Asian nations, including China and India, are experiencing rapidly growing populations and the emergence of a wealthier middle class (EIU, 2014). These Asian countries are increasingly using global imports to satisfy food demands (EIU, 2014). World demand for agricultural commodities is expected to increase about 77 per cent by 2050 because of global population increase, growth in per capita incomes and increasing urbanisation, especially in Asia (Ash et al., 2014). Consumption of perishable products including fruits and vegetables are also projected to increase significantly (Ash et al., 2014).

The current free trade agreements with different trade partners in Asia provides opportunities for the central Queensland (CQ) region to increase trade through exports. It is important to ensure an enabling infrastructure and trading facility framework will be in place to strengthen the trade relationship with international partners. Current supply chains are largely geared towards domestic markets with road and rail transport though to port facilities. However, a sustainable export supply chain could involve an efficient air-transport hub with processing, storing and container facilities and cargo planes. Currently, only Toowoomba and Cairns are regional centres that have such a hub. One of the largest and agricultural intensive regions in the state is central Queensland. Apart from the major production of beef and sugar, CQ produces horticultural crops including many varieties of tropical fruits, which are mostly perishable goods. Exporting high-value horticultural commodities and tropical fruits to the Asian markets may be a major economic opportunity for CQ.

World merchandise trade reached to 19.67 trillion US\$ in 2018 (WTO 2019) and air transportation holds about 40% share by value of world trade in goods (Rodrigue et al. 2017). In Australia, several agricultural commodities are transported by air freight to both international and domestic markets. Currently, most of the international airfreight from Australia are shipped through major international airports which are located in capital cities. Only a few regional airports have the capability to accommodate wide-body cargo aircraft (AgriFuture Australia, 2019). In a recent government-issued report, an emphasis was placed on enhancing regional export opportunities through the development and/or up-gradation of regional airports (DIRDC, 2018)

Due to the perishable nature of major agriculture products of CQ, it is important to study the export supply chain and the potential for air transport facility (transportation option with the shortest time) in this region for future economic growth. This study aims to examine the viability of developing air freight facilities in CQ to export perishable agriculture commodities from the region.

The rest of the paper is organised as follow: Section 2 provides an analytic framework based on the relevant theoretical domain. Section 3 presents a literature review on the role of regional airports in economic development and perishable agriculture commodities supply chain. Section 4 describes the methods and materials of the current study. Section 5 presents the analysis and findings of the study and section 6 conclude the paper with a brief discussion and some recommendation.

2. THEORETICAL DOMAINS

Reginal economic development

Region is a spatial unit, and researchers use the administrative classification to define a particular region which is different from the other regions. Categories of classifications are based on geography, climate, natural resources and socio-demographic concentration (Behrens and Thisse, 2007). Regional systems involve interactions of social, economic and environmental phenomena between and within the regions.

The region can be modelled according to their nature (urban, rural), size (micro, meso and macro) or specialization (eg. Silicon Valley). Regional economic development can be achieved through several dimensions including: increase in productions, export promotion, securing market access, attain specialization and development of human capital (Gurieva, 2015).

The strength of a regional economic system is based on achieving specialization through the production. Initially, regional economic development theories are considered as the extension of some neo-classical economic theories including international trade theory (Dawkins, 2003). However, recent approaches are more realistic and dynamic and based on three basic theories: development theories, location theories and growth theories (Capello, 2019). The new economic geography (NEG) theory (Krugman, 1991) was developed to study the trade interactions between the two regions. Interaction patterns between two regions are very important in the context of the NEG framework and can occur through people movement, trade (including international trade), and intra-regional and inter-regional interactions (Beherens and Thisse, 2007).

Agricultural supply chain

An agricultural intensive region can contribute to regional economic development by enhancing the efficiency of the supply chain and increasing production, which will provide a competitive advantage to producers. In supply chain management, different theories are adopted to predict sustainable competitive advantages. Among the theories, resource-based view theory and transaction cost economics theory are most important and relevant to the current study.

The strategic capabilities of a firm can be enhanced by systematic utilization of resources. The resource-based theory implies that integration occurs among all the parties involved in the supply chain (Wong 2011). Utilizing the concepts of a resource-based view a farm can uplift their capabilities both in operation and marketing sectors (Nath et al., 2010). The literature also suggests that the implication of resource-based view theory can be applied on natural resource management and cost management, and that will develop the resilience and robustness of the agriculture sectors (Brandon-Jones, et al., 2014 Haberli Jr., et al., 2019).

The key concept of the transaction cost theory is that transactions need to be completed with minimum costs involved. A transaction is defined as the transfer of products or service from an upstream to a downstream production stage (Bremen et al., 2010). These transactions stimulate a farm's activities either in the form of vertical integration or through market mechanisms (Cao, et al. 2010).

Specialization

The specialization phenomena are generally derived from trade theory and are closely related to the new economic geography theory (Aiginger and Rossi-Hansberg, 2006). Specialization could lead to several benefits, including an increase in sales, value-adding activities, better competitiveness, lower

transaction costs, technological intervention and regional diversification (Czyzewski and Smedzik-Ambrozy, 2015, Balland et al., 2019). Stakeholders in an agricultural supply chain could play a vital role in improving specialization. The key concept of stakeholder theory is to involve internal and external stakeholders and their knowledge to enhance the efficiency of the farm and its practice (Govindan, 2018, Pagell, Wu, 2009). The effort for specialization could be directed in different dimensions. However, in the current study and in the context of central Queensland region, we are focusing in three main categories which are: increasing production of high-value perishable agriculture commodities, availability of resources, and multimodal transportation systems. Figure 1 indicates the analytic framework of the current research and the theoretical domain of the framework.

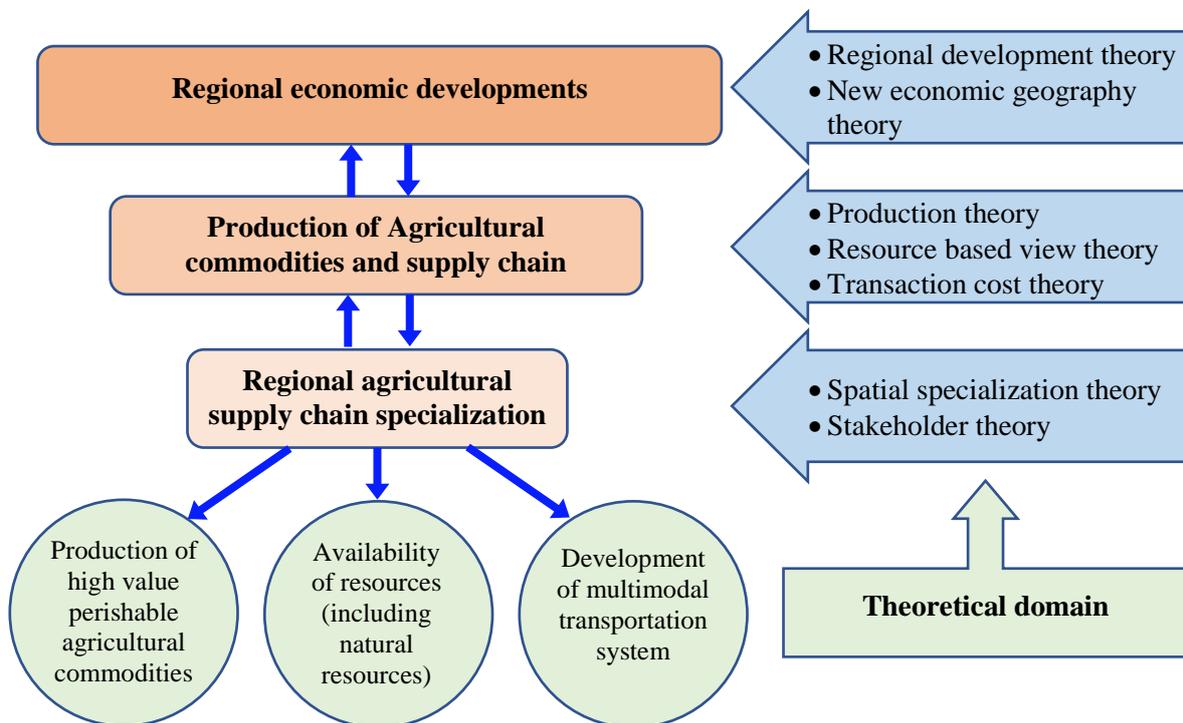


Figure 1: Analytical framework for regional economics and agriculture supply chain development

3. LITERATURE REVIEW

3.1 Role of air freight hub in regional setting

Airports in any region are considered as strategic infrastructure due to its function to connect regions. The literature indicates that an airport could contribute to the local economy through four impact categories: direct impact, indirect impact, induced impact and catalytic impact (Halpern & Brathen, 2011; Percoco, 2010). Employment opportunities and revenue from an airport generate direct contributions in the economy, while the profits obtained from engaging suppliers of goods and services may be considered as an indirect contribution. Induced impacts on an economy occurs by the spending of income of employees in the local business. The airports can also act as a driver for the growth of

other associated industry, and this type of impact is considered as a catalytic impact (Baker et al., 2015). The literature also suggests that there is a strong correlation between air transport and economic growth of a region, although the nature and the degree of correlation depends on several characteristics of the region (Mukkala & Tervo, 2013).

While passenger transport is the major function of airports, we are only focusing on goods for transportation and more specifically on perishable agriculture products in the current paper. Regional airports may provide a region with better access to international markets as well as enhancing the attractiveness of the region for future investment (Tveter, 2017). Different researchers have studied the impact of airports on regional development (Sellner & Nagl, 2010, Tveter, 2017, Hansen, & Johansen, 2017) and affirmed the linkage. In the Australian context, researchers have studied the cointegration and causality analysis (Baker, et al., 2015) and challenges to domestic air freight (Alexander & Merkert, 2017).

3.2 Supply chain for perishable agriculture commodities

A supply chain is an organizational network which produces value from a product or service for consumers through different process and activities. Supply chain management (SCM) can be defined as the management of upstream and downstream suppliers and consumers to provide superior customer value for the product or service at less cost to the supply chain as a whole (Christopher, 2016). Supply chain management deals with complex interactions among supply chain members and decision-making problems (Chandra & Grabis, 2016). The perishable nature of agricultural products makes their supply chain more complex compared with other products. Short shelf-life and appropriate temperature control during storage and transportation are the major challenges regarding perishability. The common challenges in perishable commodities SCM are described below.

Cold storage logistics: it is important to control the temperature during storage and transportation to ensure appropriate product quality at the end of the supply chain (Bogataj et al., 2005). In the global market, sets of regulations are established for perishable product handling and exporting, which need to be complied with by the enterprises.

Integration: Integration with suppliers and consumers is one of the key elements in the SCM of the perishable commodities and it could offer potential benefits to all parties (Alfalla-Luque et al., 2013). Supply chain integration could be categorised in three broad classifications: technical perspective, managerial perspective and relationship perspective (Awad and Nassar, 2010).

Transportation: One of the substantial challenges of perishable commodities SCM is loss and damage during transportation (Ruiz-Garcia and Lunadei, 2010). To reach the global market several transportation steps may be required, were any disruption in the temperature control on the process may lead to low-quality products (Aung and Chang, 2014). Temperature requirements for food items are varied due to the product type and perishable nature (Table 1).

Table 1: Variation of storage temperature for different fruits and vegetables

Storage temperature range		
1-4° C	5-9° C	10° C +
Apple, berry fruits, grapes, peach, plum, broccoli and lettuce.	Avocado, passion fruit, capsicum, mandarin, orange.	Avocado (subtropical), lemon, mango, banana, pineapple, tomato, sweet potato.

Quality: Maintaining strong quality assurance is one of the important factors for processing commodities and distributing across the food chain (Trienekens and Zuurbier, 2008). Food product quality is also closely related to food safety, which is another critical aspect for consumers (Wang and Li, 2012).

Market demand information: Detailed and up-to-date information on market demand and supply is another key element of SCM for perishable commodities. A lack of market demand information could lead to inefficient supply chains, such as those characterised by a delay in production and delivery scheduling (Thron et al., 2007).

4. METHODS AND MATERIALS

The research approach in this paper combined a literature review on types and volumes of perishable agricultural commodities in central Queensland (CQ), a stakeholder's workshop, a review on the existing airports in CQ and qualitative and quantitative data analysis. Data sources include Australian Bureau of Agricultural and Resource Economics (ABARES), Australian Bureau of Statistics (ABS), Queensland Land Survey, Queensland Department of Agriculture and Fisheries (QDAF), Bureau of Infrastructure, Transport and Regional Economics (BITRE) and Meat & Livestock Australia (MLA). To examine the feasibility of the local airport as a potential air transport hub for exporting of perishable agricultural commodities data have been collected from the airport authorities and local government database. Relevant literature of case study on air transport hub was also collected and reviewed.

Findings from the literature review and secondary data have been presented in a stakeholder's workshop; where representatives from the Queensland Government's state planning and agricultural departments, peak agricultural industry representatives, regional economic and tourism development organizations (eg. Capricorn Enterprise), commercial growers, and farmers attended. The purpose of the workshop was to understand stakeholder perceptions about the export potential of perishable agricultural commodities and the importance of building an air-transport hub in central Queensland. This study utilized a narrative analysis and some degree of content analysis. Collected data from the secondary sources are scrutinized to fulfil the purpose of the study. Both qualitative and quantitative data have been collected throughout the study. Based on the analysis of the study a few recommendations are listed to promote perishable agricultural commodities of CQ for exporting into the Asian market.

5. FINDINGS AND ANALYSIS

5.1 Perishable commodities in the central Queensland region

Central Queensland is a Level 4 Statistical Area of Queensland government (QGSO, 2019) with six local government areas (LGA). This region has a sub-tropical climate with moist and warm summer and dry winter. The major industries of this region are agriculture and natural resources (primarily thermal coal).

Perishable commodity refers to the unpreserved commodity that has a limited shelf time (about 7 days) after initial processing or harvesting. Most agricultural commodities are perishable in nature. A range of perishable commodities, including chilled beef, vegetables, fruits and herbs, are produced in the CQ region. Table 2 summarises the production of key perishable commodities of the CQ region.

Table 2: Major perishable commodities of Queensland

Perishable commodities	Queensland production tonne	Production volume (tonne) in CQ/Fitzroy	Percentage
Beef (MLA, 2018, TIQ, 2016)	1,110,816	366,570	33%
Banana (ABS 2018)	363,315	Not reported	0%
Fresh Vegetable (Tomato, lettuces, capsicum, cabbages, broccoli) (ABS 2018)	167,090	57	0.034%
Melons (ABS 2018)	89,438	3,200	3.6%
Pineapple (ABS 2018)	87,497	16,784	19.2%
Mandarin (ABS 2018)	70,280	453	0.64%
Citrus (excluding Mandarin) (Hort Innovation, 2019)	52,341	148	0.5%
Mango (ABS 2018)	34,871	1,290	3.7%
Avocado (ABS 2018)	33,785	45	0.13%
Strawberry (ABS 2018)	31,962	3.5	<0.01%
Barramundi and Prawn (Aquaculture) (Savage, 2015, Heidenreich, 2016)	7,882	80.8	1.02%
Grapes (ABS 2018)	7,704	3,368	43.7%
Lychee (ALGA, 2017)	3,000	600	20%
Fresh herbs (Parsley, coriander, basil. Mint, chives) (ABS 2017)	4,640	1,546	33.3%

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 among which 48.1% came from Queensland (MLA, 2018). In 2017-18 Australia exported about 71% of its total beef production (MLA, 2018). Central Queensland produced about 33% of the total beef production in Queensland (TIQ, 2016).

The value of Australian horticulture exports reaches to 3 billion AUD in year 2018-19 by exporting about 18% of total horticulture production (ABARES, 2018). In horticulture, Central Queensland produced about 17 thousand tonnes of pineapple which is about 19% of Queensland's pineapple production (ABS, 2018). The tropical climate in the CQ region is very suitable for growing all varieties of melons (Watermelon, Rockmelon and Honeydew melon). About 3.6% of Queensland produced melons are from CQ region.

Queensland produces 60% of Australian mandarin and each year Australia exports about 35,000 tonnes of mandarins mostly in China and South-East Asian countries. Mango is another major commodity of Queensland, where CQ produced about 3.7 per cent (ABS, 2018) of Queensland mangoes. Two main mango producing region, Burdekin and Bundaberg, are close to the CQ region and hence the aggregated volume of mangoes in this region is very high. Australia produces about 3000 tonnes of lychees, mostly in central and northern Queensland. Recent communication with Australian Lychee Growers Association (ALGA, 2017) reveals that about 1,000 tonnes of lychees are produced annually in Rockhampton and Bundaberg region. Queensland is a major producer of several fresh vegetables in Australia including tomato, lettuces, capsicum, cabbages, broccoli, herbs and sweet potatoes. A substantial amount, about 4.5 thousand tonnes (Hort Innovation, 2016), of these vegetables are exported to South-East Asian and Middle East countries. Central Queensland also grows a small amount of herbs mostly for domestic consumption.

5.2 Air freights in Australia

Air transport provides better access to international markets, but the associated costs are very high. To export perishable commodities, air transportation is the preferable mode of transportation to preserve the freshness of the products. Several goods and products are exported from Australia by air freight (Table 3).

Table 3: Australian air export commodities

Commodity type	Value (AUD)	Weight (tonnes)	Share
Meat and meat preparations	944,230,137	95,087.0	17%
Vegetables and fruit	363,362,344	92,907.0	17%
Special transactions and commodities not classified according to kind	956,478,505	86,781.1	16%
Miscellaneous edible products and preparations	1,257,269,905	76,060.4	14%
Fish (excl. marine mammals) crustaceans, molluscs and aquatic invertebrates, and preparations thereof	1,046,824,713	28,283.2	5%

Noticeably, the major shares of air freights are perishable commodities. Among the other air freight products, gold, pharmaceutical products, mechanical and electronic equipment have a very high value

(Commonwealth of Australia, 2018). Queensland holds about 15% share of Australian international airfreight, which is about 84 thousand tonnes (Figure 2).

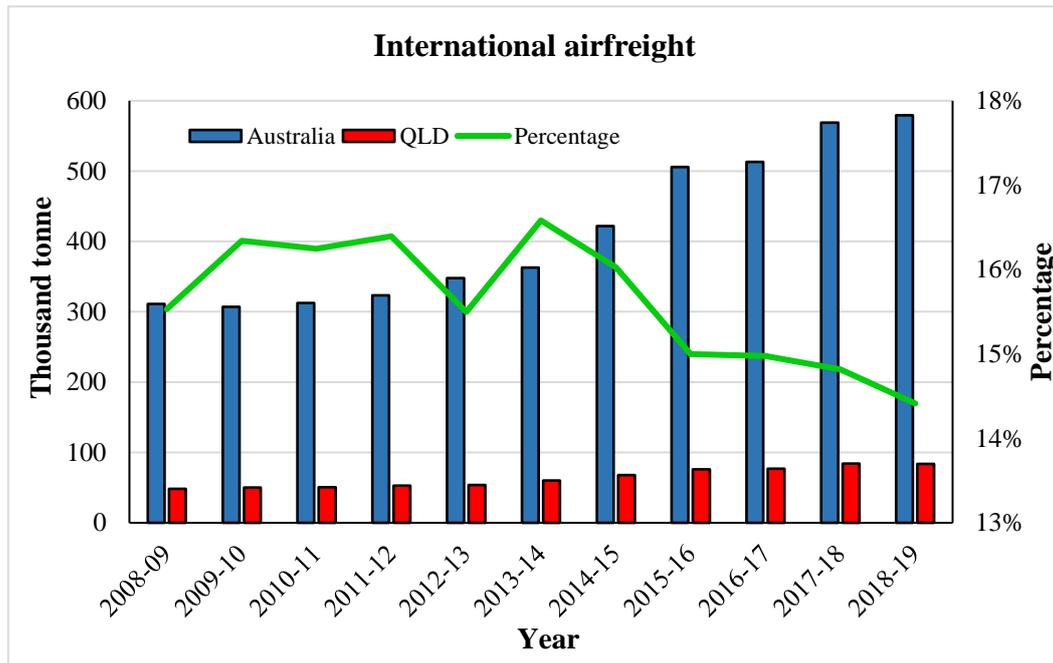


Figure 2: Volume of outbound international airfreight from Australia and Queensland (QLD)
(data source: BITRE, 2019)

Along with agriculture commodities, different goods are transported across Australia through domestic air freight. Over the last two decades, the trend of domestic airfreight has remained consistent, following a linear trend line with some occasional fluctuation (see Figure 3) (BITRE, 2018).

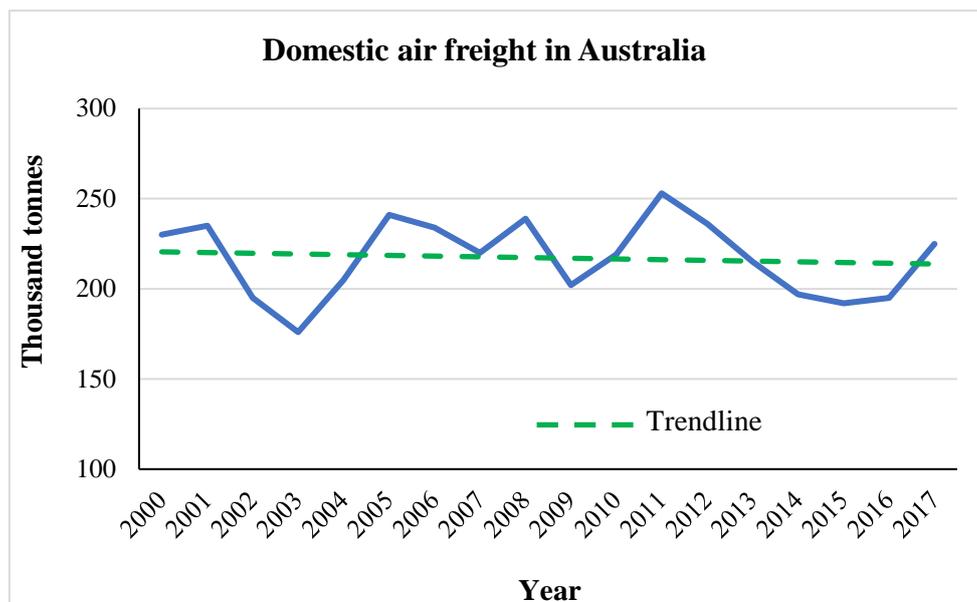


Figure 3: Volume of domestic airfreight in Australia (data source: BITRE, 2018)

5.3 Airports in central Queensland

Central Queensland has three regional airports, Rockhampton, Gladstone and Emerald. This section describes the existing air transport facilities in CQ and their suitability to be becoming an air-transport hub for exporting perishable commodities.

Rockhampton

Rockhampton has the biggest airport in central Queensland, located in the south-west perimeter of Rockhampton city with two runways that are respectively of 2568 metre and 1645 metres in length (RRC, 2017). The land area and the runway length of Rockhampton airport are suitable for upgrade to an international airport and as an export-oriented air-transport hub. Annual aircraft movement from Rockhampton airport is more than 10,000 movements per annum with some occasional international flights. In the recently released Rockhampton airport masterplan, the Rockhampton Regional Council indicates a commitment to exploring and developing air freight facilities to export agriculture and horticulture products internationally (RRC, 2017, pp 40). The council has identified three main challenges for diverting freight traffic from road to air freight facilities (RRC, 2017, pp 41), which are

- Transportation costs
- Journey time
- Available air network and aircraft serving that network.

The council have initiated several studies to investigate the extent of the international market for the agricultural products of CQ so that suitable aircraft operator and additional cargo facilities could be attracted in this region.

Gladstone

The Gladstone Airport is comparatively a smaller airport with high importance because of the Gladstone seaport. About 6000 aircraft movements per annum is recorded for this airport involving more than 300,000 passenger movements (BITRE, 2017). The sole runway of 1920 meter is long enough for medium scale cargo aircraft movements. The airport is located in the middle of the city and there is little vacant area for further extension (Table 4).

Emerald

The Emerald airport is an important regional airport in CQ because of its accessibility and connectivity to the local firms. The land size of this airport is approximately 198 hectares and it has potential extension capability to become an air-transport hub. The longer of two runways is 1900 meters and annual aircraft movements are more than 4500 per year (Table 4). Some small-scale cargo planes have operated from this airport to transfer locally grown products to the capital cities of different states of Australia. Table 4 summarises the basic features of these three airports and provides a better understanding of the potential of these airports for up-grade to air-transport hubs.

Table 4: Comparative features of regional airports in CQ

	Rockhampton	Emerald	Gladstone
Airport Location	Edge of the city	Edge of the city	Middle of the city
Airport size (approximate)	367 hectares	198 hectares	72 hectares
Runway numbers	2	2	1
Primary Runway length	2568 meter	1900 meter	1920 meter
Aircraft movement	10,002	4540	6148
Accessibility	High	High	Moderate
Extension capacity	Limited capacity	Limited capacity	None
Passenger movement annual	565,716	197,476	303,263
International flight movement	Occasionally	No	No
Cargo flight			
Aircraft acceptance	Boeing 747 to 776 and Airbus A340	Can be upgraded for Boeing 737	Boeing 737-800 / Airbus A320
Local agricultural business firm	1138	1175	442

5.4 Stakeholder's perception on developing airfreight hub in CQ

The research team organised a stakeholder workshop at CQUniversity to understand stakeholders' perceptions about the issues related to exporting perishable commodities of central Queensland. The 14 participants represented producers, local and state governments, agricultural peak bodies, agri-food processors and exporters, regional development representatives and researchers. The project team sought opinion through an open floor joint discussion on the viability of air transport hubs in CQ for regional agricultural supply chain development. At the end of the workshop, the project team also asked the stakeholders about future research issues.

During the workshop, the participants showed interest in knowing more about other high-value agricultural commodities that might be suitable for exporting the international markets. All participants agreed that central Queensland has a great road transport system with four national highways. A regional development expert mentioned that in spite of a fully functional seaport in Gladstone, local producers opted to send their product to Brisbane because of high shipment prices and/or delays in the Gladstone port. Participants also agreed that central Queensland currently has no strategic infrastructure for air freight transportation and logistics.

One participant stressed that volumes of specific products are the crucial determinants to developing a air transport business hub for export to Asian markets. Information regarding the potential international clients is also important to predict the demand and the capacity of central Queensland to fulfil the demand. In addition, the participants also questioned the regional readiness in water management (for

irrigation), as some other stakeholders considered this as a major issue of this region for producing perishable commodities. A primary producer added that the most important component for local producers is water supply through a developed irrigation system. The potential development of Rockwood weir has been discussed as it would enhance the water storage level of this region by about 76,000 mega-litres.

One of the development consultants thought that CQ has some advantages on developing a proper supply chain for perishable commodities to be exported in the Asian market. In his/her opinion Rockhampton airport has the advantages of potential cargo shipment where this airport can be upgraded to be a regional air-transport hub. One of the state government officers added two more advantages i.e., the sustainability of local production and availability of skilled labour force in the CQ region.

A local government officer emphasised the current level of government support for developing a perishable commodities business hub in this region, which was supported by several participants. A horticulture producer agreed with the idea of having proper processing infrastructure in this region and that there should be some interactions among the local producers and government bodies both at local and state government levels.

A regional development expert believed that agricultural education (vocational training) and research are also essential to advance the perishable commodities industry. Local government should also increase employment opportunities in this sector to involve the skilled workforce. A horticultural expert thought that market intelligence should be practised with some flexibility in the dynamics between producers, processors, distributors and exporters.

The project team asked the participants to discuss the immediate and medium or long-term requirements to promote CQ's perishable commodities. One local government officer assumed that the cold storage development is one of the immediate requirements for the perishable commodities. In terms of long-term requirements, one local government officer thought that land availability will be a key issue for developing processing to support the perishable commodity industries. Workshop participants agreed that the local council should engage and contribute to developing an air-transport hub and cold storage facilities. The participants acknowledged the insufficiency of the production volumes of CQ's agricultural commodities (excluding beef) compared to the international market demand. The development of air transport hub in this region should be combined with the improvement of enabling infrastructure. The international market access can be achieved by developing an intermodal network to export the perishable commodities of central Queensland.

6. DISCUSSION AND CONCLUSION

Central Queensland has a major agricultural sector which is capable of increasing production to match demand for perishable commodities in some Asian countries. Processing and transportation are the two

of most important forward linkages in the supply chain for exporting perishable commodities. CQ region has a strong road transportation infrastructure and some developed processing industries including beef and pineapples. However, this region is lacking an air transportation hub which is pivotal in exporting perishable commodities.

There are some limitations to CQ developing a consistent supply chain for perishable commodities. One of the main impediments is the lack of water supply to expand production close to the Rockhampton airport. Another impediment is the lack of transport options for perishable commodities. While there are three regional airports in central Queensland; however, none of them is operating international cargo flights.

Secondary data analysis and a stakeholder workshop revealed that beef, pineapple, mangos and lychee have the most potential for export development into targeted Asian markets. The current study also finds that the Rockhampton airport has the potential to become an air transport hub. While the Emerald airport has the advantage of accessibility to a productive agricultural region, the existing runway is not suitable for larger cargo flights and the scope for potential expansion is limited.

The current study recommends several actions for further development of intensive agriculture in the CQ region. First the production of perishable commodities needs to increase to achieve the scale required for export volumes; this will require increased access to resources such as water. Second, there should be gradual development of air transport facilities in parallel with growth in production and international market access. Relevant stakeholders including representatives from local and state government need to be engaged in the development of an air transport hub. Coordination and accumulation of supply between regions to achieve export scale, together with a network of transport options, may be required in the shorter term until a fully functional air transportation hub is established in this region.

Acknowledgements: The research presented in this paper is funded by Centre for Tourism and Regional Opportunity (CTRO) of CQUniversity and the CRC for Developing Northern Australia (CRCNA) and the project partners (Growcom, Rockhampton Regional Council, Passion Fruit Australia, Qld Dept. of Agriculture and Forestry, Qld. Dept. of State Development and Tropical Pines Pty Ltd).

REFERENCES

- ABARES, (2018), Agricultural commodities: September quarter 2018, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra. Available at: <http://www.agriculture.gov.au/abares/Documents/research-topics/ag-commodities/agcommodities-sep-2018.pdf>.
- ABS, (2017), 71210DO002_201516 Agricultural Commodities, Australia- 2015-16.
- ABS, (2018), 71210DO001_201718 Agricultural Commodities, Australia- 2017-18.

- AgriFutures Australia, (2019), The Impact of Freight Costs on Australian Farms, Publication No. 19-005, Project No. PRJ-011380. Available at: <https://www.agrifutures.com.au/product/the-impact-of-freight-costs-on-australian-farms/>
- Aiginger, K., Rossi-Hansberg, E., (2006), Specialization and concentration: a note on theory and evidence, *Empirica*, vol. 33, pp. 255–266, DOI: <https://doi.org/10.1007/s10663-006-9023-y>.
- Alexander, D.W., Merkert, R., (2017), Challenges to domestic air freight in Australia: Evaluating air traffic markets with gravity modelling, *Journal of Air Transport Management*, vol. 61, pp. 41-52, <https://doi.org/10.1016/j.jairtraman.2016.11.008>.
- Alfalla-Luque, R., Medina-Lopez, C., Dey, P.K. (2013) Supply chain integration framework using literature review, *Production Planning & Control: The Management of Operations*, Vol. 24 (8-9), 800-817.
- Ash, A., Gleeson, T., Cui, H., Hall, M., Heyhoe, E., Higgins, A., Hopwood, G., MacLeod, N., Paini, D., Pant, H., Poulton, P., Prestwidge, Di., Webster, T. and Wilson, P., (2014), Northern Australia: Food and Fibre Supply Chains Study Project Report. CSIRO & ABARES, Australia.
- Aung, M.M., Chang, Y.S., (2014), Temperature management for the quality assurance of a perishable food supply chain, *Food Control*, Vol. 40, pp. 198-207.
- Australian Lychee Growers Association (ALGA), (2017), Our industry: Background, available at, <http://www.australianlychee.com.au/our-industry/background>.
- Australian Mango Industry Assosiation (AMIA), (2017), Mango Production, available at, <https://www.industry.mangoes.net.au/mango-production/>
- Awad, H.A.H., Nassar, M.O., (2010), A Broader view of the Supply Chain Integration Challenges, *International Journal of Innovation, Management and Technology*, Vol. 1(1), pp. 51-56.
- Baker, D., Merkert, R., Kamruzzaman, M. (2015), Regional aviation and economic growth: cointegration and causality analysis in Australia, *Journal of Transport Geography*, 43, pp. 140–150.
- Balland, P., Boschma, R., Crespo, J., Rigby, D.L., (2019) Smart specialization policy in the European Union: relatedness, knowledge complexity and regional diversification, *Regional Studies*, vol. 53(9), pp. 1252-1268, DOI: <https://doi.org/10.1080/00343404.2018.1437900>.
- Behrens, K. Thisse, J.F., (2007) Regional economics: A new economic geography perspective. *Regional Science and Urban Economics* 37 (2007) 457–465.
- Bogataj, M., Bogataj, L., Vodopivec, R., (2005), Stability of perishable goods in cold logistic chains, *Int. Journal of Production Economics*, Vol. 93–94, pp. 345–356.
- Brandon-Jones, E., Brian Squire, B., Autry, C.W., Petersen, K.J., (2014), Contingent resource-based perspective of supply chain resilience and robustness, *Journal of Supply Chain Management*, vol. 50(3), pp. 55-73.
- Bremen, P., Oehmen, J., Alard, R., Schönsleben, P., (2010), Transaction costs in global supply chains of manufacturing companies, *Systemics, Cybernetics and Informatics*, 8 (1), pp. 19-24.
- Bureau of Infrastructure, Transport and Regional Economics (BITRE), (2017), Airport Traffic Data 1985–86 to 2016–17, The Bureau of Infrastructure, Transport and Regional Economics (BITRE)

- Bureau of Infrastructure, Transport and Regional Economics (BITRE), 2018, Forecasting Australian Transport: A Review of Past Bureau Forecasts, Report 149, Available at: https://www.bitre.gov.au/publications/2018/rr_149.aspx
- Bureau of Infrastructure, Transport and Regional Economics (BITRE), 2019, Airport traffic data, available at: https://www.bitre.gov.au/publications/ongoing/airport_traffic_data.aspx.
- Cao, M., Vonderembse, M.A., Zhang, Q., Ragu-Nathan, T.S., (2010) Supply chain collaboration: conceptualisation and instrument development, *International Journal of Production Research*, 48 (22), pp. 6613-6635
- Capello, R., (2019), Regional development theories and formalised economic approaches: An evolving relationship, *Italian Economic Journal*, vol. 5, pp. 1–16, DOI: <https://doi.org/10.1007/s40797-019-00085-0>.
- Chandra, C and Grabis, J., (2016), *Supply chain configuration: Concepts, solutions, and applications*, 2nd ed, Springer, New York.
- Christopher, M., (2016), *Logistics & Supply Chain Management*, 5th ed, Pearson, UK.
- Commonwealth of Australia, (2018), Northern Australia Transport study, Study report, available at: https://www.regional.gov.au/regional/publications/files/Northern_Australia_Transport_Study_2_018.pdf.
- Czyzewski, A., Smedzik-Ambrozy, K., 2015, Specialization and diversification of agricultural production in the light of sustainable development, *Journal of International Studies*, vol. 8 (2), pp. 63-73. DOI: <https://doi.org/10.14254/2071-8330.2015/8-2/6>.
- Dawkins, C.J., (2003), Regional development theory: Conceptual foundations, classic works, and recent developments, *Journal of Planning Literature*, vol.18 (2), pp. 131-171.
- Department of Infrastructure, Regional Development and Cities (DIRDC), 2018, Inquiry into national freight and supply chain priorities, Available at: <https://www.infrastructure.gov.au/transport/freight/freight-supply-chain-priorities/index.aspx>
- Department of State Development, Infrastructure and Planning (DSDIP), (2013), Central Queensland regional plan, available at www.dsdip.qld.gov.au.
- EIU (The Economist Intelligence Unit), (2014). *Feeding Asia-Pacific: Australia's Role in Regional Food Security*. London: EIU
- Gurieva, L.K., (2015), New economic geography as the theoretical platform of region innovative Development, *Mediterranean Journal of Social Sciences*, Vol 6 (3), pp. 19-25.
- Haberli Jr., C., Oliveira, T., Yanaze, M., Spers, E.E., (2019), Performance, farmer perception, and the routinisation (RO) moderation on ERP post-implementation, *Heliyon*, vol. 5, e01784, DOI: <https://doi.org/10.1016/j.heliyon.2019.e01784>.
- Halpern, N., Brathen, S., (2011), Impact of airports on regional accessibility and social development, *Journal of Transport Geography*, vol. 19, pp. 1145–1154.
- Hansen, W., Johansen, B.G., (2017), Regional repercussions of new transport infrastructure investments: An SCGE model analysis of wider economic impacts, *Research in Transportation Economics*, vol. 63, pp. 38-49, DOI: <https://doi.org/10.1016/j.retrec.2017.07.004>.
- Heidenreich, M., (2016), Ross Lobbeiger Report to farmers: Aquaculture production summary for Queensland 2015-16. Queensland Department of Agriculture and Fisheries.

- Horticulture innovation Australia limited (Hort Innovation), (2019), The Australian Horticulture Statistical Handbook, 2017/2018
- Krugman, P. (1991). Increasing returns and economic geography. *Journal of Political Economy*, vol. 99(3), pp. 483-499.
- MLA, 2018, Beef fast fact 2018, https://www.mla.com.au/globalassets/mla-corporate/prices--markets/documents/trends--analysis/fast-facts--maps/mla_beef-fast-facts-2018.pdf;
- Mukkala, K., Tervo, H., (2013), Air transportation and regional growth: which way does the causality run? *Environment and Planning A*, vol. 45 (6), 1508-1520.
- Nath, P., Nachiappan, S., Ramanathan, R., (2010), The impact of marketing capability, operations capability and diversification strategy on performance: A resource-based view, *Industrial Marketing Management*, vol. 39, pp. 317–329.
- Percoco, M., (2010) Airport activity and local development: evidence from Italy. *Urban Study* vol. 47, pp. 2427–2443.
- Queensland Government Statistician's Office (QGSO), 2019, central Queensland regional profiles, Queensland Treasury.
- Rockhampton Regional Council (RRC), (2017), Rockhampton airport master plan.
- Rodrigue, J.P., Comtois, C., Slack, B., (2017), *The Geography of Transport Systems*, 4th ed, Routledge, New York.
- Ruiz-Garcia, L., & Lunadei, L. (2010), Monitoring cold chain logistics by means of RFID. In C. Turcu (Ed.), *Sustainable radio frequency identification solutions* (pp. 37-50). Croatia: Intech.
- Savage, J., (2015), Australian fisheries and aquaculture statistics 2015, Fisheries Research and Development Corporation project 2016-246. ABARES, Canberra, December 2016
- Sellner, R., Nagl, P. (2010). Air accessibility and growth-The economic effects of a capacity expansion at Vienna International Airport. *Journal of Air Transport Management*, vol. 16(6), pp. 325-329.
- Thron, T., Nagy, G., Wassan, N., (2007) Evaluating alternative supply chain structures for perishable products, *The International Journal of Logistics Management*, Vol. 18(3), pp.364-384.
- Trade and Investment Queensland (TIQ), (2016), 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/
- Trienekens, J., Zuurbier, P., (2008), Quality and safety standards in the food industry, developments and challenges. *International Journal of Production Economics*, Vol. 113 (1), 107–122.
- Tveter, E., (2017), The effect of airports on regional development: Evidence from the construction of regional airports in Norway, *Research in Transportation Economics*, vol. 63, pp. 50-58.
- UN (2007), United Nations Statistical division, <https://unstats.un.org/unsd/environment/totalarea.htm>
- Wang, X, Li, D, (2012), A dynamic product quality evaluation based pricing model for perishable food supply chains, *Omega*, vol. 40, pp. 906–917.
- Wong, J, (2011), A relational view of resources-based theory: The case of internationalization of Li & Fung group, *The Journal of Human Resource and Adult Learning*, vol. 7(2), pp. 34-39
- WTO (2019), *World Trade Statistical Review 2019*, available at: https://www.wto.org/english/res_e/statis_e/wts2019_e/wts2019_e.pdf.