

ASSESSING THE VIABILITY OF DEVELOPING AIR-FREIGHT FACILITY IN REGIONAL QUEENSLAND, AUSTRALIA FOR EXPORTING PERISHABLE AGRICULTURAL COMMODITIES TO THE ASIAN MARKETS

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ABSTRACT: A major challenge in the agricultural supply chain in northern Australia is the lack of adequate air-freight facilities for transporting perishable commodities to both domestic and international markets. This paper examines the viability of developing air-freight facilities in northern Australia for exporting agricultural produce. Central Queensland (CQ), a predominantly agricultural region in northern Australia, is used as an example to investigate the future prospect of developing an air-freight facility to export perishable agriculture commodities. This research utilized a mixed methodology consisting of a literature review, a stakeholder workshop, and qualitative and quantitative data analysis. One of the key findings of the study is that the development of a stand-alone air transport hub is not possible in the CQ region due to some potential issues, including the risk of inconsistent supply, lack of locally based processing and packaging centres, and lack of enabling supply chain infrastructure. However, an air-freight facility supported by cold storage and processing facilities could be a viable option if the system is connected with any major air transport hub. As Queensland is very decentralized, several air-freight facility developments closer to intensive production regions would improve the current supply chain of

exporting perishable agricultural commodities from regional Queensland to Asian countries.

KEYWORDS: Supply chain; perishable agricultural commodities; horizontal collaboration; air-freight network; export; Asian markets.

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1. INTRODUCTION

World demand for agricultural commodities is expected to increase about 77% by 2050 because of population increase, growth in per capita incomes and increasing urbanisation, especially in Asia (Ash *et al.*, 2014). Many Asian nations, including China and India, are increasingly using global imports to satisfy food demands for their rapidly growing populations (Economist Intelligence Unit , 2014). Consumption of perishable agricultural commodities (PAC) such as fruits and vegetables are projected to increase significantly in the coming years (Ash *et al.*, 2014). A perishable commodity refers to the unpreserved commodity that has a limited shelf time (about 7 days) after initial processing or harvesting. Most agricultural commodities including chilled beef, fruits and vegetables are perishable in nature. Australian domestic markets are saturated with the domestic supply of agricultural products, so export markets are particularly important for longer term growth viability. Due to the perishable nature of major agricultural products, 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.

The current free trade agreements with various Asian countries provide opportunities for regional Australia, particularly Central Queensland, to increase trade through exports. Enabling infrastructure and trading facility frameworks are two critical components to increase exporting agricultural commodities. Current supply chains of PAC in Queensland are largely geared towards domestic markets with road and rail transport through to port facilities. However, a sustainable export supply chain could involve an air-transport hub with processing, storing and container facilities and cargo planes. Currently, only Toowoomba and Cairns are regional centres in Queensland (QLD) that have such a hub. Central Queensland (CQ) is

one of the largest agriculturally intensive regions in QLD. This region predominantly produces beef, grains and legumes. However, CQ also produces horticultural crops, including many varieties of tropical fruits, which are mostly perishable goods. Exporting high-value perishable agricultural commodities to the Asian markets could be a major economic opportunity for CQ. The nearest air transport hubs from CQ regions are Brisbane and Toowoomba, which are 617 km and 642 km away, respectively. It takes about 24 to 72 hours to send perishable agricultural products to these two air transport hubs depending on storage and refrigeration requirements. In some cases, it takes more than a week to ship perishable agricultural products for export destinations because of export protocols, including processing, for example, heat treatment.

World merchandise trade reached US\$19.67 trillion in 2018 (World Trade Organization, 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 air-freight from Australia are shipped through major international airports located in capital cities. Only a few regional airports can accommodate wide-body cargo aircraft (AgriFutures Australia, 2019). In a recent government-issued report, an emphasis was placed on enhancing regional export opportunities through the development and/or upgrading of regional airports (Department of Infrastructure, Transport, Regional Development and Communication (DITRDC), 2018). Rockhampton airport has the capacity to accommodate wide-body cargo aircraft, and it is also one of the regional airports in the priority list for future development proposed by the Department of Infrastructure, Transport, Regional Development and Communication (DITRDC, 2018).

This study aims to examine the viability of developing air freight facilities in CQ to export perishable agriculture commodities from the region. In light of this, three research questions arise:

RQ1: Does CQ require an independent air transport hub to export perishable agriculture commodities? If yes, then where to develop the facility?

RQ2: How would an integrated air-freight facility support increase in the export of perishable commodities from CQ.

RQ3: Which existing airport would best facilitate expansion and accommodate such a facility.

The rest of the paper is organised as follows: Section 2 provides a literature review on the theoretical domain and the role of regional airports

in economic development and perishable agriculture commodities supply chain. Section 3 describes the methods and materials of the current study. Section 4 presents the analysis and findings of the study, and section 5 concludes the paper with a brief discussion and some recommendations.

2. LITERATURE REVIEW

Integrated Supply Chain for Developing Regional Air-Freight Hubs

Regions can be classified on factors such as geography, climate, natural resources and socio-demographic concentration (Beherens and Thisse, 2007). Regional systems involve interactions of social, economic and environmental phenomena between and within the regions. Regions can be modelled according to their nature (urban, rural), size (micro, meso and macro) or specialization (e.g. Silicon Valley). Regional economic development can be achieved through several dimensions including production intensification, export promotion, secured market access, specialization achievement and human capital development (Gurieva, 2015).

The strength of a regional economic system is based on achieving specialization through 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 two regions. The trade interaction pattern between two regions are very important in the context of the NEG framework as it builds upon public movement, trade (including international trade), and intra-regional and inter-regional interactions (Beherens and Thisse, 2007).

An intensive agricultural 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 a 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 its capabilities both in operation and marketing sectors (Nath *et al.*, 2010). The literature also suggests that the implication of a resource-based theory can be applied to natural resource management and cost management and these will eventually develop the resilience and robustness of the agricultural 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 services 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).

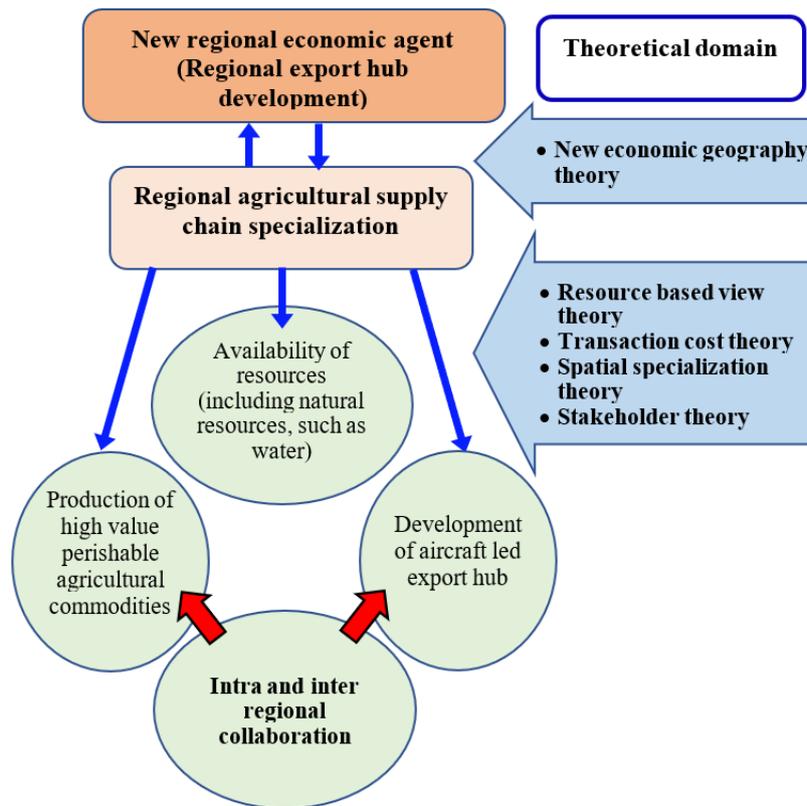


Figure 1. Analytical Framework and Components for Developing Specialized Agriculture Supply Chain. Source: The Authors.

To advance in increasing sales, value-adding activities, better competitiveness, lower transaction costs, technological intervention and regional diversification, a farm needs to achieve specialization (Czyzewski and Smedzik-Ambrozy, 2015; Balland *et al.*, 2019). The specialization phenomena are generally derived from trade theory and are closely related to the new economic geography theory (Aiginger and Rossi-Hansberg, 2006). 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 and Wu, 2009). The effort for specialization could be directed in different dimensions. However, in the current study and in the context of CQ region, we are focusing on 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.

Role of Air-freight Hub in Regional Setting

Regional airports are considered as strategic infrastructure due to their function of connecting regions. An airport could contribute to the local economy through four impact categories: direct impact, indirect impact, induced impact and catalytic impact (Halpern and Brathen, 2011; Percoco, 2010). Employment opportunities and revenue from an airport generate direct contributions to 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 take place by the spending of income of employees in the local business. The airports can also act as a driver for the growth of associated industries, which is considered a catalytic impact (Baker *et al.*, 2015). The literature suggests that there is a strong correlation between air transport and economic growth of a region, although the nature and the degree of correlation depend on several characteristics of the region (Mukkala and Tervo, 2013). The regional airports facilitate easy accessibility to the region and may attract both domestic and foreign investment in the region. One of the common challenges of the regional airport is economic sustainability, and local, state and federal government support is required to achieve that.

In the current paper, air-freight transportation, specifically transportation of perishable agriculture products, was considered. The air-freight could be destined for either domestic or international markets. Regional airports

may provide a region with better access to international markets (Tveter, 2017). Different researchers have studied the impact of airports on regional development (Sellner and Nagl, 2010; Tveter, 2017; Hansen and Johansen, 2017) and affirmed the linkage. In the Australian context, researchers have studied cointegration and causality analysis (Baker *et al.*, 2015) and challenges for domestic air-freight (Alexander and Merkert, 2017).

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 and Grabis, 2016). The perishable nature of agricultural products makes their supply chain more complex compared with other products. Management of 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 & 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, where 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 on Storage Temperature for Different Fruits and Vegetables. Source: Adapted from Aung and Chang (2014).

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).

3. METHODS AND MATERIALS

The research approach in this paper adopted a mixed methodology that combined a literature review on types and volumes of perishable agricultural commodities in 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 perishable agricultural commodities data have been collected from the airport authorities and local government database. Relevant literature of a case study on air transport hub was also collected and reviewed.

Qualitative data was collected through a stakeholder's workshop, consisting of members from agricultural sectors, government, industry, and community. The purpose of the workshop was to understand stakeholders' perceptions about the export potential of perishable agricultural commodities and the importance of building an air-transport hub in CQ. The workshop was split into two sections; the first one involved a summary of findings from a literature review, and the second one was a brainstorming session with an open floor discussion. In this section of the workshop, participants were asked:

- What are the issues you believe need to be addressed to promote exporting perishable commodities from the CQ region?
- What enabling infrastructure is required for cost-effective supply chain development (for exporting perishable commodities):
 - a) Immediate requirements
 - b) Medium or long-term needs
 - c) Weighting for an Air-transport hub development.

This study utilized a narrative analysis and some degree of content analysis. Data collected from secondary sources are scrutinized to fulfil the purpose of the study. Based on the analysis of the study, some recommendations are listed to promote the export of perishable agricultural commodities from CQ into Asian markets.

4. FINDINGS AND ANALYSIS

Perishable Commodities in the Central Queensland Region

Central Queensland is a Level 4 Statistical Area of Queensland government (Queensland Government Statistician's Office, 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). 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.

Beef is the predominant agricultural commodity in CQ 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). CQ produced about 33% of the total beef production in Queensland (TIQ, 2016).

Table 2. Major Perishable Commodities of Queensland. Source: The authors.

Perishable commodities	Queensland production tonne	Production volume (tonne) in CQ/Fitzroy	Percentage
Beef (MLA, 2018; Trade and Investment Queensland (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, 2016; 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%

The value of Australian horticulture exports reached AU\$3 Billion in the year 2018-19 by exporting about 18% of total horticulture production (ABARES, 2018). In horticulture, CQ 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 the CQ region.

Queensland produces 60% of Australian mandarins and each year Australia exports about 35,000 tonnes of mandarins, mostly to China and South-East Asian countries. Mango is another major commodity of Queensland, where CQ produced about 3.7% (ABS, 2018) of Queensland's mangoes. Two main mango producing regions, 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 the Australian Lychee Growers Association (ALGA, 2017) reveals that about 1,000 tonnes of lychees are produced annually in Rockhampton and Bundaberg regions. 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. CQ also grows a small quantity of herbs, mostly for domestic consumption.

Global Air Freights

Air-freight involved 220.7 billion tonne kilometres (btkm) of all trades both domestic and international (World Bank, 2019). Air-freight industry is heavily dependent on international air freight, which accounted for 87.4% share of all air freight movement (International Air Transport Association, 2019). USA and China are the leading air freight transporting countries in the world. Table 3 summarised the air freight volume of some countries with large landmass.

Table 3. Airfreight Volume of Selected Countries and Region with Large Land Mass. Source: World Bank (2019).

Country	Land area (million km ²)	Population million (2018)	GDP (US\$b) (2018)	Total air freight (btkm) (2018)
Russia	16.38	144.48	1,657.6	6.81
China	9.39	1,392.73	13,608.2	25.26
United States	9.15	327.17	20,544.3	42.99
Canada	9.09	37.06	1,713.3	3.43
Brazil	8.36	209.47	1,868.6	1.85
Australia	7.69	24.99	1,433.9	2.03
European Union	4.24	513.21	18,768.1	37.93
India	2.97	1,352.62	2,718.7	2.70

Australia is world's sixth largest country, yet the total air-freight transport is relatively low compared to other large developed countries. In

2018, the European Union transported about 38 btkm of air-freight and Luxembourg with a landmass of 2,430 km² is accountable for 7.3 btkm of air-freight transport (World Bank, 2019). Luxembourg achieved specialization in air-freight and became one of the leading air-freight transporting countries in the world (Eurostat, 2019). Australia, with the huge land mass and natural resources, also has the opportunity to achieve specialization on transporting perishable agricultural products through air freight in both domestic and international markets.

Air Freight 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 4).

Table 4. Australian Air Export Commodities. Source: Commonwealth of Australia (2018).

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%

Notably, the major shares of air-freight 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 air-freight, which is about 84 thousand tonnes per annum (Figure 2).

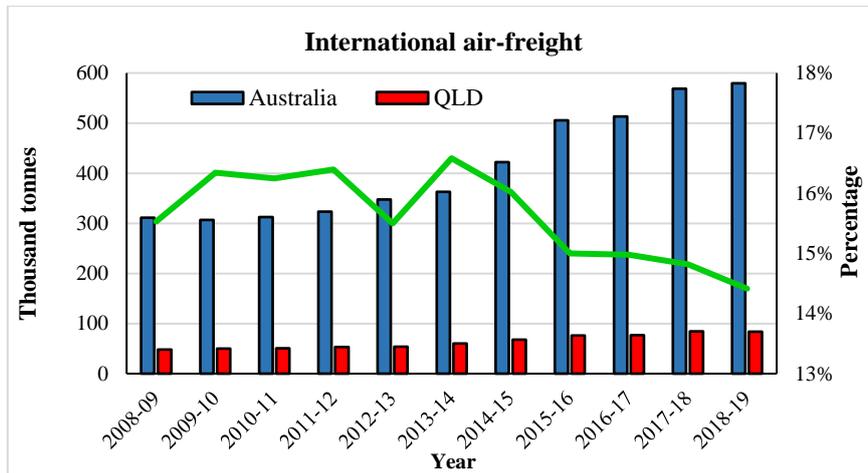


Figure 2. Volume of Outbound International Air-freight from Australia and Queensland (QLD). Source: BITRE (2019).

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

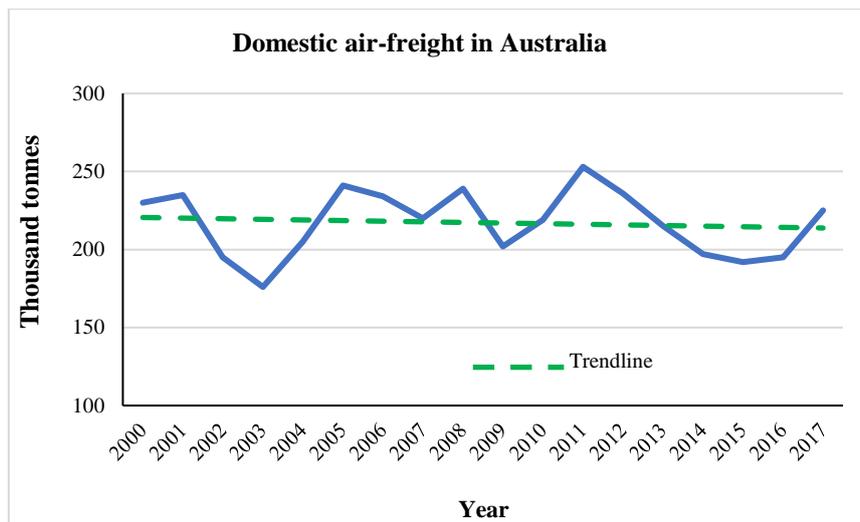


Figure 3. Volume of Domestic Air-freight in Australia. Source: BITRE (2018).

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 largest airport in CQ, located in the south-west perimeter of Rockhampton city with two runways that are 2568 metre and 1645 metres in length (Rockhampton Regional Council (RRC), 2017). The land area and the runway length of Rockhampton airport are suitable for an 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 has initiated several studies to investigate the extent of the international market for the agricultural products of CQ so that suitable aircraft operators and additional cargo facilities could be attracted to this region.

Gladstone

The Gladstone Airport is comparatively a smaller airport but has high importance because of the Gladstone seaport. About 6000 aircraft movements per annum are recorded for this airport involving more than 300,000 passenger movements (Bureau of Infrastructure and Transport Research Economics (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 a little vacant area for further extension (Table 5).

Emerald

The Emerald airport is an important 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 the 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 5). 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 5 summarises the basic features of these three airports and provides a better understanding of the potential of these airports for upgrade to air-transport hubs.

Table 5. Comparative Features of Airports in CQ. Sources: Bureau of Infrastructure and Transport Research Economics, (2017); RRC (2017); ABS (2018).

	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	Not reported	Not reported	Not reported
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

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 CQ. 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 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 CQ 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 CQ 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 an 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 CQ to fulfil the demand. The potential development of Rookwood weir was discussed as it would enhance the water storage level of this region by about 76,000 megalitres, and support further agricultural production.

One of the development consultants thought that CQ has some advantages in developing a proper supply chain for perishable commodities to be exported in the Asian market. In their opinion, Rockhampton airport has the advantages of potential cargo shipment, where this airport can be upgraded to be an 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 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 participants also added that it would be difficult to predict a timeline for CQ to increase agricultural production because this is dependent on several factors, including the availability of natural resources like water. The participants also added that the development of an air transport hub in this region should be combined with the improvement of enabling infrastructure. Access to international markets can be achieved by developing an intermodal network to export the perishable commodities of CQ.

5. DISCUSSION AND CONCLUSION

Central Queensland has a major agricultural sector that is capable of increasing production to match the demand for perishable commodities in some Asian countries. Processing and transportation are two of the most important forward linkages in the supply chain for exporting perishable commodities. The CQ region has high-quality road transport infrastructure and some processing industries, including beef and pineapples. However, this region lacks an air transportation hub, which is pivotal in exporting perishable commodities. Developing an export supply chain sometimes requires a catalyst to realise new linkages and opportunities. There is

potential for an air transport hub to provide a catalyst role for this region. Facilitating an air transport hub in the CQ region, together with other initiatives such as water infrastructure, could trigger investment in the agricultural sector and develop an export supply chain from this region. The workshop discussion suggested that an independent air transport hub would underpin future growth within this region.

However, 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 agricultural production close to Rockhampton, while another is developing scale and consistency of supply to international markets.

Secondary data analysis and a stakeholder workshop revealed that beef, pineapple, mangoes 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 secondary data and stakeholder's discussion favoured Rockhampton airport to become the air transport hub of the CQ region.

The current study recommends several actions for the 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 a gradual development of air transport facilities in parallel with growth in production and international market access. Relevant stakeholders including representatives from local and state governments 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.

REFERENCES

- Australian Bureau of Agricultural and Resource Economics (2018).
Agricultural commodities: September quarter 2018. Australian
Bureau of Agricultural and Resource Economics and Sciences
Canberra. Online version accessed June 2019,
[http://www.agriculture.gov.au/abares/Documents/research-
topics/ag-commodities/agcommodities-sep-2018.pdf](http://www.agriculture.gov.au/abares/Documents/research-topics/ag-commodities/agcommodities-sep-2018.pdf).
- Australian Bureau of Statistics (2017). 71210DO002_201516
Agricultural Commodities. Australia- 2015-16.
- Australian Bureau of Statistics (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. Online
version accessed October 2019,
[https://www.agrifutures.com.au/product/the-impact-of-freight-
costs-on-australian-farms/](https://www.agrifutures.com.au/product/the-impact-of-freight-costs-on-australian-farms/).
- Aiginger, K. and Rossi-Hansberg, E. (2006). Specialization and
concentration: a note on theory and evidence. *Empirica*, 33, pp. 255–
266, DOI: <https://doi.org/10.1007/s10663-006-9023-y>.
- Alexander, D.W. and Merkert, R. (2017). Challenges to domestic air
freight in Australia: Evaluating air traffic markets with gravity
modelling. *Journal of Air Transport Management*, 61, pp. 41-52,
DOI: <https://doi.org/10.1016/j.jairtraman.2016.11.008>.
- Alfalla-Luque, R., Medina-Lopez, C. and Dey, P. K. (2013). Supply
chain integration framework using literature review. *Production
Planning & Control: The Management of Operations*, 24 (8-9), pp.
800-817.
- Ash, A., Gleeson, T., Cui, H., Hall, M., Heyhoe, E., Higgins, A.,
Hopwood, G., MacLeod, N., Pains, 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. and Chang, Y. S. (2014). Temperature management for the
quality assurance of a perishable food supply chain. *Food Control*,
40, pp. 198-207.
- Australian Lychee Growers Association (Last updated 2017). Our
industry: Background. Australian Lychee Growers Association,

- Mooloolah. Webpage accessed on 4th June 2019, <http://www.australianlychee.com.au/our-industry/background>.
- Australian Mango Industry Assosiation (2017). Mango Production. Australian Mango Industry Association, Brisbane. Online version accessed June 2019, <https://www.industry.mangoes.net.au/mango-production/>.
- Awad, H. A. H. and Nassar, M. O. (2010). A Broader view of the Supply Chain Integration Challenges. *International Journal of Innovation, Management and Technology*, 1(1), pp. 51-56.
- Baker, D., Merkert, R. and 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. and Rigby, D. L. (2019) Smart specialization policy in the European Union: relatedness, knowledge complexity and regional diversification. *Regional Studies*, 53(9), pp. 1252-1268, DOI: <https://doi.org/10.1080/00343404.2018.1437900>.
- Behrens, K. and Thisse, J. F. (2007). Regional economics: A new economic geography perspective. *Regional Science and Urban Economics*, 37, pp. 457–465.
- Bogataj, M., Bogataj, L. and Vodopivec, R. (2005). Stability of perishable goods in cold logistic chains. *Int. Journal of Production Economics*, 93–94, pp. 345–356.
- Brandon-Jones, E., Brian Squire, B., Autry, C. W. and Petersen, K. J. (2014). Contingent resource-based perspective of supply chain resilience and robustness. *Journal of Supply Chain Management*, 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 (2017). Airport Traffic Data 1985–86 to 2016–17. The Bureau of Infrastructure, Transport and Regional Economics (BITRE), Canberra.
- Bureau of Infrastructure, Transport and Regional Economics (2018). Forecasting Australian Transport: A Review of Past Bureau Forecasts, Report 149. The Bureau of Infrastructure, Transport and Regional Economics (BITRE), Canberra. Online version accessed July 2019 https://www.bitre.gov.au/publications/2018/rr_149.aspx.
- Bureau of Infrastructure, Transport and Regional Economics (2019). Airport traffic data. The Bureau of Infrastructure, Transport and

- Regional Economics (BITRE), Canberra. Online version accessed December 2019, https://www.bitre.gov.au/publications/ongoing/airport_traffic_data.aspx.
- Cao, M., Vonderembse, M. A., Zhang, Q. and 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*, 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. Department of Infrastructure, Regional Development and Cities, Canberra. Online version accessed June 2019, https://www.regional.gov.au/regional/publications/files/Northern_Australia_Transport_Study_2018.pdf
- Czyzewski, A. and Smedzik-Ambrozy, K. (2015). Specialization and diversification of agricultural production in the light of sustainable development. *Journal of International Studies*, 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*, 18(2), pp. 131-171.
- Department of Infrastructure, Transport, Regional Development and Communication. (2018). Inquiry into national freight and supply chain priorities. Department of Infrastructure, Transport, Regional Development and Communication, Canberra. Online version accessed July 2019, <https://www.infrastructure.gov.au/transport/freight/freight-supply-chain-priorities/index.aspx>.
- Department of State Development, Infrastructure and Planning (2013). Central Queensland regional plan. , Department of State Development, Infrastructure and Planning, Queensland. Online version accessed April 2019, www.dsdip.qld.gov.au.

- Economist Intelligence Unit (2014). *Feeding Asia-Pacific: Australia's Role in Regional Food Security*. London: EIU.
- Eurostat (2019). Freight transport statistics. Online version accessed January 2020, <https://ec.europa.eu/eurostat/statistics-explained/pdfscache/1133.pdf>.
- Gurieva, L. K. (2015). New economic geography as the theoretical platform of region innovative Development. *Mediterranean Journal of Social Sciences*, 6(3), pp. 19-25.
- Haberli Jr., C., Oliveira, T., Yanaze, M. and Spers, E. E. (2019). Performance, farmer perception, and the routinisation (RO) moderation on ERP post-implementation, *Heliyon*, 5, e01784, DOI: <https://doi.org/10.1016/j.heliyon.2019.e01784>.
- Halpern, N. and Brathen, S. (2011). Impact of airports on regional accessibility and social development. *Journal of Transport Geography*, 19, pp. 1145–1154.
- Hansen, W. and Johansen, B. G. (2017). Regional repercussions of new transport infrastructure investments: An SCGE model analysis of wider economic impacts. *Research in Transportation Economics*, 63, pp. 38-49, DOI: <https://doi.org/10.1016/j.retrec.2017.07.004>.
- Heidenreich, M. (2016). Ross Lobbegeiger Report to farmers: Aquaculture production summary for Queensland 2015-16. Queensland Department of Agriculture and Fisheries.
- Horticulture Innovation Australia Limited (2019). The Australian Horticulture Statistical Handbook, 2017/2018.
- International Air Transport Association (2019). Air freight market analysis. November 2019. International Air Transport Association, Montreal. Online version accessed January 2020, <https://www.iata.org/en/iata-repository/publications/economic-reports/air-freight-monthly-analysis-nov-2019/>.
- Krugman, P. (1991). Increasing returns and economic geography. *Journal of Political Economy*, 99(3), pp. 483-499.
- Meat & Livestock Australia (2018). Beef fast fact 2018. Meat & Livestock Australia, North Sydney. 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.
- Mukkala, K. and Tervo, H. (2013). Air transportation and regional growth: which way does the causality run?. *Environment and Planning A*, 45 (6), pp.1508-1520.
- Nath, P., Nachiappan, S. and Ramanathan, R. (2010). The impact of marketing capability, operations capability and diversification

- strategy on performance: A resource-based view. *Industrial Marketing Management*, 39, pp. 317–329.
- Percoco, M. (2010). Airport activity and local development: evidence from Italy. *Urban Study*, 47, pp. 2427–2443.
- Queensland Government Statistician's Office (2019). Central Queensland regional profiles. Queensland Treasury.
- Rockhampton Regional Council (2017). Rockhampton airport master plan.
- Rodrigue, J. P., Comtois, C. and Slack, B. (2017). *The Geography of Transport Systems*, 4th ed, Routledge, New York.
- Ruiz-Garcia, L. and 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. (2016). Australian fisheries and aquaculture statistics 2015, Fisheries Research and Development Corporation project 2016-246. ABARES, Canberra. Online version accessed June 2019, <https://www.farmtransparency.org/uploads/documents/2090-000000199-43a87df513-australian-fisheries-aquaculture-statistics-20.pdf>.
- Sellner, R. and Nagl, P. (2010). Air accessibility and growth-The economic effects of a capacity expansion at Vienna International Airport. *Journal of Air Transport Management*, 16(6), pp. 325-329.
- Thron, T., Nagy, G. and Wassan, N. (2007). Evaluating alternative supply chain structures for perishable products. *The International Journal of Logistics Management*, 18(3), pp. 364-384.
- Trade and Investment Queensland (2016). Market Profile Central Queensland. Trade and Investment Queensland, Brisbane. Online version accessed January 2019, https://www.tiq.qld.gov.au/files/tiq-16-1249-regional-overview_rockhampton_final-pdf/.
- Trienekens, J. and Zuurbier, P. (2008). Quality and safety standards in the food industry, developments and challenges. *International Journal of Production Economics*, 113(1), pp. 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*, 63, pp. 50-58.
- United Nations (Last updated 2007). United Nations Statistical division. Webpage accessed April, 2019, <https://unstats.un.org/unsd/environment/totalarea.htm>.

- Wang, X. and Li, D. (2012). A dynamic product quality evaluation based pricing model for perishable food supply chains. *Omega*, 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*, 7(2), pp. 34-39.
- World Bank (2019). The world bank data- Air transport, freight. Webage accessed on January 2020, <https://data.worldbank.org/indicator/IS.AIR.GOOD.MT.K1>.
- World Trade Organization (2019). World Trade Statistical Review 2019. World Trade Organization, Geneva. Online version accessed January 2020, https://www.wto.org/english/res_e/statis_e/wts2019_e/wts2019_e.pdf.