

Investigation of the water use ratio and the importance of Christchurch aquifers to the food and beverage industry



Mandille Alcee

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Investigation of the water use ratio and the importance of Christchurch aquifers to the food and beverage industry

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Executive Summary

Understanding the socio-economic value of freshwater in Christchurch has emerged as long-term development plans for the city ensues with attempts being made to better understand this natural resource and the value it adds to business operations. However, understanding the socio-economic value of this resource can be quite complex due to the issues surrounding freshwater use and management in Christchurch. Nonetheless, this research investigates the water use ratios and importance of the Christchurch freshwater supply to the food and beverage industry.

Telephone interviews with the use of a questionnaire were conducted with 80 companies, purposely selected from within the food and beverage sector. The results from the data collected indicate that water is very important to food and beverage business operations and that the quality of freshwater is one of the key reasons for these businesses choosing to establish and operate in Christchurch. Moreover, the research also finds that the analysis conducted was limited to some degree as most companies failed to provide the necessary data to investigate the water use ratios for the food and beverage industry.

1.0 Introduction

The freshwater resources in New Zealand are critical in the provision of many goods and services across the key sectors of the economy such as agriculture, manufacturing and tourism (OECD, 2017). Across the many cities in New Zealand, this freshwater resource is derived from many sources such as lakes, rivers, reservoirs and aquifers. In Christchurch, the freshwater resource comes from the underground aquifers which provide a steady supply of naturally purified water which requires no treatment for both public and private consumption. This aquifer-fed freshwater resource in Christchurch has been very important to the city's businesses as the rebuild following the 2011 earthquakes continue.

Despite the clear benefits from the freshwater supply in Christchurch, there is limited research and evidence in relation to the socio-economic value of the resource to households and businesses in particular. The Canterbury Development Corporation (CDC) has therefore ventured to better understand the socio-economic value of Christchurch's aquifer-fed freshwater supply. This research is important as the agency policy development efforts continue with the aim of increasing economic growth and prosperity in the city. Understanding the value of freshwater is useful and can assist in making management decisions that aim to satisfy unlimited wants with limited resources and rebound to the greatest return to the public (Young & Loomis, 2014). The key broad elements of value that were identified by the agency include industry use of freshwater, operational saving from non-treatment of freshwater, ecosystem services, the intrinsic value of freshwater, and the potential marketing opportunities.

In keeping with these key broad elements highlighted above, this research investigates the water use ratios and importance of the Christchurch freshwater supply to the food and beverage industry. The information presented here can assist in long-term planning efforts for Christchurch particularly in relation to understanding the socio-economic status of the freshwater supply and the measures surrounding its management and use. The key objectives of this research are:

- to analyse the water use ratios of food and beverage companies in Christchurch over the past three years;
- to determine whether the cost, reliability of supply, and quality of freshwater in Christchurch acts as an incentive for doing business in the city; and

- to ascertain whether the purity of Christchurch's freshwater as a marketing tool can add value to food and beverage businesses.

This report initially outlines the background and literature surrounding groundwater ecosystems and the economics of water, as well freshwater in business, with a specific focus on New Zealand and Canterbury. This will be followed by an overview of the research methods used for this research and the key findings emanating from the data analysis. The latter sections will focus on the discussion of the key findings as well as some reflective thoughts on future research areas, the potential future risk to the freshwater resource, and the possibility of establishing a Christchurch brand around the high-quality aquifer-fed freshwater supply.

2.0 Literature Review

This section will provide a synopsis of the literature relating to groundwater management with particular focus on its importance to business operators and the economic value of water to businesses. The literature in this section will also provide some information on the New Zealand and Canterbury context with regard to water use in business and freshwater management.

2.1 Groundwater and ecosystem services

Groundwater is an important resource globally, and over the years the pressure on this natural resource has increased due to the economic problem of having to satisfy unlimited wants with limited resources (Tuinstra & van Wensem, 2014). The increased pressure can be attributed to increased land use activities and increasing water demands for household, agricultural and industrial use, and as explained by Tuinstra and van Wensem (2014), this may lead to issues such as scarcity, water level fluctuations, droughts and water contamination. As a result, many countries across the world including New Zealand continue to formulate policies geared towards safeguarding this important resource especially since groundwater, as explained by Falkenmark and Folke (2003), is the centrepiece for the continued health of ecosystem services to human well-being.

Ecosystem services are conceived as the benefits individuals derive from the functioning of ecosystems (Robert et al., 1997). They are a source of many marketable goods and other services and functions, namely provisioning services (e.g. as a source of food), regulatory services (e.g. water purification), cultural services (e.g. recreational purposes) and supporting services (for

example soil formation) (Bergkamp & Cross, 2006). Groundwater, as a natural capital, is critical to the provision of key ecosystem services as highlighted by Griebler and Avramov (2014) in figure 1 below.

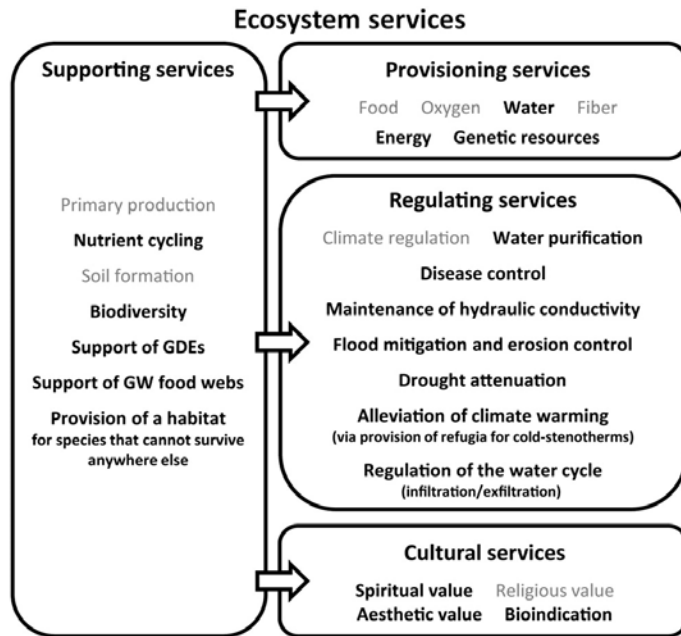


Figure 1. Categories of ecosystem services showing the goods and services from groundwater ecosystem (GDEs means groundwater dependent ecosystems, and GW means groundwater)

The ecosystem goods and services that human beings benefit from groundwater span across all four broad areas of ecosystem systems are highlighted above. Central to this is the provision of safe, potable water which is fundamental to the daily lives of human beings. The broad categories for large-scale use of groundwater are agriculture, personal consumption, industrial consumptions and household activities (Chatterjee, 2015). The scope of this research will focus on groundwater in relation to industrial or business activities.

Increases in industrial development such as manufacturing, primarily due to globalisation and increased international trade, have been one of the main drivers of change in the provisioning services provided by groundwater (Hassan, Scholes, & Ash, 2005). One of the key provisioning services from groundwater is that it serves as a key water source for the food and beverage industry (Tuinstra & van Wensem, 2014). This is critical because the Millennium Ecosystem Assessment (2005) posits that businesses have a dual interaction with the ecosystem as both users of the services and contributors to the changes in those ecosystems. Therefore, business activities can

be hampered if ecosystems are unable to provide the services necessary for business operations, for example, water for the manufacturing of various beverages.

The use of groundwater ecosystem services in business is diverse and is used both for upstream activities and downstream activities for sectors such as manufacturing and by extension, food and beverage. However, Martin-Ortega, Jorda-Capdevila, Glenk, and Holstead (2015) highlight that there are four key risks to business from groundwater ecosystem services:

- water availability and ecological risk from increased water scarcity;
- water infrastructure risk from ageing water infrastructure and the cost associated with repairs which may be borne by businesses;
- policy environment/regulatory risk in relation to the policies, legislation and regulations that govern water use; and
- reputational risks from stakeholder rights to access water as a basic human need.

In New Zealand, the risk of contamination and diminished water quality due to nitrate contamination of groundwater sources is a growing concern for public health and safety (OECD, 2017). This risk has been attributed to the increased effect of agricultural activities, primarily dairying. With increasing the change in land use towards dairying, the pollution of freshwater sources through nitrate leaching is also expected to increase with the most significant increase occurring in Canterbury (PCE, 2013) as seen in Figure 2 below.

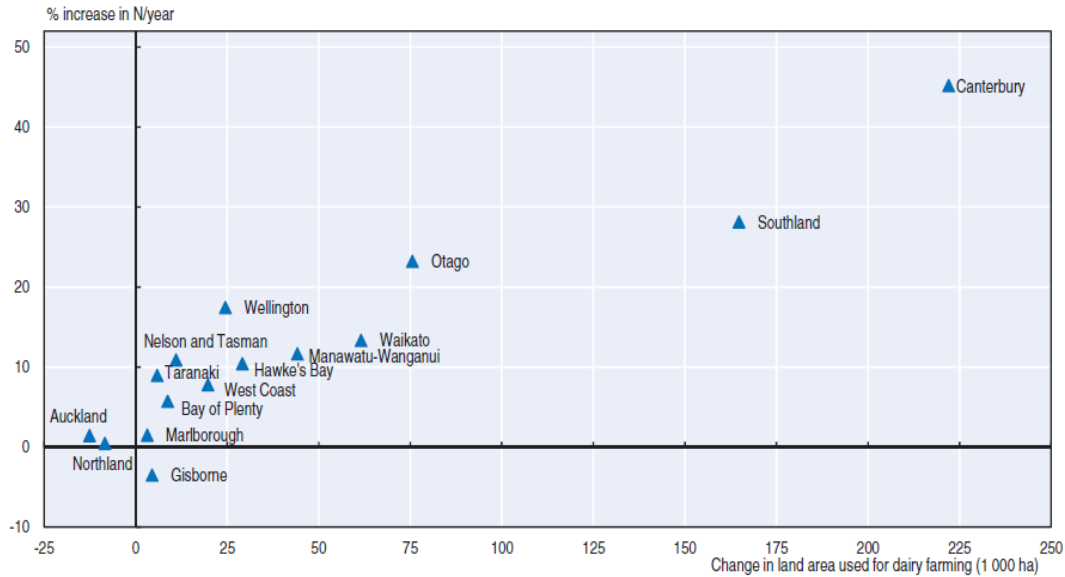


Figure 2. Predicted changes in nitrogen pollution of freshwater forecasted with large-scale land use change to dairy 1996-2020

Source: (PCE, 2013, p. 66)

These risks are expected to be compounded with global climate change issues surrounding water scarcity. Nonetheless, the management of these risks can be seen as an opportunity. The Millennium Ecosystem Assessment (2005) argues that a positive approach to reducing the pressures on ecosystems by businesses can create both an opportunity for new and innovative business activities and a way of safeguarding these services and fostering sustainability. In addition, this positive approach can also augur well for the corporate image of these businesses, as there are signs of a changing trend with customers preferring products that are manufactured in an environmentally sustainable way. Moreover, Smith, Kemp, and Duff (2000) note that businesses are aware of benefits that can be derived from positive environmental behaviour such as improved customer relations, cost saving, and a greater competitive advantage in the marketplace.

A change in behaviour towards a more ecosystem-based management approach by businesses will require a strategy that equates the benefits of this change into the tangible cost that is reflected in the financial figures (Martin-Ortega et al., 2015). Moreover, if the behaviour change is driven by external factors by way of incentives (subsidy) or disincentive (tax), these factors have to be significant enough to change the desired behaviour. Hence, in order to achieve the desired behaviour it is important to understand the role of groundwater ecosystems in the food and beverage sector, its value as a natural resource, as well as the institutional, political and socio-

economic issues surrounding freshwater management in New Zealand and specifically in the Canterbury region.

2.2 The economic value of water

The economic value of water is at most times defined by its price and serves as a guide when allocating water between competing uses, where the aim is to generate the greatest economic yield (Ward & Michelsen, 2002). However, this price does not always accurately reflect the value or utility that is achieved from the use of water (Hanemann, 2006). Therefore, the value of the water use may not always be quantifiable but this does not imply that value from the use of the commodity is low. One of the approaches that have been used to inform the economic value of water is the willingness to pay studies which have been undertaken by authors such as Burnett et al., (2015) and Welsh (1991). In simple terms, the willingness to the pay approach entails asking customers or the target population the amount of money they would be willing to pay for a particular amount of water. However, this approach was outside the scope of this report due to the limited time within which to undertake this research.

Hanemann (2006) explains that based on the characteristics of water, namely its mobility, the variability of supply, location, and quality, it has elements of both a public and private good. It is a public good in that it can be non-rival and non-excludable, which means that individuals cannot be excluded from its use and the use by one individual does not reduce the availability to other individuals. Whereas, water is a private good in that it can be rival and excludable meaning individuals can be excluded from its use and the use by one individual can reduce the amount available for consumption by another individual. The degree to which water can be a public or private good would depend on factors such as the use of water, the location of the resource, the policies and regulations surrounding the allocation and distribution of the resource.

However, Sarker, Ross, and Shrestha (2008) describe groundwater aquifers as an example of a common pool resource. Common pool resources are resources where it is difficult to exclude persons from benefiting from the resource and the use of the resource reduces its availability for other users (Ostrom et al., 1999). In essence, common pool resources are rival but non-excludable. For example, Fisher et al., (2010) explained that the use of water upstream for electricity generation or crop irrigation leaves less water available for downstream users and may also affect the fish population in rivers and lakes.

Moreover, Sarker et al. (2008) also note that water quality as an attribute of water is itself a common pool resource. This is because it is challenging to exclude individuals from appropriating water quality through pollution. Additionally, when water quality is reduced by one user, it reduces the quality available to other users. This debate surrounding water as a public good, private good or common pool resource raises questions in relation to who owns the water resource; whether individuals should be charged for the use of the resource; who is responsible for safeguarding the resource; and the approach to be taken to safeguard the resource whether it be through market-based instruments or through government rules and regulations.

Aquifers are natural water resources and can be viewed as natural assets (Pearce et al., n.d.). These natural assets (i.e. aquifers) are very complex in nature and interconnected and as a result, make it challenging to derive an economic value (Pearce et al., n.d.). Water from aquifers interact with surface water and is also important for certain natural processes which make it difficult to quantify the value of this natural asset. For example, the increased harvesting of aquifer water to satisfy short-term profits may hamper the ecosystem services supported by the aquifers. Nonetheless, Das (2015) explains that a resource or natural asset's economic value depends on what it is used for, and its availability or scarcity compared to alternative resources. Similarly, the New Zealand Institute of Economic Research (NZIER) (2014) notes that one way in which people derive value from a resource is by using it and this provides an indication of the use value from the resource. The use value of the resource is the utility gained from its utilisation, its availability and importantly its quality compared to other water sources (Das, 2015). Therefore, the greater the availability, the lower the economic value compared to regions where the resource is more scarce.

2.3 Freshwater in business in the New Zealand and Canterbury Context

In New Zealand, the discussion surrounding water and water management continue to spur widespread debate among stakeholders. The issues at the core of the discussion surrounding water in New Zealand were articulated by the Parliamentary Commissioner for the Environment (PCE) (2012) and include:

- issues of pollutants such as pathogens, sediment and nutrients, their source and the impact on water quality;
- the vulnerability of water sources to these pollutants; and
- identifying the most appropriate approaches to protecting and improving water quality.

Over the years the issue of water quality in relation to the negative externalities such as nitrogen leaching into groundwater and phosphorus moving into waterways through surface flow from dairy activities continues to spur discussion about land use policy (Larned et al., 2016)

With growing public concern over decreasing water quality, particularly in relation to health and safety standards of drinking water has led to central government actions to remedy diminishing water quantity and quality. As a result, the government of New Zealand outlined its long-term vision for freshwater with emphasis on fostering improvements in freshwater quality, efficient and productive use of freshwater, providing a safe environment for aquatic flora and fauna, and safeguarding of lakes, rivers and wetlands, *inter alia* (Ministry for the Environment (MfE), 2016). Consistent with this vision, the government has put forward various proposals geared towards improving freshwater quality and quantity (MfE, 2016). The New Zealand government's long-term vision for freshwater is geared towards ensuring the quality and quantity of freshwater is improved and maintained as it can have an effect on other sectors of the economy which depends on freshwater as a critical input. In an effort to achieve these long terms goals, the National Policy Statement for Freshwater Management (NPSFM) outlines the overarching freshwater framework that will guide local governments in the management of freshwater to ensure sustainability while providing for economic growth within set quantity and quality limits (MfE, 2014).

As outlined by the MfE (2016), freshwater is under increased pressure with competing uses which has resulted in, *inter alia*, a decrease in water quality driven by factors such as diffuse agricultural and urban pollution, erosion and climate change. In recognition of the important role that freshwater plays in New Zealand's economy, the government of New Zealand in 2009 commenced broad reforms aimed at improving the management of freshwater. A collaborative approach was used to undertake this reform on freshwater management, led by the Land and Water Forum (LAWF). The LAWF acted as a central government collaborative advisory board bringing the views of various stakeholders to light in the preparation of a blueprint for land and water management. Over the past few years, the LAWF has issued many publications providing key recommendations to drive the management of freshwater such as changing the governance structure for freshwater, outlining a national policy for freshwater, improving the allocation of freshwater and achieving targets for freshwater (LAWF, 2010, 2012, 2013).

In Canterbury, there have been efforts to ensure a high quality of freshwater and a more sustainable and strategic approach to the allocation and use of the resource, *inter alia*. This is currently driven through the Canterbury Water Management Strategy 2009 which provides a collaborative governance framework for managing the freshwater resources in the region which include Christchurch. The strategy recognises the need for a more balanced approach to economic development that is consistent with a sustainable approach to environmental protection and enhancement as water is a fundamental life engine for not only this generation but also future generations (CWMS, 2009).

The issues highlighted above in relation to the impact of pollution on water quality and the vulnerability of water sources are important because water is vital not only for life, e.g. drinking water but also for the operations of key sectors such as agriculture, dairy, food and beverage and for everyday household use. Therefore, high-quality water supports the social and economic fabric of New Zealand. For example, the food and beverage sector in New Zealand in 2014/2015 accounted for 46% of the total export of good and services of \$NZ 66.2b (MBIE, 2015) for which water is a key input. Among the key drivers identified for the success of the food and beverage sector is the international recognition of New Zealand as a world leader in food safety and product traceability as well as the country's clean and green image (MBIE, 2015).

With growing demand locally and internationally for New Zealand products, this may increase the use of groundwater by companies in the food and beverage sector. This groundwater provides a source of safe and pure water that meets health and safety standards both in New Zealand and internationally. Hence, users of groundwater resources need to adopt a more prudent and environmentally conscious approach to the use of this resource (Tuinstra & van Wensem, 2014). However, Whitehead (2013) notes that the small and medium-sized firms (of which food and beverage is a subsector) saw little justification for more environmentally prudent behaviour. This was attributed to the high cost of the change in behaviour and the perception of little environmental impact by operations. Similarly, Smith et al. (2000) highlight that small and medium-sized firms indicated that their impact on the environment was minimal and this perception influenced the way they responded to and approached environmental issues.

New Zealand's clean and green image has a significant export value and is a key driver in the provision and sale of goods and services on the international market (MfE, 2001). This augurs

well for New Zealand as many customers are getting more prudent with their buying patterns with options for more health and organic products due to health and safety concerns. Moreover, tourists also find this clean and green image appealing and some tourist attractions and hotels have indicated this as a huge selling point for customers (Bell, 2008). Nonetheless, MfE (2001) and (PMCSA, 2017) note the vulnerability to this image due to growing environmental problems such as reduced water quality. Therefore, there is a need for positive and sustainable action to protect the environment and continue to capitalise on the clean green image of New Zealand particularly due to the tourism and industrial-related benefits of freshwater.

The branding of pure freshwater as a product itself or as an ingredient of another project can provide a competitive advantage in the marketplace for both the product and the country where the project is produced. As explained by Connell (2006) the evolution of the Fiji water brand which is sourced from an aquifer, bottled and exported to international markets provides an avenue for the import revenue but also serves to market Fiji as a destination. The brand is articulated so that it tells a story of the pureness of the water as well as the geographic location and the environmental stewardship of the small island nation. Similarly, the Cascade Brewery Company in Hobart, Australia uses the pureness perception of Tasmania with its water sourced from Mount Wellington as one of the key ingredients and attributes of its beers and ales (Cascade, n.d).

The increased use of pure water branding is also evident in the branding of bottled water and acts as a distinguishing characteristic of the product (Crook, Whitefield, & Jackson, 2009). The increased concern for health and safety from consumers has been attributed by the authors as one of the key reasons driving the need for pure bottled water. An example of this is the Cloud juice brand of bottled water produced in the King Islands which is branded as being gourmet and green and as an ecologically responsible island (Khamis, 2010). Therefore, the pureness of groundwater from aquifers is important not just as an input to manufacturing but also as a marketing tool for businesses and countries.

In Christchurch, the water supplied from the city's underground aquifers requires no treatment (National Institute of Water and Atmospheric Research (NIWA), 2007), thus making it a valuable natural asset to the food and beverage industry. The city's water is sourced from over 50 aquifers and this water has gone through a process of natural purification as the aquifers act as a filter trapping sediments and other particles. These aquifers are confined to layers of clay which

prevents potential contaminants originating from activities above from penetrating the aquifer and the water is drawn from wells which penetrate the aquifers at various depths. This natural process ensures a high quality of water is fed into the city's portable water supply (NIWA, 2007).

As outlined by the Christchurch City Council (CCC (2015) some of the key activities surrounding the supply and conservation of water include ensuring that the city's water is clean and safe for public and private consumption, water sources are maintained, and water is used more efficiently and sustainably. One of the ways in which water efficiency has been monitored within the food and beverage sector is through monitoring annual water use ratios. This metric is calculated as a ratio of total water usage to total beverage/food production. It is utilised by the Beverage Industry Environmental Roundtable (BIER) to monitor water efficiency use, as well as, to monitor improvements in environmental stewardship towards freshwater (BIER, 2012).

Based on discussion with the Christchurch City Council (CCC), water is pumped directly from the aquifer and feeds into the city's potable water supply network. With regard to commercial properties, including food and beverage operators, the CCC sets a daily allowance for water based on the capital value of the property. Therefore, the more valuable the property in terms of its capital value, the larger the daily allowance. The charge (outside of annual general rates paid to the council) is an excess water charge based on the amount of water over the daily allowance that is used. Presently the water charge is NZD 0.73 for every 1000 litres over the daily allowance (CCC, 2017). For standard food and beverage operators, metering is conducted once a year unless the property was deemed to be a "high volume water user" (CCC, 2014). These high volume water users are businesses that utilise a large volume of water within their operations and are likely to exceed the daily water allowance. Moreover, the annual charge paid for water for food and beverage operators as part of the general rates paid to the Council would be NZD 0.041 of the capital value of the property (CCC, 2017). This means that there is no water charge for the direct use of the resource unless the business consumes over the daily water allowance.

What is perceived as high volumes of water use by bottling companies in New Zealand has sparked considerable debate on whether there needs to be a price on water in New Zealand. This is because fresh water has been viewed historically as an abundant resource in New Zealand which has spurred discussion surrounding its ownership and management as there are no rights of ownership, only rights to use water (Morgan, 2017). However, Jenkins (2015) argues that the water resource

is approaching sustainable limits based on the present methods of extraction and use. The NZIER (2014) notes that water users do not pay prices that reflect the true cost of water and highlights that a pricing mechanism has been suggested as a possible solution to address this.

The imposition of a price on the water can also have an adverse effect on key sectors of the New Zealand economy such as agriculture (particularly dairy) and food and beverage and as a result. The NZIER (2014) argues that a successful pricing system would require support across all stakeholders including central government. Moreover, PCE (2016) and the NZIER (2014) argue that there is merit in water pricing as it provides an avenue to deal with some of the challenges associated with freshwater management such as quality, allocation and efficiency. However, PCE (2016) notes that the problem arises when water pricing gets mixed with water ownership and water infrastructure.

The Canterbury Development Corporation (CDC) (2016) highlights that the food and beverage industry is an important contributor to Christchurch's economy as a subset of the manufacturing sector, which has been identified as a key driver of economic growth post-earthquake coupled with increased export activity. Since the earthquake, the city of Christchurch continues to restore and rebuild infrastructure to facilitate the provision of key goods and services. As such construction activities financed through both public and private sector initiatives plays a key role in generating employment and economic activity as the city continues to rebuild (CDC, 2016). The recovery has been economically positive, reflected in the high level of gross domestic product (GDP) fuelled by increased retail trade, accommodation, exports, housing and manufacturing.

The use of freshwater is paramount to the operations of the food and beverage sector as well as manufacturing operators, more so in light of increased uncertainty of future availability and rising industrial demand (Sachidananda, Webb, & Rahimifard, 2016). Therefore, the aquifers in the city provide a constant supply of freshwater to food and beverage operators and is a very valuable natural asset. This is because the aquifer water is naturally purified and requires no treatment prior to use. Having a constant and reliable supply of this pristine freshwater resource is imperative for food and beverage operators as a reduction in water quality or issues with supply due to poor infrastructure or availability of the resource would hamper the operations of the sector.

3.0 Research Methods

To achieve the objectives outlined above, a survey was undertaken to garner primary data on water usage from the natural aquifers in Christchurch, as well as, the motivation for doing business in the city, in relation to the cost, supply and quality of water from the aquifers. The target population for this research were the food and beverage operators in Christchurch whose water is supplied from the city aquifers, as this subsector utilises water in its everyday operations and is a key contributor to the city’s economy.

A survey in the form of a questionnaire was chosen to obtain the data from the selected companies via telephone interviews. This method was undertaken for this research due to its:

- versatility in investigating an array of issues from a large cross section of the target population;
- efficiency, as data can be collected from a large population within a short time period;
- flexibility, in that it can be administered in various ways; and
- capability to allow for statistical analysis of the data and also allows the original data to be analysed by other researchers (Walter, 2006).

The diagram below provides a summary of the various stages of this research method.



Figure 3. Stages of the research

3.1 Participants

To obtain information from the target population of food and beverage companies, purposive sampling was utilised. This is a non-probability sampling technique where the researcher, with

the help of experts, uses their knowledge of the population coupled with the research objectives to deduce a sample (Tranter, 2013). Although this approach poses challenges in relation to the representativeness of the sample and personal biases, it was chosen because of the limited time to undertake this research and the need to ensure that the aquifer-fed water was the primary source of freshwater used by a business in the selected sample.

To select a sample size, the following activities were undertaken:

1. A list of all companies within the food and beverage sector in Christchurch city was identified using the customer relation management (CRM) system of the CDC, as well as the food and beverage directory obtained from the Ministry of Business, Innovation and Employment (MBIE).
2. The Australian and New Zealand Standard Industrial Classifications (ANZIC) codes were also used to garner statistical data on the total number of food and beverage companies operating in Christchurch.
3. Companies were shortlisted to those that are located in Christchurch and used the aquifers as the primary source of water.
4. A sample of 80 food and beverage companies in Christchurch were selected with the expert assistance of the CDC staff based on their knowledge of the sector, their knowledge on the areas whose water is supplied by the Christchurch City aquifer, as well as the objectives of the research. The companies selected were involved in varying activities such as breweries, wineries, bakeries, dairy by-products, food processing and manufacturing.
5. The telephone numbers and contact details for each food and beverage company within the sample size were obtained from the online directory from MBIE. The contact details for some of the companies within the sample size was also sourced from the customer relationship management system from the CDC.

3.2 Survey Instrument

A questionnaire provides the opportunity to capture data on the various issues relating to the socio-economic value of freshwater in Christchurch. This survey instrument was used because it allowed for the use of both open and closed ended questions to be utilised in order to capture both quantitative and qualitative data (Bryman, 2008) to ensure that the research objectives were achieved.

The questionnaire used in this survey provided a brief overview of the project and the purpose for undertaking this research. The questionnaire was developed as follows:

1. The questionnaire comprised eleven questions to ascertain information such as business activity, water usage, production levels, and the incentives for doing business in Christchurch in relation to the cost, supply and quality of freshwater.
2. The questions developed were consistent with achieving the above-stated objectives.
3. Both open-ended and closed-ended questions were utilised. The closed questions used in the questionnaire utilised a rating scale, with one (1) being the lowest and five (5) being the highest, to ascertain the level of importance of certain aspects of the aquifer-fed freshwater supply in Christchurch.
4. The sequence of the questions and language used was reviewed with the assistance of the staff at the CDC to ensure that the questions were consistent with the objectives, did not have double meanings, and were not too general and/or vague in order to elicit equal understanding and accurate responses from the respondents.
5. Simple language was also used in the questionnaire while jargon and leading questions were avoided.
6. The questionnaire was also reviewed to ensure that it fits within the allotted 10 to 15 minutes for each telephone interview.

A copy of the questions used for this research is provided in Appendix 1.

3.3 Survey Method

The survey was undertaken through telephone interviews due to its cost and time effectiveness (Walter, 2006) and it provided an avenue to interview the sample size which was scattered around Christchurch. In addition, as highlighted by Gillham (2005), a telephone interview method allows misunderstandings to be clarified and facilitates individuals to be interviewed at any location once there is access to a telephone or mobile phone.

The telephone interview was conducted using a questionnaire and was done as follows:

1. Each company within the sample was called via telephone.
2. An overview of the research objectives was provided to solicit who was most suitable for undertaking this survey to ensure that questions were accurately answered.

3. More detailed information was provided on the type of information required for the research to each respondent and the importance of this research in better understanding the value of freshwater to the food and beverage sector in Christchurch.
4. Each respondent was assured on the confidentiality of the information to be provided and they were also provided with the option for recording the interview to ensure that responses were accurately captured.
5. A questionnaire containing 11 questions was used to elicit the appropriate responses.
6. Each question was read to the respondents and the answer was written on separate questionnaire sheets for each respondent.
7. The telephone interviews lasted approximately 10 to 15 minutes each.

3.4 Data Collection

The data collected from the telephone interviews were recorded on print and then inputted into a Microsoft Excel for analysis. This analytical tool was selected because it was easily accessible and can be used to analyse both quantitative and qualitative data, undertake analysis and make comparisons.

3.5 Limitations

Although the telephone interview with the use of a questionnaire was selected as the most suitable for this research bearing in mind the time restriction, there were some limitations to the approach used. One of the limitations were that some persons were not interested in undertaking the survey and thus reducing the response rate and representativeness of the data (Tranter, 2013). This was primarily because most calls were at random times during the business day and as such, some of the times were not appropriate to some participants while others were simply not interested. Also, the use of the telephone interview does not provide an opportunity to capture some of the non-verbal cues such as body movements and facial expressions which can be important during an interview (McNeill & Chapman, 2005).

4.0 Findings and Analysis

The section provides an analysis of the findings from the primary research undertaken to achieve the stated objectives. From the 80 companies contacted for this research, 21 companies were willing to participate, representing a response rate of 26%. The main reasons for the low number of responses were:

- companies hesitant to discuss water issues due to the political and sensitive nature of the topic;
- companies thought this was another monitoring exercise from the council to extort information from them;
- difficulties in contacting the relevant company official best suited to participate in research;
- companies not interested in undertaking any type of surveys; and
- the limited time to undertake this research.

With a low response rate, the results fell outside the 95% and 99% confidence levels and the conclusions could not be statistically significant. This means that the findings cannot be applied across the entire population of food and beverage companies in Christchurch neither can generalisations be made about specific subsectors. Nonetheless, the findings from the data can be useful in providing some contextual information based on the research objectives. The research findings can also serve as a platform for additional research geared towards valuing the freshwater resource in Christchurch and its contribution to the city's economy.

4.1 Water Use Ratio (WUR)

The water use ratio (WUR) was one of the key metrics to be utilised in this research. The water use ratio is calculated as a ratio of total water usage to total beverage/food production. In effect, it is a measure of water efficiency and stewardship within the production of foods and beverages. However, based on the limited data collected, it was not possible to use this ratio for all respondents in this research. From the 21 companies who participated, five companies provided the necessary data to calculate this metric. The reasons for not providing this information were:

- companies not presently capturing this information;
- companies have not paid particular attention to capturing water usage level; and
- companies unwilling to provide the information because for commercial reasons.

However, of the 76% of companies which did not provide the data for the calculating the water use ratio, 48% indicated that there was presently no incentive to use water more efficiently at the company site (Figure 4).

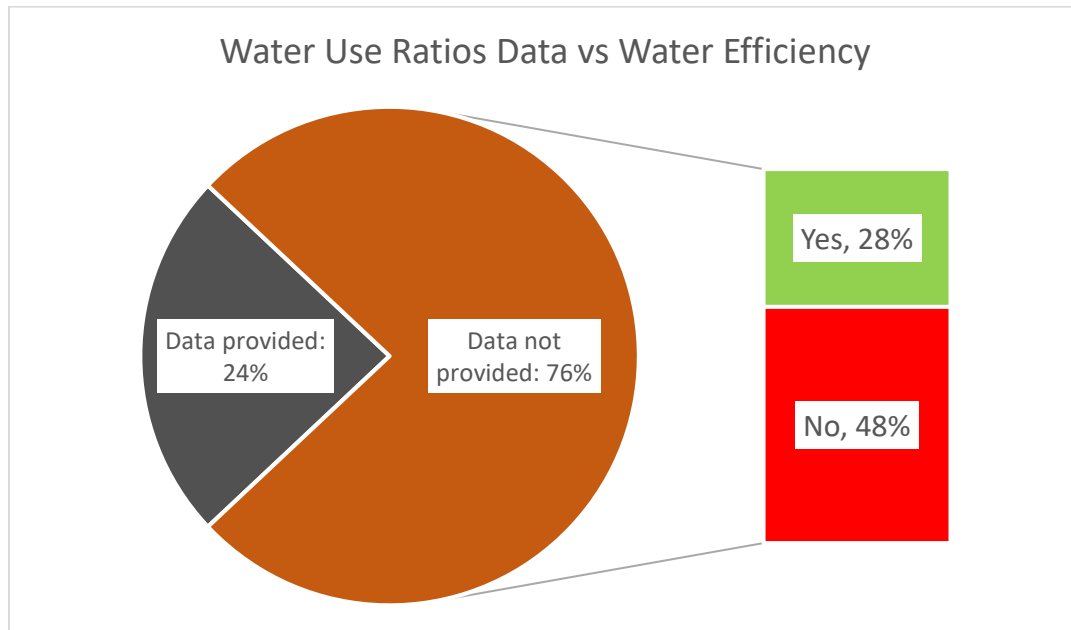


Figure 4. Proportion of food and beverage companies in Christchurch using Water use ratios vs. those with no incentive for measuring water efficiency

The results from Figure 4 further highlight that companies do not pay particular attention to water use levels and by extension water efficiency usage. Of the companies who did not provide water use information, only 28% indicated incentives to use water more efficiently, whereas a larger proportion (48%) stated no incentive to use water more efficiently in Christchurch.

4.2 Importance of water

Freshwater is used daily within the food and beverage sector in Christchurch. Based on the results obtained in this survey, 85.7% of food and beverage companies indicated that water was very important to the company (Table 1).

Table 1 Water importance rating for the Christchurch food and beverage sector

Importance of Water		
Rating	Frequency	Percentage
1	0	0.0%
2	0	0.0%
3	2	9.5%
4	1	4.8%
5	18	85.7%
Total	21	100%

The rating scale used in this research was:

- 1- not at all important
- 2- slightly important
- 3- important
- 4- fairly important
- 5- very important

Water is used in production, cleaning and sanitation for most food and beverage companies, thus, the majority of companies' rate water as very important in their industry. Based on the responses from three companies, beverage companies such as beer manufacturers indicate that water is a key ingredient that accounts for over 90% of the final product volume.

4.3 Efficiency of water use

The aquifer-fed freshwater supply in Christchurch is a very important resource to the city with water use efficiency being important towards maintaining this resource. The results from the survey indicated that 52% of the food and beverage companies aimed to use water more efficiently while the remaining 48% did not aim to use water more efficiently (Figure 5).

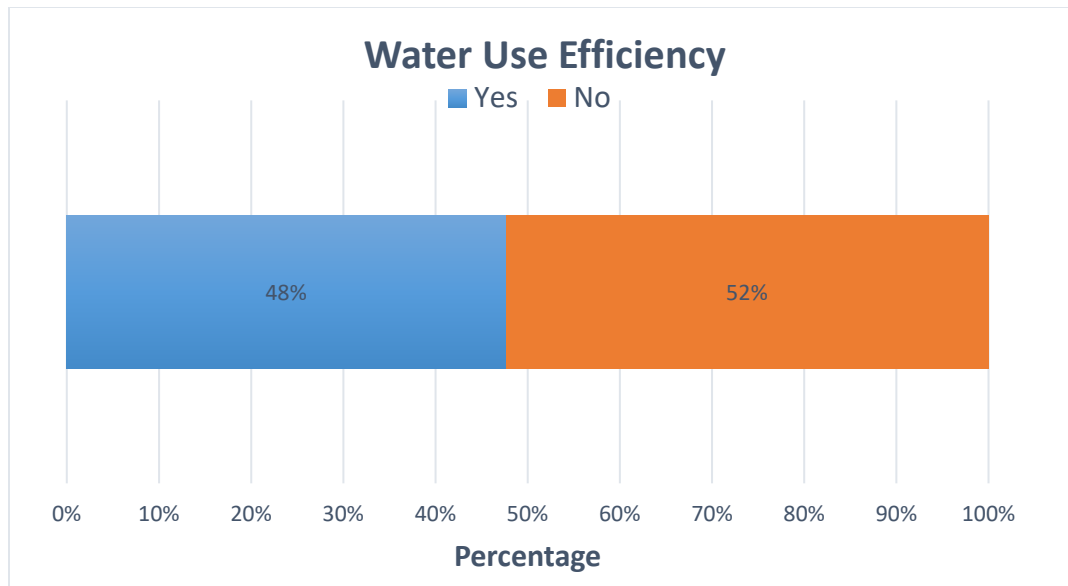


Figure 5. Water use efficiency within the Christchurch food and beverage sector

Figure 5 shows that some food and beverage companies are attempting to use water more efficiently within their companies. Three key drivers were identified as motives by 52% of respondents who aim to use water more efficiently. These are highlighted below in the order of priority:

- 1) The environmental awareness and consciousness of food and beverage companies to water and the importance of a healthy environment in ensuring the sustainable development of the sector.
- 2) The cost savings associated with using water more efficiently and recycling of water where possible.
- 3) The monitoring systems used by the Christchurch City Council for checking water usages.

The remaining 48% of respondents who did not aim to use water more efficiently identified two main reasons for this approach. These are:

- 1) The company has not actively considered water use efficiency within its operations.
- 2) The company has a set production cycle and uses water based on processes and water requirements for each process.

4.4 Incentives for doing business in Christchurch

Freshwater in Christchurch is a key input for the food and beverage industry. This resource can also play a key role as an incentive for doing business in the city as well as attracting other business

in the future to set up in the city. Therefore, certain key characteristics of freshwater in Christchurch were assessed to determine their level of importance as an incentive for doing business in the city. The three characteristics assessed were the reliability of freshwater supply, the cost of the freshwater and its quality.

4.4.1 *Reliability of freshwater supply as an incentive for doing business in Christchurch*

In Figure 6, the results show how the reliability of the freshwater supply in Christchurch acts as an incentive for doing business in the city.

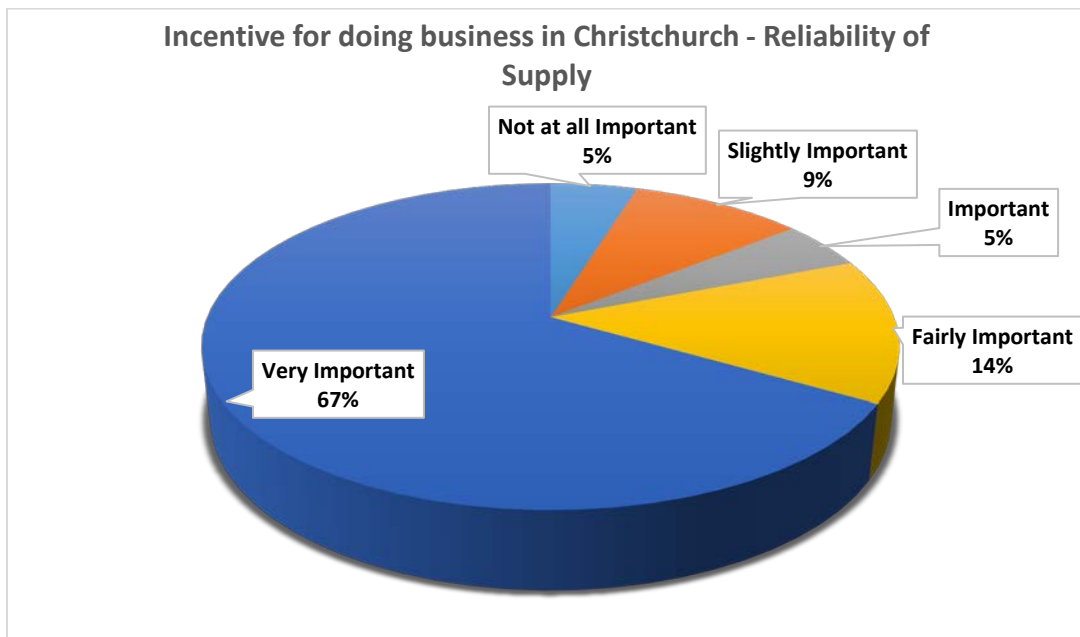


Figure 6. Reliability of supply as an incentive for doing business in Christchurch

From the food and beverage sector, 86% of respondents indicated that the reliability of water supply was an important to a very important incentive for doing business in Christchurch. The average rating across all respondents for the reliability of freshwater as an incentive for doing business is 4.3 out of 5, indicating that the reliability of freshwater supply acts as a fairly important incentive for food and beverage companies to do business in the city.

4.4.2 *Cost of freshwater as an incentive for doing business in Christchurch*

Another measure used was the cost of the freshwater and whether it served as an incentive for food and beverage companies to operate in Christchurch. The results from this measure are distributed almost evenly across 4 of the 5 ratings as seen in Figure 7 below.

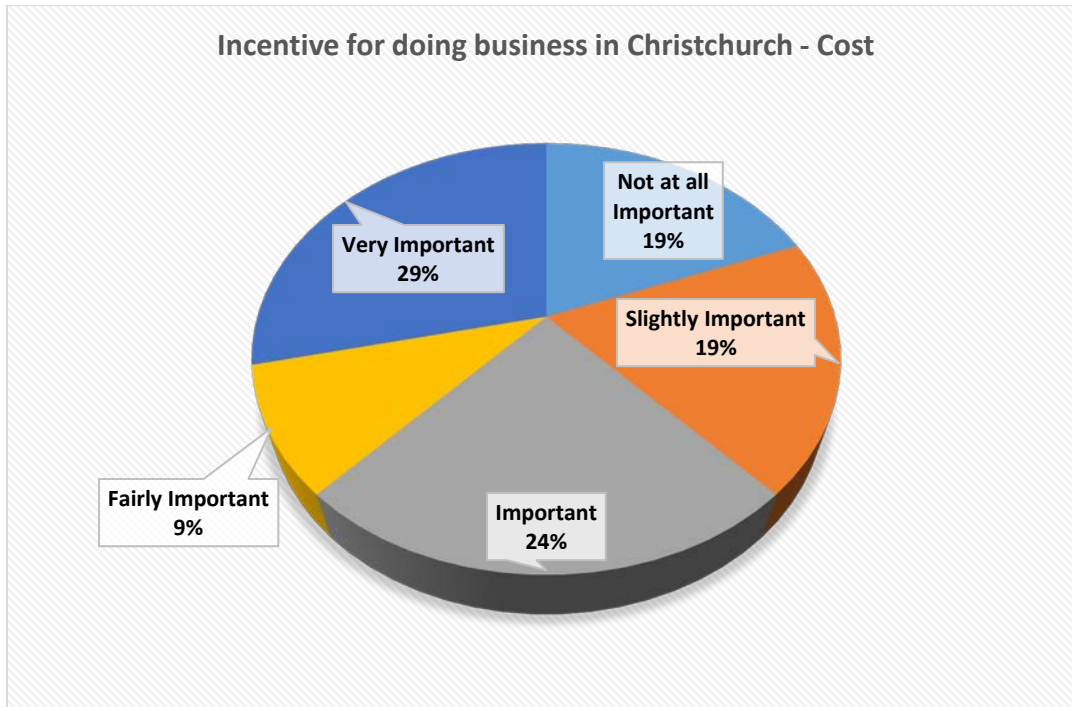


Figure 7. Cost as an incentive for doing business in Christchurch

In Figure 7, 29% of respondents indicated cost was a very important incentive in operating in the city, 9% stating that it was fairly important, 24% stating it was important, 19% stating it was slightly important and 19% stating that it was not at all important. The average rating across all respondents for cost as an incentive for doing business in Christchurch is 3 out of 5. Cost is an important incentive for food and beverage companies doing business in Christchurch but not as important as the reliability of the freshwater supply (average rate of 4.3 out of 5).

4.4.3 Quality of freshwater as an incentive for doing business in Christchurch

The quality of freshwater was also measured as an incentive for doing business in Christchurch. The majority of the food and beverage companies interviewed (76%) indicated the quality of freshwater was a very important incentive for doing business in Christchurch. In addition, 19% recognise this measure as slightly important to fairly important and the remaining 5% rated not at all important, as shown in Figure 8.

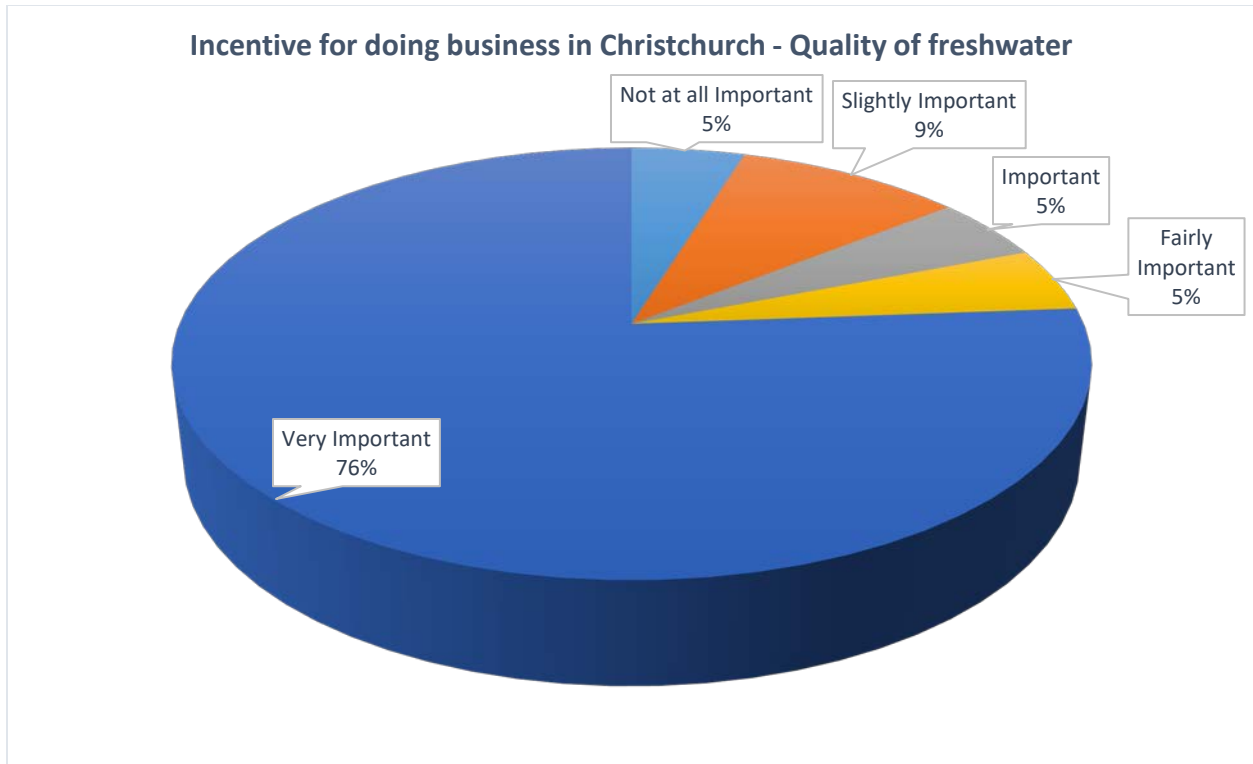


Figure 8. Quality of freshwater as an incentive for doing business in Christchurch

Moreover, the average rating across all respondents for cost as an incentive for doing business in Christchurch is 4.4 out of 5 and illustrates that the quality of freshwater was of greater importance as an incentive for food and beverage companies to operate in Christchurch more so than cost.

The high rating provided for the quality of the freshwater was attributed to four key areas as outlined by the respondents. These are:

- a) The high-quality water leads to a high-quality product being produced
- b) High-quality water leads to cost saving since water does not have to be treated and less wear and tear on machinery.
- c) High water quality assists in meeting health and safety requirements for operations.
- d) High-quality water is a key selling point for product marketing.

Based on the companies surveyed, 76% indicated that high-quality water leads to a higher quality product, 48% indicated that the quality of water leads to cost savings, 33% indicated that high water quality helps in meeting health and safety standards and 19% indicated that high water quality is a key selling point for the product marketing of the company. This shows that most food

and beverage companies focus on water quality standards when making decisions on doing business in Christchurch

On the other hand, one of the reasons provided for the low ranking for quality of freshwater in relation to doing business in Christchurch by some food and beverage companies was that their owners are from Christchurch and therefore the location was convenient. Another reason is that businesses expect high water quality to be provided by the council for its operations and thus did not recognise that as an important incentive for doing business in Christchurch.

4.4.4 Comparison of the three measures

Reliability of the freshwater supply, the cost of freshwater, and the quality of freshwater were the three factors used to measure the incentive for doing business in Christchurch in relation to water and its importance to the food and beverage sector. The results show that although all three measures were important, the quality of the freshwater is the most important incentive, followed by the reliability of supply, followed by the cost of the freshwater (Figure 9).

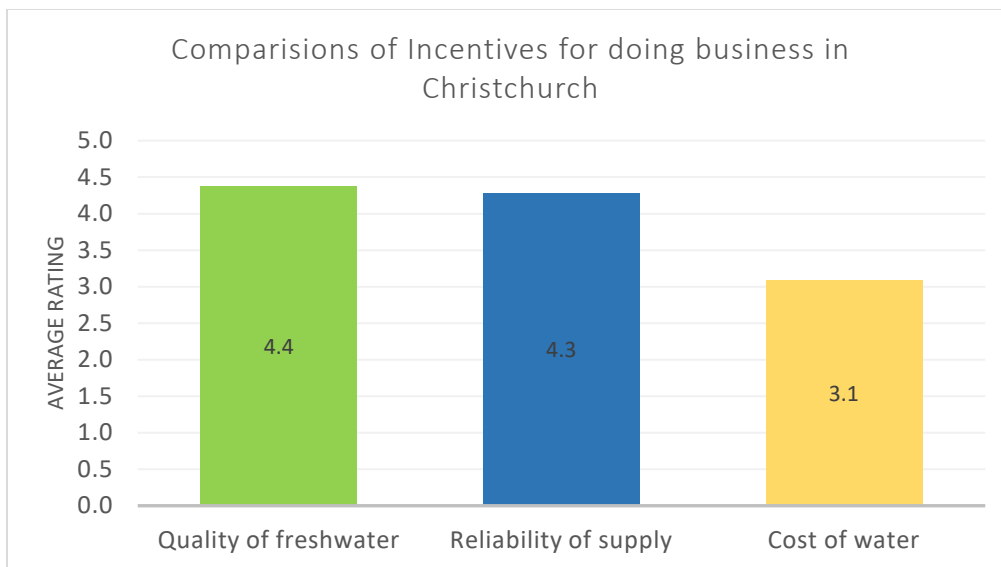


Figure 9. Average rating for reliability, cost and quality measures

The quality of freshwater has the highest average rating of 4.4 (Figure 9) indicating that this measure is very important as an incentive for doing business in Christchurch. Similarly, the reliability of freshwater supply is fairly important with an average rating of 4.3 and the cost is important with an average rating of 3.1 (Figure 9).

4.5 Purity of freshwater as a marketing tool

The degree to which the purity of freshwater from the aquifer-fed supply in Christchurch was used as a marketing tool for food and beverage companies was also analysed. As outlined earlier, water is a key ingredient for the food and beverage sector and the quality of freshwater is critical to ensure the high quality of the products delivered by the sector. The results show that presently, 24% of food and beverage companies use freshwater in Christchurch as part of their marketing strategy for their product, while the remaining 76% indicated that freshwater was not used as part of their marketing strategy.

The companies who utilised the purity of the freshwater presently within their companies all indicated that this strategy was used to promote the high quality of the product and also to meet international market standards for export markets. The promotion of freshwater quality acts as a promotion tool for exporting the products.

Conversely, from the remaining 76% of companies, 33% indicated that they have never thought about using the purity of the water as a marketing tool and the remaining 43% indicated the water purity was not important to the promotion of their product (Figure 10).

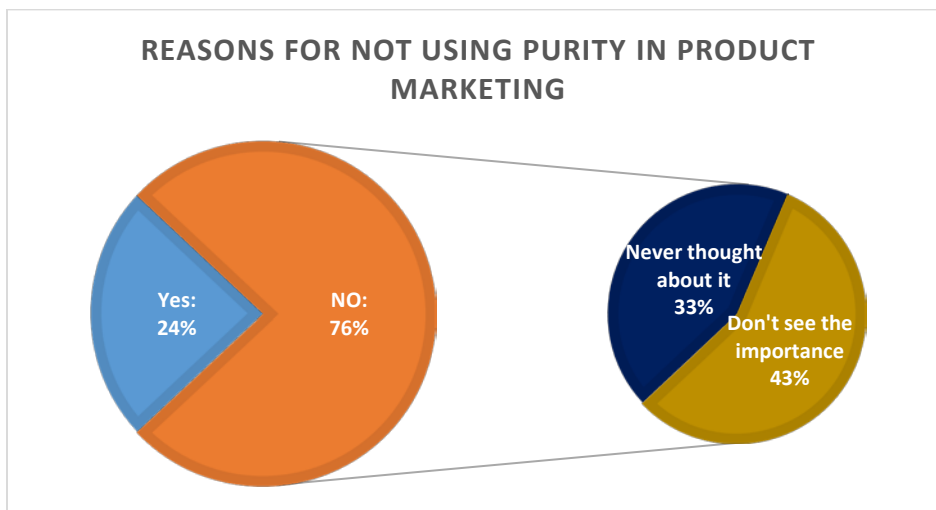


Figure 10. Breakdown of the reasons for not using freshwater purity in product marketing

4.6 Value adding ability of freshwater

The results of the survey indicated 52% of respondents believed that marketing the purity of Christchurch's freshwater can add value to their product while the remaining 48% believed that it will not add value to their product.

Of the 76% of companies who presently do not utilise the purity of the freshwater in their product marketing, 28% indicated that marketing of the freshwater aquifer as part of their marketing strategy has the potential to add value to their product, as presented by the green area in Figure 11.

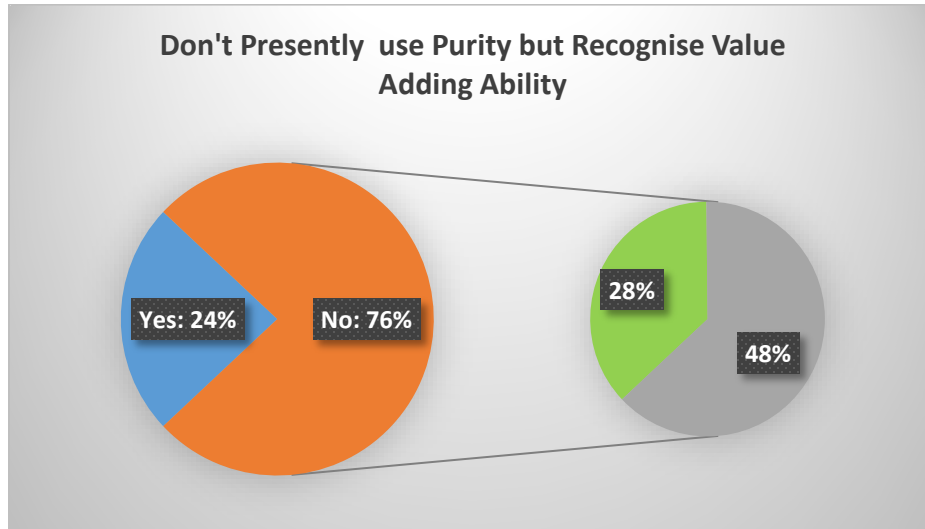


Figure 11. Percentage of food and beverage companies who do not presently use purity in marketing but recognise the possible value-adding ability

The main ways in which 52% of companies identified that marketing the freshwater purity can add value to their products are:

1. It can assist with export marketing and can be complemented with the existing clean and green image of New Zealand.
2. It can improve product quality, leading to increased customer satisfaction and increased customer base. One respondent indicated that “consumers love anything that is pure and has the backing of facts.”
3. It can improve the image of the company portraying a more environmentally conscious business.

On the other hand, the remaining 48% which indicated that marketing of freshwater purity would not add value to their products, highlighted the following:

1. Consumers are less concerned about the water and more concerned about the other ingredients of the product.
2. Consumers are more concerned about the taste of the product than where the water comes from.

3. The market for their product is too generalised to benefit from marketing the source of water.
4. The provision of good quality freshwater is expected across New Zealand.

5.0 Discussion

Freshwater from the aquifer-fed city supply is important to the operations of the food and beverage sector in Christchurch. The importance of this resource signals the need to efficiently use this resource within the operations of this sector. In addition, the potential of this freshwater resource as an incentive for doing business in the city is encouraging and provides a platform upon which to differentiate Christchurch city from other parts of New Zealand and the world for doing business. The potential benefits both direct and indirect from this freshwater resource can also contribute to the value adding ability of the city's freshwater source as a marketing tool for businesses within the food and beverage sector such as breweries, further differentiating the product of these companies both locally in New Zealand and on the international market.

5.1 Importance of water

The results in Table 1 indicate that water is very important to the food and beverage sector in Christchurch and is used primarily in production, cleaning and sanitation. This demonstrates the important role of freshwater as the centrepiece to human life as well as in the delivery of key ecosystem goods and services (Falkenmark & Folke, 2003). As articulated above, groundwater ecosystems provide certain key services namely provisioning services, regulatory services, cultural services and supporting services. These ecosystem services are critical to the provision of food, energy, and nutrients *inter alia*. The indication of water as very important is consistent with the value placed on freshwater in the delivery of provisioning services such as the production of food and water (Griebler & Avramov, 2014) which are at the core of the operations of the food and beverage sector.

The very important rating of water from the majority of respondents (85.7%) suggest an understanding of the importance of water both directly for the daily operations of the businesses (provisioning services) and also indirectly in relation to ecosystem services that freshwater supplies. In addition to the provisioning services, freshwater also provides regulatory services in terms of water purification for the sector ensuring that the water used is of the highest quality and meets health and safety standards. The supporting services of freshwater also play a key role in soil formation which is important for upstream industries that supply raw materials to the food and beverage sector. In line with Griebler and Avramov (2014), the results from this survey illustrate

the importance of freshwater as a resource to the food and beverage sector in Christchurch in terms of the delivery of goods and services.

Moreover, with increased industrial development and globalisation, the demand for products from the provisioning services of freshwater may also increase (Hassan et al., 2005). As outlined by the CDC (2016) the food and beverage sector is important to the city's economy and since water is important to the operations of this sector, the importance of water extends beyond the food and beverage sector to both the city and the national economy. The continued increase in demand for food and beverage products in Christchurch, driven by both the local and export market, also demonstrate the very important nature of freshwater as an input to the operations of the sector.

Therefore, as outlined by Sachidananda et al. (2016) issues surrounding uncertainty of future freshwater availability coupled with increased demand for products to meet growing demand further indicate the importance of freshwater as a key provisioning service provider. This further shows the very important nature of freshwater to the food and beverage sector in Christchurch and can be argued that the economic value derived from the use of freshwater is very high. As explained by Das (2015) one way of deriving the economic value of a natural resource is through its use and benefit. In the case of the food and beverage sector in Christchurch, the freshwater resource provides significant benefits as shown in the rating of very important by the majority of respondents in Table 1, as the absence of this freshwater resource can adversely affect the operations of the businesses within the sector.

5.2 Efficiency of water use

The efficient use of this freshwater resource is vital to reducing the pressure on groundwater ecosystems as noted by the Millennium Ecosystem Assessment (2005). The results show that just over half of the respondents (52%) indicated using water efficiently, with the main reasons being attributed to the concern for the environment and cost cutting measures. The proactive approach to water efficiency can positively affect the image of these food and beverage operations who are consciously undertaking water efficiency measures within their operations. This can help in increased corporate image, improved customer relations and provide some competitive advantage in the marketplace with customers gravitating towards more environmentally friendly products and businesses and products produced at a lower cost (Smith et al., 2000).

Nonetheless, the mere 52% of water efficiency efforts from respondents should also be a cause for concern. Given that freshwater is very important to the operations of the food and beverage sector in the city, using this freshwater resource with a greater level of efficiency will alleviate some of the pressures on groundwater ecosystems (Millennium Ecosystem Assessment, 2005). Hence, if safeguarding the resource is a priority as articulated by the CCC (2015), then water efficiency should be central to the operations of the food and beverage sector as they depend heavily on the resource for their operations. The lack of monitoring of water use levels by the majority of respondents (76%) signals the need for closer monitoring of water usage by food and beverage operators to safeguard this prestigious resource. This lack of monitoring of water usage also indicates that water efficiency is not at the core of the operations of these food and beverage operators with 48% out of the 76% indicating no incentive to use water more efficiently.

This lack of incentive to use water more efficiently because these food and beverages companies had not thought about it and most of these companies were following a set process for production indicate that these companies saw little justification to use water more efficiently as highlighted by Whitehead (2013). Moreover, the reasons provided for not having previously thought about water efficiency could be as a result of the perception that the operations of the company have minimal impact on the environment, as articulated by Smith et al. (2000). Hence, this may contribute to why some food and beverage companies have not had a more positive approach towards water efficiency and implemented appropriate approaches within the company operations to utilise water more efficiently.

Encouraging water efficiency within the food and beverage sector is important to safeguarding the freshwater resource in Christchurch. Although 52% of respondents do practice water efficiency, perhaps a greater thrust towards increasing this percentage should be encouraged. This may be achieved through various monitoring mechanisms or other incentives such as taxes. In Christchurch, the Christchurch City Council (CCC) undertakes yearly monitoring for most food and beverage operators based on a set daily water allowance based on the capital value of the property, with any excess water utilised being charged for based on an established rate. Hence, it can be argued that the rate presently being charged for excess water usage does not act as an incentive to change the behaviour of food and beverage operators to use water more efficiently and raises further questions about the rationale for setting this rate at the present level. As stated by Martin-Ortega et al. (2015) external incentives aimed at fostering a particular behaviour from

businesses must be significant enough in order to generate the desired result, which in this case is a more efficient use of this freshwater resource to preserve the resource.

5.3 Incentives for doing business in Christchurch city

The characteristics of water namely its mobility, variability and heterogeneity as explained by Hanemann (2006) make it a very important commodity to the operations of food and beverage sector and can act as a key incentive or reason for choosing to establish in a particular locale. Also of importance, is the type of commodity the freshwater resource is classified as. The use of freshwater by food and beverage operators indicate some elements of water being a private good since companies are paying for water (through annual services fees to the council) and the use of the resource makes it less available for other users.

Nonetheless, a more thorough analysis reveals that this freshwater resource can also be classified as a common pool resource (Ostrom et al., 1999) where it is difficult to exclude food and beverage companies from using the resource and the use of the resource by one company makes water less available for other users. The recognition of the freshwater resource as a common pool resource in New Zealand can be useful to decision makers in the use and management of the resource in the face of the increasing challenges surrounding freshwater quantity and quality. Freshwater as a common pool resource also highlights the freshwater within the entire network of ecosystem services and the complex relationship between the various elements of the ecosystem services (Ostrom et al., 1999).

Having classified the resource, the measures of reliability, cost and quality will be assessed as incentives for choosing Christchurch as a destination for doing business.

5.3.1 Reliability of supply

A reliable water supply is important to the operations of food and beverage operators in Christchurch. Nearly 90% of respondents indicated that water was very important to the operations of their company as well as the 86% of respondents who indicated that reliability of supply was important to very important for choosing to establish a presence in Christchurch. As noted by Martin-Ortega et al. (2015) water availability and scarcity is one of the key risks to businesses from the use of groundwater. The availability of water can directly influence the supply of and by extension the frequency/reliability of water for business use. The balancing of such a risk to the

operations of food and beverage companies becomes important as water is central to the operations of these businesses and hence a reliable supply of freshwater would be very important in determining the location of operations.

Moreover, the food and beverage sector is important to the economy of Christchurch (CDC, 2016) and a reliable and stable freshwater supply is important to the daily operations of these businesses and the contribution they make to the city's GDP. Freshwater is very important not just to the operations of these companies but also in relation to their profitability as water is critical to their operations. A reliable supply of freshwater is also fundamental to address increased demand for products from the food and beverage sector both in New Zealand and within the international market. This further demonstrates why a reliable supply of freshwater acts as a fairly important incentive (average rating of 4.3/5) for food and beverage companies in relation to doing business in Christchurch.

5.3.2 Cost of freshwater

The cost of freshwater was another measure used to determine whether this was an incentive for food and beverage businesses to establish in Christchurch. Generally, 62% of respondents thought the cost was an important to very important incentive while the remaining 38% indicated cost as slightly important to not at all an important incentive for doing business in the city. The important to very important rating by over half of respondents (62%) could mean that the relatively low cost of water acts as an incentive for business to establish because it helps in keeping operating cost low. Whereas, the slightly important to not at all important rating by 38% could mean that the present pricing mechanism administered by the CCC is not significant enough to act as an incentive for doing business in the city.

The present pricing mechanism administered by the CCC provides a daily water allowance for food and beverage companies based primarily on the capital value of their property with an annual service fee paid to the council as part of general rates for other services such as garbage collection and sewage. If companies go over this limit, an excess water fee of NZD 0.73 for every 1000 litres over the daily allowance is charged. Therefore, if a company operates within the daily allowance, the cost for the use of the freshwater resource would be practically NZD 0.00 apart from the annual rates paid. This illustrates that the cost of water in Christchurch as an incentive for doing business is twofold. It serves as a cost-saving incentive for food and beverage companies who value cost

savings and thus consider this an important to very important incentive for doing business. Whereas, the practically free freshwater commodity may not be an important incentive for other businesses as the cost is too low and has little impact on business behaviour.

As explained above, this low cost of freshwater in Christchurch could also be a disincentive for promoting water efficiency within the food and beverage sector. Therefore, this provides support to the argument made by the NZIER (2014) that the prices paid for water do not reflect the true cost of water nor the economic and social value of water as a resource for the provision of good and services within the food and beverage sector. The relatively mixed rating and an average rating of 3 out of 5 for cost as an incentive for doing business suggest the needs for further discussion on the present pricing mechanism utilised for the distribution of freshwater in Christchurch. With concerns about the availability of the freshwater resource in New Zealand (Jenkins, 2015) a discussion on pricing is important, particularly when determining the allocation of water across competing sectors who all contribute to the GDP of Christchurch and by extension New Zealand.

5.3.3 Quality of freshwater

The purity and high quality of the freshwater in Christchurch are critical to the operations of food and beverage operators as shown by the majority of respondents (76%) who indicated that this was a very important incentive for doing business in the city. This supplements the results in Table 1 showing that the majority of respondents indicated that water was very important to their operations. Therefore, this shows that although the water is very important as a source of input for the operations of these food and beverage companies, the quality of the freshwater is also very important. As outlined above, the high quality of Christchurch's freshwater derives from aquifers that provide a natural purification process. This means the water use for production requires no treatment prior to use within business operations. This results in cost saving to the company from not having to treat the freshwater and can also help with improving the corporate image of the company (Smith et al., 2000) and by extension the image of Christchurch and New Zealand. Hence, this high-quality water provides an incentive to business both from the direct benefits in terms of cost saving and indirect benefits in terms of corporate image.

Furthermore, consumers are becoming more health conscious with increased focus on health and safety through the consumption of goods that are produced with natural ingredients and in an

environmentally sustainable way (Millennium Ecosystem Assessment, 2005). The high quality of the pure freshwater from the aquifers in Christchurch makes it easy for food and beverage operators to meet health and safety standards for both local and international markets. This further supports the increased demand for products from the city's food and beverage operators and continues to contribute the city's GDP (CDC, 2016) and the national export and GDP of New Zealand (MBIE, 2015).

In addition, the majority of respondents who indicated that quality of freshwater was important to very important as an incentive for doing business in the city highlighted that this facilitates the production of high-quality products and can also assist with product marketing. High freshwater quality and the New Zealand clean green image serve to provide a competitive advantage to Christchurch food and beverage operators in relation to building a destination brand for New Zealand products in general (MfE, 2001) and by extension Christchurch. This demonstrates that Christchurch is seen as a high freshwater quality destination and serves as a key selling point not only for business establishment but for the production and selling of products within the food and beverage sector.

In addition to freshwater being categorised as a common pool resource in itself (Ostrom et al., 1999), the quality of freshwater as an attribute of water has also been categorised as a common pool resource (Sarker et al., 2008). This is because of the use of the high-quality freshwater by one sector of the economy that overutilizes, for example, the assimilative capacity of water or the groundwater system, makes less of this high-quality freshwater resource and purification system available for use by another company. Hence, if the quality of the freshwater is compromised or reduced it makes a lower quality of freshwater available for other users. This means that the high quality of freshwater available to food and beverage operators is incentivised due to the reliability of not just the supply of freshwater but the supply of high-quality freshwater for business operations and processes. The aquifer fed Christchurch city freshwater supply provides this source of high quality and reliable freshwater to food and beverage operators and explains further why the quality of freshwater is a very important incentive for food and beverage companies.

5.3.4 Comparison of all three measures

All three measures, namely the reliability of freshwater, the cost of water and quality of freshwater, were important incentives for doing business in Christchurch. Specifically, the research showed

that the quality of freshwater is seen as very important as well as the reliability of supply (fairly important), with the cost of freshwater supply ranking the lowest (important). The ranking of this measure reflects the significance of the four risks identified by Martin-Ortega et al. (2015) and the PCE (2013) to business from groundwater ecosystems. These risks were water availability and scarcity, infrastructure cost risk, regulatory risk, reputational risk and the risk to increased pollution particularly from nitrate leaching from increased agricultural land use practices.

These risks encapsulate these three measures and it can be argued that the risk of water availability and scarcity and the risk of pollution and access to high-quality freshwater weighs more on food and beverage business decision to establishing in Christchurch compared to the cost risk associated with water infrastructure. This can be seen from the 4.4/5 and 4.3/5 average rating given to freshwater quality and reliability of supply respectively compared to the cost of freshwater which has an average rating of 3.1/5. The higher average rating suggests a greater weight is given by food and beverage operators to these factors when making a decision on establishing in the city.

Similarly, it can be argued that the very important average rating of the quality of freshwater among food and beverage operators compared to the important average rating for cost suggest that food and beverage companies value meeting health and safety requirements and the benefits associated with high-quality freshwater water than the cost of the water in the city. This also shows that perhaps cost does act as a very good incentive for food and beverage companies in the city. As explained by Das (2015) and the (NZIER, 2014) the economic value of a natural resource (in this case freshwater) depends on its availability and its use and the utility gained from its consumption. Therefore, the results of the comparison of the three measures also indicate that the greatest economic value from the freshwater resource in the city is derived from its pureness and high quality.

The high economic value to the food and beverage companies in Christchurch not only lies in the natural resource itself as common pool resource but also as a high-quality source of freshwater and the associated benefits from this such as cost savings, improve corporate image and a higher quality product as outlined in the results above. This further explains why the quality of freshwater is rated the highest by food and beverage operators as an incentive for doing business in the city compared to the reliability of supply and cost. Nonetheless, it must be noted that reliability of

supply and cost are also important as the three measure combined each play a role for food and beverage operators deciding whether to establish in Christchurch.

5.4 Purity of freshwater as a marketing tool

Based on the results above, only a small number of respondents (24%) presently use the pureness of the freshwater in Christchurch as part of their product marketing, with the majority (76%) indicating they did not. The respondents who presently use the purity as a marketing tool indicated that this strategy helps immensely when marketing products in international markets as well as contributes to assuring customers of the high quality of the product. As explained by the Millennium Ecosystem Assessment (2005) customers have become more health conscious and are more attracted to products produced with natural ingredients and that are environmentally sustainable. Hence, using the purity of the freshwater as a marketing tool helps in creating a competitive advantage for the food and beverages companies both locally and internationally.

On the other hand, the majority of respondents who are presently not utilising this promotion strategy indicated that they had not thought about it or didn't see the importance of it. This may be because these companies are unable to see the tangible benefits from using such a strategy. As Martin-Ortega et al. (2015) explain, changes in the behaviour of business from the use of ecosystem goods and services should require an approach where the benefits are tangible and reflected in the financial figures for the business. However, the results in Table 1 and Figure 8 demonstrate the very high importance of water as an input for food and beverage companies as well as the importance of the quality of the freshwater as an incentive for doing business in Christchurch. Therefore, although these companies indicated that they did not see the importance of the pureness of the freshwater as a promotion tool, most companies consider freshwater and the quality of freshwater very important to their operations. This shows the importance of the pureness of the water to the food and beverage company but as highlighted above, there may be some difficulties in expressing this in financial terms to food and beverage operators.

5.5 Value adding ability of freshwater

Freshwater has the potential to add value to a business and its products as seen through the experiences of Cascade Brewery in Tasmania which markets its product based on the pure waters from Mount Wellington as one of the key ingredients (Cascade, n.d). The results of this survey indicated that a little over half of respondents (52%) noted that the marketing of the freshwater can

add value to their business. The main reasons attributed to this were consistent with the conclusion drawn by the Millennium Ecosystem Assessment (2005) and Smith et al. (2000) in relation to improving company image and improved customer satisfaction as customers would be more inclined to purchase products that are pure. This can be very beneficial to breweries and other beverage producers within Christchurch where water is a key ingredient in the product of these products. Moreover, the New Zealand clean and green image was also identified as a key reason since these food and beverage companies recognised this as an opportunity to capitalise on this relatively established international image of a clean and green New Zealand (MfE, 2001).

In addition, the recognition by 52% of respondents of the value adding ability of the pureness of the freshwater in Christchurch provides an opportunity to build on the clean and green New Zealand brand and explore the possibility of a Christchurch brand around the availability of pure naturally purified freshwater. This can serve to market not only the business operating within Christchurch but also for marketing Christchurch as a destination similarly to the strategy implord with Fiji water as explained by Connell (2006). Such an approach can play a dual role of providing businesses such as food and beverage operators, a competitive advantage in the locale of international markets due to the pureness of the freshwater used in these product as well as market Christchurch as a city for doing business for companies that rely on a high quality of freshwater for its operations. This can again contribute positively to the GDP of the city and stimulate employment.

From the remaining respondents who did not see the value adding ability, there were mixed responses on the reasons. The mains reasons attributed to this were that consumers were not interested in the water going into the product and more concerned with the taste. However, as highlighted by many authors such as Crook et al. (2009) and Smith et al. (2000) consumers are very concerned about their health and safety and this has resulted in a move towards products that are pure, of a very high quality and produced in an environmentally sustainable way. The marketing of the freshwater can, therefore, assist in providing a distinguishing characteristic about the product as well as the location where the product was produced. This further demonstrates that marketing the pureness of the freshwater in Christchurch has the potential to provide benefits to business as well as the city in general as a business destination.

6.0 Reflections

This research has provided some very useful insights into the five key elements outlined above, namely industry use of freshwater, operational saving from non-treatment of freshwater, ecosystem services, the intrinsic value of freshwater and the potential marketing opportunities. However, further research is encouraged in the areas of businesses willingness to pay for freshwater resources. The willingness to pay examines the price businesses are willing to pay for the provision of reliable and high-quality freshwater. This will serve to provide a better understanding of the socio-economic value of the freshwater resource in Christchurch and a better understanding of the twofold nature of cost as an incentive for doing business in the city.

Moreover, future research should also aim to address what businesses actually do with the freshwater resource and the link to ecosystem services. This will provide greater insights into water use, water efficiency efforts, and business operations rather than a focus on merely value or price so that the services could be equated to value and price by an expert. Such research can complement the research about the willingness of businesses to pay, as suggested above.

Furthermore, although the value of the freshwater is important, also important is the overall value of the groundwater ecosystem. Although the groundwater ecosystem is a key provider of provisioning services, they are part of a system with interrelated services such as regulatory services, cultural services and other supporting services. Therefore, the value of freshwater systems cannot be assessed in isolation of other land use activities such as urban development and agricultural expansion. Therefore, this raises questions and highlights the need for possible approaches for the management of the groundwater ecosystem as a whole rather than its various elements.

There is also the potential for a Christchurch City brand around the high-quality freshwater that presently exists. This can position the city and its products both within the local and international markets to capitalise on the competitive advantage from the high-quality freshwater. The approach to establishing this brand has to be a collaborative approach between regulatory institutions that manage the freshwater and the development agencies that focus on economic growth and prosperity. This ensures that development plans are consistent with long-term resource planning efforts to safeguard freshwater sources in Christchurch. In addition, building awareness among

industry business and groups and the potential for this brand is instrumental in capitalising on this opportunity.

The experience gained from this research has been remarkable. It has certainly broadened my understanding of the role of freshwater in New Zealand and its importance to businesses and households. In addition, it has also provided motivation for advanced studies in environmental policy and management as there are many environmental and sustainability issues that confront Small Island Developing States (SIDS) and more research is required to tackle those issues. Undertaking this study in New Zealand also serves to increase my knowledge and skills and identify what are some of the areas especially in freshwater management that can be applicable to SIDS. The staff of the CDC was also very professional and the experience there is invaluable. I hope this research provides some of the answers required and sets the platform for additional research as outlined above.

7.0 Conclusion

This research investigated the water use ratios and the importance of the freshwater supply in Christchurch to the food and beverage businesses. Overall, the research showed that freshwater was critical to the operations of these businesses. Although the water use ratios could not be calculated due to limited data, this did provide some indirect data to support the analysis of freshwater efficiency efforts within the food and beverage sector. The sector is also very important to the Christchurch economy and therefore, the efficient use of freshwater should be promoted to safeguard this valuable and precious natural resource.

Despite the important role of the food and beverage sector to the city's economy, the quality of freshwater is at the core of the business decision to establish in the city, along with other factors such as reliability of supply and the cost of the freshwater. The high-quality freshwater provides an opportunity to also add value to business operations in terms of the selling of high-quality products and the marketing of Christchurch using the pureness of the freshwater. Nonetheless, to maximise these benefits, there needs to be a concerted effort towards the sustainable management of the groundwater ecosystems to safeguard the freshwater resource and the services it provides. Additionally, there needs to be further discussion on the issues of pricing of the high-quality freshwater in New Zealand, as this research indicates that the cost may be a disincentive rather than an incentive for promoting freshwater efficiency in business. Addressing these issues are important in order to realise the direct and indirect benefits that can be accrued from the high-quality freshwater source in Christchurch.

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Appendix 1

Questionnaire for Food & Beverage Operators

Introduction:

Hi, my name is Mandille Alcee and I'm an Economic Research Intern at the Canterbury Development Corporation (CDC), which is the economic development agency for Christchurch.

I'm working on a project that is investigating the socio-economic value of the freshwater supplied from the aquifers in Christchurch. I would like to make an appointment for a convenient time to talk to you for approximately 10 to 15 minutes about how your company uses water.

In order to undertake this research, a list of food and beverage operators within Christchurch has been compiled so that we can develop an understanding of the importance of water to this important sector of the city's economy. The findings and information gathered from this research will be used by CDC to better understand the value of aquifer fed water supply in Christchurch and will also be used to inform regional policies and plans. In addition, the information you provide will be confidential and the results will not enable the identification of your business.

I would also like to record our discussion using a digital recorder. At the beginning of our discussion, I will ask whether it is fine to make a recording. The recording is to ensure that I capture your responses in full and will be utilised during the compilation of the data and analysis of results.

Questions:

1. Could you please explain the activity the company is engaged in and your role?
2. Can you provide an estimate of your total number of employees?
3. On a scale of 1 to 5 (one being lowest and 5 being highest), how important is water to the operation of your company?

Please give reasons for your rating.

4. Can you please give an indication of the total water use within your company for the past 3 years? (if monthly figure is provided this will be totalled to calculate annual figure). This

will include the water used for beverage or food production, cleaning, cooling, heating, sanitation and landscaping.

5. Can you please give an indication of the total beverage production / total production for your company for the past 3 years? (if monthly figure is provided this will be totalled to calculate annual figure).
6. Have there been any internal or external incentives to use water more efficiently?
If Yes, what are the driving factors?
If No, why do you not consider water efficiency when making business operation improvements?
7. On a scale of 1 to 5 (1 being lowest and 5 being highest), to what extent is the **reliability of supply** of freshwater in Christchurch an incentive for doing business in the city.
8. On a scale of 1 to 5 (1 being lowest and 5 being highest) to what extent is the **cost** of Christchurch's freshwater an incentive for doing business in the city?
9. On a scale of 1 to 5 (1 being lowest and 5 being highest), to what extent is the **quality of Christchurch's freshwater** an incentive for doing business in Christchurch?
Please provide the reason (s) for rating.
10. Do you ever use Christchurch's pure spring water as part of your product marketing?
11. Christchurch's water comes from natural aquifers which provide a source of pure spring water. Do you think that marketing the purity of Christchurch's freshwater as a promotion tool could add value to your products?
If yes, How?
If No, why not.

Thank you for your taking the time to speak with me today and assisting with this research.