Is a nutritionally-balanced and low-carbon diet affordable in Ontario?

by

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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Food plays an essential role in the path towards healthy growth and development, and enhancing the quality of life. Food systems contribute to food security, but also contribute to global environmental changes, such as climate change, and negatively affect environmental security. Food environments influence eating behaviors and food related activities. Within the "consumer nutrition environment", individual factors such as time, dietary knowledge, food preferences, values, norms and culture are among the many factors that influence how people choose what to eat. Among these factors, affordability and cost are very critical, specifically when encouraging consumers to eat more sustainable food.

This study aims to assess the affordability of nutritionally-balanced and low-carbon (NBLC) diets in Ontario, based on food baskets developed by Veeramani et al. (2017). In order to do so an assessment tool was developed to study grocery stores in Southern and Northern Ontario. The results of this study show that in terms of availability of food items, most of the items from nutritionally-balanced and low-carbon food baskets were available for Ontarians. In terms of cost, the type of store (i.e. discount vs regular) significantly affects the price of a NBLC food basket. In terms of affordability, as it is related to income, for households with higher income it is affordable to switch to a NBLC diet. However, households with lower income need to make moderate changes in their present eating behavior.

Finally, the financial aspect is an important- but not the only - driver of eating behaviors. Education and knowledge regarding food choices are important determinants of consuming healthy food. In addition, time constraints and how these constraints affect time needed for food related activities are also of significance and in some cases, it could exceed the effect of affordability. Further research is required to study the extent to which each of these factor influence eating behaviors.

Key Word: Low-carbon food baskets, Retail Food Environment, affordability, eating behavior constraints

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List of Abbreviations

GHG - Greenhouse Gases

CO_2-eq.- Carbon dioxide equivalents

GWP - Global Warming Potential

LCA - Life cycle assessment

H&S - Healthy and sustainable

ON - Ontario

WHO - World Health Organization

FAO - Food and Agriculture Organization of the United Nations

USDA - Unites States Department of Agriculture

NEMS - The Nutrition Environment Measures Survey

NFB - Nutritious food basket

RNFB - Revised Northern Food Basket

NBLC – Nutritionally-balanced and low carbon

Chapter 1: Introduction

1.1 Thesis structure

This chapter presents a background for the present study. The literature review covers general topics regarding sustainable diets, factors influencing eating behaviors and the food environment, and affordability. The Research question and the main objectives of this study are also provided in this chapter.

The subsequent 2 chapters are organized as journal articles and provide more detailed literature reviews based on the topic. Specifically, Chapter 2 covers the process of developing and assessing the tool used for data collection. It also provides a background on tools and methods used in research similar to the present study. Chapter 3 presents a background to healthy and sustainable diets and affordability and provides the results of the assessment of cost and affordability of nutritionally-balanced and low-carbon food baskets.

Chapter 4, the final chapter, is mainly a discussion regarding the interesting points derived from the outcome of this study. Limitations and suggestions for future research are also included in this chapter.

1.2 Literature review and background

1.2.1 Food systems and Global Environmental Change

Food plays an essential role in the path towards healthy growth and development, and enhancing the quality of life (Hales, Kovats, Lloyd, 2014). Food security encompasses the concept of availability of fair supply of food and access to clean drinking water to human beings (Reisch, Eberle, & Lorek, 2013). According to World Food Summit it can be defined as

> "when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 1996).

Nevertheless, our current food system is failing. Challenges such as production constraints, lack of nutritious food, distribution inadequacies and many other issues regarding human and economic development, are making it more difficult to achieve global food security (Ziervogel & Ericksen, 2010). Eight hundred million people around the world suffer from hunger and under consumption of food, and lack of access to sufficient and safe drinking water, while 1 to 1.5 billion people are overweight or obese (Reisch et al., 2013), with many of them suffering from non-communicable diseases due to their diet. Thus, food security and health outcomes related to food system activities have an inevitable link.

Ericksen (2007) presents a holistic framework that depicts the interaction between food system activities, food security, and global environmental change (Figure 1.1). According to this framework, as well as the definition by FAO (2013), food systems encompass the entire range of activities, peoples, and institutions involved in the production, processing, marketing, consumption and disposal of food. Furthermore, these activities contribute to food security outcomes, as well as environmental security which is our access to ecosystem services and natural capital.

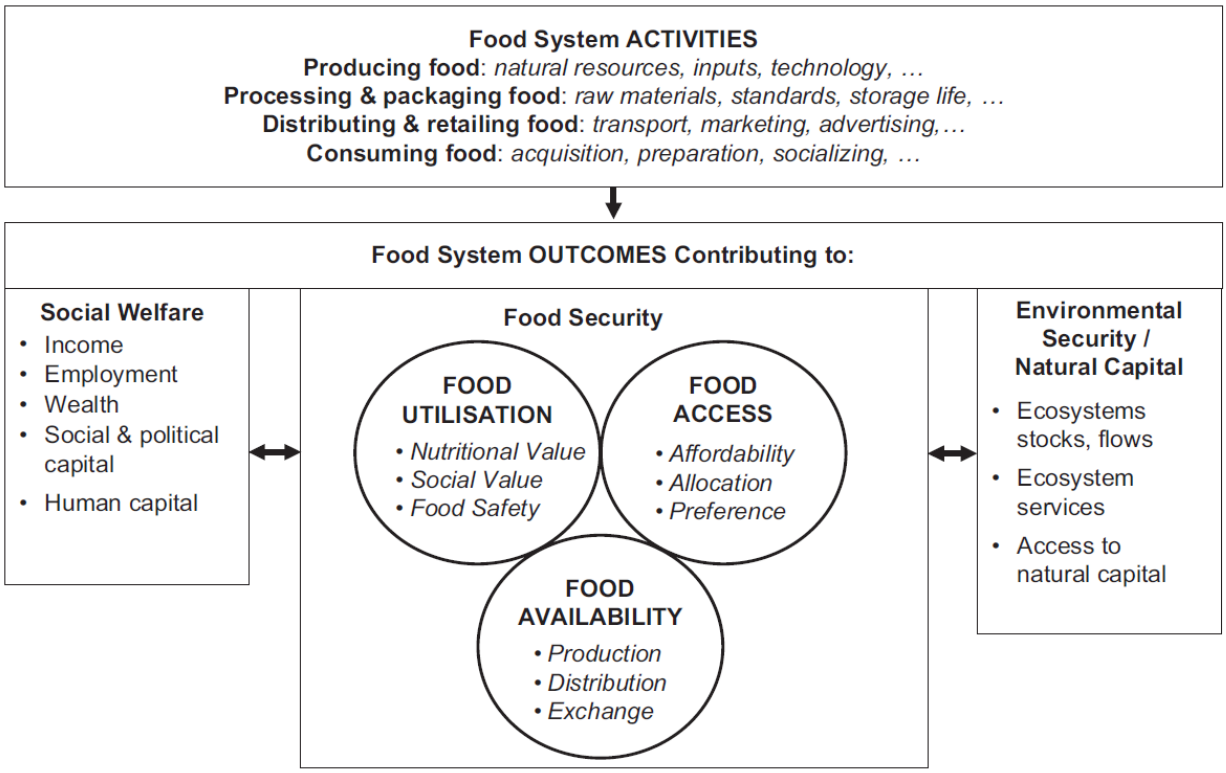

Figure 1.1 – Ericksen's framework, Source (Ericksen, 2007, p.6)

According to Ericksen and World Food Summit there are three components to food security: availability, access and utilization. This means food security is related to the amount, type and quality of food available (availability), the ability to convert financial and other assets to obtain food (accessibility) and the capacity of a unit (from and individual to a nation) to benefit from consumption (utilization) (Figure 1.1). A fourth component, stability, is also considered by Food and Agriculture Organization (FAO) (Gitz, Meybeck, & Lipper, 2016)This relates to the other three dimensions of food security and the extent to which they are stable over time. In other words, if we have a situation where enough food is produced, and everybody has access to the right quality and quantity of it, stability refers to maintaining the present conditions.

In addition, to the contributions of food systems to food security, it can also affect global environmental changes and environmental security. Global environmental change

“encompasses changes in the biogeophysical environment, which may be due to natural processes and/or human activities” (Ericksen, 2007, p.4). Whether it is water consumption for irrigation, greenhouse gas emissions, pollutions due to substances used in agricultural activities, land use change or even increase in demand of food products, they are all activities and drivers within the food system that will affect the environment (Ericksen, 2007). Therefore, there is a need for a much more universal and multi-disciplinary perspective, to understand the outcomes regarding actives within a food system.

There is also an inextricable link between food security and environmental security and social welfares. For an example, there are families -or even nations- which rely on agriculture as the main source of income, and when agriculture undermines natural capital and ecosystem stocks, flows and biogeochemical cycles, this has a direct negative impact back on the agriculture sector and its productivity (Gitz et al., 2016), by affecting their land and agricultural means as well as their financial assets. In many cases, it is the poorest, most vulnerable and food-insecure rural population that rely on agricultural livelihoods (FAO, 2016; Gitz et al., 2016) , and these changes decrease their income and consequently limit their ability to provide food for themselves. The capacity to provide food is directly related to social welfare and human well-being (Ericksen, 2007; Millennium Ecosystem, 2003), so this group will become more food insecure and face health issues. In this situation, aside from food production itself, exacerbating poverty will also have negative effects on all dimensions of food security (FAO, 2016) as it then affects the ability to afford nutritious food or limit their access.

Notably, changes in the natural environment are not the only factors effecting food systems and food security. Although, natural and climate-change induced hazards like droughts can impose stress on food security, failures of market or policies can also play a significant role (Devereux & Maxwell, 2001). Social and economic changes of recent decades, such as intensification of agriculture (Lang & Heasman, 2015) and food production, growth in food processing and packaging, distribution and retail activities and the significant changes in how

food is consumed, plus the growing number of urban consumers, are characterizing food systems and food security (Ericksen, 2007; Maxwell & Slater, 2003).

To date around 1.4 billion people have less than USD 1.25 per day and a scenario by FAO depicts that if the high impact climate changes continue and due to rapid population growth, there will be an addition of 122 million people living in extreme poverty by 2030 (FAO, 2016). According to some research, the higher the income, the more affordable switching to a sustainable diet will be (Aggarwal, Monsivais, Cook, & Drewnowski, 2011; Barosh, Friel, Engelhardt, & Chan, 2014). Hence, if poverty spreads, the probability of switching to sustainable eating behavior will decrease.

A possible solution for this complex issue is to shift to sustainable consumption and production (SCP). This can be achieved by considering strategies that benefit both production and consumption side (Tukker, Cohen, Hubacek, & Mont, 2010). Sustainable consumption and production (SCP) focuses on efficient management of resources at every stage of the product chain from resource extraction to final consumption (Tukker et al., 2010). Decoupling economic growth from environmental degradation is the fundamental goal of SCP (UNEP, 2011).

Achieving sustainable food consumption is above the issue of food security in poorer regions and both under and over consumption must be taken into consideration. Even in developed or developing regions, high demand in processed food (i.e. fast food), increase in the consumption of meat and fresh dairy products (OECD & FAO, 2011), along with the decrease in time allocated to food purchasing and cooking (Hamermesh, 2007) tend to have negative effect on climate change which will eventually impact food security.

Promotion of food choices that are sustainable and healthy could shift demand to more environmentally-benign consumption categories that reduce the production of impact-intensive industrial sectors like agriculture, while increasing food security. Although sustainable production is beyond the scope of this research, sustainable consumption requires

fundamental changes in eating behaviours through understanding dietary patterns and food environments.

1.2.2 Dietary patterns

According to a model presented by Jill Reedy (2017; Figure 1.2), this system includes the pattern itself, its causes (drivers) and its effects (consequences) (Reedy, Krebs-Smith, …, & 2017, 2017).

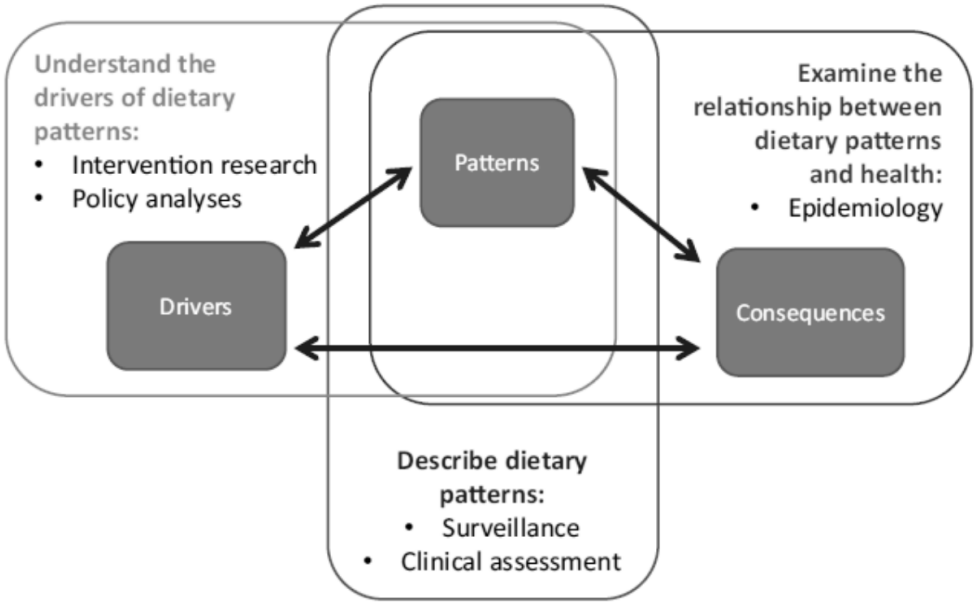

Figure 1.2 - Model of dietary patterns, Source: (Reedy et al., 2017, p.1020)

These drivers could include individual characteristics, environmental characteristics, socio-economic positions, culture and many other factors. The foresaid factors could result in a variety of social, individual, health or environmental consequences. In addition, the relationship between these factors does not follow one direction. The interaction between the different elements of this multidimensional system is what makes it complex (Reedy et al., 2017). Among the eating behavior outcomes, there have been many studies regarding the relation between dietary patterns and health. However, there is a gap regarding sustainability outcomes. In order to encourage people to eat both healthily and sustainably, food systems

should be nutrition-sensitive, hence good nutrition should be available, affordable and acceptable.

1.2.3 Food environments

A food environment can be defined as all the foods which are available and accessible to people in the settings in which they go about their daily lives (FAO, 2016). This environment works as the mediator between food systems and individual diets and plays a crucial role in shaping diets by encouraging and enabling people to choose and access healthy options. For example, in food environments where fruits are not readily available or affordable, consumers' choices will be constrained, and they will choose other option unless fruits and vegetables are discounted (Waterlander, De Boer, Schuit, Seidell, & Steenhuis, 2013).

In the latter case, various factors, including shortcomings in food environments, such as affordability or availability, mean that consumers are not making choices that are consistent with nutrition, health and environmental considerations. As a result, poor food choices are one of the prominent contributors to non-communicable diseases such as diabetes, obesity, and cardiovascular risks (Katz et al., 2011; Wilson et al., 2013). Furthermore, individuals' food consumption not only impacts their personal health, but also the health condition of others (Lang & Heasman, 2015; Vidgen & Gallegos, 2014). Weather, it is the effect of a mothers nutrition on her child's health, or on a more global scale what you eat might result in production and eventually food security issues in another country or region. Therefore, if people shift their dietary patterns to meet nutritional and health goals, it could have a variety of positive outcomes.

Geographical, spatial, ecological and socio-economic characteristics of different cities and regions result in different food environments. There is limited or reduced availability of healthy food in rural areas compared to urban areas which could result in higher rates of health issues such as obesity (Innes-Hughes, Boylan, King, & Lobb, 2012; Jilcott, McGuirt, Imai, & Evenson, 2010). Studies in USA show that access to supermarkets and their presence is associated with higher fruit and vegetable consumption. However, other research

show although supermarkets provide a full range of healthy choices regardless of their location, access to energy-dense and nutrient-poor food is higher in rural areas (Cummins et al., 2009; Innes-Hughes et al., 2012).

Moreover, the food environment in which individuals make consumption choices is complex. Therefore, there are many drivers influencing eating behaviors. This makes it difficult to persuade consumers to switch to a sustainable diet and propose a solution that encompasses these drivers. Nevertheless, although it would seem that significant efforts are required to shift food consumption to be more healthy and sustainable, it is possible to enhance (instead of replace) current food consumption patterns, and this could be more effective since modest changes are more practical (Desjardins, MacRae, & Schumilas, 2010).

Consumer demand could affects supply, so food systems are shaped by consumers' food culture and preferences. Within a food system, food should be available, affordable, convenient and desirable to people (Herforth & Ahmed, 2015). Promoting green consumption and shifting expenditures to lower impact products is one of the strategies that could be implemented (Reisch et al., 2013; Schmidt, 2009). For example, different countries in the EU are implementing strategies to facilitate the purchase of organic or healthy and sustainable food for their consumers. "Organic week" or "Organic month", in which organic products are sold with a 25% discount (reduced VAT), promotion of sustainable products, and offering both organic and conventional dairy products with the same price, are a few of the strategies used in Denmark, Norway and Sweden (Reisch et al., 2013; Schmidt, 2009).

According to the model proposed by Glanz (2005) there are four environments that influence eating patterns: community nutrition environment, organizational nutrition environment, consumer nutrition environment and information environment (Glanz, Sallis, Saelens, & Frank, 2005). "Consumer Nutrition Environment" reflects the encounters of a consumer within the retail food outlet such as grocery stores. It includes available healthy options, price/ promotion/ placement and nutritional information. This is the setting where a

consumer uses his/ her knowledge and the characteristics of a food item into consideration and chooses between a sustainable and healthy option or another choice.

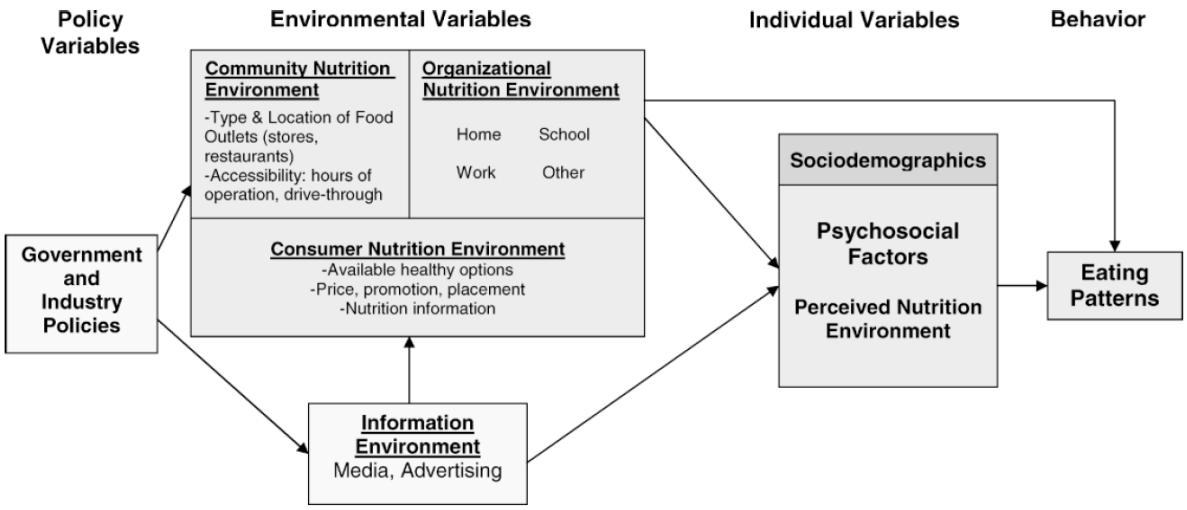

Figure 1.3 – Model of community nutrition environments based on Glanz (2005), Source: (Glanz, 2005, p.330)

Nutrition environment could explain part of socioeconomic or racial/ethnical diversity regarding nutrition and health outcomes. As an example, healthy food such as low-fat dairy or vegetables and fruits are more prevalent in high income areas; in contrast, there are more fast food restaurants in lower income areas (Block, Scribner, & DeSalvo, 2004; Horowitz, Colson, Hebert, & Lancaster, 2004).

1.2.4 Factors affecting Dietary Patterns

Within the "consumer nutrition environment", individual factors such as time, dietary knowledge, food preferences, values, norms and culture are among many factors that influence how people choose what to eat (Aggarwal et al., 2011; Deliens, Clarys, Bourdeaudhuij, & Deforche, 2014; Mullie, Clarys, Hulens, & Vansant, 2010; Waterlander et al., 2013). Also, how people perceive food related activities and allocate their time forms

their dietary patterns. For example, for many people eating out is leisure but cooking at home is more like a task (Bittman, 2011).

Among these factors, affordability and cost are very critical, specifically when encouraging consumers to eat more sustainable food. The majority of people believe eating healthy food is more expensive (GFK, 2007; Ipsos-Reid, 20015; Waterlander et al., 2013) and some research show sustainable food is even more expensive than healthy food choices (Wilson et al., 2013). Therefore, the main focus of this study is on the economic feasibility of adopting a sustainable diet.

1.2.4.1 Socio-Economic factors

Financial aspect is one of the important- but not the only - drivers of eating behaviors. Although some households may face true affordability constraints while purchasing healthy and sustainable food, there is also the perception that it is not affordable. A poll among Canadians showed that "61% of shoppers disagreed with the statement "healthier food options cost the same as regular ones."(Ispos, 2005). Therefore, it is important to understand whether healthy food is significantly more expensive, or there are other factors involved.

1.2.4.2 Food Literacy

Education and knowledge regarding food are important determinants of consuming healthy food and in some cases, it could exceed the effect of affordability. In fact, consumers with higher dietary knowledge are mostly able to achieve a healthy diet within their budget constraints (Aggarwal et al., 2011; Mullie et al., 2010). This knowledge about food will be further discussed using the holistic term "food literacy" in chapter 4.

However, education about food alone is not sufficient to make healthy dietary changes. For example, a study in Missouri showed that despite the introduction of an educational program for the students, and the fact that they transferred their knowledge to their parents, this was not sufficient in changing behaviors because they perceived that healthy food is more

expensive (Katz et al., 2011). Thus, the interaction between food education and price perceptions needs to be studied further.

1.2.4.3 Time

Another individual factor that affects dietary patterns and food related decisions is time constraints (Cawley, 2004) and how these constraints affect time needed for food shopping, preparation, cooking, and cleaning up. There is some evidence that time constraints could be a barrier to adopting a healthy diet. For example, time was the leading reason why European adults did not adopt healthy dietary guidelines (Lappalainen, Saba, Mykkanen, Gibney, & Moles, 1997).

In addition to time constraints, time availability is a relative concept and is affected by personal priorities. Some people prefer to spend their time on activities that they enjoy more than cooking (Deliens et al., 2014). Others prioritize the convenience of eating out over home-cooked meals and are even willing to spend more money (Monsivais, Aggarwal, & Drewnowski, 2014). Research in the USA has shown that time spent on preparing home-cooked meals has decreased drastically since the 1960s and recently Americans have been spending only 33 minutes on food preparation and clean up per day (Hamrick, Andrews, Guthrie, Hopkins, & McClelland, 2011).

There might be more time necessary to find sustainable food options, and consumers may need to spend substantial amount of time commuting to a certain store or even spend more time on finding what they need once they get to the store (Glanz, Sallis, Saelens, & Frank, 2007). An example of time consumption, is U.S. Department of Agriculture's (USDA) Thrifty Food plan, which includes nutritious, low and mid- cost dishes; many of these meals are time-intensive to prepare, and if time-use is accounted for, they will be very costly (Monsivais et al., 2014).

Nevertheless, when people spend time on cooking a meal at home, this is associated with adopting a healthy diet. For example, according to Monsivais (2014), families who spend

more time on cooking and cleaning up for a meal, have a healthier diet, with more fruits and vegetables, and with fewer visits to restaurants (Monsivais et al., 2014). Various solutions have been proposed for eating healthier, including developing time management skills (Deliens et al., 2014), and prioritizing healthy eating so that they plan ahead of time and overcome their busy schedules (Wolfson, Bleich, Smith, & Frattaroli, 2016). However, there are many other factors involved in the process of decision-making.

1.3 Summary and context of research

Food security and its role on health is a significant matter in today's world and for future generations. The relationship between food security and ecological environmental change, provides a strong rationale for change towards more sustainable production and consumption. To be able to consume sustainably, from people's or consumer's perspective, food with low environmental impact needs to be affordable and accessible on the global scale. In order to present a practical solution to encourage sustainable eating behavior, individual and environmental factors affecting food choices need to be incorporated. Within a consumer's nutrition environment, affordability, food literacy and time are important factors. The trade-off between these factors, among others, will determine whether it is feasible for a consumer to switch to a sustainable diet or not.

This study builds on a recent study by Veeramani et al. (2017) that determined dietary patterns in Ontario do not comply with Canadas Food Guide interns of the amount of protein and calorie. Therefore, presented modified food baskets had lower carbon footprint, while including the same food groups initially consumed in the diet. Even though there have been many studies that attempt to understand the affordability of healthy food (Cassady, Jetter, & Culp, 2007; Katz et al., 2011; Mhurchu & Ogra, 2007; Rao, Afshin, Singh, & Mozaffarian, 2013; Waterlander et al., 2013), (More context on this type of research is provided in chapter 3), the broader issue of environmentally sustainable, healthy, and affordable diets has not been fully addressed. Therefore, within this research the goal is to assess the affordability of nutritionally-balanced and low-carbon dietary patterns.

1.3.1 Thesis objectives

The overall goal of this research is to determine whether nutritionally-balanced and low-carbon dietary patterns are less expensive than "current" dietary patterns, and whether they are affordable in the province of Ontario, Canada. Ontario is a very large province with over 14 million residents (Statistics Canada, 2017a), from diverse cultural and socio-economic backgrounds. Also, there is also a difference between the food environment in Northern Ontario and Southern Ontario (the geographical boundary under study). Northern Ontario has many challenges and barriers within its food environment which results in a significantly different food environment. Specifically, in more remote areas, where there is more food insecurity, less access to healthy food and high costs (Burnett et al., 2016; Tarasuk, Mitchell, & Dachner, 2016). Therefore, affordability will be considered based on rural and urban areas, as well as Northern and Southern Ontario.

The main objectives are to:

- Determine and compare prices of the "current" and a nutritionally-balanced and low-carbon diet based on current dietary patterns of Ontarians
- Assess the affordability of a nutritionally-balanced and low-carbon diet based on region (Northern Ontario and Southern Ontario) and population density (Urban and Rural areas)
- Identify barriers to consuming affordable, healthy, and sustainable food

Chapter 2: Tool development

2.1 Overview

Consumer food choices are linked to individual's health and even global environmental change, all of which ultimately affect food security. However, food environments in which individuals make consumption choices are complex and there are many drivers influencing eating behaviors.

There have been many studies that assess retail food environments with respect to health outcomes or health-promoting dietary behaviors. These assessments use tools that cover a range of factors such as food availability, price, quality, variety in stores, type of grocery stores, and availability of healthy or unhealthy options. However, there is a lack of focus regarding assessing food environments and sustainability related outcomes. Specifically, only limited geographical boundaries, such as a city or a number of neighborhoods, were covered in previous studies.

The present study uses a revised version of the TONEMS (Toronto Nutrition Measurement Survey) tool, to assess the availability of items from seven nutritionally-balanced and low-carbon food baskets based on dietary patterns in Ontario. This study assesses the revised tool by surveying 23 grocery stores in Southern and Northern Ontario, using two raters.

The results of the present study show that except for a few items from the vegetarian and vegan food baskets (that could be replaced), in general the food items for a nutritionally-balanced and low-carbon food basket is available for Ontarians. However, there is the issue of access to grocery stores that can be addressed in further research.

Key Word: Low-carbon food baskets, Retail Food Environment, NEMS, Food Availability

2.2 Introduction

Consumer food choices are linked to individual's health (Cassady et al., 2007; Katz et al., 2011; Mhurchu & Ogra, 2007; Rao et al., 2013; Waterlander et al., 2013) and even global environmental change (Barosh et al., 2014; Ericksen, 2007), all of which ultimately affect food security (Reisch et al., 2013). A possible solution for this complex issue is to shift the current consumption patterns to a more sustainable dietary pattern; that is eating food with lower negative environmental impacts such low carbon footprint. However, in order to do so, there is a need for understanding eating behaviors, the cause of these behaviors, and the food environment in which the decisions are made.

Community food environments are defined as all the foods which are available and accessible to people in the settings in which they go about their daily lives (FAO, 2016). There is an association between community food environment and eating behavior. This environment works as the mediator between food systems and individual diets and shapes diets by encouraging and enabling people to choose and access healthy options (Glanz et al., 2005; Van Der Horst et al., 2006).

However, food environments in which individuals make consumption choices are complex (Glanz et al., 2005) and there are many drivers influencing eating behaviors. This makes it difficult to create solutions to persuade consumers to switch to a sustainable diet. Nevertheless, although it would seem that significant efforts are required to shift food consumption to be more healthy and sustainable, it is possible to enhance (instead of replace) current food consumption patterns, and this could be more effective since modest changes are more practical (Desjardins et al., 2010).

There have been many studies that assess the affordability and accessibility of a healthy food basket. These studies were mainly implemented by collecting prices from a certain store and in a limited geographic boundary such as a city or a few neighborhoods. In general, two main perspectives were taken: food groups including packaged food, snacks, meat, dairy and etc. (Barosh et al., 2014; Katz et al., 2011) or fruits and vegetables (Cassady et al., 2007;

Waterlander et al., 2013).Therefore, in most cases the food included is not a realistic representative of the food basket being consumed, because it is lacking one or more of the pivotal food groups.

Although there have been studies regarding the food environment of retail locations in Canada (Lo, Minaker, Chan, Hrgetic, & Mah, 2016; Lo, Minaker, Mah, & Cook, 2016; Minaker et al., 2016), most of these studies have focused on the association between retail food environments and health outcomes or health-promoting dietary behaviors (Minaker et al., 2016). Studies regarding "retail food environment interventions" are rather new in Canada (Glanz et al., 2005; Minaker et al., 2016). According to a scoping review of retail food environments by Minaker et al. (2016), most of the research regarding retail food environments are concerning health outcomes, specifically obesity and weight. Furthermore, the geographical boundary for most of these studies are at the municipal level (Minaker et al., 2016). Therefore, there is a need for more focus on studies across a province, which cover rural areas as well as urban areas.

The studies on retail food environments use a variety of surveying tools for the assessment. These tools cover a range of factors such as food availability, price, quality, variety in stores, type of grocery stores, and availability of healthy or unhealthy options (Glanz et al., 2005). For example, both the Nutrition Environment Measures Survey for retail stores (NEMS-S) and for restaurants (NEMS-R) were developed by Glanz et al. (2007) to assess food environments in the USA. However, tools should be designed and developed according to the type of assessment being conducted (Lo, Minaker, Chan, et al., 2016; Lo, Minaker, Mah, et al., 2016) and are not useful in every geographic context because of the difference in dietary patterns and nutritional guidelines, as well as the fact that the assessment should be relevant to the populations and subpopulations under study (Díez et al., 2016; Lo, Minaker, Mah, et al., 2016).

Therefore, the NEMS-S has been adapted for use in Canada by S. Buhler (2010) at the Alberta Health Services, by adding 4 additional measures: frozen fruits, canned fruits, frozen

vegetables, and canned vegetables. Moreover, Lo et al. (2016a), developed this tool further by adding 3 more measures, in order to comply with Canadian healthy eating recommendations (Lo, Minaker, Chan, et al., 2016). This tool called the ToNEMS-S was used to collect data from retail stores in Toronto through direct observation. Lo et al. (2016a), also developed another tool based on NEMS, for grab-and-go establishment (GGEs), to study university food environments in Toronto.

Another survey tool is the "Nutritious Food Basket" (NFB) published by the Ministry of Health in Canada. The NFB document reflects the cost of a food basket for a reference family of four based on a diet suggested by Canada's Food Guide and eating pattern results from the Canadian Community Health Survey, which used 24-hour recall to determine what Canadian residents eat. The cost is measured using the prices of 67 foods and specific pricing procedures (Hubay, King, Vanderkooy, & Wilkie, 2010).

Despite the research and tool development that has been accomplished to determine food environments and affordability of healthy diets, more effort needs to be dedicated to sustainable diets/sustainable eating behaviors and their associations with retail food environment. Recently, Veeramani et al. (2017) did research on the dietary patterns of Ontarians (as described in section 2.3.2) and found that the current diets were high in protein, provided inefficient (more or less than the suggested calorie needed for an adult) amount of calorie and were high in carbon foot print. Therefore, they presented a modified food basket for each of the 7 dietary patterns in the study. These modified food baskets had lower carbon food print than the originals while having sufficient amount of calorie and protein (Table 2.1). The aim of the present study is to develop an assessment tool which is a modified version of the ToNEMS-S, and that is able to address the association between retail food environment and sustainable diets. The result of the development of this tool, will assess the availability of items within 7 different low-carbon dietary patterns, as suggested by Veeramani (2015), within urban and rural areas in a specific boundary in Ontario. The research attempts to incorporate different dietary patterns into the calculations. Therefore,

there will be seven food baskets (for each of the seven dietary patterns) based on a one-person household (a working adult).

Table 2.1 – Carbon footprint of different dietary patterns based on Veeramani (2015)

	kg Co2-eq		
Dietary Pattern	nutritionally unbalanced realistic food baskets	calorie-adjusted food basket	nutritionally balanced, climate friendly, socially acceptable food basket
Vegan	587	955	689
Vegetarian	1,015	1,053	963
Pescetarian	1,213	1,431	1,079
No red meat	1,140	1,234	1,083
No beef	1,274	1,290	1,220
No pork	3,225	3,160	2,123
Omnivore	2,734	2,282	1,815

According to the Nutritious Food Basket the best time to perform the food basket costing is the month of May, as the Consumer Price Index (CPI) in the month of May reflects the average price for food. The prices during the month of May are least affected by seasonal fluctuations such as low prices due to availability of food from fall harvest or high prices due mid-winter transportation costs. The selection of grocery stores is also a critical step, because one of the limitations of this method is that it is not possible to cover all of the stores.

2.3 Methods

This section presents the processes of developing and testing the survey tool. For the purpose of this study, chain stores (both regular and discount) and independent grocery stores, that offer a full range of grocery products, were originally selected. However, due to various reasons, such as the store being closed (for the day or permanently) or the store manager not granting permission, the final selection only included chain stores. A list of the specific reason why each store was eliminated is provided in appendix B.

2.3.1 Geographic samples

The geographic scale of the study was Ontario, which is divided into two regions, Southern Ontario and Northern Ontario. It should be noted that Northern Ontario, for this study, included only up to the Greater Sudbury area. As shown in Figure 2.1, Northern Ontario refers to the area colored in red and green, however for this study only a small section of Northern Ontario was covered (the area under the red line). More remote areas of Northern Ontario were not included because challenges and barriers within the food environment of these areas results in a significantly different food environment than what was intended for this study. According to the 2016 report by Proof, 27.5% of off-reserve Indigenous households experience food insecurity (Tarasuk et al., 2016) .These areas are only accessible by plane or winter ice roads which limits their access to food, there is a maximum capacity and weight that can be transferred; some types food may spoil, damage or get lost during the transfer. Often people are forced to travel long distances to purchase their food from the one available grocery store, and they have the added cost of high fuel and transportation rates. All these reasons result in an increase in the price or overall cost of food in these areas (Burnett et al., 2016).

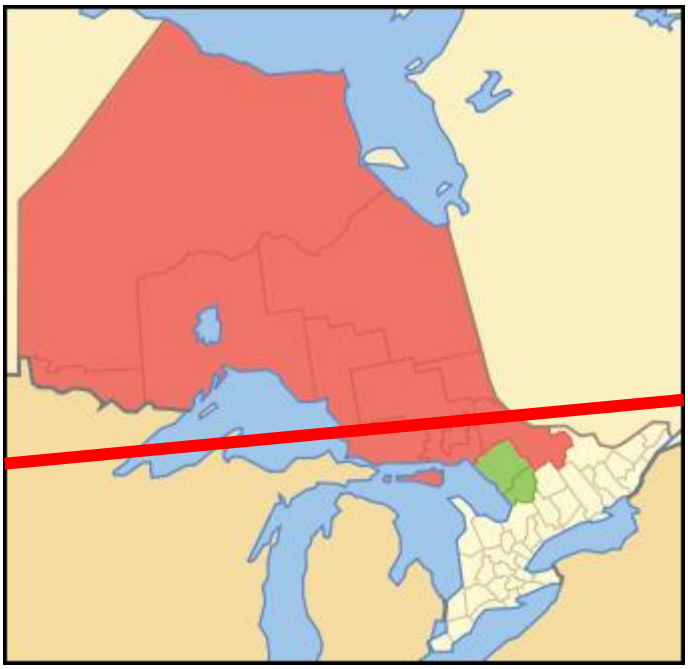

Figure 2.1 – Covered section of Northern Ontario (under the red line)

In order to cover areas with different food environment characteristics, each region was then divided into rural and urban areas. According to a scoping review of retail food environments by Minaker et Al. (2016), most (70%) of the research regarding the retail food environments are within cities. Only focusing on cities, will result in lack of outcome variation regarding features of the food environment (Minaker et al., 2016). Therefore, there is a need for more studies encompassing urban and rural areas within a province, across provinces or Canada. In this study the main focus is covering urban and rural areas within the identified boundary of Ontario.

According to Statistics Canada, rural areas are "areas with fewer than 1,000 inhabitants and a population density below 400 people per square kilometer."(Statistics Canada, 2011, P. 1). Therefore, locations were selected based on their population density.

Municipalities were stratified based on their region (north or south) and population density (above 400 people/m^2 and below 400 people/m^2). There were more municipalities selected (random selection) in low population density areas (specifically in north), as there are less

grocery stores available. The goal was to have a balanced number of stores in each cell of the proposed matrix (Figure 2.2).

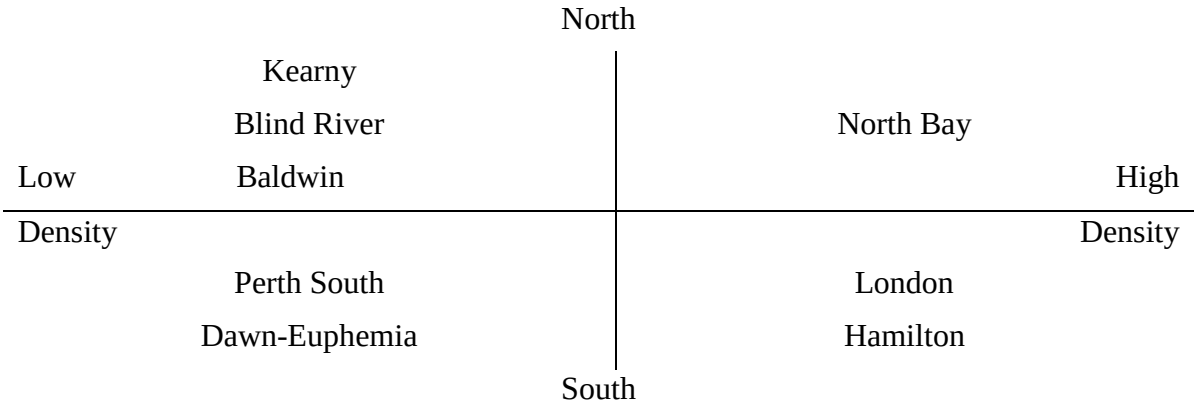

Figure 2.2 – Store selection matrix

2.3.2 Development of the survey instrument

This survey tool was developed based on the Nutrition Environment Measures Survey (NEMS), a tool developed by Glanz and coauthors (2007) and the Canadian adapted version by Lo et al. (2015). It is an observational measure to assess the availability of healthy options, quality and price of ten food categories within retail food stores (Glanz et al. , 2007). As NEMS has high inter-rater reliability and validity (Lo, Minaker, Mah, et al., 2016) the design of the present survey tool was based on elements derived from NEMS. Similar to NEMS, the present survey tool also provides information regarding the size of each store (based on number of cash registers).

The food items were selected based on previous research by Veeramani, which formulated nutritionally-balanced and low-carbon food baskets for seven dietary patterns (Veeramani, 2015; Veeramani et al. 2016; 2017). The low-carbon food baskets were developed as follows:

1. Using self-reported actual food consumption (items and amount) of 10,723 Ontarians for 24 hours based on the Canadian Community health survey (CCHS) (2004), food items were clustered into seven dietary patterns based on protein-based foods consumed on that day: vegan, vegetarian, pescetarian, no red meat, no beef, no pork and omnivore. Food items included in the final food basket of each group, were the most commonly-consumed items by more than 5% of the population in that category.
2. Daily consumption amounts of different food groups (in each food basket) was converted into annual consumption. The amounts of food were proportionally adjusted to align with required daily calories for an average adult in Ontario, so that each basket had the same number of calories.
3. Using life cycle assessment (LCA), the carbon footprint of annual actual food consumption was determined by using the amounts of each food item in each food basket. The boundary of the LCA was farm-to-fork, therefore the origin of each item and production, means of transportation and distance traveled, trips to grocery shop, cooking and waste were all taken into consideration.
4. Then, the amounts in each food basket were adjusted to align with daily protein requirements and the recommended number of servings for each food group according to Canada's Food Guide (Canadas Food Guide, n.d.) to form a "nutritionally-balanced" version of the dietary pattern. The amount of high impact food items was decreased by up to 50% (e.g beef), and lower carbon food items, that were already part of the dietary pattern were increased to meet the nutrition requirements

In the original food baskets by Veeramani, the food items were listed by "food groups" (e.g. meat and alternatives). However, the food items were re-categorized to align with grocery store layouts, so that it would be more efficient to conduct the survey using the tool. The survey tool includes 18 categories such as meat, dairy and baking goods. According to Veeramani's results, the key contributors to the global warming potential (GWP) in Ontario are meat, dairy and egg. However, the impact is directly related to the share of each food item in a food basket. To elaborate, in the Vegetarian food basket, egg and dairy make up 21% of the amount of the food basket (which is the highest share of this food category among all food baskets), thus it is in this food basket (vegetarian) where the highest GWP is demonstrated by this food category (53%).

In general, the animal based protein-dense sourced such as beef, salmon and cheese have higher GWP compared to plant based sources. An assessment of all the items in all seven food baskets, showed that beef was the single item with the highest GWP followed by cheese, butter, egg, milk, and fish (salmon and tuna in Canada). This research overall supports that "nutritionally optimal dietary patterns have a lower environmental footprint." (Veeramani, 2015, p.77).

In addition to the tool, a protocol was developed to instruct the raters. This protocol includes survey instructions, general guidelines and a detailed description on how to record the price of each item. The main purpose of this protocol is to minimize personal judgment and discrepancies. In particular, when the listed items are not available in the grocery store, it is the rater's responsibility to choose the most proper substitution. The protocol indicates specific guidelines on how to choose the substitute. Therefore, by providing a strong and detailed protocol, the tool should have higher inter-rater reliability (Appendix D and E).

Regarding the procedures, an adaptation of ToNEMS-S (B. K. C. Lo et al., 2016a) tool and NFB were employed. In the pricing method employed by the Nutritious Food basket (NFB), the minimum price of each food item is extracted and the average of these prices between all of the stores, is the price used for the calculations. However, in the present study, the goal is

not to record the lowest price, but to have an accurate comparison (between regions), hence the price of specific brands were recorded. However, the rest of the method stays similar to NFB.

2.3.3 Piloting the tool

Before the actual data collection, three pilot visits were made to selected grocery stores (not included in the list of 23 stores). In the first round the tool was piloted with 4 researchers, but the 2 subsequent pilot visits only included 2 researchers. The visits were followed by rounds of conversations regarding the order of items listed in the tool, change of brands or types based on availability. In case of any uncertainty or question during or after the visit, raters referred to the developed protocol to avoid any discrepancies.

In order to prevent any conflict or misunderstanding related to what was being done at the grocery stores, a letter was provided (Appendix G) by the supervising researchers to explain the study, and was presented to the store manager. Only a few managers (10%) did not let the researchers proceed with the pricing protocol. Although the initial goal regarding the store selection (primary store selection) was to include independent stores and local markets, specifically in rural areas, this objective was not met (Appendix B).

2.3.4 Data collection

A total of 23 grocery stores, in 8 cities, were visited by the two raters during the month of August 2017 (Figure 2.3). The data was then entered in to excel files by the author, either at the day of the data collection or at the end of the week. In addition to the data, field notes were recorded for any uncertainty faced during the process.

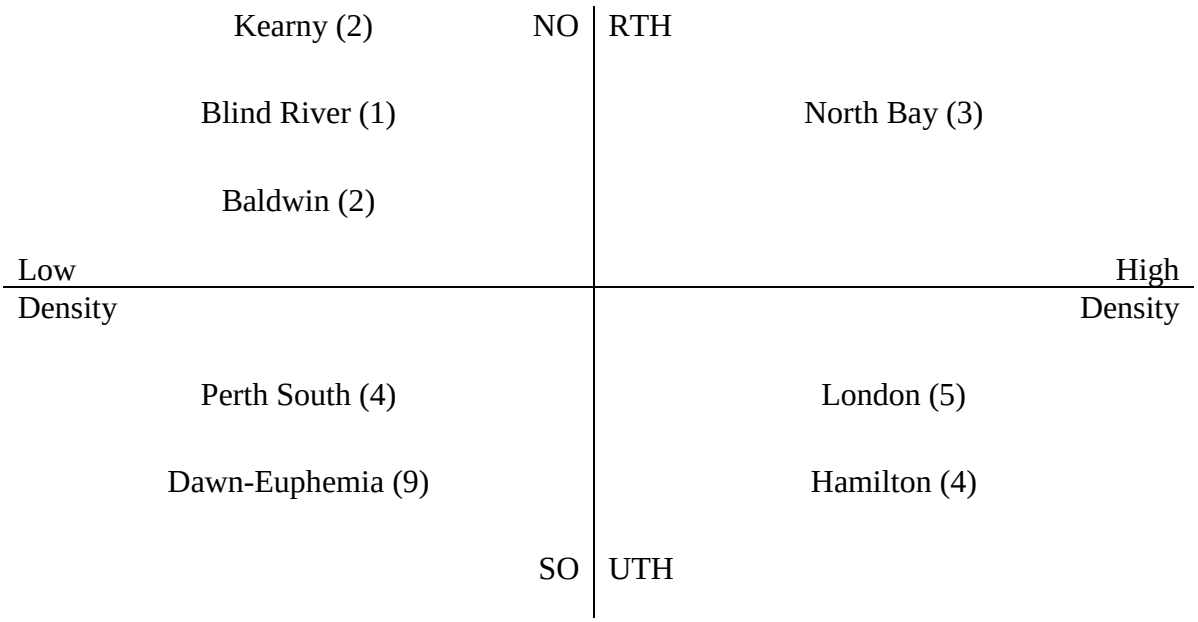

Figure 2.3 - Selected cities based on selection matrix

Systematic direct observation (ground truthing) was used to collect data (Hosler & Dharssi, 2011). The author and another graduate researcher walked in the selected grocery stores and collected the data using the developed tool. Both raters visited each store and the visits were at the same time, but the observations were made separately. For each item the price of the indicated brand and size before any discount, was recorded. When the exact (or the alternate) brand or size was unavailable, the recorder was instructed to write down the price of the smallest available packaging (in the case of unavailable size) and the brand with the most shelf space (and the lowest price). The regulations regarding price recording is explained in detail in the protocol (Appendix E).

2.3.5 Data analysis

To measure the reliability, Intra-class Correlation Coefficient (ICC) was used to assess inter-rater reliability for the tool as a whole (B. K. C. Lo et al., 2016a) and for each food group. ICC assesses the extent to which 2 or more raters have recorded the exact same data (Landers, 2015). Based on a 95% confident interval, an ICC value less than 0.5 represents poor, 0.5 to 0.75 moderate, 0.75 to .90 good and over 0.9 almost excellent agreement (Koo & Li, 2016).

2.4 Results

Results are presented in 3 sections: distribution of visited stores, availability of items from the food baskets and reliability of the developed tool.

2.4.1 Distribution of visited stores

The distribution of stores (N=23) based on region (north/south), population density (high/low) and store type (regular/discount) are shown in Table 2.2, Table 2.3 and Table 2.4.

It was intended to keep a balance between the number of stores in each category (region and population density); however, there were not enough stores (from different chain stores) to keep 50% balance. Therefore, 35% of the visited stores were in north and 65% in south (Table 2.2). Nevertheless, the distribution in urban and rural areas is almost equally balanced, with 52% of the visited stores in urban (high population density) and 48% in rural (low population density) areas (Table 2.2). This balance was also intended for the number of stores in urban and rural areas in each region (north and south) separately. Hence, in Northern Ontario, 38% of the stores were in urban and 62% were in rural areas (Table 2.3). Similarly, in Southern Ontario, 60% of the stores were in urban and 40% were in rural areas.

Regarding store type, 70% of the surveyed stores surveyed were discount stores (Table 2.2). This is due to the fact that most of the grocery stores available in low population density areas (rural), specifically in the north, were discount stores. This is also evident from Table 2.3, where 75% (13% + 62%) of the surveyed stores in north were discount.

Table 2.2 – Distribution of surveyed stores

Distribution	Number of stores	Compared to total surveyed stores
		(n=23)
North	8	35%
South	15	65%
Total		100%
High Population Density	12	52%
Low Population Density	11	48%
Total		100%
Discount	16	**70%**
Regular	7	30%
Total		100%

Table 2.3 – Distribution of surveyed stores in Northern Ontario

Distribution	Number of stores	Compared to total surveyed stores in North (n=8)
North/High Population Density	3	38%
North/Low Population Density	5	62%
Total		100%
North/HPD*/Discount	1	**13%**
North/HPD/Regular	2	25%
North/LPD**/Discount	5	**62%**
North/LPD/Regular	0	0%
Total		100%

Table 2.4 – Distribution of surveyed stores in Southern Ontario

Distribution	Number of stores	Compared to total surveyed stores in South (n=15)
South/High Population Density	9	60%
South/Low Population Density	6	40%
Total		100%
South/HPD/Discount	5	33%
South/HPD/Regular	4	27%
South/LPD/Discount	5	33%
South/LPD/Regular	1	7%
Total		100%

*HPD: High Population Density

**LPD: Low Population Density

2.4.2 Availability of items

Items that were most unavailable, as a percentage of the stores visited, were fruit butters (70%), almond butter (57%) and papayas (35%) (Table 2.5). This is not surprising since papayas are seasonal fruits, and fruit/almond butter are specialty items, compared to peanut butter, and mostly found in health stores. Tofu and soy patty were also unavailable in 22% of the stores. A brief look at the top five items from this list shows that these items mostly belong to the vegan and vegetarian food basket. Some of the fruits that are flown into Ontario, such as Papayas and pineapples, might not be the most sustainable option and can be substituted by other fruits. However, these fruits were a part of the actual consumers diet, therefore had to be studied.

Table 2.5 – List of unavailable items from the tool in visited stores (number of stores where the item was unavailable compared to all visited stores)

Item	Number of stores	Percentage
Fruit butters (apple butter)	16	70%
Almond butter	13	57%
Papayas	8	35%
Tofu	5	22%
Soy patty	5	22%
Oil roasted almonds	5	22%
Pepperoni	3	13%
Green peas (fresh)	2	9%
Lentils (dry)	2	9%
Salt	2	9%
Dry roasted cashew nuts	2	9%
Pineapple, raw	1	4%
Pears, raw	1	4%
Split pea	1	4%
Cauliflower	1	4%
Zucchini	1	4%
Roasted peanuts	1	4%

2.4.3 Reliability

The calculated inter-rater reliability for the present tool showed good agreement (K=0.819), which is acceptable and shows a high degree of agreement between the two raters. The ICC of each group illustrates good agreement in all categories, as the ICC is always above 0.75 (Table 2.6). In fact, 55.5% of the ICC is above 0.9 and 33.3% above 0.8. For frozen vegetables, the ICC is 1.000 likely because the specified brand and size was always available, and the raters did not have to choose between any other options. The lower ICC for beverages might be because, although the indicated beverage was available, not the same brand was available in every store. As there are several common brands present on the shelves, it was up to the raters to choose one for recording, as per the protocol.

Table 2.6 – Intra-class relation (ICC) for each category from the tool

Item	Intra-class Correlation
Fruits	0.964
Vegetables and legumes	0.912
Bread	0.926
Meat	0.844
Dairy	0.889
Egg	0.781
Canned fruit and vegetables	0.866
Frozen vegetables	1.000
Fish	0.952
Cereal and other grains	0.916
Nuts and Seeds	0.975
Pasta	0.832
Snacks	0.831
Beverage	0.755
Flour	0.846
Herbs and spies	0.984
Fat and oil	0.933
Sweets	0.992

2.5 Discussion

This study, to our knowledge, is the first to develop a tool to examine the association between retail food environment and outcomes regarding low-carbon dietary patterns at a scale beyond a city boundary, specifically for Ontario Canada. Employing this tool enables us to assess the retail food environment regarding the availability of items within seven nutritionally balanced and low-carbon food baskets.

There is a lack of focus regarding sustainable diets (sustainability related outcome) and their relationship with food environments and retail food environment specifically. Most of the focus has been on a healthy or nutritious diet. In general, as attention to sustainability and environmental impacts gains prevalence in different areas of research, food, which is among significant contributors to global environmental change, should be included in this multi-disciplinary study.

2.5.1 Geographical boundary

The tool developed in the present study, strives to cover a vast range of geographical areas with different food environment characteristics. It covers Southern Ontario and parts of Northern Ontario and also rural areas as well as urban areas. The food environment in these regions are different from each other and should all be addressed. A scoping review of previous research regarding food environments illustrates that most of the research covers food environments within a city rather than across a province. There is also not sufficient research regarding rural areas, considering the fact that one out of five Canadians live in rural areas (Minaker et al., 2016).

2.5.2 Availability of items and access to food

The survey using the present tool showed that most of the items within the low-carbon food basket were available in many of the grocery stores. This shows that in general, items from a low-carbon food basket, regardless of the dietary pattern, are available for Ontarians. However, among the different dietary patterns (according to Table 2.5), the top unavailable

items are from the vegan and vegetarian diet. However, there is no particular study examining the prevalence of vegan or vegetarian diets in northern areas. Therefore, lack of demand could be the reason behind unavailability. Even so, items such as fruit butter and peanut butter are usually bought from specific stores (rather than common grocery stores). In addition, regarding "exotic" fruits like papaya, availability depends on the season and unavailable fruits can be substituted by other fruits.

Nonetheless, there might be the issue of access to items from a low-carbon food basket. Past research shows in urban Canada, access to food is good, even in more deprived areas but this high access is to minimally nutritious food (Minaker et al., 2016). Therefore, customers are more likely to purchase items with higher access rather than searching for items from the low-carbon food baskets. In addition, lack of access to food, amplifies issues regarding insufficient income (Mah & Timmings, 2014; Minaker et al., 2016) and as food needs to be purchased in urban areas and often in rural areas, prices will determine affordability and thus accessibility (Ziervogel & Ericksen, 2010). Lack of access and unavailable food items can constrain the consumers willing or ability to adopt a low-carbon diet, specifically a vegan or vegetarian diet.

2.5.3 Limitations

There are several limitations to this study that could be addressed by further research. Primarily, the time span during which the survey takes place is critical. This study was done during the month of August and September. However, seasonal changes affect the availability of many fruits and vegetables that could significantly impact the result. Therefore, the research can be repeated in different seasons to account for the possible changes.

Secondly, assessing access to stores where items from the low-carbon food baskets are available should be added to the tool. Specifically, in Northern Ontario where discount grocery stores are not as dispersed as the South, access it a critical determinant of adapting a low-carbon diet.

Finally, as there is a comparison being made between discount and regular chain stores, adding measures to assess the quality of available items (Glanz et al., 2007), in the case of fresh fruits and vegetables will enhance the tool. According to informal conversations with the store managers, the quality of many fresh fruits and vegetables is significantly different in different type of stores (discount and regular). Therefore, it should be addressed in future research, for a more comprehensive understanding of the food environment.

Although, assessing how the surrounding environment influences eating behavior with any precision is very complicated and it is mostly an attempt (Lytle, 2009); the gap in research regarding retail food environments and its association with sustainable eating behaviors should be addressed.

In conclusion, due to the relation between food consumption, natural environment and global environmental change, food related issues should be addressed from different aspects. Therefore, if we can analyze the food environment and its relationship with low-carbon diets, we are more likely to achieve sustainable food consumption.

Chapter 3: Assessing the affordability of nutritionally-balanced and low-carbon diets

3.1 Overview

Globally, there has been an increasing number of studies considering the health and nutritional implications of dietary patterns, but few studies have considered the combined aspects of health and environmental sustainability, and their connection to food security.

The main purpose of this study is to determine whether nutritionally-balanced and low-carbon diets are affordable. This was accomplished by determining the cost and affordability of a proposed low-carbon food basket for seven dietary patterns in Ontario. The pricing methods used in this research were similar to the approved procedures used in Ontario's Nutritious Food Basket.

The outcome of this study showed that the affordability of a sustainable diet is mostly related to the type of store where food is purchased and the household's income. In addition, although there is not a significant difference between the affordability of a low-carbon diet in northern Ontario compared to southern Ontario and rural areas compared to urban areas, there is a matter of access and availability which constrains the likelihood of a sustainable diet. Within a consumer's nutrition environment, affordability, food literacy and time are important factors. The trade-off between these factors, among others, will determine whether it is feasible for a consumer to switch to a sustainable diet or not.

Key Word: Low-carbon food baskets, Affordability

3.2 Introduction

It is increasingly recognized that there is a strong connection between food production and consumption, and global environmental change as well as food security (Ericksen, 2007); all activities and drivers within the food system will affect the environment and its global changes. Therefore, these activities need to be within the planetary boundaries in order to avoid passing limitations and thresholds (Ericksen, 2007; Rockström et al., 2009). At the same time, there is increased recognition on the role of food on health and non-communicable diseases or obesity (FAO, 2016; Glanz et al., 2016; Kleinert & Horton, 2015). However, the studies that link both health and environmental impacts of dietary choices are few. Different types of food with the same nutrition and health impact, might have different environmental impacts during their life cycle. Therefore, it does not mean healthier food is more sustainable. There is a need to address these aspects as a whole, because there are alternative dietary choices which have low GHG emissions while being healthy (Tilman & Clark, 2014).

Individuals must cautiously navigate their food intake to maintain their health (therefore, eating healthy food), they should also take the environmental impacts of their food in to consideration (eating sustainable food). There is a general understanding on what is considered healthy food or a healthy diet. Healthy diets are defined as,

> "adequate, comprising sufficient food for a healthy life; diverse, containing a variety of foods, including plenty of fruits and vegetables, legumes and whole grains; low in food components of public health concern: sugars and salt consumed in moderation (with all salt iodized) and fats being unsaturated rather than saturated or trans-fats." (FAO, 2016, p. 8).

There are general values of nutrients proposed in the form of Daily Reference Values (DRVs) and Reference Daily Intakes (RDIs) (Health Canada, 2016; USDA, 2013). In addition, in order to eat healthy, options such as vegetables (especially ones that are dark green or orange), fruit, whole grains (like barley, brown rice, oats, quinoa, and wild rice), lower-fat milk (skim, 1% or 2% milk) and milk alternatives like fortified soy beverages, fish, lean meat, and meat alternatives (like beans, lentils, and tofu) should be used more often.

Moreover, consumption of saturated fats and trans-fats, added sugars, and sodium should be limited (USDA, 2015).

However, distinguishing between sustainable and unsustainable food is much more challenging. According to Food and Agriculture Organization (FAO) the definition of a sustainable diet is

> "those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources" (FAO, 2010).

The different stages of providing food - from agriculture, manufacturing, packaging to household consumption - are responsible for 19 to 31 percent of the total greenhouse gas emissions (Garnett, 2008). Although, it is difficult to measure every negative environmental impact of food, it is possible to quantify its contribution to greenhouse gas (GHG) emissions using tools like Carbon Footprint (CFP). There has been disagreement on whether carbon footprint is the proper tool for assessing food sustainability or not (Ribal et al., 2016), as there are many aspects to food sustainability such as water footprint and waste, among others, but CFP only measures GHG emissions. Nevertheless, there is no doubt that climate change due to GHG emissions is one of the most important issues and CFP connects to this significant matter.

While recommending different options and portions of food in a food basket, prices along with family budgets or affordability in general should be considered (Cassady et al., 2007). Affordability is

> "the purchasing power of households or communities relative to the price of food. The determinants of affordability include pricing policies and mechanisms, seasonal and geographical variations in price, local prices relative to external prices, the form in which households are paid, income, and wealth levels" (Ericksen, 2007, p. 7).

Research regarding the affordability of a healthy diet is a prevalent topic (Cassady et al., 2007; Rao et al., 2013; Waterlander et al., 2013). In addition, researchers are also starting to focus on the environmental and sustainability aspects of dietary choices and considering cost, nutritional value and GHG emissions to optimize food baskets (Barosh et al., 2014; van Dooren, Tyszler, Kramer, & Aiking, 2015; Wilson et al., 2013). However, there is a lack of such holistic studies in the Canadian context. A recent study by Veeramani (2015), proposed 7 low-carbon food baskets for 7 dietary patterns in Ontario. Yet, the affordability of these food baskets, which affects the likelihood of their adaptation by consumers, needs to be addressed.

Taking the food basket approach to assess and monitor food availability or affordability is a common method employed by researchers (Friel, Barosh, & Lawrence, 2014; Hubay et al., 2010). The food basket is a set of food items representing typical food intake on a weekly, monthly or annual basis. Generally, when taking the food basket approach, two baskets are considered: the realistic food basket and the hypothetical one. The most common method used in this approach is to form the food basket based on the consumption of a certain household (a family of four, two parents and two children / a family of two / or a one-person household) in a limited time (i.e. A week) (Barosh et al., 2014; Cassady et al., 2007; van Dooren et al., 2015). The hypothetical food basket is based on existing dietary choices, dietary intakes and it also incorporates necessary guidelines (Jensen, Saxe, & Denver, 2015).

Although, assessing retail food environments and their health implications has been addressed in a number of studies (Lo et al., 2016; Lo et al., 2016; Minaker et al., 2016); sustainability outcomes of retail food environment and the affordability of nutritionally-balanced and low-carbon (NBLC) food baskets (as proposed by Veeramani) still need to be studied. Therefore, the present study is aiming to assess the affordability of NBLC food baskets in Ontario Canada. This study is an effort to incorporate nutritional aspects, environmental aspects and economic feasibility of dietary patterns in to one comprehensive research. The results from this study could be further used for food environment policies and assessment of the possibility of altering eating behaviors to a more sustainable manner.

3.3 Methods

3.3.1 Creating food Baskets

As explained in Chapter 2, the food baskets used in this study were derived from a previous study by Veeramani (2015). After the analysis and modification of the CCHS data, Veeramani presented two sets of food baskets for each of the seven dietary patterns: the modified calorie adjusted annual food baskets and the NBLC food baskets. The transformation (or modification) from only nutritionally balanced to both low-carbon and nutritionally-balanced, was done by decreasing the amount of a high impact food item. If needed the item was replaced by a low impact alternative within the same food group. Therefore, the resulting food baskets will have sufficient number of servings, calorie intake and amount of protein complying with Canada's Food guide, and lower carbon footprint compared to what was consumed initially.

The present research (based on Veeramani's previous research), defines a healthy diet as a nutritionally balanced diet (by calorie and protein intake, and number of servings). According to Health Canada the ideal amount of protein for an average adult is 18,580.6 per year (which is around 50 grams a day) and the sufficient calorie intake is 837,400 calories (about 2300 calories a day). Nevertheless, if there were a more concrete definition of a healthy diet (or meal) including sufficient intake amounts for each of the main food groups, could provide a more precise healthy food basket. In addition, including the sufficient amount of other nutrients, such as minerals or vitamins would be beneficial to the accuracy of outcomes.

The negative environmental impact of a specific food during its life cycle is affected by many factors such as the process of production, transportation and even how it used and stored. In the present study the environmental impact accounted for is carbon foot print. Food storage and food waste could also be the determinants of how sustainable a diet is. Therefore, even if the food basket is sustainable, the consumption stage could affect the overall sustainability of the diet.

3.3.2 Choosing stores

3.3.2.1 Geographical boundary

The second step of this study was to choose the cities and grocery stores for data collection. It was hypothesized region, population density and type of store have a significant effect on the cost of each food basket. Therefore, the goal was to cover an inclusive range of regions within the scope of this research (urban/rural and north/south) in Ontario. Remote areas and on-reserve communities such as Attawapiskat and Moose Factory were not included in this research. This definition of "Northern Ontario" drastically effects the final results of this study. These areas have challenges and great barriers within their food environment which is significantly different than the food environment covered in this study. According to the 2016 report by Proof, 27.5% of off-reserve Indigenous households experience food insecurity (Tarasuk et al., 2016). These areas are only accessible by plane or winter ice roads which limits their access to food, there is a maximum capacity and weight that can be transferred; some types food may spoil, damage or get lost during the transfer. Often people are forced to travel long distances to purchase their food from the one available grocery store, and they have the added cost of high fuel and transportation rates. All these reasons result in an increase in the price or overall cost of food in these areas (Burnett et al., 2016). The furthest northern cities included in this study, were Sudbury and Sault Ste. Marie.

Using the list of municipalities in Ontario, two categories were created: northern municipalities and southern municipalities. The municipalities in these two categories were then sorted based on population density in order to distinguish rural and urban areas. The population density used to distinguish urban and rural areas is 400 people per square kilometer (Statistics Canada, 2011). Therefore, during the selection of urban (high population density cities) only cities with population density higher than 400 people per square kilometer were selected in Southern Ontario. However, the same method was not possible for the selection of high population density cities in Northern Ontario. As not all top large cities in Northern Ontario had a population density over 400 people per kilometer, cities were

selected based on population. Hence, the top three cities with the most population were selected (excluding Thunder Bay).

As 85% of the municipalities had a population density lower than 400 people/km^2, they were regrouped into two categories. The groups were created in a way that there were close number of municipalities in each group (Table 3.1). According to the distribution of "the number of cities" (based on their population density), 14 .1 people per square kilometer was selected as a limit for stratifying, which is also the average population density in Ontario (Statistics Canada, 2011).

Table 3.1 – The distribution of municipalities in the two categories based on their population density

Population Density	Number of municipalities	% of number of municipalities
d<14.1	169	41%
d>=14.1	245	59%
Total	414	100%

d is population density

Finally, the remaining cities were selected from 4 groups:

1. In the north and population density higher than 14.1 people per square kilometer
2. In the north and population density lower than 14 people per square kilometer
3. In the south and population density higher than 14.1 people per square kilometer
4. In the south and population density lower than 14 people per square kilometer

We can also illustrate this stratification using a matrix (Figure 3.1).

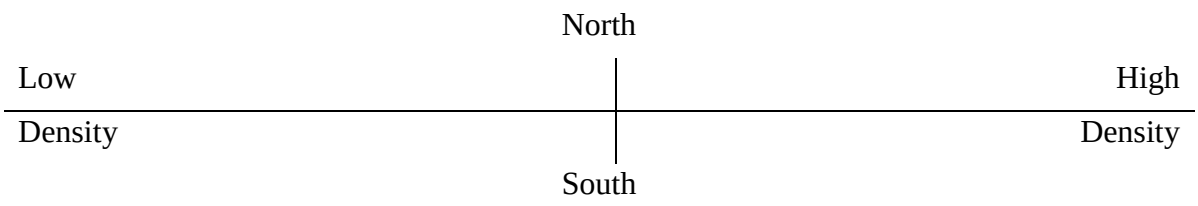

Figure 3.1 – City and store selection matrix

The goal of this research was to select a combination of 50 regular, discount and independent stores (Lo, Minaker, Mah, et al., 2016). To have a balanced selection, initially 3 cities and 4 stores in each city were going to be selected in each cell of the matrix. However, there were not enough number of stores in all of the cities, specifically low density northern cities. In some cases, the city had only one store. Due to this issue, more cities (6) were selected in the "north/low population Density" cell. Furthermore, as mentioned earlier, a few store managers did not grant permission to include their store in the study. Eventually, a fourth city was added in the "south/high population density" cell to make up for the eliminated stores. The final selected cities and their population density is provided in Table 3.2.

Table 3.2 – Selected cities and their population density

City	Population Density (person/km^2)
Toronto	4,334.4
Waterloo	1,639.9
London	912.6
Hamilton	480.6
Sault Ste. Marie	328.6
North Bay	161.6
Greater Sudbury	50.1
St. Charles	3.9
Blind River	6.6
Melancthon	9.7
Perth South	9.7
Baldwin	7.4
Dawn-Euphemia	4.4
French River	3.6
Kearney	1.7
The Archipelago	0.9

3.3.2.2 Store selection

Up to five stores were selected in each city (or in the vicinity – closest to the city). The stores were selected from a list (provided in appendix C) of major chain grocery stores and their affiliations suggested by NFB Guidance Document (2010). As mentioned before, due to the challenges, only 2 independent stores were included in the selection, which were regarded as regular stores in the analysis as their prices were close to a regular store in comparison with a discount store.

The selected cities and stores are provided in Table 3.3:

Table 3.3 – Selected cities and the number of stores in each city

Kearney	Blind river	Baldwin	Greater Sudbury		Sault Ste. Marie	North Bay
2 grocery stores	1 grocery store	2 grocery stores	4 grocery stores		4 grocery stores	5 grocery stores
St Charles	French river	The Archipelago				
1 grocery store	2 grocery stores	2 grocery stores				
Total number of stores: 10			Total number of stores: 13			
Dawn-Euphemia	Perth south	Melancthon	Hamilton	Waterloo	London	Toronto
2 grocery stores	4 grocery stores	3 grocery stores	3 grocery stores	4 grocery stores	5 grocery stores	5 grocery stores
Total number of stores: 9			Total number of stores: 18			

3.3.3 Data collection

Using the survey, which was formerly developed and tested as described in chapter 2, 50 stores were visited over the course of around one-month (mid Aug to mid Sep). The visit to each store took approximately 30 minutes depending on the size of the stores. The process of collecting the data was similar to the developing stage (as described in chapter 2).

Eventually, the cost of 7 food baskets from 50 stores were derived from the recorded prices in the survey tools. For the purpose of calculation, the missing prices were replaced by the mean price of all the other stores in that specific category; for example, if the price of apple

butter was missing in No Frills – Toronto, this price was replaced by the average price of apple butter in all the discount stores in high population density cities of the south.

3.3.3.1 Consumer price index

In addition to the collected prices, the cost of each food basket was also calculated using the "average retail prices of food and other selected items" category (September 2016) of the consumer price index (CPI) presented by Statistics Canada (2017b). "The Consumer Price Index (CPI) is an indicator of changes in consumer prices experienced by Canadians. It is obtained by comparing, over time, the cost of a fixed basket of goods and services purchased by consumers. Since the basket contains goods and services of unchanging or equivalent quantity and quality, the index reflects only pure price change." (Statistics Canada, 2017b) The geographic boundary of CPI data, is all of Canada except the reserves and it includes prices paid by the consumer after any discount. Over 90% of these prices are collected from the personal visits to a retail by a CPI interviewer and it is collected every month. The reason behind using the CPI in addition to the collected prices, is to have an assumption of the costs when buying in bulk or after sales and discounts, which is likely how most people shop.

3.3.4 Data analysis

3.3.4.1 Determining Cost

During calculating prices and comparisons, it was assumed that,

$$\text{Cost} = \beta_0 + X_{\text{discount}}\beta_1 + X_{\text{urban}}\beta_2 + X_{\text{north}}\beta_3$$

To test this assumption a linear regression was performed on all of the gathered data.

3.3.4.2 Assessing affordability

The final step, was to compare the cost of each food basket to income in order to assess affordability. As the food baskets were based on the annual food consumption of one adult (19-51), the income was also based on the single/working/adult household. To cover an acceptable range of incomes, scenarios were presented regarding the amount of income. The proportion of money spent on each of the food baskets compared to the income, resulted in

an expenditure percentage. Comparing this number to what is presented as “the average household expenditure on food” in Ontario (by Statistics Canada), could explain the economic feasibility of a nutritionally-balanced and low-carbon diet.

To assess whether a NBLC diet is affordable, 6 scenarios are presented. According to the census in 2015 (Statistics Canada, 2016) the distribution of “Ontario’s population with income”, based on their income after tax is provided in Table 3.4. More than half of the population (67%) have an income lower than 50,000 CAD and around 4% have an income over 100,000 CAD. Therefore, for the fifth scenario an annual income of 50,000 CAD was used. Also, 12% of the population have and income over 80,000 CAD, therefore the last scenario is an income of 80,000 CAD. Table 3.5 shows the 6 selected income scenarios based on one-person household income.

Table 3.4 – Percentage of population based on annual income after tax per capita

Annual income after tax per capita	Percentage of population
Under $10,000 (including loss)	14%
$10,000 to $19,999	17%
$20,000 to $29,999	14%
$30,000 to $39,999	12%
$40,000 to $49,999	10%
$50,000 to $59,999	7%
$60,000 to $69,999	5%
$70,000 to $79,999	4%
$80,000 and over	8%
$80,000 to $89,999	3%
$90,000 to $99,999	2%
$100,000 and over	4%

Table 3.5 – Income scenarios

scenario	Annual Income of a one-person household in Ontario		Amount (CAD)	Source
1	Social Assistance Payment	-	7,872	(Ministry of community and social services, 2016)
2		on ODSP	13,176	
3	Minimum wage	36 hours	19,288.80	(Ontario.ca, 2017)
4	Median Total income		40,830	(Statistics Canada, 2015)
5	Scenario 5		50,000	Proposed scenario
6	Scenario 6		80,000	Proposed scenario

3.4 Results

The cost of each food basket was calculated based on the prices collected in each of the 50 stores. A table including all the calculated prices, based on the three suggested determinants of price (region, population density and store type) is provided in appendix F.

3.4.1 Distribution of stores

Table 3.6, Table 3.7 and Table 3.7 show the distribution of the stores based on region and population density. It was intended to have almost equal number of stores in north and south (46% and 54% - Table 3.6), as well as urban and rural areas (62% and 38% - Table 3.6). However, the number of grocery stores from each category (discount (68%), regular (28%) and independent (4%)) depended on the availability of stores (Table 3.6). The same distribution of stores in urban and rural areas was intended for Northern Ontario and Southern Ontario separately. Therefore, in north, 57% of the stores were in urban and 43% were in rural areas (Table 3.7); and in south, 67% urban and 33% rural (Table 3.8). The reason why there are more stores in urban areas of Southern Ontario, is due to the fact that a few stores were eliminated and eventually Waterloo (Urban/South) was added.

Table 3.6 – Distribution of all surveyed stores

Distribution	Number of stores	Compared to total surveyed stores (n=50)
North	23	46%
South	27	54%
Total		100%
High Density	31	62%
Low Density	19	38%
Total		100%
Discount	34	68%
Regular	14	28%
Independent[+]	2	4%
Total		100%

[+]Independent stores were regarded as regular stores during the calculations

Table 3.7 – Distribution of surveyed stores in Northern Ontario

Distribution	Number of stores	Compared to total surveyed stores in North (n=23)
North/High Population Density	13	57%
North/Low Population Density	10	43%
Total		100%
North/HPD/Discount	9	39%
North/HPD/Regular	4	17.5%
North/LPD/Discount	7	30.5%
North/LPD/Regular	3	13%
Total		100%

Table 3.8 – Distribution of surveyed stores in Southern Ontario

Distribution	Number of stores	Compared to total surveyed stores in South (n=27)
South/High Population Density	18	67%
South/Low Population Density	9	33%
Total		100%
South/HPD/Discount	10	37%
South/HPD/Regular	8	30%
South/LPD/Discount	8	30%
South/LPD/Regular	1	4%
Total		100%

3.4.2 Determinants of the cost of food baskets

The factors that affect food basket costs were assumed to be the region, population density, and type of store. The p-values (Sig.) from the linear regression (Table 3.9) illustrate that among the three independent variables (region, population density and type of stores), the only variable that significantly affects the price of a food basket (dependent variable) is the store type (amounts are in bold). This is true for all of the food baskets except for the Omnivore diet, where in addition to the store type whether the area is rural or urban will also affect the price. Moreover, the B value correspondent with population density is a negative value (-1820.308), meaning the price will increase in rural (low population density) areas.

Table 3.9 - P-value (Sig.) and regression coefficient of the linear regression for each food basket

Variable (Value) / Food Basket	Region (North)		Population Density (High Population Density)		Type of store (Discount)	
	p-value	Regression Coefficient	p-value	Regression Coefficient	p-value	Regression Coefficient
Vegan	0.444	-432.718	0.276	-644.552	**0.011**	-1599.955
Vegetarian	0.310	-566.043	0.695	-227.657	**0.000**	-2241.969
Pesceterian	0.183	-698.265	0.900	-68.056	**0.000**	-2662.987
No red meat	0.279	-589.812	0.673	-238.888	**0.000**	-2204.196
No beef	0.294	-573.331	0.704	-215.727	**0.000**	-2193.869
No pork	0.247	-627.769	0.640	-263.074	**0.000**	-2211.502
Omnivore	0.122	-781.699	**0.014**	-1324.968	**0.001**	-1820.308

3.4.3 Comparison between the cost of different dietary patterns

The results from the final price calculation (based on the average price from the stores) illustrate that among all seven nutritionally-balanced and low-carbon food baskets the Omnivore food basket has the lowest cost and the No Pork food basket has the highest cost (Figure 3.2).

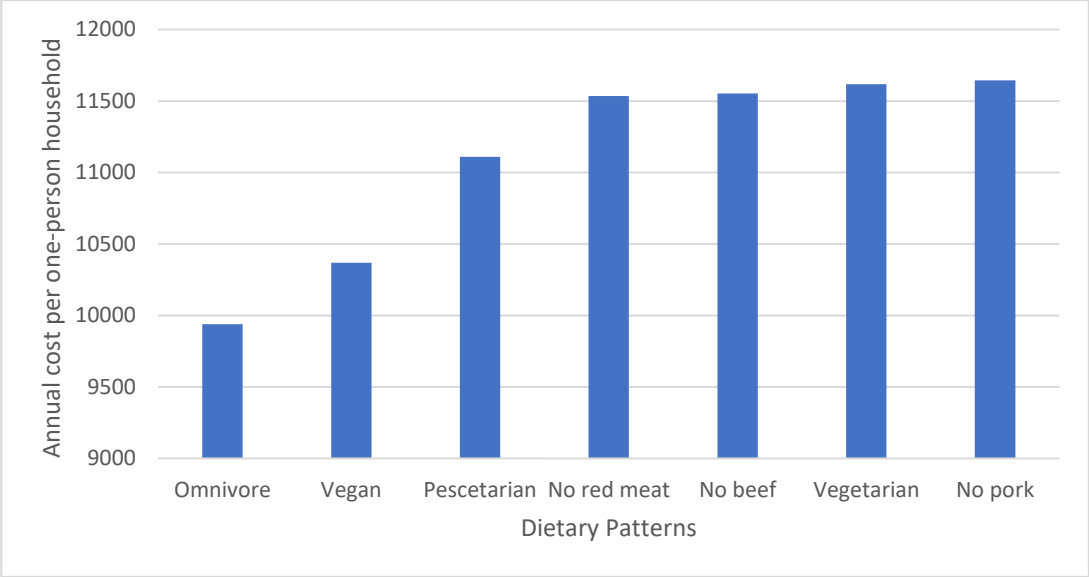

Figure 3.2 – The price of all food baskets based on the average price from all 50 stores

As concluded from the linear regression, "type of store" is the only determinant of the cost for each of the seven NBLC food baskets. It is obvious that the cost of any food basket will be lower if purchased from a discount store, however, the difference between the cost for each food basket (from regular and discount store) is not the same. As shown in Table 3.10, among the seven dietary patterns, the vegan followed by the omnivore food basket have the lowest, and the pescetarian food basket has the highest cost difference.

Table 3.10 – Comparison between the cost and the cost difference for each food basket purchased from regular and discount store

	Vegan	Vegetarian	Pescetarian	No red meat	No beef	No pork	Omnivore
Regular	11,382.58	13,126.29	12,926.30	13,016.91	13,029.36	13,128.07	11,021.51
Discount	9,891.53	10,909.12	10,253.22	10,838.86	10,857.77	10,946.09	9,428.64
Difference	1,491.05	2,217.18	2,673.08	2,178.04	2,171.60	2,181.98	1,592.87

Regarding the omnivore dietary pattern, in addition to the "store type", purchasing from urban or rural area is also affecting the cost of the food basket. The difference between the price of the omnivore food basket in rural areas is 1031.33 (CAD/year/ one-person household) more than the cost in urban areas.

3.4.4 Comparison between collected prices and price index

Realistically, groceries (specifically unperishable goods) are purchased in bulk and customers tend to buy discounted or on sale items. Therefore, the cost of each food basket was also calculated using the price index in September. The average cost (among all NBLC food baskets), calculated with the collected data is 3235.19 (CAD/year/ one-person household) more than the cost calculated using the price index (Table 3.11). For each of the food baskets separately (Table 3.11), the vegan diet is the cheapest and the omnivore is the most expensive. However, except for the pescetarian and the vegan food basket, the different dietary patterns have similar prices based on the calculations using the price index (Figure 3.3). This means, in general dietary pattern does not have a significant effect on the cost of a NBLC diet. Regarding the difference between the cost calculated using the price index and the collected data, the vegetarian food basket has the lowest difference and the pescatarian food basket has the highest.

Table 3.11 - Comparison between the cost and the difference between the cost of each food basket

	Vegan	Vegetarian	Pescetarian	No red meat	No beef	No pork	Omnivore	Average
Average Price	9,938.36	10,368.67	11,108.61	11,535.84	11,552.68	11618.61	11,644.32	11,109.58
Price Index	**7,521.18**	7,986.17	7,450.66	7,993.82	7,999.95	8,079.41	**8,089.55**	7,874.39
Difference	2,417.18	2,382.50	3,657.94	3,542.02	3,552.72	3,539.21	3,554.77	**3,235.19**

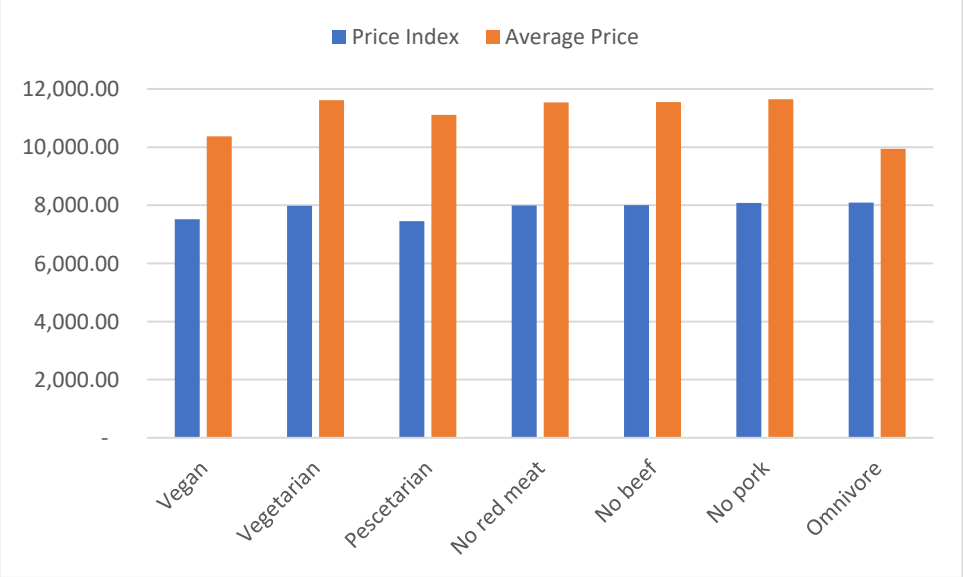

Figure 3.3 – Comparison between the cost of each food basket based on price index and modified NEMS prices

3.4.5 Comparison between current food baskets and nutritionally-balanced low-carbon food baskets

As mentioned before, during the development of the food baskets, a "calorie adjusted annual food basket" was presented for each of the seven dietary patterns. These food baskets were according to the actual dietary intakes of the population under study. To make comparisons between baskets, the calorie amounts were slightly adjusted for the average population requirements (based on male female ratios in Ontario and average age of those included in the survey). Additionally, some of the food items were eliminated because they were not available in the LCA food database. However, the percentage of each food group compared to the whole food basket was kept the same. Hence, the "calorie adjusted annual food basket" represents the current dietary pattern of the population under study. This basket was then

adjusted to align with Canada's food guide recommendations of servings for each food group. In order to ensure that the dietary patterns would be socially acceptable, no food group was completely removed, just increased or reduced to meet the guidelines for nutrition. Past research shows that for some people the only important characteristic of food is the amount of energy it provides. In this perspective, the more energy dense the food the better, regardless of its nutritional value (Aggarwal et al., 2011; Mullie et al., 2010). If we characterize a high energy food by the amount of calorie it provides, the following comparison is made between the cost of a calorie-adjusted "usual consumption" diet (current diet) and a NBLC diet, based on the calculations using the average of the collected data (Figure 3.4)

With the exception of the vegetarian diet (Figure 3.4), the NBLC food baskets were cheaper. The biggest differences between the NBLC and the actual baskets was for the vegan followed by the pescetarian diet (Table 3.12).

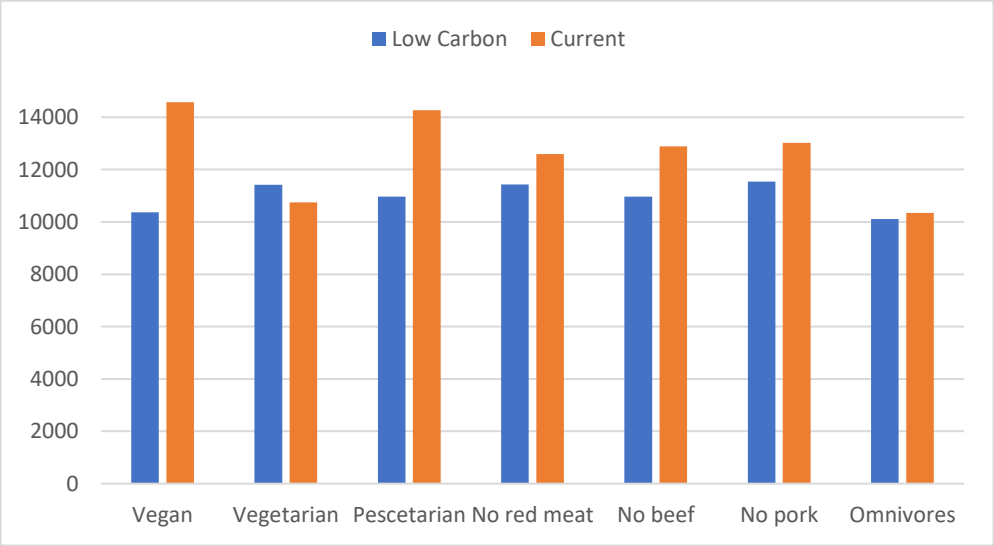

Figure 3.4 - Comparison between nutritionally-balanced low carbon diet and calorie-adjusted "usual consumption" diet based on collected prices

Table 3.12 – Cost of different NBLC food baskets and calorie-adjusted "usual consumption"

	Vegan	Vegetarian	Pescetarian	No red meat	No beef	No pork	Omnivores
Low Carbon	10367.45	11420.01	10962.70	11431.27	10962.37	11538.85	10114.23
Current	14577.65	10741.46	14267.88	12596.04	12888.46	13017.91	10346.98
Difference	**4210.20**	-678.55	**3305.18**	1164.76	1926.09	1479.06	232.75

Even in the case of the vegetarian diet, the price trade-off is very little and negligible (Table 3.12). However, in many cases when the consumer chooses the high energy food, they will choose fast food rather than buying grocery with enough or high calorie. In addition, the time spent on grocery shopping, preparing the food and cleaning up should also be accounted for.

3.4.6 Affordability

According to Statistics Canada (2015), the annual expenditure on food for a one-person household is 4,943 CAD. The items included in the food expenditure are both food purchased from stores and food purchased from restaurants. The expenditure used for this research is only the proportion allocated to food purchased from stores; this amount includes bakery products, cereal grains and cereal products, fruit and nuts, vegetables, dairy products and eggs, meat, fish and seafood, and non-alcoholic beverages and other food products (Statistics Canada, 2015). There is also another data regarding food expenditure in Ontario, however as the type of household is not specified in this data and the amount was higher than 4,943 CAD, this data was not used. The number of people in a household is an important determinant of the amount of food expenditure, therefore it cannot be disregarded (knowing that the food baskets used in this research are for one adult and such comparison would not have been accurate).

Using the food expenditure, the percentage of expenditure on food based on our scenarios, are shown in Table 3.13.

Table 3.13 – Percentage of food expenditure based on income scenarios of a one-person household

scenario		Present Food expenditure Based on data from statistics Canada
1	Social Assistance Payment	63%
2	Social Assistance Payment on ODSP	38%
3	Minimum wage (36 hours)	26%
4	Median Total income	12%
5	High Income Scenario A	10%
6	High Income Scenario B	6%

According to scenarios defined in the methods section (Table 3.5) the percentage of food expenditure is calculated for each of the seven dietary patterns using the price index. As the linear regression showed that region (north or south) and population density (rural or urban) does not have a significant effect on the cost, a comparison between these variables was not made.

Table 3.14 - Percentage of food expenditure based on the price index and one-person household income scenarios

Income Scenario		Vegan	Vegetarian	Pescetarian	No red meat	No beef	No Pork	Omnivore	Average	Present expenditu
1	Social Assistance Payment	96%	101%	95%	102%	102%	103%	103%	100%	63%
2	Social Assistance Payment on ODSP	57%	61%	57%	61%	61%	61%	61%	60%	38%
3	Minimum wage (36 hours)	39%	41%	39%	41%	41%	42%	42%	41%	26%
4	Median Total income	18%	20%	18%	20%	20%	20%	20%	19%	12%
5	High Income Scenario A	15%	16%	15%	16%	16%	16%	16%	16%	10%
6	High Income Scenario B	9%	10%	9%	10%	10%	10%	10%	10%	6%

Comparing the percentages in Table 3.13 and Table 3.14, depicts that in order to consume the low-carbon food basket, higher percentage of income should be allocated to food. However, in higher income scenarios this percentage gets lower and closer to what is already paid for food (the supposedly affordable amount). The results of the present study illustrate that households depending only on social assistance payment will have to spend 100% of their money if they wish to have a low-carbon diet. Obviously, it is not affordable for them. Therefore, although a low-carbon diet might not look affordable compared to the present expenditure on food, especially in low and mid-income households, small changes in consumption, purchase and effective planning could go a long way.

3.5 Discussion and conclusion

3.5.1 NBLC food baskets

The present study used the food baskets presented by Veeramani (2015) as the nutritionally-balanced and low-carbon food basket. Although, it is possible to form a food basket based on recommended food groups in food guides (Katz et al., 2011; Wilson et al., 2013), or the sales reports from certain grocery stores used in the study (Mhurchu & Ogra, 2007; Waterlander et al., 2013); the more realistic approach is to divide people into different groups based on their dietary patterns (Turner-McGrievy, Leach, Wilcox, & Frongillo, 2016; Veeramani, 2015). Veeramani (2015) did so by dividing people into seven groups: vegan, vegetarian, pesceterian, no red meat, no beef, no pork and omnivore.

In addition, Veeramani created the food baskets based on the actual consumption of Ontarians. Regarding the appropriate food groups to include in the basket, two main perspectives are generally taken: food groups including packaged food, snacks, meat, dairy and etc. (Barosh et al., 2014; Katz et al., 2011) or fruits and vegetables (Cassady et al., 2007; Waterlander et al., 2013). However, there has been research that included all of the food groups; Wilson (2013) conducted a research in New Zealand in which he formed a food basket including all of the necessary food groups (fruits and vegetables - cereal and grains – pulses, seeds and nuts - dairy products – other foods such as eggs, oil spreads and etc.).

3.5.2 Determinants of cost

The results of the present study, showed that regardless of where you live the type of store where grocery is purchased, has the most significant effect on the cost of a diet. This finding matches the informal discussions with the store managers indicating that in a particular type of a chain store within a region, Ontario, (for example all the FreshCo branches), the prices are set within a specific range and should not differ much. However, it was expected for the prices to be significantly higher in Northern Ontario. This could be explained by the

definition of Northern Ontario used in the present research, where remote and on-reserve northern areas were not included.

Previous research (Tarasuk et al., 2016), shows that in remote northern regions of Ontario (specifically On-reserve households in Fort Albany) households pay around 50% of their median income on basic nutritious diet. In northern regions an alternate for the NFB is proposed which is called the Revised Northern Food Basket (RNFB). “The Revised Northern Food Basket (RNFB) is a survey tool created by Indigenous and Northern Affairs Canada, in consultation with Health Canada, to monitor the cost of food in remote northern communities. The RNFB is also based on average overall consumption for a sample population and contains 67 items (as revised in 2008) and their purchase sizes” (Tarasuk et al., 2016, p. 13). In remote northern regions, the calculation regarding the cost of a nutritious diet is done based on RNFB. The average cost of RNFB per month for a family of four in three on-reserve communities (Attawapiskat, Fort Albany and Moose Factory) is 1,793.40 CAD. If we adjust this number for a one-person house hold (using the method suggested by NFB - 1 person – multiply by 1.20), it will be 537.9 CAD per month. This number is around double (1.8) the monthly food expenditure for a nutritious food basket in Sudbury (299 CAD) (Sudbury & District Health Unit, 2016) and Waterloo (290.40 CAD) (Region of Waterloo, 2016).

3.5.3 Cost of NBLC diets

According to the results from the present study, using the average price from all 50 stores, the omnivore diet is the cheapest and the no pork diet is the most expensive (Figure 3.2). However, using the price index the vegan diet was the cheapest and the omnivore was the most expensive (Figure 3.3). If we accept that the price index provides a more realistic cost, the results are consistent with previous research. It was expected that plant-based diets, such as vegan and vegetarian diets, that rely on legumes for protein instead of meat, cost less than meat-based diets. These diets are also low in Carbon Footprint which makes them more

likely to be environmentally sustainable (Turner-McGrievy et al., 2016; van Dooren et al., 2015; Veeramani, 2015).

In order to evaluate the results of the present study, in Table 3.15 a comparison is made between these numbers and the outcome of two other studies which calculated the percentage of income allocated to food in Waterloo Region and in Greater Sudbury Area. These calculations were based on the expenditures of one adult (age 19-54) with the average income. The food basket and method in both studies was the NFB. The results of the present study are close to the previous studies. Specifically, when prices are calculated using the price index (which includes lower prices and is closer to the reality of how food is purchased) where there is only a 3% difference.

Table 3.15 – A comparison between the results of the present study and previous studies

	Present Study				Waterloo	Sudbury
	Price Index	Collected Data	Waterloo	Sudbury		
Percentage of Income Required to Purchase Food*	41%	57%	26%	29%	38%	38%

(Region of Waterloo, 2016; Sudbury & District Health Unit, 2016)

*The food basket used in Waterloo and Sudbury study were based on NFB. As mentioned before, the NFB method records the lowest price available. However, in the present study the employed method focused on recording similar brands (for the purpose of more accurate comparison) rather than the lowest price; hence, a slight difference between the percentages was probable.

3.5.4 Price index Vs. Collected data

The results of the present study show that the cost of NBLC diets are much lower using the price index compared to the collected prices. Therefore, it could be said that buying groceries on sale, with discount or in bulk will have a significant influence on the cost and will decrease it drastically, as the price index is the price after sales and discounts. Specifically, when financial resources are limited, managing purchases can be very effective. If food is

purchased with discount, in bulk or using coupons, the final cost (compared to income) can be lower by 4 to 8 percent in high income and as much as 39% in low-income households.

Costs calculated in this study using the collected data are, more or less, the worst-case scenario. For most of the items, the recorded brand was not the cheapest one available and the price of small packages were recorded. The goal was to have almost identical food baskets in all of the stores, therefore the focus was on choosing the common brand (not the one that costs less in each store). We can say this goal was achieved based on the high inter-rater reliability. Hence, it could be expressed that the calculated prices are higher than the reality.

3.5.5 Affordability of NBLC diets

The present study shows that households with annual income higher than 50,000, spend 6-10% of their income on food and to switch to a low-carbon diet, they will have to spend 10-16% (based on the calculations using the price index, which is closer to the reality of how people spend their money on food). This means they should spend around 4-6% more to have a low-carbon diet (regardless of the dietary pattern). In the case of low income households (Social Assistance Payment on ODSP), the result of food expenditure from Statistics Canada shows that they are paying around 38% of their money on food. Using the price index for calculation, this group will still have to pay more than half of their money (60%) on food. This is consistent with the results from a study done by Barosh (2014) in Australia. According to his research, high income households spend 6-8% of their income on their typical food basket and if they were to switch to a healthy and environmentally sustainable (H&S) food basket this number will be 8-9% which is still affordable. In addition, Barosh (2014) concluded that low income households that spend around 33-44% of their income on food, will have to spend 40-48% of their income on a H&S food basket; that is around half of their income (Barosh et al., 2014).

3.5.6 Limitations

The first limitation of this study is the geographical boundary. Although, the food environments are significantly different in more remote areas in Northern Ontario, they need to be incorporated in the research for a cross province study.

The second limitation is regarding the food outlets under study. Due to unforeseen reasons, many of the independent grocery stores were eliminated from this study. However, prices are significantly different in different types of stores; chain super markets are more likely to be cheaper than small independent stores (Barosh et al., 2014). Therefore, in order to present a comprehensive and realistic picture, other stores such as farmer markets or independent stores should be studied in future research.

Finally, there is a quality difference in the products provided in discount and regular stores (particularly fresh fruits and vegetables). Therefore, customers may buy their packaged goods from a discount store and purchase fruits and vegetables from more expensive stores where the quality is higher. The present research assumed that a customer buys the whole food basket from a particular type of store. Further study on purchasing patterns, could enhance the accuracy of presented results.

3.5.7 Conclusion

In conclusion, it is important to know having a low-carbon diet does not necessarily mean eating organic food or eliminating beef. How food is prepared (cooking method), stored and food waste are as important as choosing low impact food. In general, the goal is not force consumers to completely switch to a plant- based diet, rather to moderately enhance their eating behavior and make small improvements (Katz et al., 2011).

The results showed, there is not a significant difference in the affordability of a low-carbon diet among the seven dietary patterns. However, the omnivore diet is in fact the most prevalent. According to the CCHS (2004) data 30% of Ontario population was reported omnivorous, 27% meat-based diets avoiding pork, 16.5% avoided beef, 3.5% pesceterian,

7% vegetarian, and 0.4 % vegan. Moreover, the omnivore diet is the second most unsustainable diet (no pork diet is the first one). Therefore, there needs to be more attention directed towards understanding the reason behind such eating behaviors and then finding solutions to encourage altering these behaviors to a more sustainable manner.

In general, past research shows that a healthy and nutritious dietary pattern is more expensive than consumer's present food basket and there is a need for price incentives, such as discounts and promotions, to encourage people to choose nutritious and healthy food options (Aggarwal et al., 2011; Cassady et al., 2007; Katz et al., 2011; van Dooren et al., 2015; Waterlander et al., 2013). However, the cost difference is not significant in all food groups (Katz et al., 2011; Mhurchu & Ogra, 2007; Turner-McGrievy et al., 2016). Therefore, small improvements in some food groups will not necessarily increase the price but will enhance the quality of eating (Katz et al., 2011).

In addition to research, the result of this study could be used for food environment policies regarding rural and urban areas. It could also be utilized in revising food guides in a way that they will take sustainability of food choices into consideration. Providing affordable and accessible food choices for consumers that will meet their nutritional needs while minimizing negative environmental impacts is significant with respect to food security. This requires holistic planning along with educational programs to encourage consumers to make appropriate food choices and alter their eating behavior.

Chapter 4: Discussion and Conclusion

4.1 Discussion

It has been shown that if a person's annual income is above the median income (40,830 CAD), depending on their dietary pattern, they would have to pay an average of 19% of their income for food (5% more than what they had already been paying) if they choose to adapt th NBLC diet. This is consistent with the results from prior research by Barosh (2014).

In addition, there was no significant difference between the affordability of a NBLC diet in north or south (in Ontario) and in urban or rural areas. However, for the Omnivore diet, the cost was higher in rural areas. Prices are generally known to be higher in Northern Ontario (Burnett et al., 2016; Tarasuk et al., 2016), which was not the case in the present study. This could be due to the definition of "the geographical boundary of Northern Ontario" in the present research. Not including remote and on-reserve areas significantly affects the average prices from Northern Ontario (Burnett et al., 2016).

4.1.1 Access to NBLC food baskets

As mentioned in chapter 2, aside from availability, access to items from NBLC food baskets is a concern. The main issue is that discount stores are not equally dispersed and available in north vs south and rural areas compared to urban areas. Figure 4.1 and Figure 4.2 show the distribution of 2 discount chain stores in the areas covered in this research.

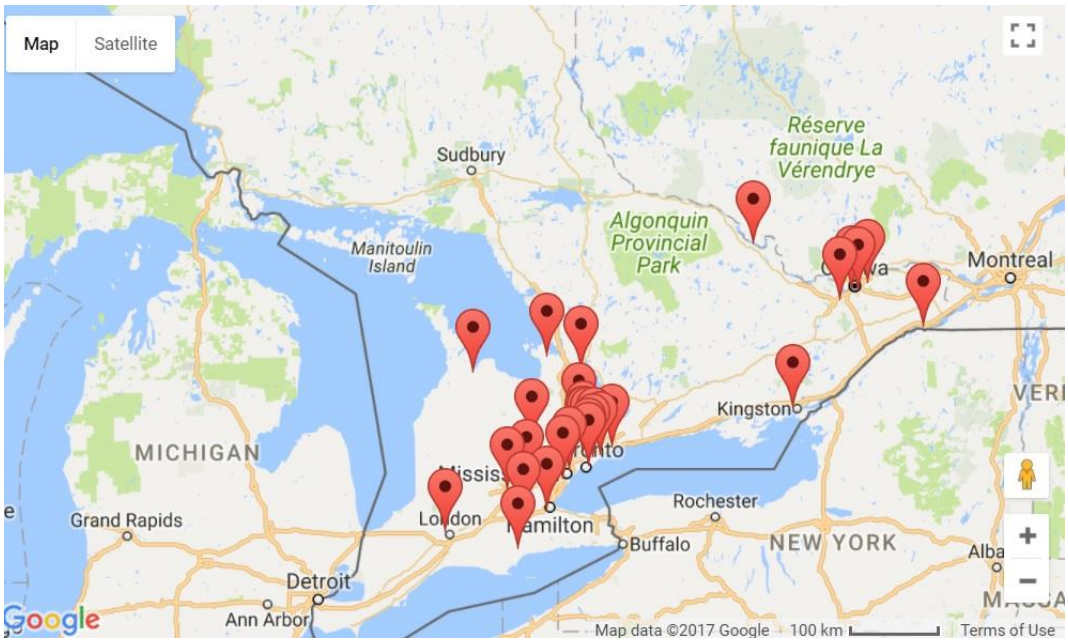

Figure 4.1 – Distribution of Food Basics locations;

Source: (Shopping Canada, 2017)

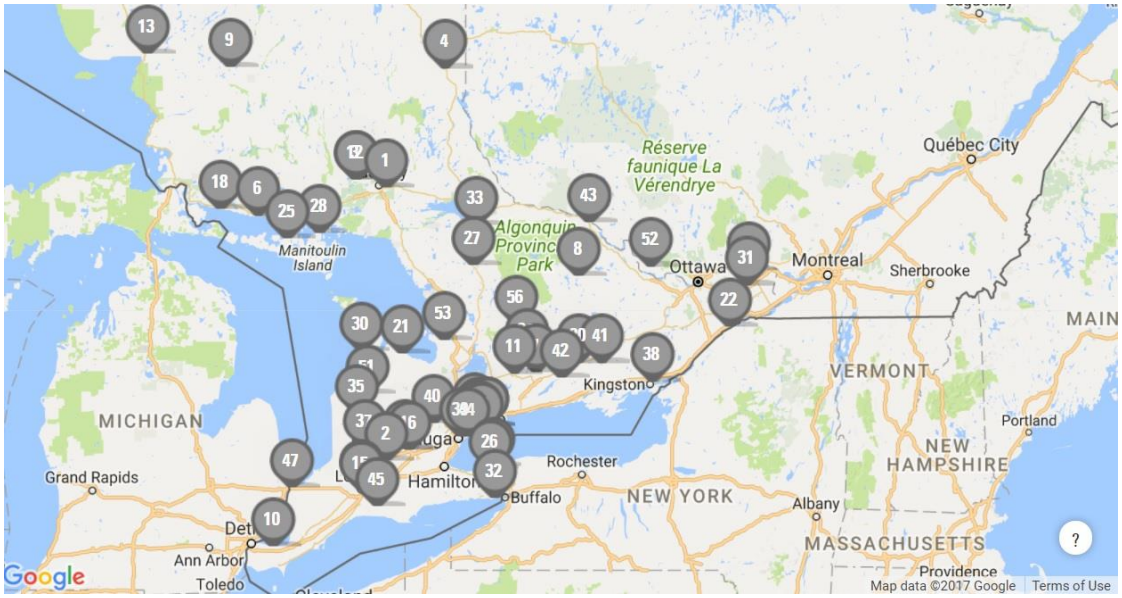

Figure 4.2 – Distribution of Valu-mart locations;

Source: (Valumart, 2017)

This shows there is an unbalanced access to (discount) chain stores resulting in an excess cost which will be added to the final cost of the food basket. When there are many stores close by, less time will be spent during the actual period of purchasing and transportation cost will also decrease. While developing NBLC food baskets, it was considered that according to the "Master Index Report" (MasterCard, 2008), grocery shopping is often done once a weak for an average of 35 kilometer-round-trip and shorter trips for purchasing snacks or perishables for an average of 2 kilometers. Canadians make an average of 37 long and 76 short grocery shopping trips per year, which will result in a total of 281.5 kilometers (Veeramani, 2015). The transportation emissions are one of the factors influencing the sustainability of a food basket. Therefore, a person living in Northern Ontario who is a vegan (may be living in a rural area) is considered having a sustainable eating behavior; however, there might not be a discount grocery store available within the foresaid boundary. Therefore, this person has to travel long distances and go to several stores to purchase food. Eventfully, he/she is spending more time and money than anticipated and his/her diet will become not as sustainable as he had anticipated.

When people have to commute long distances (either for work or grocery shopping), they tend to decrease their health-related activities, such as an increase in the likelihood of purchasing none-grocery food (Christian, 2009). This access and availability issues are what makes the difference between affordability in north vs south and rural vs urban, even though the actual cost itself might be the same.

4.1.2 Other factors constraining sustainable food consumption

Affordability which is the main topic of the present research, or the perception of affordability, is one of the major barriers (Aggarwal et al., 2011; Barosh et al., 2014; Mullie et al., 2010) and has received a great deal of attention from researchers (Barosh et al., 2014; Cassady et al., 2007).

However, there are multiple variables in an individual's food environment that influence eating patterns (Glanz et al., 2005), resulting in multiple barriers and limitations to adopt sustainable and healthy dietary patterns.

As previously mentioned one of these factors is "time spent on food related activities": purchasing, preparing and even cleaning up after a meal. The availability of time, and the person's willingness to spend time on food related activities in an important factor effecting eating behaviors. However, there is a lack of focus on this topic in Canadian context. Having a healthy diet must be feasible and not everyone has the same resources. Aside from the financial factor, time is another source that people need because of the association between time scarcity and healthy behaviors. Time pressure has adverse effects on a person's healthy eating habits (Mothersbaugh, Herrmann, & Warland, 1993).

As a study by Wolfson (2016) in USA showed that, regardless of a household's income, cooking at home was perceived less expensive than eating at restaurants. However, if the goal were to cook healthfully and from raw materials, particularly fresh vegetables or meat, cooking was perceived as a challenge. The majority participants in his research expressed that if they had more time or food was more affordable, they would have been able to eat healthier. In addition, they mentioned not having enough time to balance their busy lives, forced them to have extensive plans regarding their eating schedule, which was not always feasible (Wolfson et al., 2016).

Research shows that there is less time spent on preparing and cooking a meal at home compared to the past (Pettinger, Holdsworth, & Gerber, 2006; Smith, Ng, & Popkin, 2013; Soliah, Walter, & Jones, 2012; Zick & Stevens, 2010), and the population has fewer/ different cooking skills specifically skills to prepare a home meal from scratch (Van Der Horst et al., 2006; Worsley, Wang, Wijeratne, Ismail, & Ridley, 2015). For example, one of the reasons contributing to a decrease in time spent for cooking is employment, specifically women employment (Mancino & Newman, 2007).

Time scarcity increases the frequency of eating out, calorie intake and the likelihood of inadequate fruit and vegetable intake. One additional meal eaten away from home increases daily caloric intact by about 134 calories, and lowers diet quality by two points on the Healthy Eating Index (Todd, Mancino, & Lin, 2010). If time scarcity is combined with financial constraints it will amplify the risk of showing healthy behaviors (Minaker et al., 2016; Venn & Strazdins, 2017). Time is not equally dispersed and certain groups such as women or lone parents have more constraints and commitments (Strazdins, Welsh, Korda, Broom, & Paolucci, 2016). Therefore, due to these constraints and commitments not everyone can spend sufficient time on food related activities.

In addition to having constraints, sometimes people are not willing to spend their free time on food preparation (Lavelle et al., 2016). For people with high income and high access to food, cooking is a hobby and a source of relaxation and joy (Wolfson et al., 2016). According to Kalenkoski (2013), discretionary time spent on preparing and eating healthy meals fall under the category of leisure (Kalenkoski & Hamrick, 2013). However, this might not be true for everybody. Therefore, how people prioritize their activities for time allocation, or perceive food related activities (whether it is a task or leisure), will influence their eating behavior.

In addition to lack of time or time pressures (Jabs & Devine, 2006; Lavelle et al., 2016), cost of convenience food and desire to save money (Lavelle et al., 2016), other constraints such as cooking skills or limited food resources (Vidgen & Gallegos, 2014) are barriers of home meal preparation. As previously mentioned knowledge about food and food preparations could be discussed using the holistic term of "food literacy."

Food literacy is one the factors influencing consumers' choice regarding eating behavior. In order to describe the practicalities associated with an individual's endeavor to navigate the food system and assuring they are consuming adequate amount of nutrition the term "food literacy" emerged (Vidgen & Gallegos, 2014). This term has been investigated in various countries (Caraher, 2012; Vidgen & Gallegos, 2014) but is a fairly new concept within the Canadian context (Cullen, Hatch, Martin, Higgins, & Sheppard, 2015). There are many

different definitions encountering various aspects of food literacy. According to Tracy Cullen comprehensive definition of food literacy should include components of literacy and food security. He proposed the following definition based on 22 different definitions used in other researches and specifically definitions of health literacy, as food literacy was a concept which emerged following health literacy (Carbone & Zoellner, 2012).

> "Food literacy is the ability of an individual to understand food in a way that they develop a positive relationship with it, including food skills and practices across the lifespan in order to navigate, engage, and participate within a complex food system. It's the ability to make decisions to support the achievement of personal health and a sustainable food system considering environmental, social, economic, cultural, and political components." (Cullen et al., 2015, p. 143)

Therefore, food literacy not only includes individual interpretive skills, but it also encompasses the healthy inter-action between the individual and the society to empower them both. The significance of food literacy on individual or community basis is inevitable. It relates the knowledge regarding food and nutrition to food choices and decisions about dietary intake. In addition, food literacy goes beyond nutrition knowledge; it includes knowing where your food came from and how you should prepare it, skills and behaviors are also a part of food literacy (Lichtenstein & Ludwig, 2010; Vaitkeviciute, Ball, & Harris, 2015). Striving to improve food literacy is a possible means of enhancing eating patterns to a more healthy and sustainable manner.

Time and food literacy are among many factors that impact eating behaviors. These factors could act as both constraints or incentives. There is need for more research and focus on the extent of which these factors influence eating behaviors and how they do so, specifically in the Canadian context. Further research could be implemented on the interaction between all contributing factors, as the relationship between these factors are not linear and cannot be addressed induvial.

4.2 Limitations

The main limitation of this is study is that it did not cover every factor influencing eating behavior within “Consumer Nutrition Environment”. Affordability, knowledge and time may be among the most important factors, but the results could be more specific if more limitations are taken into consideration (Deliens et al., 2014; Waterlander et al., 2013).

The second limitation is regarding the definition of a sustainable food basket. There are many attributes that make a food basket sustainable. Among many impacts this study only covers carbon footprint. Other impacts could also be accounted for in further research to develop a more accurate food basket.

Finally, costs estimated from the pricing method may not be exactly replicating the reality of prices due to seasonal fluctuations or changes in the market. However, the goal is to provide a general assessment of the affordability of existing dietary patterns using approved methods such as the ones employed in Nutritious Food Basket.

4.3 Conclusion

In conclusion, financial feasibility is one of the main (among many) determinants of the likelihood of adapting a sustainable diet. Other factors such as time and food literacy should be further investigated as people have different priorities and tendencies. The present research showed that for Ontarians with higher than average levels of income, it is affordable to eat sustainable food. However, when financial resources are limited, small changes in diets and planning ahead of time regarding how and where to purchase groceries could be very effective (Katz et al., 2011; Turner-McGrievy et al., 2016).

Finally, although, affordability of sustainable food is related to income, it does not mean that if consumers have sufficient money they will choose the healthy and sustainable options. In order to promote sustainable consumption of food, more incentives and promotions, such as discounts, are needed by retailers and policy makers. There should be sufficient access to the

necessary ingredients. Consumers need more information regarding sustainable food choices, as well as the more sustainable methods of preparing food.

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Appendices

Appendix A. Food baskets

Item / Dietary Pattern	Vegan	Vegetarian	Pescetarian	No red meat	No beef	No pork	Omnivores
	Amount in kg						
apples, raw	26	21.11	25.33	28.26	26.4	21	22.5
bananas, raw	13	37.95	28.52	24.65	35.2	22.4	15
grapes, raw	13	14.91	15.5	10.91	10.4	9.8	15
melons, cantaloupe, raw	19.5						
oranges, raw	13	13.22	11.08	8.52	8	9.1	22.5
papayas, raw	6.5						
pears, raw	16.9		9.57				
pineapple, raw	6.5						
strawberries, raw	15.6			7.65		7.7	
broccoli, boiled	21.45	15.16	15.16	15.16	15.16	15.16	15.16
cabbage, boiled	8.05						
carrots, raw	28.11	22.27	22.27	22.27	22.27	22.27	22.27
cauliflower, boiled	3						
peas, grean, boiled	11.57		9.95	4.16	4.61	4.09	2.01
beans, snap, boiled	27	20.72	11.2	5.2	8.39	5.42	4.69
lettuce, iceberg, raw	6	10.45	10.45	10.45	10.45	10.45	10.45
onions, raw	8.05	31.2	33.9	35.25	38.37	41.8	38.75
peppers, sweet, raw	2.7						
potatoes, baked	2.5						
tomatoes, raw, year round average	8.1	32.4	33.9	35.2	28.86	25.03	15.9
zucchini, boiled	8						
tofu, regular, fried (calcium sulfate)	27						
soy patty		13					
lentils, boiled		8					
peas, split, boiled	11.57						
bread, white, toasted	51.85	44.02		42	38.5	41.91	41.19
bread, whole wheat, toasted			45				
beef, ground, medium, pan fried						24.7	15
chicken, meat, water chill, roasted				25	11	10.55	8.4
pepperoni, pork, beef							3
pork, tenderloin, roasted					12.5		7
cheddar cheese		15.8	7.78				13.3
partly skimmed milk		106.82	148.2	188.34	188.34	188.34	119.72
Egg, raw		15.6	14.57	22	20	20	20
beans, snap, canned			3	1.04			
olives, ripe, canned	2.7						
tomato puree, canned	2.7	6					
tomatoes, canned, whole		6					
tomatoes, sauce, canned							18.76
Tuna, canned				6.24	3.44	5.46	5.46
Salmon, canned			3.44	1.56	4.36	2.34	2.34
cereal, ready to eat, Cheerios	18.43	9.35	13.16	2.55	2.55	2.55	2.55
oats, quick, cooked	18.43	9.35					
oats, cooked			63.05	48.45	48.45	48.45	48.45
rice, white, long, cooked	45.65	30.5	44.4	44.7	48.17	46.5	40

Item / Dietary Pattern	Vegan	Vegetarian	Pescetarian	No red meat	No beef	No pork	Omnivores
	Amount in kg						
cashew nuts, dry roasted		0.5	0.64				
almonds, dried		1.5		0.35	1		0.25
almonds, oil roasted			1				0.75
peanuts, dry-roasted		2		0.9	0.8		
peanuts, roasted			1.8			0.88	
walnuts, dried		0.5	1	0.35	0.4	0.25	
spaghetti, enriched, cooked	26.64	27	20	27.8	20.7	25	36
potato chips, plain		3.36	2.53	4.2	3.48	3.79	4.7
Granola bar	0.9						
apple juice, canned/bottled + vitamin c	14.72	17.96	10.93	27.52	18.09	18.2	22.5
grape juice, canned/bottled		5.39					
orange juice, chilled	7.36		33.83	18.35	27.13	27.3	
orange juice, canned	7.36	21.55					22.5
tomato juice, canned	3.1	0.77	3.14	2	2.66	2.5	2
carbonated drinks, cola	47.2	31.5	29.97	30	34	34.72	47.82
coffee, brewed		45.63	91.25	45.7	45.7	45.57	91.25
coffee, instant	72.36	45.63		45.7	45.7	45.57	91.25
tea, brewed	72.36	91.25	91.25	91.25	91.25	91.14	
wheat flour, white	24	25.2	15.5	17.4	24.4	17.39	19
salt, table	0.87	0.88	1.28	1.29	1.86	1.78	1.8
vegetable oil, olive							0.25
vegetable oil, canola	10.22	3.99	4.91	3.07	5.37	2.3	1
butter, regular		9.2	7.36	10.27	7.67	10.73	9.33
margarine, tub, unspecified vegetable oils	2.56	2.15	3.07	1.99	2.3	2.3	2.2
sugars, granulated	1.43	4.38	4.38	4.38	4.38	4.38	2.92
fruit butters, apple	1.43						
almond butter	1.45						
jam and preserves / strawberry		1.53	1.13	1.22	1.99		
peanut butter, smooth, fat, sugar and salt added	4.35	3	3	2.25	1.84	1.38	1.5

Appendix B. The list of eliminated stores

City	Store Type	Comment
St Charles	Independent	The store was temporarily closed.
Perth south	Independent	The manager did not allow.
Melancthon	Independent	The market was not held on the date it was visited.
Dawn-Euphemia	Independent	The manager did not allow.
Greater Sudbury	Discount	Manager said the head office will not allow, however this issue was not faced during visits to other locations of this chain store
Hamilton Waterloo	Discount	Manager said the head office will not allow. As this happened in other locations as well, this chain store was eliminated from the study

Appendix C. The list of chain stores

Chain store	Code
Discount	
No Frills	A
Foodland	C
Food Basics	D
Your Independent Grocer	E
Real Canadian Superstore	F
Fresh Co	H
Walmart	K
Valu-mart	P
Regular	
Sobeys	B
Loblaws	G
Metro	J
Zehrs	S

Appendix D. Survey Tool

Sustainable food basket survey				
Rater ID:	Store ID:	Date: dd/ mm/ yr	Start Time:	End Time:
Type of Store:		Number of cash registers:		

Measure #1 Fruit

Item	Specification	Available Yes	Available No	Price	Unit #	Unit pc	Unit kg	Unit lb	Comment
Apple	○Red delicious ○	○	○	$ __ . __ __	__	○	○	○	
Banana	○	○	○	$ __ . __ __	__	○	○	○	
Grape	○Red seedless ○	○	○	$ __ . __ __	__	○	○	○	
Melon	○ Cantaloupe ○	○	○	$ __ . __ __	__	○	○	○	
Orange	○Navel ○	○	○	$ __ . __ __	__	○	○	○	
Papaya	○	○	○	$ __ . __ __	__	○	○	○	
Pear	○Bosc ○Bartlett ○	○	○	$ __ . __ __	__	○	○	○	
Pineapple	○ Whole ○	○	○	$ __ . __ __	__	○	○	○	
Strawberry	○ 1 lb container ○	○	○	$ __ . __ __	__	○	○	○	

Measure #2 Vegetables and Legumes

Item	Specification	Available Yes	Available No	Price	Unit #	Unit pc	Unit kg	Unit lb	Comment
Broccoli	○1 head ○	○	○	$ __ . __ __	__	○	○	○	
Cabbage	○ Green ○	○	○	$ __ . __ __	__	○	○	○	
Carrot	○2lb bag ○	○	○	$ __ . __ __	__	○	○	○	
Cauliflower	○ 1 head ○	○	○	$ __ . __ __	__	○	○	○	
Green peas	○	○	○	$ __ . __ __	__	○	○	○	
Green Beans	○	○	○	$ __ . __ __	__	○	○	○	
Lettuce	○Iceberg ○	○	○	$ __ . __ __	__	○	○	○	
Onion	○yellow – 2lb bag ○	○	○	$ __ . __ __	__	○	○	○	
Bell Pepper	○Loose Green ○	○	○	$ __ . __ __	__	○	○	○	
Potato	○white – 10lb bag ○	○	○	$ __ . __ __	__	○	○	○	
Tomato	○Loose field ○	○	○	$ __ . __ __	__	○	○	○	
Zucchini	○Loose ○	○	○	$ __ . __ __	__	○	○	○	
Tofu	○Sunrise, extra firm ○	○	○	$ __ . __ __	__	○	○	○	

Measure #3 Bread

Item	Specification	Available Yes	Available No	Price	Unit #	Unit pc	Unit kg	Unit lb	Comment
White bread	○Wonderbread, 675gr ○ Dempsters, 675gr ○	○	○	$ __ . __ __	__	○	○	○	
Whole wheat bread	○Wonderbread, 675gr ○ Dempsters, 675gr ○	○	○	$ __ . __ __	__	○	○	○	

Measure #4 Meat

Item	Specification	Available Yes	Available No	Price	Unit #	Unit pc	Unit kg	Unit lb	Comment
Ground beef	○Lean ○	○	○	$ __ . __ __	__	○	○	○	
Chicken	○One whole chicken with skin ○ Thigh with skin and bone	○	○	$ __ . __ __	__	○	○	○	
Pork pepperoni	○Pillar, sliced ○	○	○	$ __ . __ __	__	○	○	○	
Pork tenderloin	○	○	○	$ __ . __ __	__	○	○	○	
Soy patty	○Yves, 4 piece, 300gr ○Sol ○	○	○	$ __ . __ __	__	○	○	○	

Measure #5 Dairy

Item	Specification	Available Yes	Available No	Price	Unit #	Unit pc	Unit kg	Unit lb	Comment
Medium cheddar cheese	○ Black diamond, 450gr block ○CrackerBarrel,460 gr block ○	○	○	$ __ . __ __	__	○	○	○	
Milk (1%)	○ Neilson 2L ○ Sealtest 2L ○ Beatrice 2L ○	○	○	$ __ . __ __	__	○	○	○	
Butter	○Lactancia, 454gr ○	○	○	$ __ . __ __	__	○	○	○	
Margarine	○Becel, 454 gr ○	○	○	$ __ . __ __	__	○	○	○	

Measure #6 Egg

Item	Specification	Available Yes	Available No	Price	Unit #	Unit pc	Unit kg	Unit lb	Comment
Eggs (dozen)	○Gray Ridge, Large white ○	○	○	$ __ . __ __	__	○	○	○	

Measure #7 Canned fruits and vegetables

Item	Specification	Available Yes	Available No	Price	Unit #	Unit pc	Unit ml	Unit kg	Unit lb	Comment
Snap bean	○Green Giant, 398ml ○ Del Monte, 398 ml ○	○	○	$ __ . __ __	__	○	○	○	○	
Green olives	○ Unico jar, sliced pizza, 375 ml ○	○	○	$ __ . __ __	__	○	○	○	○	
Crushed tomatoes	○Aylmer, 796 ml ○Unico, 796 ml ○	○	○	$ __ . __ __	__	○	○	○	○	
Canned whole tomatoes	○Aylmer,796 ml ○Unico, 796 ml ○	○	○	$ __ . __ __	__	○	○	○	○	
Tomato sauce	○ Prego, 375 ml ○Primo, 375 ml ○	○	○	$ __ . __ __	__	○	○	○	○	

Measure #8 Frozen fruits and vegetables

Item	Specification	Available Yes	Available No	Price	Unit #	Unit pc	Unit kg	Unit lb	Comment
Frozen beans	○Green Giant, 750gr ○	○	○	$ __ . __ __	__	○	○	○	
Frozen peas	○Green Giant, 750gr ○	○	○	$ __ . __ __	__	○	○	○	
Mixed vegetables (carrots, corns, green beans & peas)	○Green Giant, 750gr ○	○	○	$ __ . __ __	__	○	○	○	

Measure #9 Fish

Item	Specification	Available Yes	Available No	Price	Unit #	Unit pc	Unit kg	Unit lb	Comment
Canned Tuna - Flaked light canned tuna in oil	○Cloverleaf, 170 gr ○Unico, 198 gr ○	○	○	$ __ . __ __	__	○	○	○	
Canned salmon – Pink Salmon	○Cloverleaf, 213 gr ○	○	○	$ __ . __ __	__	○	○	○	

Measure #10 Cereal and other grains

Item	Specification	Available Yes	Available No	Price	Unit #	Unit pc	Unit kg	Unit lb	Comment
Plain Cheerios	○ Box, 400 gr ○	○	○	$ __ . __ __	__	○	○	○	
Quick oats	○ Quaker, 360 gr – 12 pack ○	○	○	$ __ . __ __	__	○	○	○	
Oat	○Quaker large flake oats, 1kg ○	○	○	$ __ . __ __	__	○	○	○	
White rice	○ Unico, 750 gr ○	○	○	$ __ . __ __	__	○	○	○	
Red lentils	○Nu Pak, 900 gr ○Quik kook, 900 gr ○ Cedar, 907 gr ○Suraj, 900 gr ○	○	○	$ __ . __ __	__	○	○	○	
Yellow split peas	○Nu Pak, 900 gr ○Quik kook, 900 gr ○ Cedar, 907 gr ○Suraj, 900 gr ○	○	○	$ __ . __ __	__	○	○	○	

Measure #11 Seeds and Nuts

Item	Specification	Available Yes	Available No	Price	Unit #	Unit pc	Unit kg	Unit lb	Comment
Cashew Nuts (Dry roasted)	○ Planters, 225 gr ○	○	○	$ __ . __ __	__	○	○	○	
Almonds (Oil roasted)	○ Planters, 275 gr ○	○	○	$ __ . __ __	__	○	○	○	
Peanuts (Dry roasted)	○ Planters, 600 gr ○	○	○	$ __ . __ __	__	○	○	○	
Peanuts (Roasted)	○ Planters, 300 gr ○	○	○	$ __ . __ __	__	○	○	○	

Measure #12 Pasta

Item	Specification	Available Yes	Available No	Price	Unit #	Unit pc	Unit kg	Unit lb	Comment
Enriched spaghetti	○Unico, 500 gr ○Barilla, 454 gr ○	○	○	$ __ . __ __	__	○	○	○	

Measure #13 Snacks

Item	Specification	Available Yes	Available No	Price	Unit #	Unit pc	Unit kg	Unit lb	Comment
Potato chips	○Lays classic, 180 gr ○	○	○	$ __ . __ __	__	○	○	○	
Granola bar	○Nature Valley, sweet &salty,5 pack ○	○	○	$ __ . __ __	__	○	○	○	

Measure #14 Beverage

Item	Specification	Available Yes	Available No	Price	Unit #	Unit pc	Unit ml	Unit kg	Unit lb	Comment
Apple juice	○100% - SunRype, 1.98 L ○	○	○	$ __ . __ __	__	○	○	○	○	
Grape juice	○100% - SunRype, 1.98 L ○	○	○	$ __ . __ __	__	○	○	○	○	
Orange juice	○100% -Chilled ,Tropicana, 1.65 L ○	○	○	$ __ . __ __	__	○	○	○	○	
Orange drink	○100% - SunRype, 1.98 L ○	○	○	$ __ . __ __	__	○	○	○	○	
Tomato juice	○V8 - Regular ○	○	○	$ __ . __ __	__	○	○	○	○	
Carbonated drinks	○Regular Coke, 12 pack ○Regular Pepsi, 12 pack ○	○	○	$ __ . __ __	__	○	○	○	○	
Brewed coffee	○Maxwell house original roast, 200 gr ○	○	○	$ __ . __ __	__	○	○	○	○	
Instant coffee	○Nescafe Rich / classic, 100 gr ○	○	○	$ __ . __ __	__	○	○	○	○	
Brewed tea	○Tetley – earl grey, 48 bags ○Red Rose ○	○	○	$ __ . __ __	__	○	○	○	○	

Measure #15 Bakery goods

Item	Specification	Available Yes	Available No	Price	Unit #	Unit pc	Unit kg	Unit lb	Comment
Unbleached wheat flour	○Robinhood, 1kg bag ○	○	○	$ __ . __ __	__	○	○	○	
Almonds (Dried)	○	○	○	$ __ . __ __	__	○	○	○	
Walnuts (Dried)	○	○	○	$ __ . __ __	__	○	○	○	
Granulated sugar	○ Red path, 1kg ○Lantic, 1kg ○	○	○	$ __ . __ __	__	○	○	○	

Measure #16 Herbs and spices

Item	Specification	Available Yes	Available No	Price	Unit #	Unit pc	Unit kg	Unit lb	Comment
Salt	○Windsor, 1kg ○Sifto, 1kg ○	○	○	$ __ . __ __	__	○	○	○	

Measure #17 Fat and oil

Item	Specification	Available Yes	Available No	Price	Unit #	Unit pc	Unit ml	Unit kg	Unit lb	Comment
Olive oil	○Gallo, 1L ○Bertolli, 1L ○	○	○	$ __ . __ __	__	○	○	○	○	
Canola oil	○Gallo, 1L ○Mazola, 1L ○	○	○	$ __ . __ __	__	○	○	○	○	

Measure #18 Sweets

Item	Specification	Available Yes	Available No	Price	Unit #	Unit pc	Unit ml	Unit kg	Unit lb	Comment
Apple butter	○Wellesley ○	○	○	$ __ . __ __	__	○	○	○	○	
Almond Butter	○ ○	○	○	$ __ . __ __	__	○	○	○	○	
Strawberry jam	○Smucker's, 250 ml ○	○	○	$ __ . __ __	__	○	○	○	○	
Peanut Butter	○Kraft, smooth, 500 gr ○	○	○	$ __ . __ __	__	○	○	○	○	

Comments Sheet

Measure	Comments

Appendix E. Survey Protocol

Survey Instructions

These measures are designed to price a sustainable food basket for different dietary patterns and assess its affordability.

Instructions

The basic principle of these measures is to gather information on prices of items across stores and types of food, so when possible, rate items within the same brand or exactly as specified.

Time

1. Complete grocery store measures between 9 am and 4 pm. (This helps to ensure that items have been stocked for the day and are not sold out.)

Availability

1. Before recording any information, first look for the preferred brand or instructed item
2. If not available look for the cheapest alternate.
3. If an item is sold out, write "sold out" in the Comments section and record any available information. Continue down the list until an item is available or the list has been exhausted

Pricing

1. If price is not available, ask an employee at the cash register or at customer service. Wait until all of the measures have been completed before asking the price of the items that are needed. There may be exceptions to this (i.e., you are in the produce section and there is no price shown but an employee is working there), so use your judgment.
2. Do not use a sale price unless it is the only price posted and write "sale price" in comments.
3. Do not use club card/loyalty card prices unless specifically noted. If used, record both prices if possible

Preparation

At the top of each page, fill in the following:

- Rater ID
- Store ID
- Type of grocery store:

1. **D** - Discount grocery stores include Food Basics, No Frills, FreshCo, Giant Tiger, Walmart and other stores that heavily market the low prices.
2. **R** - Regular grocery stores include: Loblaws, Metro, Sobeys, and other grocery stores that do not appear to be "discount stores".
3. **E** - Ethnic grocery stores include: T&T and any other store that caters to a specific ethnic or cultural group (often signs are written in English as well as another language)
4. **F** – farmers markets or daily local markets
5. **O** - Other grocery stores include: Any grocery store that does not fit in one of the other categories

- ❖ Record whether the store is a chain **(C)** or independently owned **(I)**.
- ❖ Date
- ❖ Start time (when you enter the store)
- ❖ End time (when you have finished the measures and reviewed them for completeness)

General guidelines

1. Look for the brand indicated in either the protocol or the survey list. If not available choose the alternate suggested brands
2. If the indicated brands are not available, look for the cheapest brand. When two or more brands have the same price, choose the one with the most shelf space.
3. Make sure the name of any alternate brand is recorded in the comments section.
4. When a specific size is indicated, record the price of the pack not price per gr or ml.
5. If the indicated size is no available or no size is indicated, record the price of the smallest package available.
6. Choose items with their regular price; if an item is on sale calculate the regular price and mention x% sale in the comments section.
7. Only if the exact indicated brand and size is available, mark **"yes"** for availability; if not mark **"no"**.
8. If no specific brand is indicated mark **"no"** for availability.
9. If only a brand name is indicated make sure to record the weight in comments section.
10. If no specific brand is indicated, choose the one with the lowest price and the most shelf space.

Measure #1 Fruit

1. Find the produce department in the store.
2. Look for the fruit listed. If it is **available**, mark the bubble next to it.
3. If it is not available and there is a line below it for an alternate item, look for the <u>cheapest</u> similar alternate. Write it down and mark the bubble next to it. For example,

if there are no Red delicious apples and Gala apples are the cheapest alternate, write "Gala" on the line below "Red delicious".

4. If the fruit or alternate is available, mark "yes". If it is not available, mark "no". If the item is sold out, write "sold out" in comments and record the available information.
   - ❖ If the fruit is only available as pre-sliced and in a container, still mark "yes" for available and write "pre-cut in container" and any size information in comments.
   - ❖ If the fruit is available but mixed with other fruit in a container, mark "no" for available but note the fruit cup contents, price and size in comments.
5. Record the regular **price** of the fruit. If it is on sale and the regular price is not posted, see if it can be calculated based on the sale price label (i.e., add the sales price and the "you save" price) and record it. If the regular price cannot to be calculated based on the sale price label, just record the sale price.
   - ❖ Always choose the price per kilogram if there is an option.
6. Write the **quantity (#)** of the fruit that is listed **for the price**. For example, if the sign says 2 for $1.00, write "2" for the quantity. If the sign says 3 lbs for 99¢, write "3" for the quantity.
   - ❖ If the fruit is not loose but packaged (e.g., pint or container), count the quantity as "1" and write the quantity of the package in comments.
7. Indicate if the price of the fruit is calculated by the piece or Kilogram by marking "pc" or "kg". For example, if the sign says 2 for $1.00, mark "pc" for piece. If the sign says $1.00/kg mark "kg" for kilogram
   - ❖ If packaging is other than pc/kg (e.g., per pint or bunch), mark "pc" and note under comments.

Measure #2 Vegetables and Legumes

1. Find the produce department in the store.
2. Look for the vegetables listed. If it is **available**, mark the bubble next to it.
3. If it is not available and there is a line below it for an alternate item, look for a similar alternate. Write it down and mark the bubble next to it. For example, if there are no 2 lb bags of <u>whole</u> carrots but there are 1 lb bags, write "1 lb bag" on the line below "2 lb bag".
   - ❖ For carrots, look for whole carrots. Only select baby or precut carrots as a <u>last</u> resort and make a note in comments.
   - ❖ For tomatoes, look for the loose field tomatoes (regular size) first. If not available, look for alternate loose tomatoes. Choose tomatoes on the vine or cherry tomatoes as a <u>last</u> resort and make a note in comments.

4. If the vegetable or alternate is available, mark “yes”. If it is not available, mark “no”. If the item is sold out, write “sold out” in comments and record the available information.
5. Record the regular **price** of the vegetable. If it is on sale and the regular price is not posted, see if it can be calculated based on the sale price label (i.e., add the sales price and the “you save” price) and record it. If the regular price cannot to be calculated based on the sale price label, just record the sale price.
   - ❖ If the vegetable is not specifically listed as packaged (e.g., okra or bok choy) but is sold as packaged or loose, record the price of the one that is cheapest.
6. Write the **quantity (#)** of the item that is listed **for the price**. For example, if the sign says 2 for $1.00, write “2” for the quantity. If the sign says $1.00/kg write “1” for the quantity.
   - ❖ If the item is sold by the package (e.g., corn), count the quantity as “1” and write the number of the item included in the package in comments (e.g., 3 in package).
   - ❖ Always choose the price per kilogram if there is an option.
7. Indicate if the price of the item is by the piece or pound by marking “pc” or “lb”. For example, if the sign says 2 for $1.00, mark “pc” for piece. If the sign says $1.00/kg, mark “kg” for kilogram.
   - ❖ If packaging is other than pc/lb (e.g., per pint or bunch), mark “pc” and note in comments.
   - ❖ If an item is packaged and its size is listed in pounds, mark “lb” for kilogram.

Measure #3 Bread

1. Find the bread aisle in the store.
2. If Wonderbread 100% whole wheat bread is available mark "yes".
3. Record the **loaf size** in grams and **price** of the loaf. (mark one piece in survey sheets and record the weight of the loaf in comments.)
4. If Wonderbread is not available, look for Dempsters 100% Whole Wheat Bread. If that is available, mark “yes” and record the size and price.
5. If Dempsters is not available, mark “no” and choose the brand with the lowest price and most shelf space. If there is equal shelf space for different brands, select the one that has a brand name closest to the beginning of the alphabet (e.g., Colonial instead of Sunbeam).
6. Write its name, size and price.
7. Repeat steps 2-6 for white toast.

Measure #4 Meat

1. Find the fresh meat case in the store.
2. Most stores sell only their own ground beef. If there is meat with a brand name, choose the store brand first.
3. Preferably, locate the lean ground beef with ≤ 17 % fat, it should be labeled **Lean**. If **available**, mark yes. Choose the package of lean ground beef closest to 500 grams. Record the **prices per kg** listed and **not** the actual price of the package of meat (i.e., the label should have a price/kg and price. Record the price/kg.). Mark "N/A" for the alternate items.
4. If no lean ground beef with ≤ 17% fat is available, mark "no" and look for lean ground beef with ≤ 10% fat usually marked extra-lean. If available, write in the % fat (e.g., 7), mark "yes" and record the price per kg listed. Mark "N/A" for the remaining alternate item.
5. If no lean or extra-lean ground beef is available, look for other ground beef choices. Record details (e.g., regular ground beef) in the comments.

For Tofu and Soy patty:

1. Locate the vegetarian section.
2. Choose the smallest size possible for each item. Record the weight in comments section.
3. Record the price
4. If soy patty is not available record the price of an alternative vegetarian patty.

Measure # 5 Dairy

Milk Definitions

- Partly Skimmed: 1% fat

For Milk:

1. In the milk aisle, look for Neilsen, Beatrice OR Sealtest as they are the most common brands. If **available**, record which brand has the most shelf space. Use this brand for all price data.

2. If these brands are unavailable, mark "no" and look for the brand with the most shelf space. If there is equal shelf space for different brands, select the one that has a brand name closest to the beginning of the alphabet. Write the name of the brand in the space provided. This brand is now the reference brand for this measure since the preferred was not available.
3. Using the reference brand, look for partly skimmed milk. If **not available**, look for skimmed milk (0% fat) or whole milk. Make sure to record the fat content.
4. Record the **price** of 1L carton of whole milk of the reference brand.
   - ❖ If the reference brand does not have milk available in the 1L carton size, select another brand similar in price and write its name in comments.

For Butter and Margarine:

1. Find the butter section of the store.

2. Locate the Becel margarine.
3. Choose the smallest size possible. Record the weight in comments section.
4. Record the price
5. Repeat the previous steps for unsalted Lactancia butter.

Measure #6 Egg

1. Find the eggs section of the store. Look for the products listed.
2. Locate the pack of Gray Ridge large white 12 eggs.
3. If a 12 pack is not available, choose the smallest package available.
4. If possible weight 3 or 4 eggs to calculate the average weight of an egg. If not possible record the weight on the box.

Measure #7 Canned fruit and vegetables

1. Find the canned fruit/ vegetables section of the store. Look for the products listed.

2. If the listed product is not available look for an alternate brand of the same fruit/ vegetable. Look for the cheapest alternate brand. Look for the cheapest alternate brand. Mark the "other" bubble and write down the brand name.

3. If the listed canned fruit or alternate is available, mark "yes". If not available mark "no". If the item is sold out, write "sold out" in comments and record the available information.

4. Record the regular price of the canned fruit. If it is on sale and the regular price is not posted, see if it can be calculated based on the sale price label (i.e., add the sale price and the "you save" price) and record it. If the regular price cannot be calculated based on the sale price just record the sale price and note it in the comment section.

5. Record the net weight of each can.

Measure #8 Frozen Fruits and Vegetables

1. Find the frozen vegetables section of the store.
2. Locate the 750 gr pack of frozen peas.
3. If the indicated size or brand is not available, look for the smallest pack available from the same brand or the cheapest brand with the most shelf space.
4. Record the price.

5. Repeat the previous steps for frozen beans and mixed vegetables (carrot, corn, green peas and beans).

Measure #9 Fish

1. Find the canned fish section of the store.
2. Locate Clover leaf flaked light canned tuna in oil.
3. Record the price of one can, if Clover Leaf was not available, look for the cheapest available brand with the most shelf space.
4. Make sure to record the net weight of one can in comments.
5. Repeat the same steps for Clover leaf canned pink salmon in oil.

Measure #10 Cereal and other grains

For Cereal:

1. Look for plain Cheerios.
2. Record the **smallest size** box of Cheerios available in grams listed on the bottom front of the box.
3. Record the **price**.
4. If they are not available, look for an alternate. Write its name, marking "yes" under available and follow steps 3-4 for size and price.

For Quick Oat:

1. Look for Quaker quick oat and normal oat.
2. Record the **smallest size** box available in grams listed on the bottom front of the box.
3. Record the **price**.
4. If they are not available, look for an alternate. Write its name, marking "yes" under available and follow steps 3-4 for size and price.

For Oat:

1. Look for the 1kg pack of Quaker oats, not the small packages in one box.
2. Record the **price**.

For Rice:

1. Look for long grain white rice.
2. Record the **smallest size** box available in grams listed on the bottom front of the box.
3. Record the **price**.

For Lentil, beans and split peas:

1. Record the **smallest size** available in grams listed on the packaging.

2. Record the **price**.

Measure # 11 Seeds and Nuts

1. Look for the seeds and nuts section of the store.
2. Look for the different types of nuts indicated in the tool. Make sure to select the correct type of roast or dried nut.
3. Find the **smallest size** box available in grams listed on the bottom front of the box.
4. Record the **price**.
5. If they are not available, look for an alternate. Write its name, marking "yes" under available and follow steps 3-4 for size and price

Measure #12 Pasta

1. Look for Unico spaghetti.
2. Record the **smallest size** box available in grams listed on the bottom front of the box.
3. Record the **price**.
4. If they are not available, look for an alternate.

Measure #13 Snacks

1. For **grocery stores**, go to the MAIN chips/snacks aisle.
2. Locate Lays® Potato Chips Classic and mark the 180 g size if **available.** (Do not choose chips that come in multi-packs). If the 180 g size is not available, mark "other" and write the size that is available.
3. If Lays® Potato Chips Classic is not available, mark "no" and look for an alternate classic chips item that is 180g. If the 180 g size is not available, mark "other" and write the size that is available.
4. Record the **price** of the Baked Lays® or the alternate item.

For Granola Bar:

1. Locate the 5 pack of sweet& salty Nature Valley granola bars.
2. If not available look for another type of granola bars from the same brand.
3. If Nature Valley was not available, look for sweet & salty granola bars from the brand with the cheapest price and the most shelf space
4. Record the price.

Measure #14 Beverage

Beverage Definitions

a. Diet soda - 0 kcal
b. Sugared soda – Regular
c. 100% juice – Natural fruit juice with no added sugars. Container must say 100% fruit juice on label.
d. Juice drink/beverage – Fruit juice with added sugar and water

For fruit/ vegetable juice, and soda:

1. Find the shelf-stable beverage section of the store.
2. Locate the 12 pack of regular can/ bottle size (330 ml). If not available choose the smallest size.
3. Look for the diet soda. If not available choose the regular.
4. Repeat the previous steps for fruit/ vegetable juice.
5. For the juices look for 100% natural juice. If not available choose the closest option.
6. For Orange drink look for 100% chilled Tropicana 1.65 L.

For Tea:

1. Find the tea section of the store.
2. Locate the Tetley tea bag, original black tea. Choose the 48 tea bags package .
3. If Tetley is not available, look for Red Rose or Lipton.
4. Record the price

For Coffee:

1. Find the Coffee section of the store.
2. Locate the Nescafe instant coffee. Choose the 100 gr jar.
3. Record the price.
4. Repeat the previous step for Maxwell house original roast brewed coffee. Choose the 200 gr pack.

Measure #15 Baking Goods

For Flour:

1. Find the flour section of the store.
2. Locate the Red Rosses wheat flour and choose the 1 kg size.
3. If the indicated size is not available choose the smallest size possible. Record the weight in comments section.
4. Record the price.

For Sugar:

1. Locate the 1kg granulated sugar.
2. If the indicated size is not available choose the smallest size possible. Record the weight in comments section.
3. Record the price.

For Nuts:

1. Look for the dried almonds and walnuts.
2. Find the **smallest size** pack available in grams listed on the bottom front of the box.
3. Record the **price**.

Measure #16 Herbs and spies

1. Find the Spices section of the store.
2. Locate the salt and choose the 1 kg size.
3. If the indicated size is not available choose the smallest size possible. Record the weight in comments section.
4. Record the price.

Measure #17 Fat and oil

For oil:

1. Find the Oil section of the store.
2. Locate 1L Gallo olive oil.
3. If the indicated size is not available choose the smallest size possible. Record the weight in comments section.
4. Record the price.
5. Repeat the previous steps for 1L Gallo Canola oil.

Measure #18 Sweets

For Jam:

1. Find the Jam section of the store.
2. Locate the Smucker's strawberry jam. Choose the 250 ml jar.

3. If the indicated size is not available choose the smallest size possible (not the single portion jars). Record the weight in comments section.

4. Record the price.

For Fruit Butter:

1. Locate the Wellesley apple butter.
2. If the indicated size is not available choose the smallest size possible. Record the weight in comments section.
3. Record the price

Appendix F. Food basket prices

	Vegan	Vegetarian	Pescetarian	No red meat	No beef	No pork	Omnivore
South	10,530.46	11,541.47	11,259.34	11,657.31	10,698.01	11,788.39	10,638.74
North	10,204.44	11,298.55	10,666.07	11,205.24	11,226.73	11,289.31	9,589.71
Urban	10,180.27	11,431.74	11,193.94	11,527.99	10,981.13	11,625.15	9,598.56
Rural	10,554.63	11,408.27	10,731.47	11,334.56	10,943.61	11,452.55	10,629.89
Regular	11,382.58	13,126.29	12,926.30	13,016.91	13,029.36	13,128.07	11,021.51
Discount	9,891.53	10,909.12	10,253.22	10,838.86	10,857.77	10,946.09	9,428.64
North/HPD	9,983.76	11,267.18	10,765.55	11,180.55	11,224.95	11,266.10	9,386.65
North/LPD	10,425.12	11,329.91	10,566.59	11,229.93	11,228.50	11,312.52	9,792.77
South/HPD	10,376.79	11,596.30	11,622.34	11,875.42	10,737.31	11,984.20	9,810.47
South/LPD	10,684.13	11,486.64	10,896.35	11,439.20	10,658.71	11,592.57	11,467.01
North/Regular	11,472.78	12,876.20	12,408.06	12,783.83	12,798.97	12,900.81	10,703.40
North/Discount	9,564.48	10,596.51	9,943.51	10,501.22	10,530.00	10,578.26	9,060.24
South/Regular	11,312.43	13,320.80	13,329.37	13,198.18	13,208.56	13,304.82	11,268.93
South/Discount	10,182.24	11,186.99	10,528.52	11,139.00	11,149.11	11,273.05	9,756.11
North/HPD/Regular	11,572.68	13,289.36	12,971.37	13,177.76	13,222.68	13,324.87	10,648.70
North/HPD/Discount	9,302.91	10,388.74	9,815.02	10,317.03	10,360.06	10,379.43	8,801.01
North/LPD/Regular	11,926.72	13,375.12	13,162.51	13,320.83	13,340.73	13,526.79	11,210.57
North/LPD/Discount	9,900.79	10,863.65	10,108.70	10,738.03	10,748.50	10,833.89	9,393.54
South/HPD/Regular	11,235.64	13,314.02	13,350.23	13,182.85	13,192.04	13,277.08	11,276.22
South/HPD/Discount	9,780.70	10,970.35	10,296.14	10,909.76	10,920.99	11,033.49	8,523.85
South/LPD/Regular	11,339.57	12,325.32	11,656.99	12,258.61	12,234.03	12,335.40	10,776.34
South/LPD/Discount	10,684.18	11,457.79	10,818.99	11,425.54	11,434.27	11,572.49	11,296.42
Price Index	7,521.18	7,986.17	7,450.66	7,993.82	7,999.95	8,079.41	8,089.55

Appendix G. Letter

UNIVERSITY OF WATERLOO
SCHOOL OF ENVIRONMENT, ENTERPRISE AND DEVELOPMENT (SEED)
200 University Avenue West, Waterloo, ON, Canada N2L 3G1
519-888-4567, ext. 38540 | seed.uwaterloo.ca

August 8, 2017

Dear Manager:

Ms. Sadaf Mollaei is a Masters student in the Sustainability Management Program at the University of Waterloo. My colleague, Prof. Leia Minaker, and myself, are supervising her thesis project entitled "Is a healthy and sustainable diet affordable? A comparison between urban and rural areas in Ontario."

She is currently carrying out her field research at a range of grocery stores, where she will be taking note of prices for commonly consumed foods in Ontario. We appreciate your cooperation in allowing her to do this.

Should you have any questions or concerns, please don't hesitate to contact me.

Sincerely,

Goretty Dias, Ph.D.
gdias@uwaterloo.ca
519-888-4567 x38571
Assistant Professor
School of Environment, Enterprise and Development
University of Waterloo

Glossary

Food security: When all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (Ericksen, 2007).

Healthy food: Healthy food can be defined as a food with the right intervals of calories among the macronutrients (50-55% carbohydrates, 12-15% proteins and 30-35% fat). Simultaneously, some micronutrients should be encouraged (vitamin A, vitamin C, vitamin D, calcium, iron, magnesium, etc.) while others should be limited (sodium, saturated fat, etc.) (Drewnowski, 2009)

Sustainable food: According to FAO the definition of a sustainable diet is "those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources (FAO, 2010).

Dietary pattern: A dietary pattern could be defined as a system that appears simplistic at first but is in fact very complex. According to a model presented by Jill Reedy (2017), this system includes the pattern itself, its causes (drivers) and its effects (consequences) (Reedy et al., 2017).

Food basket: The food basket is a set of food items representing typical food intake on a weekly, monthly or annual basis. It is another common method to reflect food consumption. It can also be used as a unit to express the composition of various diets and food choices (Friel et al., 2014; Pretty, Ball, Lang, & Morison, 2005; Tukker et al., 2010).

Nutritious Food Basket: Nutritious food basket (NFB) is a survey tool that is a measure of cost of basic healthy eating that represents current recommendations and average food purchasing patterns (Hubay et al., 2010).

Revised Northern Food Basket: The Revised Northern Food Basket (RNFB) is a survey tool created by Indigenous and Northern Affairs Canada, in consultation with Health Canada, to monitor the cost of food in remote northern communities. The RNFB is also based on

average overall consumption for a sample population and contains 67 items (as revised in 2008) and their purchase sizes (Tarasuk et al., 2016).

Affordability: the purchasing power of households or communities relative to the price of food. The determinants of affordability include pricing policies and mechanisms, seasonal and geographical variations in price, local prices relative to external prices, and the form in which households are paid, income, and wealth levels (Ericksen, 2007)

Availability: Food availability refers to the amount, type and quality of food a unit has at its disposal to consume (Ericksen, 2007).

Access: Access is determined by how well people can convert their various financial, political, and other assets into food, whether produced or purchased. Access to food refers to the ability of a unit to obtain access to the type, quality, and quantity of food it requires. (Ericksen, 2007).

Food environment: The food environment which is thought of as all the foods which are available and accessible to people in the settings in which they go about their daily lives (FAO, 2016).