Alternative vs. conventional food networks: A geospatial analysis in relation to neighborhood sociodemographic characteristics in Montreal

By

Matthew Cheveley

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Department of Geography
McGill University
Montréal (Québec) Canada
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Thesis Abstract

There has been growing interest in 'alternative' food systems in North America over the past couple decades, coinciding in part with concerns over increased distancing between food producers and consumers as well as scepticism over the 'conventional' food system. This interest has led to the expansion of alternative food networks (AFNs), which aim to connect farmers and consumers while increasing the ties in the local community. While the expansion and popularity of these networks is clear, their role in the urban food environment remains understudied. In this study, I aim to address this gap by examining the distribution of different types of food sources in Montreal, including how equitable the availability of AFNs is across neighborhoods with different sociodemographic characteristics. Specifically, I categorised an existing spatial database of food businesses and organizations based on a 'food network' typology, then compared it to a multivariate classification of neighborhoods (census tracts) based on key sociodemographic characteristics by using the '*k*-means' method. I then overlay the food network categories with the census tract clusters in order to explore their distribution based on sociodemographic attributes (i.e., prevalence of low-income households, population density, prevalence of recent immigrants). While a vast literature has considered social and economic aspects of urban food environments at increasingly fine scales, to my knowledge, none have compared the distribution of different food networks at a city-wide scale. My findings show some distinct patterns in the types of food sources occurring in certain neighborhoods in Montreal, offering a basis for further research to investigate the role of different types of 'alternative' food provision and their impacts within the food environments at the city-wide scale.

Chapter 1: Introduction

Alternative food networks (AFNs) have gained popularity as advocates try to develop social change within food provisioning by moving away from conventional food networks that are increasingly shaped by globalization and corporate interests (Goodman, 2012). This movement developed at least in part due to the increased distancing of food production from the consumer. This distancing along with conventional food provisioning (e.g., large supermarkets) has led to consumers turning to their communities and looking for ways to shorten the food supply chain (Renting, 2003). The development of AFNs has been further aided by the localisation of policymaking within city councils who, to support the local area and help food insecurity, have pushed for AFNs and helped fund certain initiatives (Matacena, 2016). This has led to a rapid growth in the size, variety, and number of AFNs to the point that they are now starting to become a significant part of certain urban food consumption. However, the growing number of different AFNs has led scholars to become sceptical of their positive claims of sustainability, increased social inclusion, health, and benefits to the local economy; this has led to claims for a finite definition of AFNs and more research to be done into this growing sector of our food supply (Forssell, 2014; Johnston et. al, 2009).

Another aspect of the broader food systems literature addresses the growing variety of food supply and distribution channels in food environments, including access to food by consumers. This area of focus on 'food environments' has become prominent especially in the health geography literature in recent years. For example, many scholars are trying to link the access of food and the variety of food within a person's food environment to their diet (Lucan, 2015; French 2001; Walker 2010). This research has further led to research comparing the socioeconomic situation of a neighborhood with the food environment of the neighborhood (McInerney, 2016). This emphasis on one's food environment links to the AFN movement as consumers are becoming much more aware of their food choices and its origins. This awareness of our food sources has led scholars from looking at access to all food types more generally to now looking at access to foods with certain attributes, such as local and organic food (Jarosz, 2008). It is at this point that AFNs play a large role, as they generally focus more on local and organic food and are therefore likely to be a key source of these in urban food environments. However, research into the different types of AFNs and the

sociodemographic nature of the urban food environments in which they are located has been minimal.

1.1: Research Aim and Questions

The literature surrounding alternative food networks has focused mainly on specific types of AFNs within cities, while the literature on food environments has been primarily health- and nutrition-focused with less emphasis on spatial patterns at the city-scale. Therefore, my research aim in this thesis is to gain an understanding of the potential access to alternative food networks within the broader urban food environment by using an analysis of the Island of Montreal in Quebec, Canada. My research questions are:

1. What are the patterns of food distribution hubs throughout Montreal and are they equitable across neighborhoods with different sociodemographic characteristics?

2. What sociodemographic factors affect potential access and proximity to locally produced foods in particular?

3. Do different types of alternative food network distribution hubs tend to locate in neighborhoods with specific sociodemographic characteristics?

1.2: Significance of Research

When looking through the previous literature surrounding AFNs, I found that there was more of a focus on a few specific types of AFNs (e.g., farmers' markets, urban gardens) rather than a comparison of all the different food sources within a city. Past studies also tend to focus on case studies of the AFNs themselves rather than the potential impact within a local community, including the sociodemographic characteristics of the populations that might benefit from alternative food provisioning. The literature on AFNs has also been critiqued for taking their benefits for granted and having a too narrow definition for the growing variety of AFNs, such as large-scale urban farms (Johnston et. al, 2009). My research therefore attempts to gain a broad understanding of which populations are able to interact with different AFNs based on their distribution and proximity in the same neighborhood. Another aspect of this research is to study the differences between presence of local foods throughout different sociodemographic neighborhoods in the city compared to conventional foods. I provide an initial assessment of the role AFNs might play in food environments throughout the city,

which is pertinent to informing issues such as the incidence of ‘local food deserts’ or food insecurity more broadly.

1.3: Thesis Structure

In chapter 2 of this thesis, I explore the conceptual framework behind my research. This involves a summary and critique of the relevant literatures regarding three themes: *food environments*, *alternative food networks*, and *access to local foods*. Chapter 3 contains as outline of the methodology used in this study and discusses the different visualizations and statistical tools used for the analysis, as well as their limitations. Chapters 4-6 provide further context and the results of my analysis. Chapter 4 provides details about food network categorisations, and the rationale for choosing each category; I then outline the results of this. Chapter 5 then steps through my decision-making process for selecting the census variables and clustering method for the sociodemographic analysis before showing the results of the clusters. Chapter 6 is the final results chapter and describes the results of overlaying the food distribution points with the census clusters. The final chapter of this thesis synthesizes the results and discusses potential future areas of research that can be conducted.

Chapter 2: Conceptual Framework

To contextualize the socioeconomic nature of food distribution hubs across Montreal, I developed a conceptual framework that enables the comparing and contrasting of different types of alternative and local food networks, and the socioeconomic distribution of their distribution hubs within Montreal. Therefore, the conceptual framework is built upon three areas: *alternative food networks*, *food environments*, and *access to food*. The literature upon AFNs offers insight into the nuances of how they are defined (and its flaws), as well as the place of AFNs within the urban food system as a whole. The next section regards food environments where the current focus of the literature, which is mainly drawn from the field of health geography, will be examined before being critiqued. The last section of the conceptual framework examines access to local foods which is a convergence between AFN and food environment literature. All three of these areas together will provide an overall picture of how AFNs and the urban food environment are interlinked and the need to examine the cross-section between them.

2.1: Alternative food networks

Alternative food networks (AFNs) are defined as 'alternatives to the more standardised industrial modes of food supply' (Renting et al. 2003: Pg. 394). Their primary role is to create a shortened food chain that brings the consumer and producer closer together (Thorsoe, 2015). They began to emerge with the growing globalisation of agricultural economies in the late 1900s. The emergence of these new networks can be attributed to not only consumer opinions but also increasing pressure on farm incomes (*ibid.*).

In general, consumer opinions evolved over time due to a string of food scandals such as the addition of bovine spongiform encephalopathy (BSE) to dioxine residues in milk or more recently the horse meat scandal. This led to mistrust in the primary food market (Renting et al. 2003). This mistrust of the global food market led to consumers looking for more local food sources (Marsden et al., 2000). A paper by Thorsoe (2015) demonstrated that AFNs were not about the effectiveness of food production but primarily about the trust formed within the community. This focus on trust in the food and the belief that it is healthy is in my opinion the primary reason for the growth in the alternative food network. This view is backed up in the literature that categorises alternative food networks as 'healthy' (Berti, G. 2016; Michael D et. Al. 2010). However, while the rise in alternative food networks is clear,

what is classified as an alternative food network, and their influence and place within the food system remains unclear.

2.1.1: Where do Alternative food networks currently sit within the food system?

AFN is an umbrella term under which many individual food networks fall. It is used concerning the current food system. However, as you will see what defines an AFN varies from paper to paper. These varying descriptions of AFNs are useful since they usually describe the key goals of these food networks. These descriptions include healthy, shortened supply chain, local, community-based, and sustainable. Once the primary role of AFNs has been identified, a more thorough explanation of these descriptions will be given. The primary role given to AFNs by Thorsoe, (2015) which was to reconfigure the food system to shortened supply chains. This description encompasses the majority of AFNs. However, some papers offer a critique to this definition of AFNs. Johnston et al. (2009) argue that the local/binary distinction is too prominent in AFN literature and that the literature needs to pull away from the automatic assumption of local is good. While this critique holds weight, it is not a reason to disregard the definition, rather this critique looks for more transparency in how the term local is being used. Johnston et al. (2009) find that while the local definition of AFN is used it automatically becomes connected with environmental, health, and sustainability which is not necessarily the case.

The next component of the definition of AFNs deals with the provision of sustainable and healthy food (Matacena. 2016; Bruce, A. 2017). The sustainable nature of these food networks is not surprising due to their growth coming from a lack of trust in the health and sustainability of the current food system (Renting et al. 2003). However, the literature has to be cautious about attributing the broad nature of sustainable practice to AFNs due to their versatile nature. In particular, it should "carefully consider what evidence there actually is about the believed sustainability impacts" (Forssell, 2014: Pg. 73). The large amount of evidence needed to support the literature on this is due to the variety of AFNs. However, Forssell (2014) does conclude that AFNs can play a role in sustainability if their role is correctly defined. This aspect of AFNs helps us to see their importance and room for growth within the food system as sustainability is a constantly growing issue in today's world.

Lastly, certain AFNs are defined as community based. One of the most common community-based AFNs is community-supported agriculture (CSAs). CSAs were first introduced to North America in 1984 and have been expanding since. They started in rural areas where young workers wanted less regimented lives and an increased community spirit

(Adam 2006). There are two primary strains of CSA's: the first being subscription-based which makes up about 75% of CSA's (Adam 2006); the second strain, which has an upscaled network, involves shareholder CSA often run by non-profit organizations or larger farming operations that produce food shares as a way to foster greater community involvement. An example of this in Quebec, Canada, is the Coopérative pour l'agriculture de proximité écologique (CAPÉ), which is related to Equiterre's "Family Farmer Network" (https://www.fermierdefamille.org/en/the-network). This is an organic farmer cooperative that helps farmers organize but it's the farmers themselves who create the CSA baskets. These baskets are made up of seasonal fruit and vegetables and are sent weekly/biweekly to the subscribers. CSA's have been known to have many benefits within a social context. The academic research has primarily examined the socio-economic benefits and seasonality problems surrounding the formation of CSAs (e.g., Cooley & Lass, 1998; Galt, 2013).

Based on combining these three distinct components of CSAs, they are often combined in literature as involving attributes of local, sustainable and healthy food, as well as being community-based. These aspects will differ in nature depending on the AFN we look at; however, these aspects represent the importance of AFNs and the area of the food system which they address. Although while these attributes are important the critical literature (Johnston. 2009; Forssell, 2014), argues that a local food network cannot automatically be assumed to be sustainable and healthy.

2.1.2: Role of AFNs within the food system as a whole

Having established the areas that AFNs address and why they have come about within the food system. There is another large problem that AFNs face within literature which is their size. Cicatiello (2020) claims that AFNs act more as a complementary food network and have a minor role in the food system as a whole. The other side of this claim is that while the food source may only be complimentary it has a large impact on other factors locally. It is shown that buyers will go to AFNs to support the local economy (European Commission, 2012). This shows that AFNs current importance is still on an extremely local scale. Therefore, the location of these AFNs is important to their impact socially and economically. In this thesis, I will analyse whether the presence of alternative food networks within an urban environment and communities is equitable, or whether we see a socioeconomic disparity within community-based alternative food networks. This is an important role as critical scholars have warned about an idealization of AFNs, since in many cases they can mask potential environmental impacts and reproduce social inequalities (Moragues-Faus and Marsden,

2017), for example by creating exclusive landscapes for highly educated and well-off consumers, or concealing exploitative labour conditions (Goodman, 2004; Guthman, 2004). Therefore, considering the geographic distribution of alternative food networks should give us a basic idea of any socioeconomic disparities within the distribution of alternative food networks.

2.1.3: AFNs within the Urban environment

The process of urbanization and rural restructuring is crucial to the development of AFNs (Jarosz, 2008). The literature has found one of the main focuses of AFNs to be the shortening of the food supply chain which has become particularly common within the urban environment. There is a spike in demand for seasonal and organic vegetables that have been grown nearby (*ibid*.). However, this demand is not necessarily equitable and hard to spot. Studies in the literature have found a range of reasons for why certain customers in urban environments turn to AFNs. A study on solidarity purchase groups in Italy found that they were less interested in local food and gave priority to "food healthiness and safety attributes" (Baldi, 2019; pg. 18). These findings confirmed the critiques and worries of Johnston et. Al (2009) that urban consumers have fallen into the possible misconception that local means healthy and sustainable. These findings also align with the idea that the urban consumer has turned to AFNs out of mistrust in the conventional food system (Renting 2003). However, on the other side of this debate, some literature has seen the rise in demand for AFNs within the urban context as gentrification fuelling demand for local organic produce (Jarosz, 2008). This view of demand within the urban context can still align with ideas of health and safety but slightly takes away from the idea of equity within the demand for AFNs. This also goes further to say in a lot of cases the urge for seasonality and local produce within the growing urban area is not necessarily sustainable for the local farmers (Jarosz, 2008). Within this paper, a study was conducted concerning Seattle farmers and it showed that the labour-power and uncertainty of crops each year can make producing a profit difficult for farmers even within CSAs and farmers markets (*ibid*.). It is in this literature that one starts to see that AFNs do not all fit within the community-based sustainable nature that benefits all as is seen in certain literature. There is rather a diversified element to AFNs that is found within all forms of business as society as capitalism creeps into the system and people try to benefit from the growing demand (Van De Ploeg and Renting (2004). This leads to critiques of the literature that the term AFN may not be sufficient to categorize the growing diversity and depth of the expanding sector (Venn et al. 2006).

The next aspect of the urban environment that plays a role in this is the government policy within urban spaces and how that can impact the nature and role of AFNs within the metropolitan area. The rule of regulation and policy has become more important within urban environments as local states reorganize themselves as local and regional partnerships aiming to promote local growth (Jessop, 2002). This movement of development policy to the local scale of cities opens up possibilities for local farmers to connect themselves with municipalities. Food policy councils within cities play a large role in AFNs as networkers, they can help bring together and form new links between farmers and the consumers (Sonnino, 2009). Another role that Urban food policy needs to perform within the non-profit and possibly more disadvantaged nature of AFNs is to build up their political capital (Matacena, 2016). This relates to our earlier example of farmers involved in AFNs in Seattle. There is a need for urban food policy to make sure that these farmers are being protected against farming variances such as disease and bad harvests. This element also factors into the sustainability and food security aspect of urban food policies (Matacena, 2016). However, while there is a key need for them these policies vary from city to city and therefore, require a lot of research to assess their outcomes. This is where a broader and more quantitative analysis can play a role in identifying the potential customer of AFNs and their prominence throughout the city, one can examine questions such as the equitable access to local food within AFNs.

2.2: Food Environments

A food environment is defined as the consumers' food choices and diet produced within a local context (Kelly, 2011). In the urban context, local can range from a borough to a much smaller neighborhood or, areas around your home and work. This thesis concentrates on the local environment as the census tracts throughout Montreal which will be expanded on in the methodology section. The reason food environments were chosen as important literature in this thesis is because they "contain the total scope of options within which consumers make decisions about which foods to acquire and consume" (Downs et. Al, 2020). This leads to the idea that drives a lot of the modern food environment literature, how one's local food options affect one's diet (Lucan, 2015; French 2001; Walker 2010). The literature around food environments strays away from geographic articles we see with alternative food networks and more into health research. Based on my review, the majority of the articles on the food environment were published in health-related journals such as the American journal of preventative medicine, and Health and Place. This differentiation in areas of study is why

there may be a large rift between types of food networks and their impact on the food environment. Instead, the majority of food environment literature revolves around how the availability of healthy compared to unhealthy food affects one's diet. The actual nature of the food network itself is rarely brought up within the context of the food environment, even though it may help to define and categorise individual food networks.

2.2.1: Scope of Food environments

The literature on the food environment often attributes our diet to the surrounding food choices we are presented with each day (Kelly, 2011). These food options have been categorized into different food environments that people are exposed to daily. Earlier in this thesis the scope of a residential food environment versus work and school was defined. However, the literature goes beyond this; for example, Mckinnon et al. (2009) found that food environments can be categorised into food stores, restaurant environments, and work/school food. This is a categorisation of food environments based on the primary consumption areas. They differ as consumers are likely to travel further and therefore, have higher variability although at a higher expense as well when eating at restaurants, compared to work/school where there are usually much faster food options such as vending machines (*ibid.*). This is an important scope to note as this thesis is solely concentrating on the food environment as food stores. This is due to the quantitative nature of my assessment, the literature on work and school food options uses a more qualitative methodology in checklists, questionnaires, and interviews (Lythe, 2017). A quantitative approach involves additional considerations such as need to obtaining information on people's homes and work environments. Therefore, throughout the literature quantitative approaches have been used concerning one's local store environment or restaurant environment.

The final scope of food environments found in the literature is the emergence of food deserts. One of the first uses of the term 'food desert' was in Scotland in the 1990s (Walker, 2010). It has been popularized since then, including in research on food environments. Food deserts have been defined in different ways, including one quantitative definition as "urban areas with 10 or fewer stores and no stores with more than 20 employees" (Hendrickson et al. (2006): Pg. 372). This definition demonstrates the changing definition of what can be a food desert. The term is broadly used to determine areas with limited access to food. It is also often associated with low-income neighborhoods, as the literature primarily concentrates on finding this link between poorer neighborhoods and limited access to food (Cummins and Macintyre, 2002; Gordon-Larsen et al., 2011).

Alternative food networks have crossed over with food environments within the scope of food deserts when we look at more seasonal food networks. In a paper by Widener et al. (2011), it was shown that farmers markets are specifically important for food security in low-income areas of Buffalo, NY. When the farmers markets are in season the average distance from a farmer's market or supermarket dropped below average from well above average in neighborhoods with the most impoverished occupants. This paper adds a new layer to food environments which emphasises the importance of food markets within the context of urban food environments (*ibid.*). This importance is often looked over in favour of looking at larger supermarkets and convenience stores. This demonstrates an importance into looking into not only the total production of alternative food networks but also their distribution throughout the urban food environment.

This background in the literature on the scope of food environments has hopefully shown how large the scope is, and how many different approaches there are to assessing food environments. This literature has resulted in a range of studies both focused on either identifying food vulnerable areas throughout cities or seeing whether the nature of the food sources within an area affect the residents' diet. However, in both of these scenarios they are often looked at from a health perspective, rather than a more theoretical food network perspective.

2.2.2: Socioeconomic disparities in food environments

As mentioned in the previous section food environment literature belongs mainly within the subject of health. However, while maintaining a focus on health and individuals' diets, another common theme throughout the literature is the link between food environments and socioeconomic status (McInerney, 2016). This was touched on a small amount in the section on food deserts and literature associations between food deserts and its connection to poorer neighborhoods (Cummins and Macintyre, 2002). However, the link between socioeconomic analysis and food environments extends beyond a lack of food availability to a difference in food availability around the home. The previous literature has also noted that there is a difference in diet for individual and neighborhood socioeconomic status. Ball (2015) noted that there was difference in diet between socioeconomic neighborhoods independent of the individuals own socioeconomic status. This literature notes the importance and legitimacy of using census data to measure food environments of larger areas as a poor local food environment affects each individual diet independent of their socioeconomic status. While the main focus of socioeconomic status tends to look at income within food environments there is

also literature on other differences such as racial and ethnic differences in diet based on neighborhood (Kong, 2013). This aspect of the literature has guided my thinking to look at a broader range of socioeconomic factors that may play a role within Montreal. One such factor that was investigated was allophone first generation immigrants within Montreal (Girard, 2013). A paper such as this shows the need to look at a variety of socioeconomic variables such as language and immigration status. While a lot of these studies are done at the qualitative levels, I believe quantitative studies help to identify possible issues which can then be investigated through qualitative studies.

A further section of literature also looks at organic foods and their presence within food environments. The literature first started looking at organic AFNs and noted that high-up front costs of a lot of community programmes excluded lower socio-economic population (Macias 2008). However, as organic food has moved into the conventional food network and AFNs have grown this exclusion of the lower socio-economic population was again brought into question. It was found when looking at organic food in relation to the previous studies on food variety and availability that "organic food availability also follows similar neighborhood-to-neighborhood inequality" (Chang, 2014; pg. 17). These findings noting the inequity within potential access to organic foods from conventional food networks between different sociodemographic neighborhoods shows the importance of urban food policy and AFNs to try and address inequities.

2.2.3: Critiques of food environments

The literature on food environments is noted to be expansive and McKinnon et al. (2009) noted the need to synthesize all the data from the vast number of approaches to food environments. The need to synthesize this data was to show whether food environments are actually a factor of one's diet. The reviews to synthesize this data over the next few years found that many of the tools used to measure food environments were lacking in "reliability, validity, robustness, as well as sensitivity to change" (Lytle, 2017: Pg.19). On top of this most of these studies describe a cross-sectional association between health and environment, rather than a causal and longitudinal relationship between health and environment (Lytle, 2017; Gamba et al., 2015).

Another critique of the literature revolved around the lack of insight into the affordability, accommodation and accessibility of food (Caspi 2012). It was found that while accessibility was looked at often within the literature linking the food environment to diets, the link between food outlets in an area and one's diet was made unclear by the number of

different food types used (*Ibid).* The large variation in food types within food environment analysis make it hard to understand the link between diet and which type of food hubs, such as restaurants, farmers' markets or supermarkets, the foods are procured from. This critique is what has led me to my research in this thesis, which looks at identifying and categorising different food environments based on the local food hubs and socioeconomic factors,

2.3: Access to Local Foods

For the final part of my conceptual framework, I consider an area of literature that is at the intersection of food environments and AFNs. Local foods are a primary example of narrowing down AFNs into a smaller example with a stricter definition. While this definition is stricter it is still contested, the most common definition and the one used in this thesis is based on geographical distance. This is usually stated as food that is produced near where it is sold (Coelho, 2018). However, the exact proximity that determines the term local varies within the literature. The primary ruling in the US is that local foods are those which "less than 400 miles from the origin of the product" or "the State in which the product is produced" (U.S. Congress, 2008). This differs from Smith and Mackinnon (2007) who believe it should be within 100 miles. These two definitions do not only differ in spatial proximity, but the US definition of local also brings into the factor of State boundaries. The importance of State boundaries comes into effect when we think about buying locally to support the economy. When we buy from out of province even though it's only 50 miles away, we are not supporting our economy but another political entity's economy. Another definition suggests that local foods are those which have a cultural or historical connection to the area where they are sold (Sonnino, 2007).

Lastly, local foods are often perceived by consumers to have a positive impact on the environment and economy compared to non-local foods (Onozaka and McFadden, 2010). While this last definition is an issue that is being studied, this thesis takes it more as the assumption, due to a lack of time to research all of the food networks. However, as with AFNs, this is an area that requires more research and transparency for the consumer. Therefore, due to these faults in the other definitions, we are left with spatial proximity being the main indicator for local food throughout the literature.

In this thesis, the most common definition of local foods is used to increase transparency and normality within the literature. Therefore, since this research is being conducted in Canada, it adopts the Canada's Centre for Food in Canada's (CFIC) definition

of local food as "food that is grown, processed, sold, and consumed within the same local area (ranging from local community-scale to provincial-scale)" (Edge, 2013:1). This idea of spatial proximity of food is one of the most important features of AFNs as they are more likely to stimulate the local economy, help create social connections that longer food chains do not, and they help promote the conversation on sustainability (Coelho, 2018).

2.3.1 Access to local food Networks

The one example of a local food network that was previously stated was the CSA. This is an example of a direct marketed sales network. This is where the producer of the food markets and sells the food directly to the customer as they do in CSAs with the food baskets or in farmers markets (Printezis, 2018). The other form of local food network is intermediated marketing. This is when local food is sold through another party such as a restaurant or supermarket. The literature suggests that intermediate marketing is actually the bigger portion of sales for local marketing. However, this is due to large farms appealing more towards intermediate marketing and the small to mid-size farms leaning more to direct customer sales (Low, 2011).

Direct-marketing local food sales while being smaller than intermediated sales have still grown massively over the last few decades. For example, the number of farmers' markets in the US more than tripled in the last two decades from 2,863 to 8,718 (Printezis 2018). On top of this, CSA initiatives have increased from 761 to 7,398 from 2001-2015 in the US (Adam, 2006). This demonstrates the rapid growth in direct-customer local food networks. This massive increase in CSAs is also important as they differ in their nature as talked about in the AFN section. This means that there is the opportunity for further research into these CSAs to see if they are creating community engagement and increasing inclusion, or if they are simply recreating social exclusion and the class system.

The direct-marketing channels also show us that while they are small compared to the food system as a whole, local food networks do make up a large number of sales. In 2015 sales through local food networks were $8.75 billion USD, with $3 billion USD being through direct-marketing systems (NASS, 2016). This demonstrates that there is a need to take note of these systems and study their effectiveness, while also making sure they do not fall back into the larger industrial food supply chains. On top of this the majority of the smaller, direct-marketing farms are along urban corridors, which means that urban areas should be a point of focus for future literature (Martinez et al., 2010).

2.3.2: Equity and justice within local food systems

Within this thesis the common perspectives on the size of local food systems and the competing definitions of local food systems have been explained. However, there is another side of the literature that looks at the equity and justice which is brought about and is within local food systems and how this relates to their accessibility. A study looking at multiple local food networks within Burlington Intervale found that when looking at equity the risk is "to assume that these qualities will emerge naturally if human communities are simply reoriented toward the importance of local agriculture" (Maclas, 2008; pg. 1098). This theme coincides with the AFN literature which looks to remove the idea surrounding AFNs that local means sustainable and, healthy (Johnston et. al, 2009). Instead, Maclas (2008) found that the local community food networks needed to work and strive to be equitable and just. Other literature also assesses the equity of access to local food networks saying that local food networks which consist of direct marketing tend to be offered primarily to the middle-class and highly educated population (Hinrichs and Kremer, 2002). Initiatives within local food networks that are equitable tend to be pre-planned out and partnered with urban food policy such as subsidized farmers markets (Maclas, 2008). Further literature has built on this by explaining that regular face-to-face interaction is what builds community interaction (Putnam, 2000). This need for regular interaction is why there is a need to look at the access to local food options within socioeconomic census tracts. Therefore, when making access to a local food network equitable, past research emphasizes the importance of ensuring that socio-economic disparities and inequities are addressed in terms of potential to interact with local food networks such as CSAs and urban gardens. For them to regularly interact with local food networks they need to have them situated within their local neighborhood.

2.4: Chapter conclusions

The conceptual framework I have developed helps to highlight the crossover between the consumers' environment and the place that local food chains play within the metropolitan area. This background has helped to guide my research as it shows the areas which have been overlooked, while also recognising other variables and networks which are not the focus for the research. This led the final analysis to concentrate on how to categorise local and alternative food networks, by the distribution of their outlets throughout different store-based food environments within Montreal. The conceptual framework on food environments demonstrated the gap in the research on food environments from a more geographical and theoretical perspective. The research into AFNs and local food networks presents a gap in

past research on whether local and alternative food networks can contribute to a more inclusive food system. This question will be addressed by the categorising of these food networks by the socioeconomic nature of their distribution outlets.

Chapter 3: Methodology

This chapter outlines the methods used to conduct the analysis for my research. The first stage of the analysis consisted of developing a typology for comparing 'alternative' and 'conventional' food distribution points based on an existing database of food points of interest. Section 3.1 expands upon the dataset that was used throughout this project. The following section outlines the structure and content of the dataset, before detailing how I filtered and edited the dataset, and the rationale for excluding certain food points. Section 3.1.1 is where the rationale behind the preliminary categorisation of the food network types is explained. The second aspect of the analysis looks at the different sociodemographic characteristics of neighborhoods on the Island of Montreal at the census tract level. As there are a large number of census tracts and multiple different variables, the census tracts were clustered into groups. The food network distribution hubs would then be overlayed on top of these census tracts to see their sociodemographic distribution. This chapter ends with two sections detailing the limitations of the methods as well as a reflection upon my positionality throughout the research.

3.1: Overview of the food network distribution hubs dataset

My analysis is based on a dataset containing roughly 14,000 different food business and organization points on the Island of Montreal contained from the *Justice Alimentaire Montreal* (JAM) database. The JAM was developed by researchers in the Food Justice and Sustainability project at Dawson College and Concordia University (Montreal Food Justice Map, 2020). The original dataset (A. Aunio, personal communication) was supplied as four separate spreadsheets based on a general categorization: *Fresh food drop off* (e.g., CSAs, Lufa Farms); *Community gardens* (e.g., enterprise gardens, community gardens); *Community food organizations* (e.g., food banks, food vouchers); and *Commercial food* (e.g., supermarkets, grocery stores, butchers). These data were collected from multiple different sources; some came from external agencies or data repositories, such as the *Ministère de l'Agriculture, des Pêcheries et de l'Alimentation* (MAPAQ) and *Centre de référence du Grand Montréal*, while other points were manually digitized. In addition, they held talks with stakeholders in more community-based projects to gain information on their distribution points while also showing them how this map benefits their own business. The mixture of these data-gathering efforts led to the final database containing the ~14,000 points.

Given the comprehensiveness of the food points contained in the JAM database, a portion of them were not relevant to my research aims. Therefore, all food points that belonged to food sources outside of my focus (e.g., speciality chocolate and cheese shops) were removed. The first food network distribution hubs removed were those that were not a part of the retail food environment. Therefore, all the restaurant points were removed, as well as any food workshops which do not directly distribute groceries. This was done for multiple reasons, firstly consumers may travel further for restaurants making them harder to analyse side by side with stores (Mckinnon et al., 2009). In addition, restaurants are often not used as a constant food source. The next points removed were specialised stores: these included commercial stores focusing on specific foodstuffs, such as bakeries, breweries, chocolatiers, and cheese stores, which mainly cater to special interests and therefore, are less comparable.

Finally, duplicate entries in the database were removed. It was clear when the data were mapped by the available spatial coordinates, that there were duplicates for data points such as farmers' markets. To get the most accurate analysis all obviously overlapping or misaligned distribution hubs were removed.

3.1.1: Categorisation of Food network distribution hubs dataset

My food typology was aided by the pre-existing categorization I described above for the JAM database. The data was categorised with the purpose "to gather information about our food environment to understand how we can change it" (Montreal Food Justice Map, 2020). This made it a great starting point for looking at observational studies into alternative food network distribution and food environments throughout Montreal. However, here I apply the JAM data specifically to examine the distribution of 'alternative' food sources in relation to potential food environments. While this is similar in scope to the original JAM categories focused more specifically on food justice and food security, my typologies emphasized AFNs and local foods. The data had been primarily categorised into first categories, subcategories, and finally types of food network. To aid my own categorisation of the food networks I used the 'types' of food network as categorised in the dataset (e.g., family farms in reference to CSAs) (Montreal Food Justice Map, 2020).

After filtering the dataset based on the study criteria, my own categorisation of the food networks was produced to help future analysis. To address the research objectives, the dataset was categorized into six total categories by separating the data into two different categories three separate times. The first set of categories was growers + distributor or only distributor, followed by Community or private, and lastly Alternative or conventional.

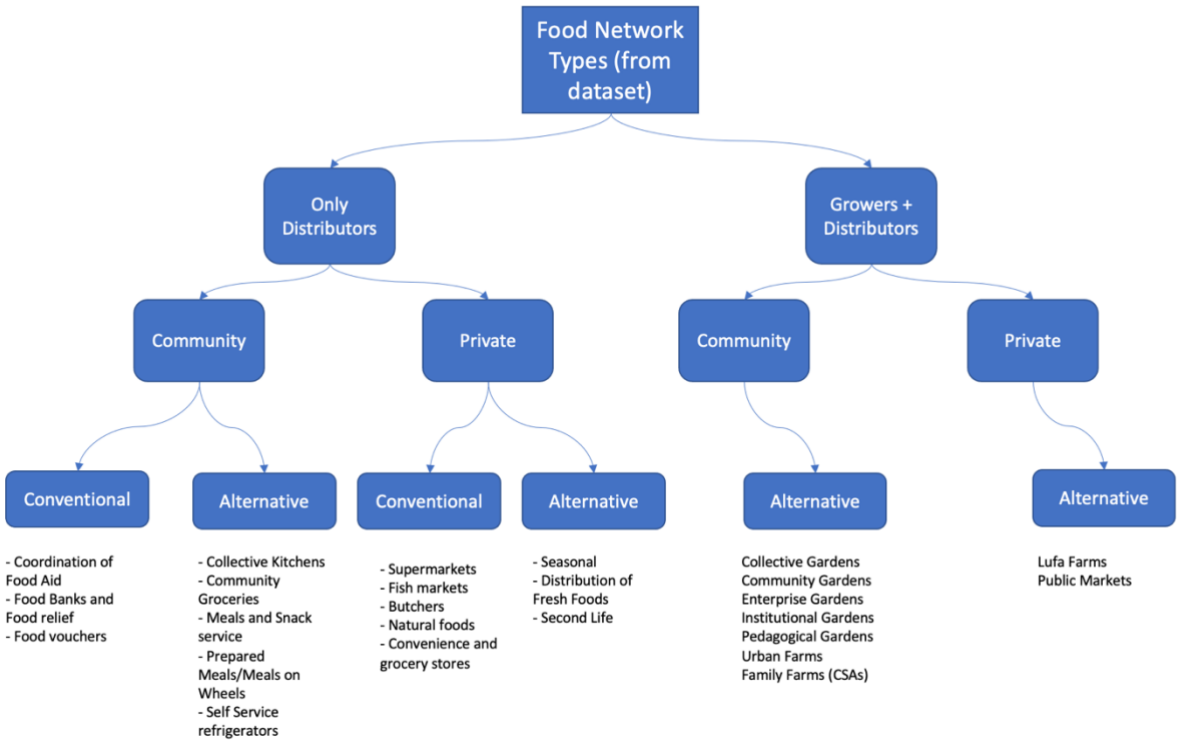


Figure 3.1 – Flow chart showing how I formed my typology through categorising food networks by their key traits. The final categories will be shown in Chapter 5, Figure 2.

The flow chart in figure 3.1 shows the categorisation of the food networks based on the three aces. The first axis was Growers and distributors against distributors which was used as a proxy to local and non-local food when categorising the data as it required less information about each food network. This method is not perfect as supermarkets will distribute local food but not produce it (Low, 2011). However, it does allow us to see all of the direct-marketing local food networks in one category. This allows us to analyse whether this specific type of food network helps social integration as well as showing us what kind of access we have to this type of local food network.

The two new categories were split again between private and community. This axis helps to separate the more commercial food networks from those that are based on social inclusion and created through the community or municipality. The interest in these axes comes as it can isolate whether the commercial nature of private food networks takes away

from the emphasis on helping the local community and access to food. This separation also produced the category: “distributor only, community” which represented solely food aid networks (e.g., food banks, food vouchers, etc.).

Lastly, the food networks were split into conventional and alternative. This separated the alternative food networks that could play a large social role as well within the food environment. This distinction was a point of interest in the research as they could be networks in which we see social exclusion by the well-educated and wealthy, rather than the social inclusion people believe AFNs have (Goodman 2004; Guthman, 2004).

The second part of the statistical analysis was to visualise the distribution of the newly formed categories. I used geographic information systems (GIS) programs as they allow the researcher to manipulate and visualise spatial data (Higgs, 2004). A map with six separate frames was produced to help visualise the distribution of each newly formed category throughout Montreal Island.

3.2: Methods for multivariate clustering of census tracts according to sociodemographic characteristics

To conduct the categorisation of the census tracts I used *k*-means clustering with the *clValid* package in the R statistical programming software (v. 3.6.2). I used this programme as there were multiple numerical variables across a large number of census tracts, which made it difficult to detect patterns and cluster the census tracts manually. This approach helps to find homogeneous groups by minimizing the Euclidean distance between the data points and the centre of each cluster in a given dataset (Likas, 2003). This will be partitional clustering, which aims at partitioning a given dataset into disjoint subsets (clusters) so that specific clustering criterion are optimized (Likas, 2003). The census variables used were number of people below the low-income measure, prevalence of people aged 15-64 (working age), population density, prevalence of first-generation immigration, prevalence of francophone population (Statistics Canada, 2016). The reason for using these categories is because they give a good range of the demographics and socio-economic status of each area. The immigration variable was used specifically as it has been shown to affect access to food within Montreal (Tarraf, 2016).

3.2.1: k-means clustering

The use of this statistical approach was useful as it allowed me to consider the interaction among several continuous variables. As stated above the five socioeconomic variables I

chose to create each cluster were population density, percentage of the population in lower-income, percentage of the working-age population, percentage of people whose main language is French, and the percentage of First-generation immigrants. These five variables were based on interest as well as reading into the literature. When starting the analysis, there was a sixth variable in the number of obtained university degrees and above. However, after running the *k*-means analysis I found that this value was strongly correlated with another variable which made the clustering process less significant. Another attribute which would have been interesting was the number of English and French-speaking population, however, this had a significant correlation with the number of recent immigrants and so had to be removed to maintain more accurate clusters. The following paragraphs outline the rationale behind each variable which was used and the census tract scale before going on to talk about the results.

The first variable is population density. This was an interesting variable as it helps to highlight more concentrated areas such as downtown Montreal where less food distribution hubs may be required to cover the census tract. In addition, it will be interesting to see if certain alternative networks which require more space such as one urban farms and gardens are based primarily in less dense neighbourhoods. However, this may show that the dominant local alternative networks still come from outside of the city and are brought into distribution points.

The second variable was the percentage of people with French as their primary work language. This variable would help be a proxy to identify potential language barriers or a lack of local interconnection that develops from speaking English within Montreal. These factors may lead to difficulties in accessing certain alternative food networks found here. French was chosen as variable language rather than English as it shows if there is an existing correlation between French speakers and access to AFNs. The presence of this correlation would then in turn highlight potential language barriers. A possible language barrier that could exist for non-French speakers would be anglophone Canadians who have moved into Quebec and not learned French and whether this has hindered them from the community aspect of alternative food networks. In a study by Caro (2015), it was found a lot of foreign European workers ended up being segregated when they moved to a new country and one of the reasons for this segregation was the language barrier. In this case, if it shows segregation of food networks to low-income neighborhoods (Gordon-Larsen et al., 2011) it follows that we may see this same segregation with language and the potential food environment. However, while this is an interesting variable to look at quantitatively concerning food networks one must keep in mind

that it is a proxy and simply provides observations to correlations which further qualitative studies may address to find causation.

The third variable following on from the second is the number of first-generation immigrants within the census tract. This variable was chosen based on the literature which developed my conceptual framework. Specifically, a study by Girard (2013), which found a high food insecurity rate of 10% among allophone first-generation immigrants who were taking French language courses. This paper compelled me to look at first-generation immigration status and whether AFNs helped to fill in this food accessibility gap or if they happened to be less present in these neighborhoods. This is another moment where it is important to note that the presence of an AFN in a neighborhood does not mean it is necessarily accessible to someone. Someone who is allophone may have problems with first finding out about the existence of some AFNs such as CSAs and then there is the hurdle of becoming involved in a CSA when possibly your community ends up more segregated and even less connected to the local farmers. However, by conducting quantitative analysis we will see if the issue is possibly in part at the neighborhood level rather than just at the individual level.

The fourth variable was the prevalence of low-income based on the low-income measure after tax. This measure states that a household of four is under the low-income measure if they earn less than $38,322 after tax (Crossman, 2013). The reason for choosing this specific income measure instead of a measure such as average income is because of the size of my census tracts. A lot of census tracts on the Island of Montreal are relatively large and income is not uniformly distributed throughout. Therefore, if a census tract has a large range in income, a large low-income population within a census tract would be hidden by a few very rich people. This led to the choice of prevalence of low-income instead, as low-income citizens have been the basis for many researchers' studies into food deserts (Cummins and Macintyre, 2002; Gordon-Larsen et al., 2011). While low-income prevalence may show potential socio-economic inequality throughout the entire food system, there may also be a correlation between low-income measures and the three different groups of alternative food networks that were defined earlier.

The last variable picked was the percentage of the population between the age of 15-64. This is otherwise known as the percentage of the working population. This statistic was appealing as there may be a positive correlation between the prevalence of the non-working population such as children and retirees and community initiatives. The rationale behind this is that non-working population either means families and the elderly who tend to be more

settled into a community and often have more time to become involved with their community and community projects. This could easily mean the recruiting of potential Alternative food networks into their community.

After having chosen the variables a multicollinearity was run between them to make sure that no correlation was above 0.7 as this would then give too much wight to these variables when creating the clusters. When running the *k*-means algorithm itself followed from the methods of Boudet (2020) and found the optimal number of clusters was 5 as decided by the highest silhouette width. 5-10 clusters were chosen as any less or anymore would lead to either too few clusters to see a correlation, or too many clusters in which case some clusters would be irrelevant.

3.2.2: Overlaying food network distribution hubs and cluster data

The last part of the analysis involved overlaying the food network distribution hubs on top of the census clusters to show the sociodemographic distribution of each food network's distribution hubs. This process involved the use of ArcGIS, and the spatial join feature. Having projected both the census clusters and the food network distribution hubs, I was able to use the spatial join feature to create a data table identifying which census cluster each food network distribution hub was located in. I exported this dataset into an excel spreadsheet which allowed me to create pivot tables from the data. These pivot tables would allow me to see the number of different food network distribution hubs within each census cluster. However, while this data gave us some idea of the distribution it was not adjusted from the population in each census cluster. This was especially important since some clusters contained a much higher number of census tracts than others. Therefore, I used the following equation to create a table showing the number of food distribution hubs in each cluster per 100,000 people:

*(Number of food points / Total cluster population) * 100,000*

After producing this table, I finished the analysis by comparing the patterns and trends in the food distribution hubs within the table to the maps I had created.

3.3 Limitations

As commonly stated in the literature, accessibility to food is only part of the problem. A large problem within urban areas is rather the affordability and availability of different food groups at the food outlets (Caspi, 2012). In addition, I cannot fully separate and investigate all of the

local foods as the majority are sold through intermediaries such as supermarkets (Printezis, 2018; Low, 2011). This means that access to local food will be higher and more evenly distributed than my data points find. However, this analysis would require a lot more background research to carry out.

3.4: Positionality

Throughout this project, I have been reflecting on my positionality and how it has influenced and evolved throughout the project. Although I am working with secondary data my bias can still play a role in my analysis and interpretation of both the input data and results. When picking out the data points and the socioeconomic variables my positionality plays a part. Therefore, I tried to be as objective as possible and used previous literature to help me pick the socioeconomic variables and the final food networks to use in my analysis. In addition, I focused my discussion on not conforming to the views of academia to interpret my results. In the context of my project, when looking at the distribution and effects of food networks on access to food, I kept a statistical view rather than forming opinions and conclusions about how it affects different socioeconomic groups.

3.5: Chapter conclusions

The previous two chapter gave an overview of the methods explaining the steps taken to achieve the final results. These steps started with the cleaning and organising of the dataset to suit the project's aims. After this stage the data was further categories with the limitations of this categorisation being recognised. Next, the software analysis of the project was undertaken using *k*-means clustering within R. Then maps were created to visualise the census clusters and food network distribution hubs using GIS to show how different AFNs played a role within Montreal in terms of access to food. After going through these stages of the analysis, I reflected on my positionality throughout the project and the aim to keep the project as objective as possible.

Chapter 4: Categorization of Montreal Food Networks

The first stage of the analysis was categorizing my obtained dataset showing different types of food networks. The first section will talk about each of the categorisation axes and what they may potentially highlight within the literature; it will then show the final types of food networks in each category before showing the distribution of each food network's distribution hubs throughout the Island of Montreal. Lastly, this chapter will expand on the AFNs within Montreal and provide some background on a few of the largest networks.

4.1: Categorisation results

When categorising the food distribution points, there were three distinct axes. The first axis was producer and distributor, the second was private and community, and lastly, the groups were separated again into alternative and conventional. The rationale behind this decision to categorise the food networks further than alternative and conventional was so the potential analytical differences between the alternative framework as well as the local foods network could be compared. In addition, to observe the variation in impacts of different AFNs on Montreal's food environments the networks needed to be categorised further.

4.1.1: Producer and Distributor

The first category chosen for the food networks related to the primary definition for AFNs as short supply chains (Thorsoe, 2003; Allaby et al. 2020; Feenstra 1997). However, the term 'short' is hard to define and the exact data on each food type's supply chain was not available. Therefore, I defined the categories as distributors who produce their product against those who distribute other people's product. This allowed for a clear and easy separation of networks while also helping to isolate the more local food networks. This helps to encompass alternative food networks such as farmers markets and CSAs. These food networks are a couple of the most referenced and researched AFNs (Matacena. 2016; Bruce, A. 2017).

4.1.2: Private and Community

The second category was related to AFNs as a social, community-based practice as seen in CSA literature (Adam 2006; Cooley & Lass, 1998). In this section, it is important to note that I was strict on my definition and to recognise in many circumstances there is scope for debate. In my definition of this, if the acquiring of the product itself was not government-

funded or was not part of a community-funded initiative, it was characterised as private. The primary example would be a public market as a private venture. This is a difficult one to categorise as often there is some community involvement and papers have noted public markets to be community ventures (Beckie, 2012). The differentiation made here is that while public markets as an organisation are non-profits the farmers themselves who are creating the product and selling the products are on the whole private entities. Therefore, while public markets do hold community attributes and could be categorised as such, the obtaining and distribution of the food is done by a private entity, therefore I chose to categorise them as private.

4.1.3: Alternative and Conventional

The last category ascribed to the data was alternative and conventional networks. This category was decided using Renting's (2003) description of AFNs as food networks that were created out of mistrust for the conventional food networks. The reason this definition was chosen is because AFNs are adapting beyond the "local" definition. An example of this in Montreal is the food network "Second Life". Their mission statement promoting "quality, zero waste, and eating healthy" aligns with the common environmental and health values associated with alternative food networks. However, while they offer local food services helping Quebec farmers, they also offer international food which was rejected by the conventional food system due to aesthetic defects. This is a food network that is not necessarily local but can be categorised as an alternative food network as it aligns with a large section of the literature (Renting, 2003; Matacena. 2016).

The second aspect of this final categorisation is looking at types of food aid. In this aspect, certain types of food aid are not necessarily local, but would still be referred to as an alternative form of food network. This is another area where the categorisation is justified by my use of Renting's (2003) definition of alternative food networks being a response to something lacking in the conventional system. This categorisation could be a point of interest as it separates newer initiatives such as meals on wheels and food vouchers, from the conventional food banks. This is a useful distinction when looking into food environments and their possible change over time.

4.1.4 Final Food Network Categories

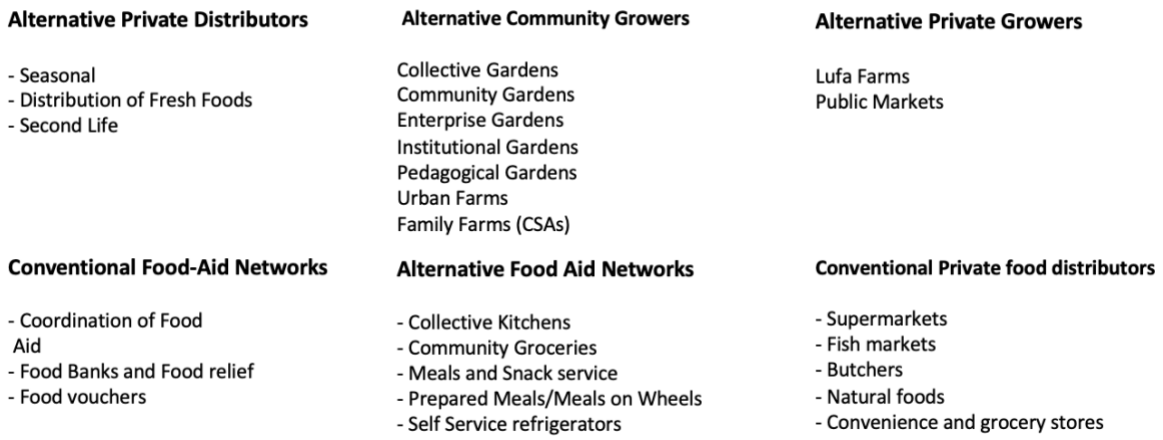


Figure 4.1 – The final six categories created, and the food types contained within each.

The final categories can be seen in Figure 4.1. The process left me with six distinct groups of food networks. There were four groups of alternative food networks and two groups of conventional food networks. I am less concerned about the lack of variety in conventional food groups as I will be using the distribution of conventional food networks as merely a comparison for the alternative food networks. A noticeable outcome of the categorisation process is that no food networks existed in certain categories such as conventional producer networks. The primary reason for this is that literature still sees one of the primary features of AFNs as introducing a shortened supply chain (Thorsoe, 2003). However, the rise in AFNs and a possible reaction of the conventional food chain to a demand for local goods may lead to an increase in conventional food networks which produce all the products that they sell and tend to be more local.

4.2 AFN and Conventional distribution hubs Montreal

This section details the background of Conventional and Alternative food networks in Montreal to provide a further understanding of the AFNs being analysed. A few large AFNs will be explained in depth before moving on to the conventional food network options. In the JAM dataset I identified two major alternative food networks within Montreal which were Lufa Farms and Equittere's Family Farmer Network (CSA). These two networks are also different with one being community-based alternative food network and the other a private alternative food network.

Lufa Farms is a Montreal-based company that was founded in 2009 and aims to "grow food where people live and grow it more sustainably" (Lufa Farms, 2021). Their

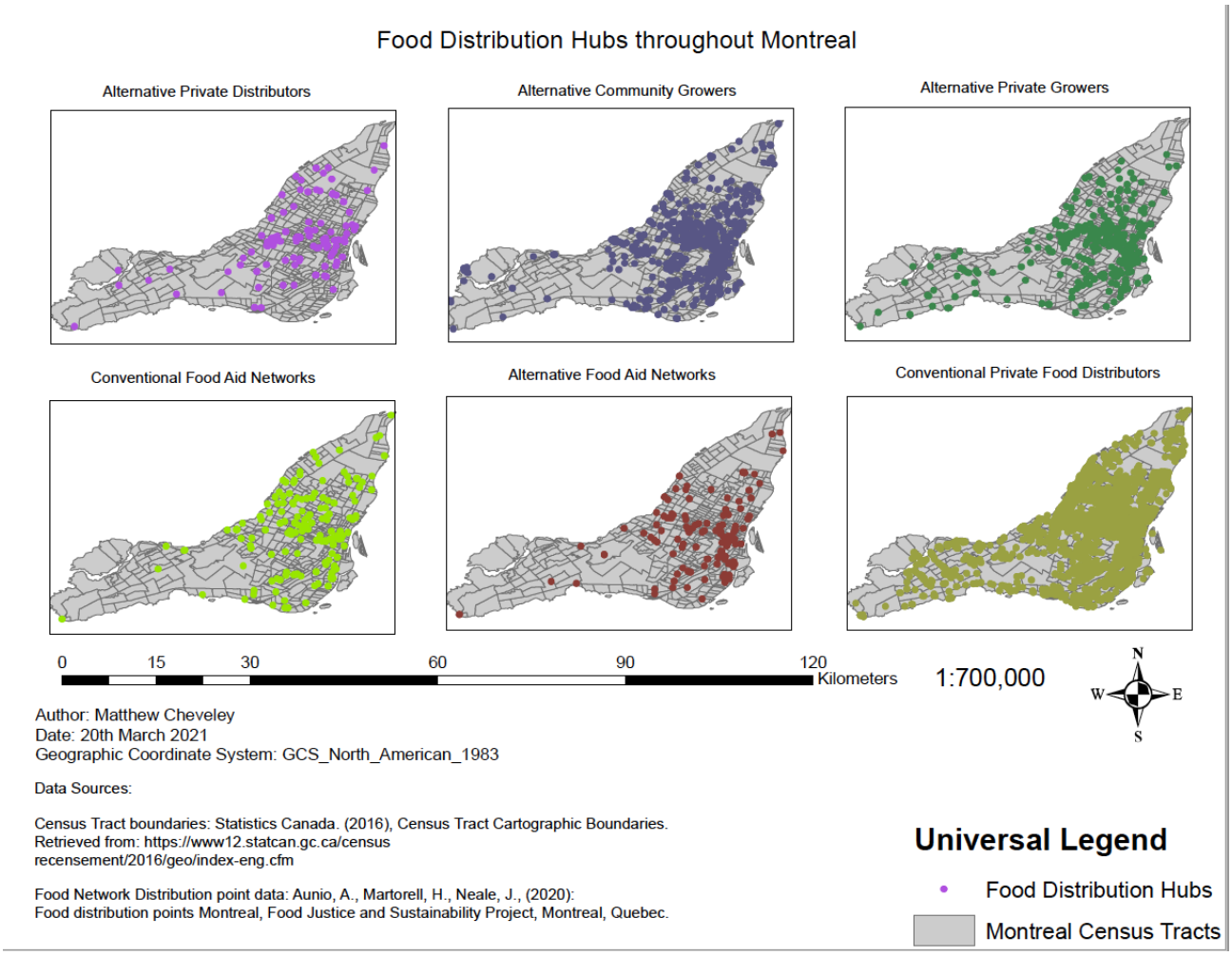
expertise lies in creating urban greenhouse farming using rooftops. These farms, built on top of industrial buildings, aim to create "high-yield, year-round farming" (ibid.) which can then be used to feed the surrounding city. However, the difference with Lufa Farms from the majority of the alternative food networks that are talked about in literature is that they still have a goal of being "commercially viable" (Allaby et al. 2020). Although despite this difference Allaby et al. (2020) argue that Lufa Farms are an AFN because they have many alternative characteristics despite being a private company. This leaves us with an AFN that has the combination of building upon the sustainable and local nature of alternative food networks to create a commercially viable alternative shows the possibility of AFNs becoming a significant portion of the commercial food network within cities. Lufa Farms already supplies 11,000 customers in Montreal with fresh vegetable baskets (Lufa Farms, 2021). This large-scale example of an alternative food network in Lufa Farms was a reason why I chose Montreal as the city to conduct my research since it has a lot of unique and significant alternative food networks.

The second alternative food network I wanted to look at within Montreal is one of the earlier and more traditional networks in CSAs. Equiterre is "one of the main environmental organizations in Quebec with 130,000 supporters and, 25,000 members" (Equiterre, 2010). This organisation is responsible for creating a large number of CSA networks within Montreal by connecting citizens directly with farmers. The network today brings together "145 farms with 28,000 families each year" (ibid). The goal of this network is to help out local farmers while also educating the local community about healthy organic food and their local community. This organization also works with municipalities to urge them to play "an active role in the development and consolidation of this contribution to the local economy by adjusting their regulations" (ibid.) This involves the opening of public spaces all year round in order to create areas for farmers to sell their products and connect with the local community within the city. This network is another example of how smaller initiatives within Montreal are trying are starting to scale up alternative food networks to the point that they can match certain conventional food networks such as grocery stores. This also reinforces the importance of my research into looking at if AFNs are present to everyone within Montreal from a quantitative perspective or if they have ended up reinforcing inequalities within the food environments.

The conventional side of food networks within Montreal can be diverse if one takes into account speciality shops such as chocolatiers and cheese shops as well as the large range of restaurants. However, since this project uses census tracts which constitute people's home

food environment, there needed to be a focus on everyday food stores where someone can buy a variety of food. Therefore, the primary conventional food network in Montreal consists of supermarkets and convenience stores, with convenience and smaller grocery stores (depanneurs) being the most numerous food network throughout Montreal. Within the dataset, there are 2933 convenience and grocery stores throughout the Island of Montreal. The next biggest food network is bakery's which there are only 365 of throughout the Island of Montreal. All AFNs have even fewer distribution points than this. This massive difference in points shows the length AFNs have to go through to become as accessible as the conventional food network in terms of the number of distribution points throughout the city.

4.3: Visually representing the locations of different food distribution hubs



Map 4.1 - showing the distribution of each food network category, throughout the Island of Montreal.

Map 4.1 was produced to help visualise the distribution of each food network category throughout the Island of Montreal. The results of the mapping show that the conventional food networks are still much more prominent than the alternative food networks.

Furthermore, the quantity of conventional food distribution points allows them to be more accessible across the entire island of Montreal.

When looking at the alternative food networks and food aid networks there is a clustering of distribution points in downtown Montreal and very few points in the West island or Montreal East. A possible explanation for this is the larger amount of open space, park, industrial, and institutional land use within both Montreal East and the West Island (Shekarrizfard, 2017). However, there is still a large proportion of the land that is primarily residential that also contains high amounts of commercial food outlets within the area. This demonstrates that there is an unequal distribution of AFNs across the Island of Montreal. However, this map alone does not tell us whether this is just a matter of AFNs trying to start in the more populated downtown areas of Montreal before expanding throughout the island, or whether this may be a sign of inequitable distribution within AFNs.

Chapter 5: Results of sociodemographic census clustering

The results from the *k*-means clustering led to the creation of 5 unique census clusters. These clusters consisted of one low-income cluster and two middle- and high-income clusters. The high- and middle-income clusters each contained one francophone cluster and one non-francophone (higher prevalence of first-generation immigrants) cluster. The low-income cluster was primarily first-generation immigrants.

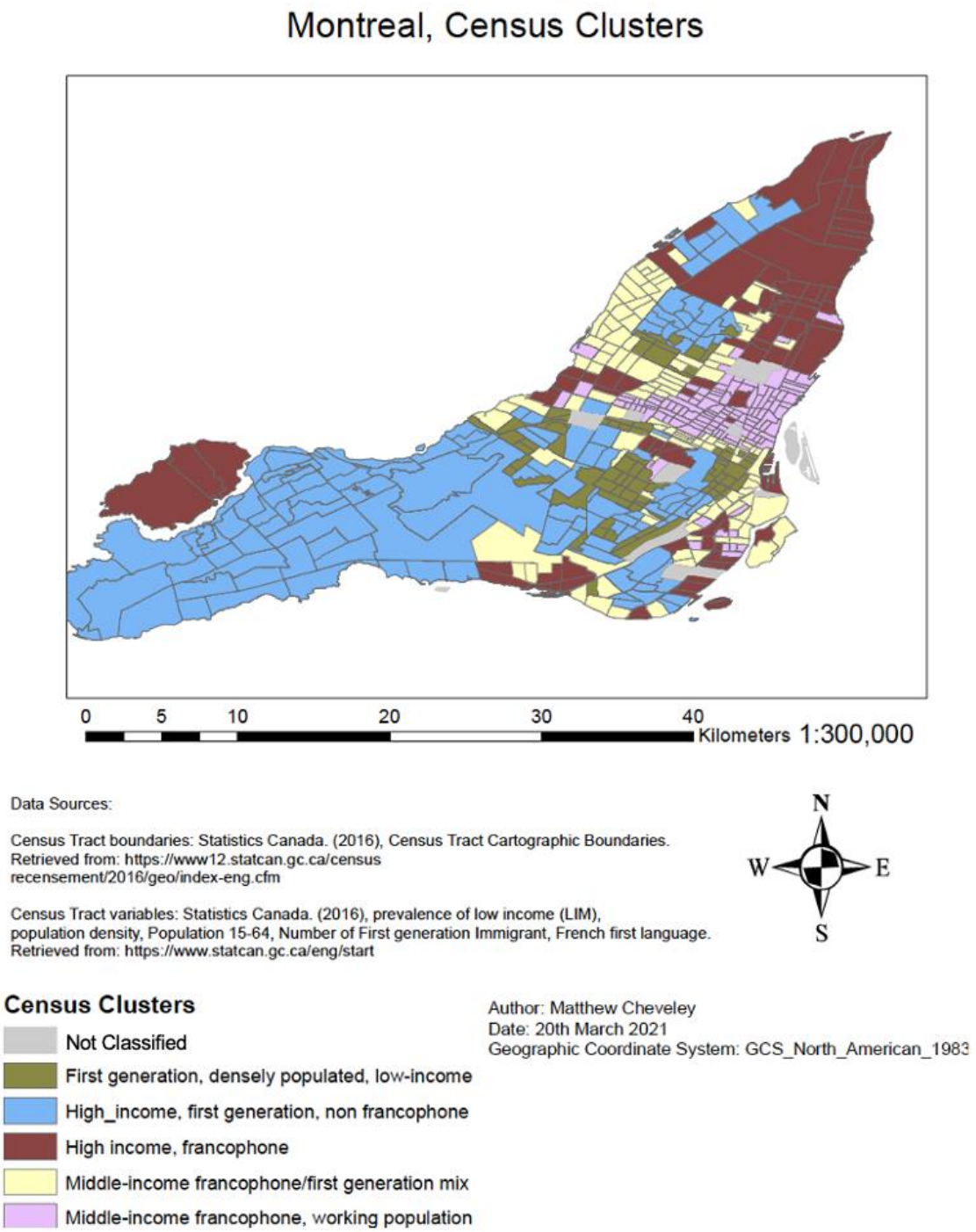
The first step in my clustering analysis was to run a Pearson correlation between each of my normalized variables, as shown in Figure A1 in the appendix. None of the variables had a correlation of over 0.7 with the highest correlation being -0.653 between the variables of low-income and recent immigrant population. While this is a high correlation it is low enough that it will not affect the clustering greatly. On top of this, the rest of the correlations between variables remained between -0.5 and 0.5. We can also be sure of the results as all results were significant apart from Francophone and low-income which was so low that a correlation could not be found.

Table 5.1 – The variable centers for each census cluster

	Norm Low income	Norm Francophone	Norm Age 15 - 64	Norm Population density	Norm First generation	Number of Tracts
First generation, densely populated, low-income	53.5	30	74.1	25.4	74.1	78
High income, first generation, non-francophone retired	21.1	27.4	67.1	8.8	49.1	124
High income, francophone	21.9	75.4	70.1	9.7	25	77
Middle -income francophone/first generation mix	36.5	55.9	73.5	17.2	47.8	119
Middle-income francophone working	36	80.4	82.1	23.6	32.5	122

The final results of the 5 clusters are shown in Table 1. This figure shows the centers for each of the clusters as well as the number of clusters that fall into each. The final silhouette width for the clusters ended up being 0.26. This means that some of the census points within the cluster could have possibly been attributed to other clusters. However, since the clusters were created using census data, there was a low chance a high silhouette width, more importantly, as seen in the table each cluster has a set of unique attributes which are a reasonable distance away from each other.

To identify each census cluster, their most prominent attributes were identified and use that as their defining features. Therefore, the first cluster was recognized as low-income, densely populated, first-generation. The high first-generation immigration feature of this cluster alongside the low francophone speaking makes me believe that the residents in this cluster are likely to be anglophone as well as allophone. This cluster also stands out as having the highest prevalence of low-income. The second cluster was identified as a Suburban High-income anglophone and francophone mix. The relatively high number of first-generation immigrants in this cluster does not necessarily suggest allophones as the low prevalence of low-income and the smaller working population suggests that these are settled, first-generation immigrants. The third cluster was defined as the high-income Francophone population. This cluster has low first-generation immigration rates as well as a large francophone population. The fourth and fifth clusters denote similar rates of low incomes with their main differentiator being the number of first-generation immigrants and difference in francophone speaking. Cluster four was categorised as the middle-class working population. This cluster is a harder one to define and shows some of the difficulty of clustering census data. The mix of average numbers of francophone speaking and first-generation immigrants means there is likely a large variance within this cluster as the two variables seen earlier do have an aspect of negative correlation. However, while being mixed we can still use this cluster to help identify trends seen in the more extreme clusters. Category five on the other hand is the middle-income francophone working population. The high working population and high population density suggest younger downtown workers.



Map 5.1 – Results of the multivariate clustering for the 518 census tracts across the Island of Montreal. 'NA' indicates census tracts that were not further classified.

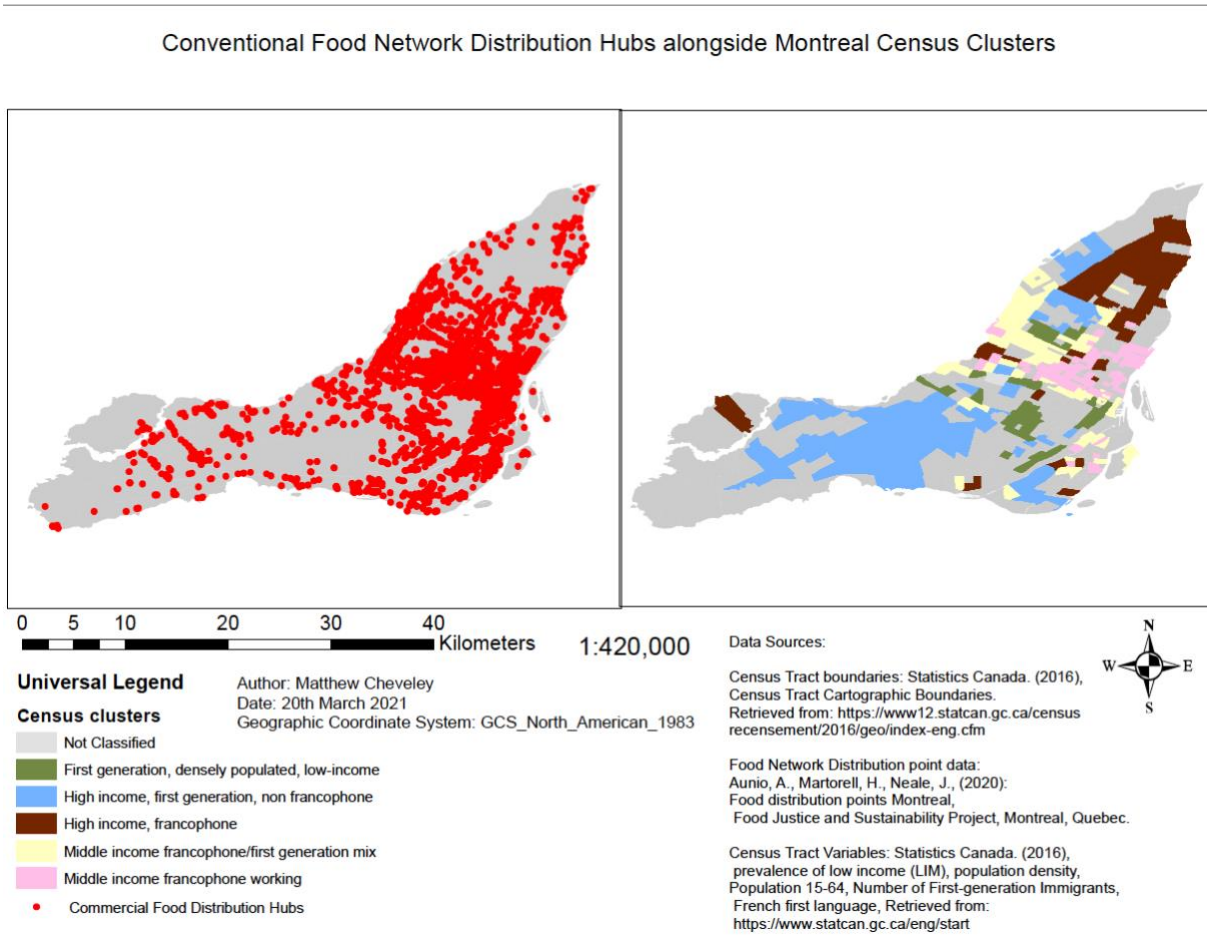
With each cluster defined, Map 5.1 was produced showing the distribution of the clusters throughout the Island of Montreal. The map shows that each census group is also spatially clustered together, we see that the higher-income clusters are found primarily outside of downtown Montreal. The high-income francophone population tends to be found in Montreal East while the equivalent first-generation and anglophone population tends to reside in Montreal West and moves more into downtown Montreal. In downtown Montreal to

the East of Mont-Royal, there is a mix of the middle-class working populations. The plateau and more southeast are the Francophone working population. Whereas to the northern side, there is more of a mix of francophone speakers and first-generation immigrants. Lastly, the lower-income, recent immigrant population is found to the west of the downtown core of Montreal more prevalent in the inner city. These areas are also close to some of the industrial zoning on Montreal island (Shekarrizfard, 2017).

This spatial clustering of each of our census groups is beneficial for my quantitative study as each group is more isolated and so the number of food points within each cluster becomes more significant. This is because the spatial clustering of the groups means there are less instances where a person's food environment lies within a mixture of different sociodemographic census clusters.

Chapter 6: Distribution of food network distribution hubs by census clusters

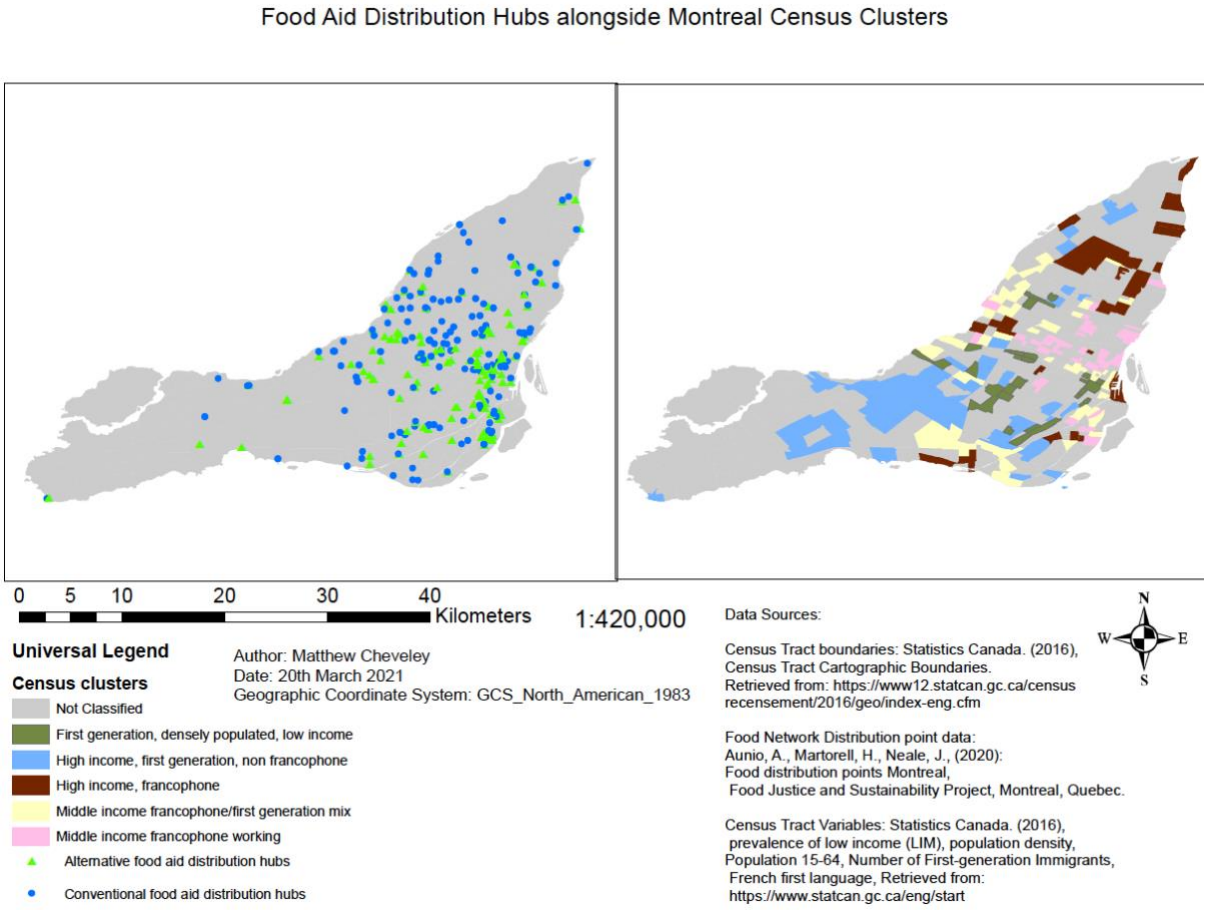
After organising the data, the last stage performed was the geospatial analysis. This consisted of overlaying the food distribution hubs on top of the census clusters to visualize as well as to measure their distribution. I created three different maps to show the distribution of the different food networks throughout each census cluster. The maps are divided into food aid, AFNs, and conventional food networks.



Map 6.1– Consists of two data frames, one showing the distribution of conventional food network distribution hubs. The other showing the census clusters where 5 or more conventional distribution hubs are located.

The first of the three maps show the conventional food network distribution hubs alongside the censes clusters, see Map 6.1. With over 3000 different distribution points, they cover the entirety of Montreal Island. However, they are also clearly concentrated in downtown Montreal while being more sparsely spread out in the west island and East Montreal. The highest grouping of points occurs within both the middle-income clusters. The

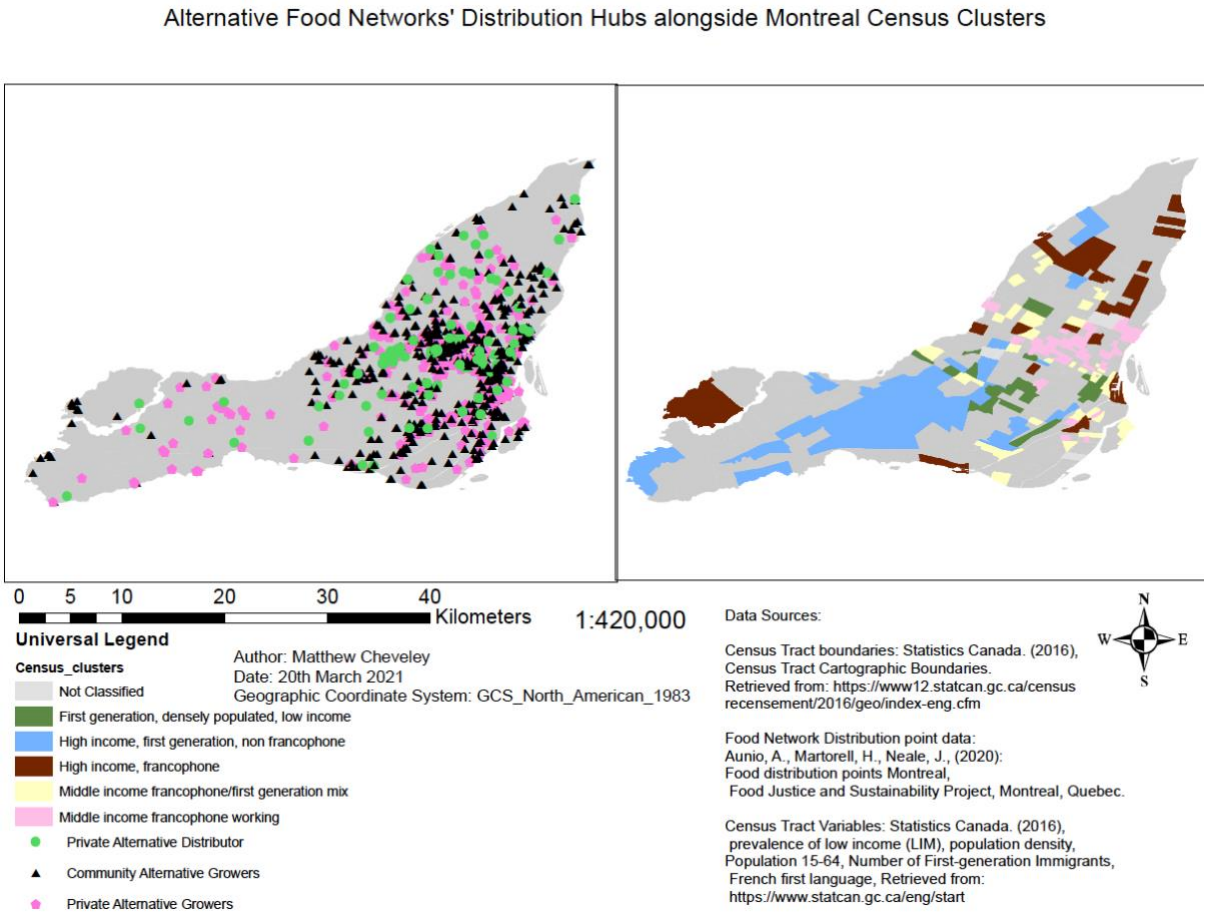
inner city, lower-income cluster while containing a large number of points it contains less than the middle-income clusters. An interesting factor that is not visible on the map, but I inquired into while making the map is, a much larger proportion of the points within the west island and the east island are supermarkets compared to convenience or grocery stores. The distribution of the supermarkets is less clustered across Montreal island than the convenience and grocery stores which are the majority of points seen on the map.



Map 6.2 – Two data frames, one showing the distribution of food aid distribution hubs. The other showing the census clusters where the food aid distribution hubs are located

The next map looks into the distribution of food aid distribution hubs across the Island of Montreal, see Map 6.2. The map shows again a higher number of points within the inner city. However, interestingly again these food points seem to have slightly more grouping within the middle-income neighborhoods. This is a surprise as the group of lower-income neighborhoods has the highest population density and therefore, one would assume contains more food aid, especially when the socioeconomic factors are considered. Another interesting feature is that between the two high-income areas there tends to be

more food aid within Montreal East and the Francophone clusters. Lastly, while there is a lot fewer alternative food aid networks, they tend to be more focused in the lower-income neighborhoods, whereas the conventional food aid is more spread out and mainly prevalent in the middle-income areas. This could show that alternative food aid networks such as meals on wheels are useful to supplement the conventional food aid within lower-income areas where there could be a higher demand for it.



Map 6.3 – Two data frames, one showing the distribution of alternative food distribution hubs. The other showing the census clusters where 3 or more Alternative distribution hubs are located.

The last map shows the distribution of the three groups of Alternative food networks alongside the census clusters, see Map 6.3. As a whole, we again see the majority of alternative food network points within the inner-city region. However, we also see a more uniform distribution of points throughout the West Island, with some small clusters in East Montreal. The main difference we see is fewer points in the anglophone/francophone mixed middle-income neighborhoods and a much higher concentration in the francophone middle-class neighborhoods. There are also some distinctions between the three separate groups of

AFNs. The solely distributive private AFNs tend to be in the middle – high-income neighborhoods and there are very few distribution points within the low-income cluster. The private growers and distributers such as Lufa Farms are the most dispersed data points. However, they still favour the higher-income neighborhoods and only have a few distribution points in the lower-income inner-city areas. Lastly, the community alternative networks which grow their own produce follow a similar distribution pattern to the food aid networks. This type of network is much more prevalent in the lower-income neighborhood. This could suggest that the less private and more community-based programs plan out their food network to be as equitable as possible, thus targeting lower-income neighborhoods which according to the literature is what local-food networks must do when trying to be just (Maclas, 2008).

After creating the map, the food point dataset was spatially joined with the census data and exported the dataset. This enabled the creation of an excel spreadsheet where all the food distribution hubs were associated with the corresponding census cluster, they were located in. Once the excel spreadsheet was obtained, a pivot table could be created showing the number of each category's food network distribution hubs were in each census category which is figure 10 in the appendix. This table is a useful visual showing number of each food network distribution point, that is present within each cluster. It helps to back up the observations one makes about the previous maps shown. Demonstrating that the more downtown middle-income clusters had the highest concentration of food points out of all the census data. However, it does offer a counter view that the high-income first-generation area ended up having a similar number of food distribution points to the low-income area. This is interesting as that cluster was mainly based in the west island where on the map even though the area was larger it looked as if there were a smaller number of points. The reason they end up similar is some possibly gentrified inner-city areas that fell into the same cluster contained a high number of food distribution points. Although further population correlated analysis is required to gain more insight into the relative sociodemographic pattern of food distribution hubs.

Table 2. –The number of each food category per 100,000 people within each census cluster

Food networks	First generation, densely populated, low-income	High income, first generation, non-francophone	High income, francophone	Middle income francophone/first generation mix	Middle income francophone, working	Total
Alternative Food Aid Networks	7.7	5.5	4.9	6.5	12.9	37.5
Conventional Food-Aid Networks	5.8	4.8	7.2	11.0	13.9	42.7
Alternative Private Distributors	4.0	5.7	5.3	4.5	11.4	30.8
Conventional Private food distributors	228.1	108.3	134.1	210.3	293.5	974.4
Alternative Community Growers	30.6	14.9	32.6	30.7	54.2	163.1
Alternative Private Growers	13.2	12.9	10.2	21.7	35.6	93.6
Alternative	47.8	33.5	48.1	56.9	101.2	287.5
Food Aid	13.5	10.3	12.2	17.5	26.8	80.2
Conventional	228.1	108.3	134.1	210.3	293.5	974.4
Grand Total	289.4	152.2	194.4	284.6	421.5	1342.1

Table 2 shows a different distribution in the number of food points. The main item that stands out is that the middle-income francophone cluster has by far the most food points per 100,000 people. This is a point of interest as the map showing the food points showed us that the majority were in the inner-city and the outer high-income neighborhoods had fewer food points which are also shown on the table. However, the map did not show the difference per person in food points which this table shows as favouring the francophone clusters at similar income levels. This table also shows that the lower-income first-generation population

in Montreal has a high number of food points suggesting a more equitable distribution of food environments throughout the cities compared to what the previous literature has said (Cummins and Macintyre, 2002).

The next aspect of the table that is the focus of this study, is the number of alternative food networks per 100,000 people. As we see again just like the total number of food networks the middle-income francophone neighborhoods have the highest number of AFNs of every kind. On top of this, the high-income francophone population also has an uncharacteristically high number of AFNs per person due to a high number of community AFNs within the region. The interesting aspect here is that compared to food-aid and conventional food networks the First-generation low-income neighborhood has a lower number of AFNs. The main AFN which they are missing is perhaps the more commercial solely distributive private AFNs. This table suggests that these forms of larger scale, less-local AFNs are possibly less equitable than the more community-based AFNs. The last observation from the table is that the high-income, non-francophone cluster had less than half the number of community-based AFNs compared to the other clusters.

Chapter 7: Discussion and Conclusion

The previous chapters outlined the results from the grouping of food networks, the clustering of census tracts, and the spatial overlay of both. This chapter follows on from these results discussing the themes that appeared and identify areas where further research may be needed within the various food environments. Lastly, the different AFN groups will be compared based on the pattern of their urban food distribution points. The starting point in section 7.1 which looks at the distribution of food points across Montreal Island as a whole. The following section 7.2, expands upon the overlap between language and food environments, offering possible explanations for the difference in food networks within the census clusters. Section 7.3 brings forth the last theme comparing the distribution of community and private AFNs and possible differences this may show within the attributes and goals of the food networks. In Section 7.4 I will offer a short summary of the most important aspects of this research before suggesting further research that one could conduct from the basis provided in this thesis.

7.1 Reflecting on the spatial patterns and distribution of Montreal's food networks

One of the unique aspects of this study is that it gives a comprehensive assessment of an entire city's food system examined from a quantitative perspective. It is at this point that I need to note the fortune I had of being able to gain access to a database of almost every food network point in the city. The privilege of having this dataset has allowed me to look at food accessibility within Montreal on a large scale.

The first stage of this discussion is looking at Montreal's food system as a whole. The first thing I noticed when looking at the Island of Montreal is that there is often a high variety of food options within each food environment. On top of this taking the definition of a food desert as "urban areas with 10 or fewer stores and no stores with more than 20 employees" (Hendrickson et al. (2006): Pg. 372), there are few places on the Island of Montreal which meet these specific criteria. Looking at the map almost all residential areas were within 1km of at least 10 stores, usually a lot more. On top of this, the areas which often had fewer stores tended to be the high-income neighborhoods which usually favoured having more green space in a more suburban feel. On top of this the high-income neighborhoods still had a lot of variety and within literature higher income has often equated to a better a more varied diet (Ball 2015). A reason this is the case is because they are more likely to own a car and be

more mobile than residents who live in lower-income neighborhoods. I consider in this project that while I mention accessibility this paper does not address what people are eating, how much it costs and, how easy it actually is to access it. These aspects could be considered in future studies through qualitative methods such as surveys and interviews. These surveys either look at the average price of a consumer's food basket or the consumers perception of how expensive certain stores are (Cassady, 2006; Drewnowski 2005)

Another pattern that was identified through Montreal's food network was the distribution of food aid throughout Montreal Island. The food aid was predominantly found in the lower to middle-income neighborhoods. The slight deviation in the food aid was that it was concentrated in the more middle-class neighborhoods rather than the poorer first-generation cluster. However, while the conventional food aid was lower per person in this cluster, the alternative food aid tended to be higher in the lower-income areas. This is an area of study I saw less of when looking at food environments and food accessibility was more alternative community initiatives to tackle food aid and their effectiveness. An interesting study, in this case, would be a more qualitative look at initiatives such as meals on wheels and how effective it is at making food more accessible in the lower-income first-generation neighborhood.

The last theme was the size of AFNs compared to the overall food network. When looking through the literature on AFNs they are still treated as a complementary food network (Cicatiello, 2020). They are mostly looked at for their benefits to the local economy and social relationships (European Commission 2012). However, looking at our data while they are still smaller than the conventional food networks, they are on their way to being a major part of the overall food network. Based on distribution points the alternative food networks had 30% the number of distribution points as the conventional food networks. While each of these points are smaller than the equivalent conventional food network it still shows their growing importance when it comes to food accessibility. On top of this AFNs are growing with networks such as Lufa Farms already supplying 11,000 customers in Montreal and CSAs with the Equiterre and partner networks, containing 25,000 members in Quebec (Allaby et al., 2020; Equiterre, 2010). In the case that other AFNs continue to expand with these networks then they will become a large part of not only access to local foods in urban areas but also access to food as a whole.

7.2 Potential intersection between language and food environments

The main socioeconomic variables that stood out to me regarding the locations of food distribution hubs were the primary work language and prevalence of first-generation immigration. In both high-income and middle-income neighborhoods, there were a significantly higher number of food distribution points per 100,000 people within the francophone neighborhoods which had a lower prevalence of first-generation immigration. This difference was prevalent in both conventional and alternative food networks, as well as in conventional food aid. One explanation that may be offered for the trend is that neighborhoods that have fewer French speakers and more first-generation immigrants, could be newer residential neighborhoods with which the conventional food network is catching up. This explanation works when looking at the much higher number of food networks within the francophone middle-income cluster. However, the lower-income first-generation cluster has more conventional food distribution points per person than the middle-income francophone/first generation immigrant mix. This suggests that alternative and food aid networks may be part of the difference and more susceptible to language barriers.

When looking at the AFN distribution one can see a significant increase in AFNs in the francophone neighborhoods compared to the anglophone neighborhoods with the same income levels. This aligns with the study conducted by Girard (2013) who found that allophone first-generation immigrants were likely to be more susceptible to food insecurity. In the case here we add onto the literature of (Ball 2015) and find that this individual language barrier to food networks may also be a neighborhood barrier, especially when it comes to AFNs. This data shows that while AFNs are prevalent across all income levels there may need to be more of an effort to advertise and include first-generation immigrants and possibly anglophone and allophones. This problem also aligns with the community nature of AFNs, the literature cites one of their key components as connecting customers and farmers (Sonnino, 2009) which becomes a harder task when there is a language barrier between the two. While this trend is visible within our results and aligns with some literature one must remember that our data is a proxy and does not show the extent to which the language barrier affects the home food environment. To understand the nature of this one would need to perform a further qualitative study into language and food environments as well as possibly a study into AFNs who have managed to bridge the language gaps.

7.3 Community AFNs compared to 'Private' AFNs

The last theme of my discussion revolves around how different types of AFNs are present within food environments. When I refer to private AFNs, I refer to food networks that that I assume follow a corporate structure. A clear example of this is Lufa Farms, which gained an "initial CAN$2 million (~ US$1.5 million) investment" from different sources (Allaby et al. et al., 2020. pg: 5). Throughout my results, I found that there is a new type of alternative food network which is moving more towards the capitalist nature of the conventional food network and away from AFNs. However, before looking at this I wanted to see the difference in accessibility between private and community local AFNs. I found that community-based AFNs tended to be more evenly distributed across different levels of income. This aligns with the literature, which talks about how offering equitable access to lower-income groups requires effort and direction from the AFN itself (Putnam, 2000; Maclas, 2008). This effort is more likely to come from a community-based initiative than a private initiative as they are often funded by urban food policy councils who are trying to solve food insecurity (Matacena, 2016). However, while the community-based AFNs are more evenly distributed over different income levels. the private-based AFNs tended to be more evenly distributed with more distribution hubs located in neighborhoods with a high number of first-generation immigrants and a high number of non-francophones. A possible explanation for this may consist of the language barrier seen in Girard's (2013) allophone study, this would tend to hinder community initiatives more. While there is a lot of overlap between both types of food networks, more research is needed into separating which AFNs are truly community-based and which AFNs use community as a marketing point. However, the results in this study lead me to believe that both AFNs are needed in unison help to give the most equitable access to local foods.

The last AFN which differs more than most is a new type of AFN that has been brought about by the growth in AFNs. This type of AFN holds all the values of sustainability, quality, and helping local farmers such as other AFNs. However, while they may have started only selling local food, they have expanded to selling organic foods from further away. These AFNs also tend to stick to fruits and vegetables although this may also change as the area and demand for AFNs expands as the mistrust in conventional food networks increases. These food networks in our data tend much more towards the higher-income neighborhoods compared to the other food networks. This is significant as it may be offering evidence to the AFN literature which sees capitalism making its way into the realm of AFNs and starting to

push them back into a more conventional food system (Van De Ploeg and Renting, 2004). This again is an area of AFNs that I think needs a more in-depth look in the literature in a more qualitative study to see if AFNs are starting to change and develop more capitalist rather than community tendencies.

7.4 Conclusion

The food network throughout the Island of Montreal offers a high accessibility to food containing few spatial food deserts. It is also heavily influenced by the AFNs which have integrated themselves into Montreal's food network and become a significant part of the food environment for most of the island. However, there are possibly some inequalities which require further research. These inequalities in the distribution of food points suggest lower food options for first generation immigrants and the non-francophone population. However, there is a need for a more detailed assessment of the role of AFNs in food environments, including the actual utilization of different food outlets and resulting food consumption from them by consumers rather than just looking at the quantitative spatial patterns that I conducted in this thesis. I believe that this thesis helps set the stage for more targeted qualitative studies using surveys and interviews to gain a fuller understanding of some of the patterns shown here.

This project first demonstrated the need for a better classification of AFNs, while I gave a broad categorization in this thesis a future study may want to look into each individual alternative food network in a style such as (Allaby et al., 2020) to gain a more comprehensive classification. Furthermore, organisations such as a food policy council should conduct further research into private AFNs and factors affecting their accessibility in ways other than their spatial location. Lastly, AFNs which are becoming larger and less local, should be studied to see if they still hold the "environmental, socially conscious, and healthy' attributes often associated with an alternative food network.

Reference List

Adam, K. L. (2006). "Community Supported Agriculture." National Sustainable Agriculture Information Service, National Center for Appropriate Technology.

Allaby, M., MacDonald, G.K. & Turner, S. (2020). Growing pains: Small-scale farmer responses to an urban rooftop farming and online marketplace enterprise in Montréal, Canada. *Agric Hum Values* https://doi.org/10.1007/s10460-020-10173-y

Aunio. A et al. (2020) "Montreal Food Justice Map". https://www.dawsoncollege.qc.ca/food-justice-sustainability/our-food-map/ and https://foodmap.anagraph.io/en)

Baldi, L., Bertoni, D., Migliore, G., & Peri, M. (2019). How alternative food networks work in a metropolitan area? An analysis of Solidarity Purchase Groups in Northern Italy. *Agricultural and Food Economics*, *7*(1), 1-21.

Ball, K., Lamb, K.E., Costa, C. *et al.* (2015). Neighbourhood socioeconomic disadvantage and fruit and vegetable consumption: a seven countries comparison. *Int J Behav Nutr Phys Act* **12,** 68. https://doi.org/10.1186/s12966-015-0229-x

Beckie, M.A., Kennedy, E.H. & Wittman, H. (2012). Scaling up alternative food networks: farmers' markets and the role of clustering in western Canada. *Agric Hum Values* **29,** 333–345. https://doi.org/10.1007/s10460-012-9359-9

Berti, G.; Mulligan, C. (2016). Competitiveness of Small Farms and Innovative Food Supply Chains: The Role of Food Hubs in Creating Sustainable Regional and Local Food Systems. *Sustainability 8*, 616.

Boudet, F., MacDonald, G. K., Robinson, B. E., & Samberg, L. H. 2020. Rural-urban connectivity and agricultural land management across the Global South. Global Environmental Change 60: 101982.

Bruce, A., & Som Castellano, R. (2017). Labor and alternative food networks: Challenges for farmers and consumers. *Renewable Agriculture and Food Systems*, *32*(5), 403-416.

Caspi CE, Sorensen G, Subramanian SV, Kawachi I. (2012) The local food environment and diet: a systematic review. Health Place. (5):1172-87.

Caro. E., Berntsen, L., Lillie, N., Wagner, I. (2015) Posted Migration and Segregation in the European Construction Sector, Journal of Ethnic and Migration Studies, 41:10, 1600-1620, DOI: 10.1080/1369183X.2015.1015406

Chang, Y., Adams, R., Carithers, T. C., & Ruetzler, T. (2014). Do Grocery Store Personnel's Perceptions, Attitudes, and Knowledge Determine Availability of Organic Food Products? *Journal of Food Distribution Research*, *45*(856-2016-58142), 1-25.

Cicatiello, C. (2020). Alternative food shoppers and the "quantity dilemma": a study on the determinants of their purchases at alternative markets. *Agric Econ* **8,** 15.

Coelho, F., Coelho, E.M., & Egerer, M.H. (2018). Local food: benefits and failings due to modern agriculture. Scientia Agricola, 75, 84-94.

Cooley, J. P., & Lass, D. A. (1998). Consumer benefits from community supported agriculture membership. Review of Agricultural Economics, 20, 227–37.

Cummins, S., & Macintyre, S. (2002). "Food deserts"--evidence and assumption in health policy making. BMJ (Clinical research ed.), 325(7361), 436–438.

Downs, S. M., Ahmed, S., Fanzo, J., & Herforth, A. (2020). Food Environment Typology: Advancing an Expanded Definition, Framework, and Methodological Approach for Improved Characterization of Wild, Cultivated, and Built Food Environments toward Sustainable Diets. Foods, 9(4), 532. MDPI AG.

Drewnowski. A, Darmon. N. (2005) Food Choices and Diet Costs: An Economic Analysis, *The Journal of Nutrition*, Volume 135, Issue 4, Pages 900–904

Edge, J. (2013). Cultivating Opportunities: Canada's Growing Appetite for Local Food. Canadian for Food in Canada. The Conference Board of Canada.

European Commission (2012) Europeans' attitudes towards food security, food quality and the countryside. Special Eurobarometer 389.

Equiterre's Family Farmer Network. (2010): https://www.fermierdefamille.org/en

Fallah-Shorshani, M., Shekarrizfard, M., & Hatzopoulou, M. (2017, August 10). *Evaluation of regional and local atmospheric dispersion models for the analysis of traffic-related air pollution in urban areas*. https://www.sciencedirect.com/science/article/abs/pii/S1352231017305307?via%3Dihub.

Forssell, S., & Lankoski, L. (2014). The sustainability promise of alternative food networks: an examination through "alternative" characteristics. *Agriculture and Human Values*, *32*(1), 63-75.

French S.A, Story M., and Jeffery R.W. (2001). Environmental influences on eating and physical activity. Annu. Rev. Public Health; 22: pp. 309-335

Galt, Ryan E. 2013. The moral economy is a double-edged sword: explaining farmer earnings and self-exploitation in Community Supported Agriculture. *Economic Geography* 89 (4):341–365

Gamba, R.J., Schuchter, J., Rutt, C. *et al.* (2015). Measuring the Food Environment and its Effects on Obesity in the United States: A Systematic Review of Methods and Results. *J Community Health* **40,** 464–475.

Girard, A. and Sercia, P. (2013), "Immigration and food insecurity: social and nutritional issues for recent immigrants in Montreal, Canada", *International Journal of Migration, Health and Social Care*, Vol. 9 No. 1, pp. 32-45:

Goodman, M. K. (2004). Reading fair trade: Political ecological imaginary and the moral economy of fair-trade foods. *Political Geography, 23*, 891–915.

Gordon-Larsen, P., Guilkey, D. K., & Popkin, B. M. (2011). An economic analysis of community-level fast food prices and individual-level fast food intake: a longitudinal study. Health & place, 17(6), 1235–1241.

Guthman, J. (2004). *Agrarian dreams: The paradox of organic farming in California*. University of California Press, Berkeley.

Hendrickson, D., Smith, C., & Eikenberry, N. (2006). Fruit and vegetable access in four low-income food deserts communities in Minnesota. *Agriculture and Human Values*, *23*(3), 371-383.

Higgs, G. (2004). A Literature Review of the Use of GIS-Based Measures of Access to Health Care Services. Health Serv Outcomes Res Method 5, 119–139.

Hinrichs, C., & Kremer, K. S. (2002). Social inclusion in a Midwest local food system project. *Journal of Poverty*, *6*(1), 65-90.

Jarosz, L. (2007, December 27). *The city in the country: Growing alternative food networks in Metropolitan areas*. Journal of Rural Studies. https://www.sciencedirect.com/science/article/abs/pii/S0743016707000654?via%3Dihub.

Jessop, B. (2002). Liberalism, neoliberalism, and urban governance: A state–theoretical perspective. Antipode, 34(3), 452-472.

Jetter, K.M., Cassady, D.L. (2006): The availability and cost of healthier food alternatives Am J Prev Med, 30 (1), pp. 38-44

Johnston, J., Biro, A., & MacKendrick, N. (2009). Lost in the supermarket: the corporate-organic foodscape and the struggle for food democracy. Antipode 41: 509-532.

Kelly, B., Flood, V. M., & Yeatman, H. (2011). Measuring local food environments: an overview of available methods and measures. *Health & place*, *17*(6), 1284–1293.

Kong, A., Odoms-Young, A. M., Schiffer, L. A., Berbaum, M. L., Porter, S. J., Blumstein, L., & Fitzgibbon, M. L. (2013). Racial/ethnic differences in dietary intake among WIC families prior to food package revisions. *Journal of nutrition education and behavior*, *45*(1), 39-46.

Likas, A., Vlassis, N., Verbeek, J. (2003). The global k-means clustering algorithm. Pattern Recognition, Elsevier, 2003, 36 (2), pp.451 - 461.

Low, S., and Vogel S. (2011). Direct and Intermediated Marketing of Local Foods in the United States. USDA-ERS Economic Research Report No. 128,

Lucan, S. C. (2015). Concerning limitations of food-environment research: a narrative review and commentary framed around obesity and diet-related diseases in youth. Journal of the Academy of Nutrition and Dietetics, 115(2), 205-212.

Lufa Farms Inc. (2021). *About Lufa Farms*. https://montreal.lufa.com/en/about.

Lytle, L. A., & Sokol, R. L. (2017). Measures of the food environment: A systematic review of the field, 2007-2015. *Health & place*, *44*, 18–34.

Macias, T. (2008), Working Toward a Just, Equitable, and Local Food System: The Social Impact of Community-Based Agriculture*. Social Science Quarterly, 89: 1086-1101. https://doi-org.proxy3.library.mcgill.ca/10.1111/j.1540-6237.2008.00566.x

Martinez, S.W., Hand, M.S., Michelle Da Pra, Pollack, Susan L., Ralston, Katherine L., Smith, Travis A., Vogel, Stephen J., Clark, Shellye, Lohr, Luanne, Low, Sarah A., (2010). Local Food Systems: Concepts, Impacts, and Issues. 97. United States Department of Agriculture, Economic Research Service.

Matacena, R. (2016). Linking alternative food networks and urban food policy: A step forward in the transition towards a sustainable and equitable food system? International Review of Social Research 6 (1): 49–58

McInerney, M., Csizmadi, I., Friedenreich, C.M. *et al.* (2016). Associations between the neighbourhood food environment, neighbourhood socioeconomic status, and diet quality: An observational study. *BMC Public Health* **16,** 984. https://doi.org/10.1186/s12889-016-3631-7

McKinnon, R. A., Reedy, J., Morrissette, M. A., Lytle, L. A., & Yaroch, A. L. (2009). Measures of the food environment: a compilation of the literature, 1990-2007. American journal of preventive medicine, 36(4 Suppl), S124–S133.

Michael D. M. Bader, Marnie Purciel, Paulette Yousefzadeh & Kathryn M. Neckerman (2010) Disparities in Neighborhood Food Environments: Implications of Measurement Strategies, Economic Geography,

Moragues-Faus, A., & Marsden, T. (2017). The political ecology of food: Carving "spaces of possibility" in a new research agenda. *Journal of Rural Studies, 55*, 275–288.

NASS. (2016). Direct Farm Sales of Food. Results from the 2015 Local Food Marketing Practices Survey
United States Department of Agriculture. National Agricultural Statistics Service 2016.

Onozaka, Y., Nurse, G. and Thilmany McFadden, D. (2011), Defining Sustainable Food Market Segments: Do Motivations and Values Vary by Shopping Locale? Amer. J of Ag. Econ., 93: 583-589.
Putnam, R. D. (2000). Bowling alone: America's declining social capital. In *Culture and politics* (pp. 223-234). Palgrave Macmillan, New York.

Printezis, I., & Grebitus, C. (2018). Marketing channels for local food. Ecological Economics, 152, 161-171.

Renting, H., Marsden, T. K., & Banks, J. (2003). Understanding Alternative Food Networks: Exploring the Role of Short Food Supply Chains in Rural Development. *Environment and Planning A: Economy and Space*, *35*(3), 393–411.

Smith, A. and MacKinnon, J.B. (2007). The 100-Mile Diet: A Year of Local Eating. Vintage Canada.

Sonnino R. (2007). The power of place: embeddedness and local food systems in Italy and the UK. Anthropol Food. S2, March.
Sonnino, R. (2009). Feeding the city: Towards a new research and planning agenda. International Planning Studies, 14(4), 425-435.

Tarraf. D, Sanou.D, Giroux.I. (2017). Immigration and Food Insecurity: The Canadian Experience--A Literature Review. Chapters, in: Ingrid Muenstermann (ed.), People's Movements in the 21st Century - Risks, Challenges and Benefits, IntechOpen.

Thorsøe, M. and Kjeldsen, C. (2016), The Constitution of Trust: Function, Configuration and Generation of Trust in Alternative Food Networks. Sociol Ruralis, 56: 157-175.

U.S. Congress (2008) H.R.2419.

Van der Ploeg, J. D., & Renting, H. (2004). Behind the 'redux': a rejoinder to David Goodman. *Sociologia ruralis*, *44*(2), 234-242.

Venn, L., Kneafsey, M., Holloway, L., Cox, R., Dowler, E., & Tuomainen, H. (2006). Researching European 'alternative'food networks: some methodological considerations. *Area*, *38*(3), 248-258.

Walker et al., (2010) R.E. Walker, C.R. Keane, J.G. Burke (2010). Disparities and access to healthy food in the United States: A review of food deserts literature. Health & Place, 16 (5), pp. 876-884

Widener, M. J., Metcalf, S. S., & Bar-Yam, Y. (2011). Dynamic urban food environments a temporal analysis of access to healthy foods. American journal of preventive medicine, 41(4), 439–441.

Data Sources:

Justice Alimentaire Montreal (2020): Food distribution points Montreal, Food Justice and Sustainability Project, Montreal, Quebec. Database by Aunio, A., Martorell, H., Neale, J:

Statistics Canada. (2016), Census Tract Cartographic Boundaries.
Retrieved from: https://www12.statcan.gc.ca/census-recensement/2016/geo/index-eng.cfm

Appendix

Figure A1 – A Pearson's correlation matrix between the clustering variables.

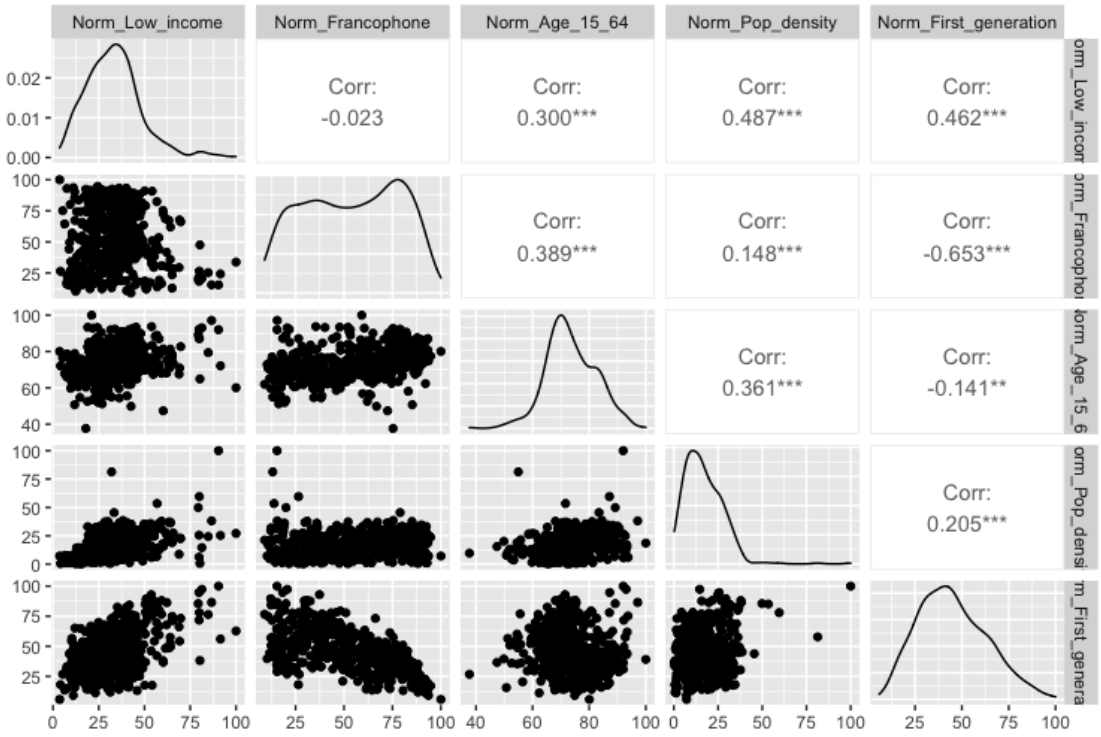


Table A1 - A table showing the number of each food network category within the different census clusters.

Food Networks	First generation, densely populated, low-income	High income, first generation, non francophone	High income, francophone	Middle-income francophone/first generation mix	Middle-income francophone, working	Total
Alternative Food Aid Networks	25	30	15	29	41	140
Conventional Food-Aid Networks	19	26	22	49	44	160
Alternative Private Distributors	13	31	16	20	36	116
Conventional Private food distributors	745	588	407	939	931	3610
Alternative Community Growers	100	81	99	137	172	589
Alternative Private Growers	43	70	31	97	113	354
Grand Total	**945**	**826**	**590**	**1271**	**1337**	**4969**