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Eating Local: Defining A Local Foodshed to Meet Local Food Goals

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Eating Local: Defining the Local Foodshed to Meet Local Food Goals

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Abstract

An increasing number of regional and municipal local food goals are being promoted around the world based on perceived benefits to society including local food security, environmental benefits and the economic welfare of local communities. One of the challenges to studying the benefits of local food is the ambiguity around the definition of "local." Another challenge is the lack of primary production information available for a local market relative to current and future local food demand. This thesis demonstrates a method for determining the size of a local foodshed with the operational potential to meet a percentage of current or future food needs relative to specific municipal food goals. To demonstrate this approach to foodshed analysis, the method was applied to a local food target outlined in the City of Calgary's "imagineCALGARY" Long Range Urban Sustainability Plan. Results show that mapping a local foodshed by individual food type provides a powerful visual understanding of what is local, the distances that food travels and the production area that comprises the local footprint, and, contributes new understanding to local food capacity and a starting point for future discussions on the development and implementation of local food targets.

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List of Symbols, Abbreviations, Nomenclatures

AEZ	Agro-ecological zoning system
AB	Alberta
AARD	Alberta Agricultural and Rural Development
AMDR	acceptable macronutrient distribution ranges
BC	British Columbia
BCNS	BC nutritional surveys
CCHS	Canadian Community Health Survey
CAR	Census Agricultural Region
CCS	Census Consolidated Sub-division
CS	Census Division
CIFA	Canadian Food Inspection Agency
CSA	Community Supported Agriculture
Euclidean	straight-line distance between two points
FAO	Food and Agriculture Organization
FDR	Food and Drug Regulations
Foodshed	The geographic region that produces the food for a particular population.
FOE	Friends of the Earth
GIS	Geographic Information Systems.
GTA	Greater Toronto Area
ha	hectares
Km	kilometres
LHA	Local Health Authority
LMS	Lower Mainland South
NFD	National Food Disappearance data
NYS	New York State
RDA	Recommended dietary allowances
Road Network	actual travel distance by road between two points
Tonnes	Metric tonnes
U.S.	United States
USDA	United States Department of Agriculture

Chapter 1: Introduction

Canada is home to a vibrant local food movement, with initiatives to increase local food consumption in every province. The Canadian Co-operative Association (2009) found that there were 2,314 organized local food initiatives across Canada between 2008 and 2009. Alberta accounted for 255 or 11% of these initiatives and was one of four provinces, which made up 75% of that total number. The study also found that individual organizational initiatives abide by a variety of interpretations of local food.

As interest in local food grows, particular questions about how local food is defined, and to what extent a localized food system is feasible arise. How far away from a city can food be grown and still be considered local? Is distance equal for all foods? Inherently, the word "local" implies proximity to a particular place (Feagan, 2007). Often, the term "local food" carries undertones that are not necessarily contingent on geography, however, it is difficult to achieve a local food goal without a sense of the land base required, the types of foods that are grown locally and where they are grown in relation to the local population.

In spite of a high level of interest in local food, few assessments of current and future local food needs have been undertaken. Assessments to determine the size of a local foodshed required to meet food demand by a particular urban food goal were not found in the literature. Previous self-sufficiency studies have typically compared local consumption needs to actual or potential production yields from within a circumscribed production area to determine whether or not agricultural production was capable of meeting food demand (Gerbens-Leenes, 2001; Peters, et al, 2002; Giombolini et al., 2010; Desjardins et al., 2010; and Forkes, 2011). These methods permit researchers to determine the portion of food demand met within a circumscribed region, but not the reverse, i.e., to determine the local area required to meet food demand. This thesis addresses that gap.

Largely an urban phenomenon (Chinnakonda, et al, 2007), local food initiatives are beginning

to gain support from municipal governments. For example, food targets, including an increase in local food consumption to 30% by 2036 were set out in the imagineCALGARY Long Range Urban Sustainability Plan (2007). An Ipsos Reid poll (2008) reported that 78% of Calgarians were willing to buy food grown locally to reduce their ecological footprint, and in 2012, under the direction of city council, the Calgary Food System Assessment and Action Plan were completed in response to growing citizen demand and community awareness of the value of a sustainable food system. This thesis develops a method to determine a city's current and future local foodshed as a first step towards understanding local food production capacity. In this study, the local foodshed was defined as the smallest production area within the nearest travel distance of that city, with the capacity to meet all, or a percentage of food demand in that city.

1.1 Purpose and Rationale

Local food initiatives have begun to gain support from various levels of government and the number of food system assessments in the literature has tried to keep up with the demand for information on the capacity of local food production at various local scales. In this research a method is developed to determine a local foodshed by individual food groups, with the capacity to meet food demand, or a specified percentage thereof.

Given the lack of clarity around the term local food, the concept of a local production region, or the spatial area associated with a particular food target is generally poorly understood. Mapping a local foodshed by individual food type provides a powerful visual understanding of what is local, the distances that food travels and the production area that comprises the local footprint – or *foodprint* – associated with current food consumption.

The purpose of this study is to determine the smallest existing production area within the nearest distance of a city, with the capacity to meet all, or a specified percentage of food demand of that city. Rather than a predictive model, the method developed in this thesis provides a starting place – a benchmark foodshed – by spatially mapping the existing production area that meets local demand. The development of a benchmark enables us to have

more informed discussions about local food definitions, policies, targets and strategies.

The method developed is generic and customizable to each locality. In order to make the model widely accessible, it uses widely available data and simple assumptions about future demand, however a more sophisticated model, for example one which incorporates projected consumption and production trends, or demographic changes due to increased urbanization or an aging population, can be developed from this base model as additional information becomes available.

To demonstrate this approach to foodshed analysis, the method was applied to the City of Calgary's local food consumption target outlined in the "imagineCALGARY" Plan (2007), and in doing so fills an information gap.

1.2 Objectives

To achieve the stated purpose, five primary objectives were addressed:

- To review current definitions and operationalization of "local food", and assess their strengths and weaknesses

- To review and assess current methodologies to determine total food consumption of a city and food production in the "local area" surrounding the city, as defined above, and using this information, calculate the minimal local foodshed required to meet specified local food goals

- To identify the most appropriate methodologies, given current data availability, to calculate total food consumption and nearby food production for the purpose of creating a baseline foodshed.

- To spatially map the existing food production in the local area

- To demonstrate the proposed method by applying it to the sample city of Calgary, based on the City of Calgary local food goals.

1.3 Chapter Overview

Chapter Two begins with a comprehensive overview of how local had been defined in the literature. It includes consumer perceptions of local and a critical review of the methods used in previous food assessments to calculate local production capacity relative to food demand of a population. Shortcomings and gaps in the existing body of literature with respect to local food boundaries are discussed. Chapter 2 concludes with the conceptual framework that was developed for this research.

Chapter Three describes the methods identified in the literature to analyze food consumption at a local population level and critically compares the strengths and weaknesses of each. A description of the methodology selected to calculate food demand by type and quantity in the Calgary context is provided.

Chapter Four identifies methods in the literature previously used at different scales to estimate food production capacity and critically compares the strengths and weaknesses of each. Methods used to estimate food production in this thesis are described and demonstrated on the city of Calgary. Maximum local food capacity is calculated for production near Calgary and compared to current and future food demand based on Calgary's local food goal from empirical Census of Agriculture data.

Chapter Five demonstrates a methodology for mapping the smallest local foodshed with the potential to meet a percentage of food demand by food type. Key assumption and limitations of the research are identified. Using geographic information systems (GIS) software, local foodshed maps for nine different food groups are generated using the approach of increasing the local production area in nearest land increments until local food demand is satisfied.

Chapter Six provides a summary of the results and a critical discussion on the implications of the findings.

Chapter Seven concludes the study and evaluates its contribution to the literature. Recommendations for further research are identified followed by a brief summary of the thesis.

Chapter 2: How do we define local?

This chapter examines the various ways local has been defined in the academic literature and the professional and popular media. A review of the methods used in previous foodshed analyses and a framework for understanding the local foodshed concept is presented.

2.1 Foodshed Concepts

In spite of the interest in local foods, there is a lack of clarity around the definition in the literature and popular media. We understand what local food is conceptually, but in absolute terms, various definitions have been used.

Statutory definitions define local food by distance or jurisdictional boundaries but other definitions include social and ecological attributes based on perceived health, environmental and economic benefits. Consumer perceptions tend to align with statutory definitions although definitions of proximity are subjective, and various levels of jurisdiction, such as county, region, province or state have been used. However, it is becoming increasingly necessary to have clear definitions of local in order to determine how and what the desirable performance outcomes of a localized food system should be. For example, without consensus on what qualifies as of local food, large scale grocers have leeway in the way they market local food and *local* could be construed at the consumer level as a marketing ploy, thus not gaining desired buy-in. At the political level, clarity around the definition of local is necessary in order to measure performance outcomes or to reduce negative outcomes of food localization efforts.

Foodsheds are analogous to watersheds in that foodsheds outline the flow of food feeding a particular population, just as watersheds outline the flow of water draining to a particular location. Hedden coined the term in his book *How Great Cities Are Fed* (1929), in which he characterized the size and shape of the foodshed by political and economic mechanisms as well as natural physical barriers. The term has since been used in the literature to conceptually define the social and natural geographic extent of a local food supply (Kloppenburg, 1996; Getz, 1991; Feagan, 2007) within close proximity to the food source. But how do we define close?

The size and shape of a local foodshed, according to this understanding, has no predetermined distance or boundary constraint; rather it is dependent upon the food needs of the population being studied and the surrounding food production, which is unique to each location.

2.1.1 Social and Ecological Undertones

Popular and academic literature defines local food and foodshed in a multitude of ways. For example, explicit in the definition for local food, Helen La Trobe's report (2002) for Friends of the Earth, United Kingdom, stated on page 13 that a local food system should deliver social, economic and other environmental benefits, such as:

- local economic welfare benefits;
- food security (feeding the food deserts) and health benefits (fresh food);
- environmental benefits through diversification of agriculture;
- environmental and health benefits by minimizing the carbon footprint;
- environmental and health benefits through sustainable farming practices; and
- social benefits through closer contact between producers, consumers, and the land.

This long list of social and ecological characteristics associated with the term 'local' was intended to imply the development of an entire local food economy brought about by shorter, less centralized food chains involving much closer and greater contact between farmers and the consumers, processors and retailers they serve. As a result, the economic activities associated with local food production, processing and retailing would remain contained within a specific area and lead to a broad range of social, economic, environmental and health benefits to the communities in these areas (FOE, 2002). However, the fundamental problem with inscribing social and spatial characteristics through geography is that the moral conditions are not necessarily linked to a location. Burn and Purcell (2006), cautions the *a priori* assumptions that eating local foods are more ecologically sustainable and socially just in *Avoiding the Local Trap*. Unpacking the list of underlying assumptions may indicate where

policymakers can focus resources to support desirable outcomes not currently provided in the marketplace, or where policies may be counter-productive (Hand and Martinez, 2010).

Attempts by eight European countries to define, or at least develop a common concept of local food at a workshop in European Science Foundation (Amelien, et al., 2006) resulted in a notable difference between northern and southern European perceptions. While there was some overlapping agreement on concepts, generally, the participants from northern Europe associated 'local food' with geography and history, and concepts such as sustainability of production methods, traceability, animal welfare, health and safety. Their southern counterparts developed specific "terroir" or know-how, which included regional aspects of the food that are deeply connected to culture, soil, climate and people.

2.1.2 Statutory Definitions

Statutory definitions in the context of local food systems tend to be geographic in scale. According to the American Food, Conservation, and Energy Act (2008 Farm Act), the total distance that a product can be transported and still be considered a locally or regionally produced agricultural food product is less than 400 miles (644 kilometres) from its origin, or within the State in which it is produced.

Agriculture and Agri-Food Canada has published four ways of geographically delimiting a local food boundary in Canada, including:

- *Geographic distance:* calculated in units of straight-line travel distance, usually with a defined maximum distance but in some cases a minimum distance;
- *Temporal distance***:** calculated in units of time, e.g. the food can be trucked to the point of consumption in 24 hours or less;
- *Political and administrative boundaries***:** based on municipal, regional, or national borders; and

- *Bioregions***:** natural boundaries of an ecosystem.

In Canada, local food is often defined geographically by provincial boundaries. Understandably, urban food systems are embedded in the provincial legislative context and as such it is difficult to address jurisdictional roles and relationships at the various levels of government. Provincial boundaries have been widely accepted as Calgary's local food boundary and the term 'local' for Calgary was defined as Alberta in the Calgary EATS! Assessment published in 2012.

The National Farmers' Retail & Markets' Association (FARMA) in the United Kingdom (UK) offers an accreditation system for participating farmers markets that comply with a particular definition of local and the distance food travels. Typically, that distance is 48-80 kilometres (30-50) miles of the market, or 161 kilometers (100 miles) of London and is decided upon by the market organizers. In some cases, the definition might be the county boundary. The certification system is voluntary and at the time of writing, less than one third of all farmers markets in the UK participate in the certification program, although some abide by the principles just the same (Exner, R. 2010, n.d.).

Canada's Food and Drug Regulations (FDR) have been less concerned with actual distance and describe local food as food that is manufactured, processed, produced or packaged in a local government unit and sold only in the same local government unit or government units that are immediately adjacent to the one in which the food is manufactured, processed, produced or packaged.

In a report on urban and peri-urban food and nutrition, the World Health Organization described local food as "food produced within municipal boundaries" (Chinnakonda & Telford, 2007). However, municipal boundaries vary greatly across nations. In China, for example, all municipal boundaries are designed to be food self-sufficient. They include the surrounding rural and peri-urban areas, which is often many times the size of the built up

urban area (G. Lang & B. Miao, 2013). In many other countries, built up urban areas often exceed municipal boundaries, and no agricultural areas are included.

In June of 2013, the Canadian Food Inspection Agency (CFIA) undertook an initiative to modernize its food labeling approach and adopted an interim policy recognizing local or locally grown food as foods that are produced in the province or territory in which they are sold or foods that are sold across provincial borders not more than 50 km or 31 miles of the originating province or territory. This change reflects an increase in distance between production and consumption under the previous policy but excludes a clause that permits foods grown within distances that met requirements of the FDR, whichever distance was least restrictive to be considered local.

Jurisdictional boundaries can be problematic for localized food initiatives in provinces such as Alberta where a significant percentage (61%) of the province is covered in forested, non-agricultural land (Alberta Land-Use Framework, 2012), or in a province like British Columbia (BC) where food production is highly regionalized (Morrison, 2011). The benefit of defining local food by a provincial boundary in Canada is that local production can be governed under federal or provincial policy frameworks and regulated by various levels of government departments (Forkes, 2011). Generally though, food systems are not neatly contained within political boundaries and governmental agencies have little authority over what happens outside of their respective political jurisdictions.

2.1.3 Consumer Perceptions

Food descriptors like “local,” “farm-fresh,” and “home grown,” are nebulous and conjure up different meanings about the place of local agriculture in the minds of consumers. These concepts have no legal definition nor are they well defined by retailers and food professionals. Political boundaries are often inconsistent with land uses and agricultural conditions and as such, may not be ideal units within which to examine the capacity of local agriculture to meet food needs of the population.

In some instances, an exact distance between production and municipality may be less important in an absolute sense than it is conceptually. Consumer perception of local may be motivated by the amount of food available in a given locality and the goal of the individual or community (Linthicum & Beatley, 2007). For the average consumer, a local foodshed's size and shape may be impacted the by the community's ability to align its procurement and consumption patterns with social, economic, and environmental concerns. From a policy perspective, consumer perceptions of local may help to shape the focus food policy to support desirable goals and identify policies that may be counter-productive.

Results from a comprehensive Canadian review of food systems definitions (Chinnakonda & Telford, 2007), suggest that consumers prefer definitions of local based on proximity of production. In addition, the ability to trace food to its exact source (traceability), preferably back to the farmer, appears to be a significant consideration for consumers of local food.

Results from an American online survey that asked consumers what they considered "local" or "regional, but not local" based on both physical distance and political boundaries (Figure 1) indicated that more than 40% of consumers surveyed considered food produced within one's county as "local." To the majority (70%) of respondents a 50-mile (80 kilometre) radius was considered local, and a 300-mile (483 kilometre) radius was considered regional rather than local (Onazaka, Nurse & McFadden 2010). While there was no consideration for social, political or environmental definitions included in the survey, findings indicated that geographic proximity to where foods are produced was key in consumer's notions of local food.

In a consumer survey on the meaning of local and seasonal food distributed in two upstate New York food stores, respondents differentiated local food from regional food by a particular distance. The majority of respondents (77%) identified local food as food produced or grown within a 50-mile radius of consumers (Wilkins, Bowdish, and Sobal, 2002). The results from both surveys were consistent in that a short distance between production and consumption was an important criterion on the definition of local.

Local was also defined by distance in a survey conducted by the International Food Economy Research Group given to consumers in Guelph, Ontario in 2008. Forty-nine percent of respondents perceived local as food produced within the province of Ontario and 38% percent perceived local as municipal or county. Only a small percentage (8%) of the sample respondents defined local without any specific reference to the geographical area within which food is produced.

Smith & MacKinnon (2007) popularized a geographical 100-mile (161 kilometre) local food boundary in their book the *100-mile Diet.* The book recounts the year-long experience of a couple who restricted their diet to foods grown within 100 miles of their residence in Vancouver, British Columbia. The authors put little thought into the feasibility of meeting their food consumption needs from agricultural production within that radius; rather, the 100-mile radius was an arbitrary choice based on convenience and to counteract feeling disconnected from where their food was grown. In the words of the authors; the 100-mile radius was selected because "it was large enough to reach beyond a big city and small enough to feel truly local."

While the book and the 100-mile radius was greeted with extensive publicity and endorsed by local food advocates, the potential for agricultural production to meet the food demands of a large population within a surrounding 100-mile radius in some cities may be very low. Highly regional farming methods such as industrialized mono-crops, which diminish crop diversity, may limit the amount and type of foods grown in a particular area. Geographic and climatic conditions, soil suitability, and levels of precipitation in a particular region also affect productive capacity, and consequently may impact a locality's ability to satisfy food needs within short distances. Proximity-based definitions resonate well with consumers who are concerned about local as a contrast to the global food economy; however, the larger the population, the more difficult it may be to source an adequate food supply within close proximities.

The 100-mile concept was explored in Calgary (Bailey, Broda, Chan and Ekelund, 2009) by

comparing agricultural census data in 2006 to nutritional recommendations in the Canada Food Guide. The study resulted in an inventory of the types of foods grown within 100-miles (161 km) of Calgary and found that the daily recommended servings of proteins, total fats, carbohydrates and dietary fibre could easily be met by eating only food grown or raised within 100 miles. However, the variety of foods produced locally was limited and results did not include an assessment of seasonal constraints or an equitable share of food production for other localities near the same foodshed.

In general, short distances may work for small populations within, or close to rural settings, but they often prove inadequate for larger, densely populated cities. Time-based definitions appear to be more common in the U.S. than in Europe and may have evolved because of the time required to get to rural agricultural settings from major urban areas and or because of the long haul trucking systems established in the U.S. food distribution system (Chinnakonda & Telford, 2007).

In practice, conflated definitions of local and foodshed that include social and ecological characteristics are largely ignored. Community-based organizations such as farmers' markets and community-supported agriculture (CSA's) tend to opt for concepts that are easier to operationalize, such as a definition of local based on distance (Hand and Martinez, 2010). Culinary tourism initiatives tend to use politically based definitions based on county, regional municipality or provincial boundaries and food security groups often use politically based definitions at city or provincial scales. Box programs that tend to run year round and require access to large amounts of food (often organic), define local at larger scales, such as regions. Often they indicate that they source food regionally in the summer months and wherever they can during the winter (Chinnakonda & Telford, 2007).

Cities with large populations or located in northern climates, where growing seasons are short and soils are incapable of supporting a wide variety of fresh produce, a distance of even 500 miles or farther may be considered local and a significant improvement over the 1200 to 1500 miles that conventional food typically travels (Kremer, 2011, as cited in Pirog, 2001;

Benjamin, 2003). Regardless of the size of the foodshed or the distance between producer and consumer, the feasibility of a local land base to meet a percentage of food demand and still be considered local, is foundational to measuring the success of any kind of food goal.

2.2 Literature Review of Local Foodshed Capacity

Several studies have compared food consumption to production at various scales in an effort to determine a degree of food self-sufficiency for a particular area, but none have sought to establish methods for quantifying the size of the foodshed required to meet local demand by a particular food goal. Various methods of calculation have been used and all, in some way, compare local food production estimates to food needs. Generally, the results of these studies reviewed found that total population in the region of analysis was greater than the available land resources could support. However, these studies were useful as a starting point to understand local foodshed analysis. The following section highlights the key studies that have guided the methods used in this research.

At the national scale, (Gerbens-Leenes, 2001) developed a method to calculate the amount of land required to produce individual food commodities in the Netherlands and feed the population based on national household expenditure data. The methods resulted in an overview of land requirements for more than a hundred individual food items and denoted the effect of different food consumption patterns on total land requirements.

Forkes (2011) evaluated production yield data for total self-sufficiency at the national and regional scale using Canada, and the Greater Toronto Area (GTA) as case studies. At the regional scale, Forkes examined the size of a foodshed required to determine food self-sufficiency for the GTA within three circumscribed areas of increasing size. Results found that the harvested areas within the GTA itself were insufficient to feed the GTA population while harvested areas within a 100-km radius of the GTA (within Ontario only) could potentially provide 100% of food needs for cereals; pulses and most vegetables, but only when no other urban population were supplied food from the same production area. Similarly, when production yields in the Southern, Western, Central and Eastern Agricultural

Regions (SWC-AR), the largest foodshed selected for analysis only flowed onto the GTA, the study found 100% food self-sufficiency for cereals, pulses, vegetables, livestock as well as some roots and tubers and met varying degrees of demand for other food groups analyzed. No assessment was made to determine an equitable per capita distribution of locally produced foods to other urban populations sharing the same foodshed.

At the regional scale, Giombolini et al. (2010) and Desjardins et al. (2010), calculated production yields from within circumscribed, bounded regions; the Willamette Valley in Oregon, and the Waterloo Region in Ontario, respectively. The goal in both studies was to determine whether or not food production of the identified geographic regions could meet the dietary requirements of the region's population, based on nationally recommended dietary allowances (RDA's). The results in both studies indicated that agricultural production was insufficient to meet the recommended dietary guidelines for the size of the population in either region. Calculations of production by this method permit researchers to determine the portion of food needs met within a circumscribed region, but not the reverse.

At the State level, Peters et al. (2002) compared New York State (NYS) vegetable production and fruit production (2003) to vegetable and fruit consumption within NYS based on the dietary guidelines of the United States Department of Agriculture (USDA) Food Guide Pyramid. The objective of both studies was the same: to provide benchmark data on how the state's fruit and vegetable consumption, fruit and vegetable production, and the Food Pyramid recommendations compared with one another. The results of both studies indicated that state production was insufficient to meet state demand for either commodity with the exception of a few crops. Furthermore, a crop-by-crop production comparison to USDA guidelines suggested that optimal dietary requirements could not be met in either variety or quantity. These studies were limited to production only within NYS and no assessment of the size of the land base required to supply the vegetable demand in NYS was made.

At the provincial level in British Columbia (BC), Canada, Morrison (2011) developed map-based methods to calculate production estimates for each Local Health Authority (LHA) in

BC. Federal and provincial agricultural data was compared to food consumption data obtained from provincial nutritional surveys (BCNS). The results indicated that agricultural production in BC was highly regional and that most regions lacked sufficient nutritional variety to form a complete diet. This study was useful in understanding the negative implications of highly regional production on both the local food movement and local food security since regions typically only produced food from one or two groups. Like other previous studies, no attempt was made to assess the size and shape of the foodshed required to meet complete or partial food demand for local populations.

Following similar methods used in regional scale studies, the city of San Francisco conducted a self-sufficiency study (2008) to evaluate the potential of the existing food supply with a 100-mile (161 kilometre) radius of the city. Results suggested that local production could meet a percentage of food self-sufficiency but this was only possible with some foods. As with the previous studies, the San Francisco assessment began with a circumscribed boundary, which included only those foods produced within a 100-mile boundary (161 kilometre) of the city.

Methodologies to estimate the size of the local production area necessary to meet food demand are limited and underdeveloped. The previous studies have explored local foodshed capacity within relatively restricted spatial scales. The goal of this work is to improve the understanding of foodshed capacity by mapping the spatial distribution of crop and pastureland nearest a city with the capacity to meet all, or a percentage of food demand at the municipal level. Peters, et al., (2008) developed a spatial model using a geographic information system (GIS) software program to allocate New York State (NYS) food production capacity to meet the food needs of NYS population centers within the minimum possible distance. Food production capacity was calculated by a theoretical relative productivity of soils obtained from soil and land cover data and the location of agricultural land in NYS. Results of the study indicated that the total population in the region of analysis was greater than the available land resources could support and, as with previous studies, the results provided an estimate of the portion of food needs met within a circumscribed region, but not the reverse.

The previous food self-sufficiency analyses were useful in understanding the potential of local agricultural production from a pre-ordained production zone to meet food consumption patterns or nutritional needs at various population scales. However, missing from all of them was an empirical assessment of a local foodshed with the capacity to meet all or a percentage of food demand of a population based on current production practices and existing agricultural methods. Further, studies to determine a foodshed by a particular municipal food goal were not found. How far out would we have to go to meet food demand or a percentage thereof? Is the distance between production and consumer the same for all types of food and at what distance would food production still be considered local? This thesis addresses these gaps.

In contrast with the previous studies reviewed, this research does not maintain a fixed boundary for food production. Building on mapping methods developed by Peters et al. (2008), this study uses statistical census and annual agricultural production data to develop a methodology to determine the size of a foodshed that could potentially meet all, or a specified percentage of the current or future food needs of a large city based on a municipal food goal.

Given that an expanding number of local food initiatives has placed pressure on municipalities to examine their role in supporting food related projects that enhance current food policy or to explore the creation of a local food policy where one does not exist (Bailey, 2013), a greater understanding of local area production capacity, relative to demand is needed. A spatial or visual understanding of the foodshed associated with local demand contributes new understanding to local food capacity and provides a starting point for future discussions on the development and implementation of local food targets.

For Calgary, a quantitative assessment of where food is produced, the types of food produced and a different way of thinking about the relationship between local food goal targets and foodshed production capacity specific to Calgary is needed in order to advance the goal to increase local food consumption of urban and regionally produced food over the next two decades. The municipal food goal is the impetus behind the method developed in this research and the mechanism is applied to the City of Calgary.

2.3 Conceptual Framework

The following conceptual framework was developed to determine the local foodshed, defined earlier as the local land requirement to meet all (or maximum portion of), or a specified percentage of the current or future food needs of a city based on a municipal food goal. The steps described below were applied to the city of Calgary. Figure 2.3 provides a schematic illustration of the relationship between all of the main elements.

As illustrated, the conceptual framework identifies six main elements and their interconnections:

- food demand,
- local food production
- empirical baseline,
- local food consumption goal,
- spatial plotting of local food production areas; and,
- map of local foodsheds

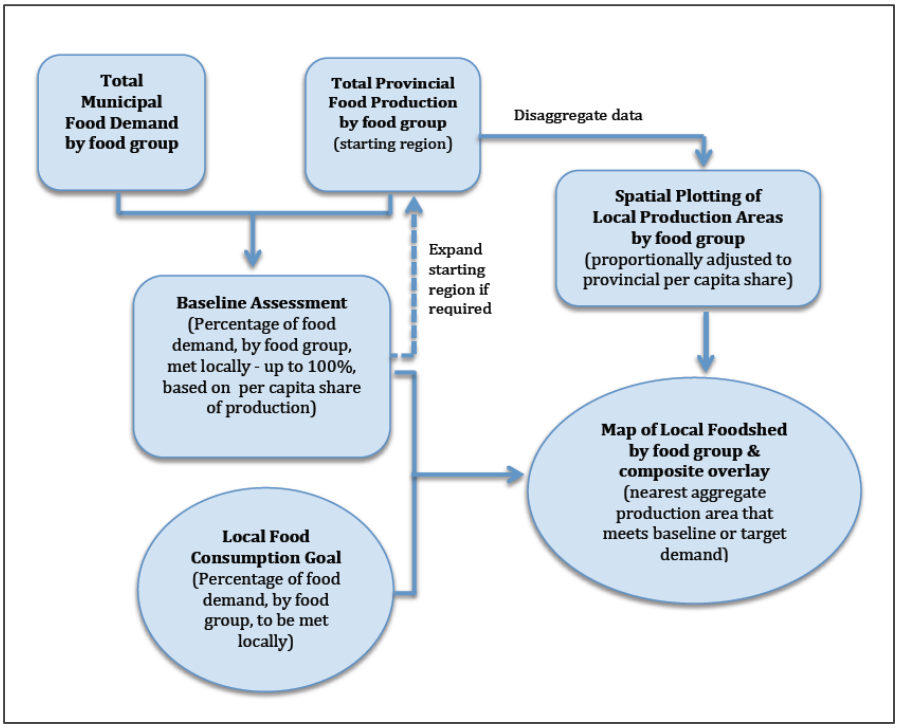


Figure 2.3 Conceptual Framework

Food Demand

To create a local foodshed, one first has to establish what the local food demand is. An operational definition of municipal food demand can be based on dietary recommendations in national food guides, nutritional surveys, consumer food expenditure or national food availability data. A comparison of the various methods is discussed in Chapter Three. For the purposes of determining the types and quantities of food actually eaten relative to current local production, annual national food availability data provides the most appropriate measure of food consumption.

Food consumption data specific to Calgary were not available. Therefore, food consumption patterns in Calgary were assumed to be similar to national-level statistics provided by two national Canadian nutritional health surveys. Average per capita food consumption data from these surveys is applied to the municipal population to quantify current municipal food demand. For future food goals, the average consumption is applied to the projected population for the year corresponding to the goal. A further discussion of the methods used to determine food demand in a Calgary context is also provided in Chapter Three.

Local Food Production

The starting point for assessing current local food production is to put it in a provincial context. The choice of the province as the starting region is two-fold, drawing on the literature discussed above: (i) consumers identify provincial products as local; and (ii) it is conventional practice to use the province (or in the case of the US, state) jurisdictional boundaries because that is the level at which agricultural data is collected and published, and the government level at which agricultural policy is set. Agricultural production data for all provinces in Canada is released at sub-provincial levels (regional and county) providing empirical data and has been a consistent source in the literature from which to estimate local food production. (Maps showing sub-provincial census divisions are provided in Appendix C). Selecting data that can be broken down to the smallest geographic levels available is important for subsequent steps,

i.e., spatial plotting of local production and foodshed mapping.

For the purpose of method design, food production data is organized by food groups to facilitate comparison with food demand. For the purposes of the City of Calgary demonstration, production data was initially compiled at sub-provincial levels for nine selected food groups: wheat, oilseeds, dairy, beef, poultry and eggs, vegetables, fruits and sugars within the Province of Alberta. Fish production was initially considered but excluded because local area aquaculture data was missing. Beverages were also excluded although juices produced from the processing of fruits and vegetables grown locally are included in the data.

Where local demand exceeds production within the starting region (i.e., province), as determined by the baseline assessment, discussed below, it is necessary to explore adjacent regions to identify the nearest production areas outside the province. In the case of Calgary, based on the data used, only two food groups had insufficient production levels in Alberta to meet Calgary's local food consumption goals: fruits and vegetables. A brief review of soil suitability maps and plant hardiness zones in Canada and in the United States indicated that the area east of the Rocky Mountains in Alberta, Saskatchewan, Manitoba and Montana falls within the Western Plains Region. Biogeoclimatic conditions within this region are well suited to grain and livestock production, which was already being met within the province. Further north, more challenging conditions severely limit most agricultural production. However, west of the Rocky Mountains, significant quantities of fruits and vegetables are produced in the Lower Mainland-Southwest, Thompson-Okanagan and Kootenay regions of the province of British Columbia (BC). Therefore, fruit and vegetable production zones in these regions of BC were included in Calgary foodshed calculations. Production estimates for these crops likely resulted in an overestimation of supply, since no assessment of local fruit and vegetable demand for British Columbia's population was made. The methods used to calculate local area food production, relative to food demand are discussed in Chapter Four. Numerical production tables for the selected food groups are located in Appendix A and B.

Empirical Baseline

Calculations, described in Section 4.4 of Chapter 4 are made to compare empirical food production and consumption data to determine whether or not provincial production is sufficient to meet food demand. The maximum percentage that can be met, up to a maximum of 100%, is calculated. This provides a quantitative baseline for assessment of local food self-sufficiency, and indicates whether the starting region needs to be enlarged. In the case of Calgary, this type of baseline assessment had not been previously done.

Comparing food demand in one city to the entire production capacity in the province will produce an overestimate, as a local food policy would need to address local food needs of the rest of the provincial population. To address this, production capacity is adjusted to reflect the portion potentially available to the locality in question. While accuracy is important to production estimates, it is also important to have a method that is simple enough to enable ease of data collection and calculation. Thus, simple rather than weighted averages are used. A fundamental assumption was that all foods produced locally would be available in the local system and that provincial production would be shared equally across the provincial population and not just flow into one city. As such, calculations were made to account for equitable per capita distribution of all foods grown and produced within Alberta. The per capita share of production for the population in BC was not assessed. For simplicity of method design, fruits and vegetables grown in LMS, Okanagan and Kootenay regions of the province of BC were calculated by the same proportional distribution. Based on statistical data, this was a conservative assumption for the quantity of fruits and vegetables that BC might export given that approximately 53% of vegetables and over 90% of fruits in 2011 were exported from BC in 2011 (BC Agri-food Industry Report, 2011).

For Calgary, the supply of provincial production potentially flowing into Calgary was estimated as roughly equal to 1/3 of that produced in Alberta since Calgary's population is approximately one third of the provincial population. Once this initial baseline is created, it serves as the benchmark from which future food needs can be measured.

Local Food Consumption Goal

Next, a local food goal, which can be current or future, is inputted based on stated goals. To meet targets at some future point in time, food demand must be projected. The simplest, most straightforward method to calculate future food demand is to calculate the current average per capita food demand and apply it to population projections.

Projected population estimates can generally be obtained from population outlook reports produced every five-census year. Food demand is calculated by multiplying the baseline average per capita consumption patterns by the projected population. This step assumes that eating habits in the future would be similar to current eating habits and that only the number of people being fed would change. It is further assumed that food production in the local area remains constant in the future.

For Calgary, a 30% of local food consumption goal was applied to each food group for the projected population in 2037, which was obtained from the City of Calgary population outlook report, release every five-census year. Although Calgary's food goal was set for 2036, population data was not available for that year; thus, the population in 2037 was selected. A discussion of local food consumption goals is located in Chapter Three.

Spatial Plotting of Local Food Production

The next step is to spatially plot the local food production. Food production data for the smallest geographic scale available is entered into a geographic information system (GIS) to spatially plot the food supply in the starting region for individual food groups. Production capacity is averaged over each land unit, and adjusted to reflect the per capita share available to the city.

As Peters, Bills, Lembo, Wilkins and Fick (2008) demonstrated, the use of GIS to compile and integrate land-use information and empirical production data is a critical step in order to

determine which food production areas are within the closest distance of a city, and to be able to calculate the amount of food each of those areas can supply to a locality. Discussion of the methods used is available in Chapter 5.

Map of Local Foodsheds

Once all the production areas in the starting region are plotted, an incremental approach is used to determine the nearest production areas required to meet the baseline demand, or a stated portion of local demand. Starting with the nearest production zone, production zones are incrementally added in an outward fashion until the baseline or target demand could be met in each food group. The aggregated area that meets the demand forms the foodshed for the individual food group. Overlaying the foodsheds for individual food groups creates a composite foodshed for the city. The advantage of this approach is that it enables a local foodshed to be determined for food goals of any size and for any variety of food groups.

For Calgary, foodsheds for each of the nine selected food groups were produced for two time frames. The first was for the baseline demand, based on maximizing the amount of local demand that could be met, up to 100%, as calculated in the baseline assessment. Then, the foodshed that met the target goal of 30% of food demand for the projected 2037 population was mapped by food type. A fundamental assumption was that future food production levels would be consistent with current production levels. Foodshed maps for each of the food groups and a discussion on techniques including the assumptions and limitations of the mapping methods are found in Chapter Five.

Chapter 3: Food Consumption

Food demand specific to a local population is typically missing in the literature and studies with consideration for food demand by a cultural diverse demographic are also limited (CFC, Serecon, 2012). This chapter reviews methods commonly used in the literature to estimate food demand at a local population level and critically analyzes the strengths and weaknesses of each. The method adopted in this thesis to estimate local food demand is explained and applied to the Calgary case.

3.1 Estimating Local Food Demand

In order to determine a local foodshed, one first has to establish local food demand. The most common methods found for estimating food demand of a local population are:

- Recommendations in national Food Guides (Giombolini, 2010; Desjardins, 2010; Peters, 2002, 2003);
- Nutritional surveys, at the National or Provincial level (Morrison, 2011);
- Household Expenditure Data (Gerbens-Leenes, 2001; CFC, Serecon, 2012); and
- Empirical Food Availability (Forkes, 2011).

Food Guides

Nutritional requirements per person from recommended daily allowances (RDA's) in national food guides and pyramids across a variety of food groups have been used to calculate local food demand (Giombolini, et al. 2010; Peters, 2002, 2003). Methods using dietary guidelines can provide an idealized estimate for individual-level caloric intake based on healthy food choices of the population. Estimating consumption patterns by this method does not tell us the type and quantity of food that is actually consumed by the local population or is available for consumption. Furthermore, daily recommendations are based on levels of activity ranging from mildly active to very active by gender and age, which is difficult to quantify. Therefore,

consumption estimates based on RDA's were not considered the most effective source of food consumption estimates in this study.

Nutritional Surveys

In Canada, the Bureau of Nutritional Sciences occasionally carries out nutrition surveys in collaboration with the provinces to determine the dietary intakes of Canadians (Morrison, 2011). The most recent national dietary survey from which the food and nutrient intakes of Canadians were collected was Nutrition Canada in 1970-1972 and at the time of this writing, the most recent provincial nutritional survey from which the food and nutrient intakes of Albertan's was published in 1994 (Health Canada, 2010). Nutritional surveys are typically self-administered diet history questionnaires that collect information about the quantities and types of foods that were *actually* eaten, however, these surveys are not without limitations. Surveys exclude certain populations, such as the homeless, Aboriginal people living on-reserve, those living in remote and isolated communities, and those not able to speak English or French. Data is collected is at the household level and the list of foods gathered may include a wide variety of products difficult to track and analyze. Additionally, data would not include food spoilage and waste at the household level unless grocery receipts were included in the study, which may result, in an underestimation of food demand (Timmons, et al., 2008).

Dietary surveys provide an estimate of the quantities and types of foods that were *actually* eaten and they are useful to measure demographic variations and regional differences in consumption habits where gaps in provincial agricultural census data is insufficient to calculate food demand. However, since it is possible that changes in food habits may have a significant impact on the applicability of non-current data to current food demand over time, and, given the limitations mentioned above, nutritional surveys were not considered the most appropriate method for estimating consumption for a local population for the purpose of this research.

Food Expenditure Data

In contrast to dietary surveys, population-level food consumption has been estimated from national or provincial level Survey of Household Spending (SHS) data (Gerbens-Leenes, 2002; Thompson et al 2008; CFC, Serecon, 2012). Food expenditure is closely related to the notion of access to food since it is based on the amount of money the average household spends on food per year. Since the percentage of food expenditure declines as a percentage of income, economic disparity may impact food expenditure and consequently influence estimates for food demand by this method.

Food Availability

Formerly called national food disappearance (NFD), food available represents amount of food available for human consumption in the domestic food system. It is calculated by taking the amount of imported and domestically grown foods at the beginning of a year and subtracting ending supplies, exports, foods produced or imported for livestock feed and waste at the macro level at the end of the year. This residual is then divided by the national population without any adjustments for age, gender or other dietary considerations to determine a national per capita estimate of foods consumed and has been used as a proxy for per capita food consumption at regional and municipal scales (Morrison, 2011; Cowell & Parkinson, 2003; Peters, Bills, Wilkins & Smith, 2003; Johansson, 2005). Since food available at the national level may not accurately reflect the food consumed at the regional or local population level, NFD data is often combined with nutritional guidelines to estimate food demand to ensure that food demand is met with a sufficient quantity and quality of food for optimal health.

One of the weaknesses with food available data is that it does not tell us the quantity and types of foods that are actually purchased or consumed per person per year. Food availability data does not account for differences in food demand by age or gender and has a limited ability to account for potential regional differences in food demand. Individuals in various age demographics such as children or the elderly may have different food requirements, and the

variations in consumption levels may produce underestimations and overestimations in food consumption estimates.

However, annual publications provide consistent and current information on the amount of food that disappears from the domestic food system after consideration for waste and spoilage at the macro level. This is an important distinction because food spoilage and waste at the retail, restaurant and household level is unaccounted for in food expenditure estimates or nutritional surveys, and if ignored, may produce a significant underestimation of local demand, thus, adding a level of inaccuracy in the results. Further, since data is reported at the aggregate level and divided by the population, food available data may be less susceptible to human error in reporting at the household level.

3.2 Method Choice

Since specific data for food demand for a city was not available, the use of statistical Food Available data was considered the most accurate and realistic source from which to estimate a city's food demand for the purpose of this research. To accurately match demand to supply, all food brought to the city, including that which is lost to waste at the retail and household level, needs to be factored in, which Food Available data does. As discussed above, there are significant shortfalls in estimates for demand from the national food guide and sales data from some food vendors is known to be incomplete. Further, as stated above, nutritional surveys may include food products difficult to track and analyze and could exclude food spoilage and waste at the household level resulting in an underestimation of food demand. Thus the food available approach is used to estimate demand in this foodshed model.

3.2.1 Common shortcomings in Consumption Estimates based on averaging across a population

Estimating food demand by averaging consumption patterns across the population to can be problematic since personal eating patterns are influenced by age, perceptions, affordability, ethnicity, and cultural dietary preferences. All methods above apply averages to the municipal population but how closely these averages reflect actual consumption depends upon economic

disparity, the incidence of food deserts, and the speed at which the ethnic and age composition is changing. Nonetheless, it is still a reasonable assumption of feed demand for the purpose of the method in this research.

Food deserts, where nutritious and affordable foods are hard to come by, have been long thought to influence eating habits and food purchases. However, as cited by Storrs, (Storrs, 2011), a recent study published in the Archives of Internal Medicine found that living near a supermarket had no measurable impact on fruit and vegetable consumption or the overall quality of a person's diet. The study tracked the eating habits of thousands of people in four major cities, over a 15-year period, and concluded that food purchases food preferences and affordability may be stronger indicators of what people purchase than access and availability.

Although Calgary has a culturally diverse population that is expected to increase in size primarily through immigration, with a shift to an older and more culturally diverse demographic in the future (CFC, Serecon, 2012 this methodology does not attempt to factor in changes in future food demand. Changes to the demographic composition may drive changes in consumption patterns of the local population, however, due to the uncertainties and complexity of trends in ethnic compositions and future eating habits, it is difficult to accurately forecast or project future capacity for long term local food goals. Monitoring such demographic changes over time will provide a more comprehensive understanding of the current food consumption trends.

3.3 Food Demand in Calgary

In the Calgary EATS! Food System Assessment published by the City of Calgary in April 2012, a lack of available information that was geographically specific and consistent over time was identified as a barrier to calculating food demand for Calgary. As a result, similar to Gerbens-Leenes (2001), estimates of food sales from provincial retail establishments were broken down on a per capita basis and used as a surrogate for per capita food demand in Calgary. Since retail sales data only provides information on consumer's food purchases at the household level, nutritional intake recommendations from *Eating Well with Canada's*

Food Guide were applied to the population of Calgary to estimate total food demand (by weight in tonnes) for various food groups.

Using this approach, food demand for adults in Calgary between the ages of 19-50 years resulted in 20,477 tonnes of protein, 5,560 tonnes of fat, 52,200 tonnes of carbohydrates and 10, and 238 tonnes of dietary fibre per year. In contrast, food available data (2010 and 2011) suggests that on average, Canadians consume more than five times as much protein, 1.5 times as many carbohydrates, and 32 times more fibre and fats per annum than recommended in *Canada's Food Guide* (Table 3.3). By these estimates, recommendations of nutritional intake from national food guides resulted in an underestimation of food demand at the local level and may provide an idealistic estimate. Figure 3.5 displays national per capita consumption in 2011 that was used to estimate the food demand in Calgary.

Table 3.3 Comparison of Food Availability Data to Canada's Food Guide, 2011

Food Group*	Food Guide*	Actual Consumption*	Actual % of Food Guide
Proteins	20,477	104,355	509%
Fat	5,560	178,029	3202%
Carbohydrates	52,200	84,400	162%
Dietary Fibre	10,238	332,604	3249%

*All calculations in tonnes
Proteins were compared to consumption data for meats, fish and eggs
Fats were compared to consumption data for milk and dairy, oils
Dietary fibre were compared to consumption data for fresh and processed fruits and vegetables
Carbohydrates were compared to consumption data for cereal products

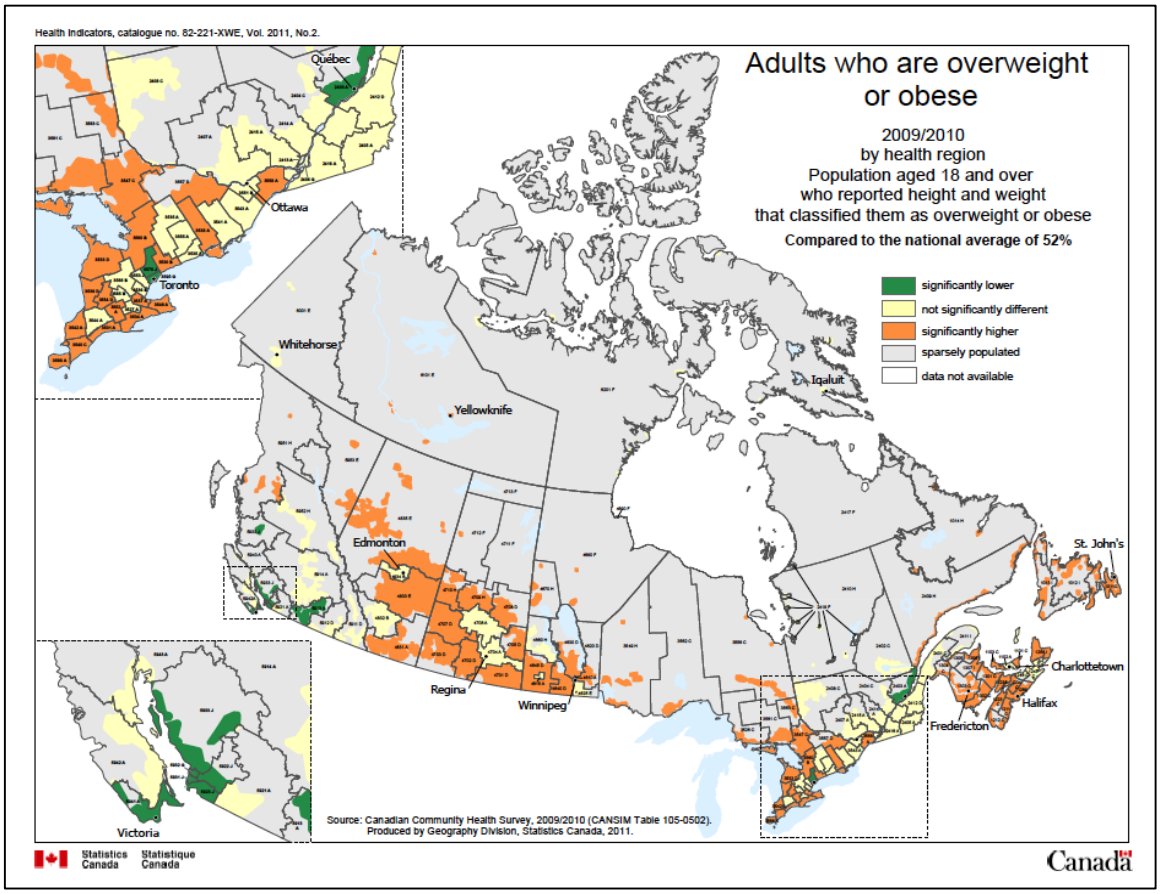
Specific data for food demand in Calgary is not available, so the Food Available approach was used. While there are studies that analyze food demand/availability for particular segments of the population (Fernando, J., 2013; Andreyeva, Long and Brownell, 2010), none have been conducted for the population as a whole. While these studies underscore the factors influencing demand, for the purpose of this kind of model, it is more important to have a good ballpark figure of total demand, such as that provided by food availability data, rather than more specific but incomplete data. Once the base model is created, it would be possible to incorporate these demand factors and trends into the demand estimate to create a more complex model, if desired.

Several studies have shown that Calgary's food consumption pattern is in line with national

averages. A review of two Canadian Community Health Surveys (CCHS), indicated that Calgary's eating habits were comparable to national eating habits and met the overall nutrient requirements of Canada's Food Guide. Findings from the first CCHS (2004), published in the *Overview of Canadians' Eating Habits* (Garriguet, 2006), indicate on average, that Canadian eating habits are within the "acceptable macronutrient distribution ranges" (AMDR). In other words, when averages were considered, Canadians were generally within acceptable ranges for the number of servings from the four major food groups and the percentage of calories from fat, protein and carbohydrates. This was generally true for both sexes; all age groups, by region, and by household income.

Other CCHS findings also show Canadian dietary habits to be similar across the country, although Garriguet (2006) noted averaging dietary intakes using the AMDR method could mask the fact that many people do not have a balanced diet. However, CCHS results (Statistics Canada, 2009/2010) found the number of Canadian adults classified as overweight or obese in the Calgary region was not significantly different from the national average. Figure 3.3 provides a map showing the regional distribution of obesity or overweight populations across Canada in 2011.

In addition, Calgary's demographic profile is not dramatically different: 82% of the current population in Calgary is over fifteen years old; and the median age in Canada and Calgary is currently 40.6 and 36.4 years old respectively (Statistics Canada, 2011). Finally, based on findings in the Canadian Community Health Survey 3.1 (2005) the average weight and height of adults in Canada were similar to the average weight and height of adults in Calgary. Therefore, food consumption patterns in Calgary could be assumed to be similar to the national average, and thus per capita national food availability data could be used to estimate Calgary's total food demand. Based on this data, the recommended daily allowances (RDA's) in *Eating Well with Canada's Food Guide* were met, so no further modifications were needed. Calculations and results used in this thesis are specific to Calgary's current context.



Statistics Canada, 2011. Map of overweight or obese population over 18 by region.

Figure 3.3 Regional Map of Overweight or Obese Population, Canada 2011

3.4 Food Consumption Calculations and Findings

Both current and projected populations of Calgary were required in order to explore the feasibility of achieving Calgary's 30% local food consumption goal. Population outlook reports produced by the City of Calgary every five-census year were consulted for municipal population trends and forecasts (City of Calgary, 2007). Since no forecasts for the population in 2036 were found, this study based the local food consumption goal on the projected population of Calgary in 2037. Table 3.4 provides census population data for the city of Calgary in 2011 and projected population forecast in 2037 (Statistics Canada, 2011).

Table 3.4 Current and Projected Population of Calgary

Population Forecast	2011	2037
Calgary	1,096,833	1,562,600

Per capita consumption estimates for nine food groups **(**fresh and processed fruits and vegetables, poultry and eggs, milk and dairy, red meat, cereal grains, sugars, oils and fats**)** from Food Available statistics was multiplied by the current and projected future population and used as a surrogate for municipal food demand in Calgary. Food consumption levels for 2037 were calculated using the same methods as for 2011 and assumed national consumption patterns were constant.

Per capita food consumption data was disseminated in units of weight (kilograms), which were converted to metric tonnes in order to maintain a common unit of measure with food production. Table 3.5 provides the municipal food consumption estimates for the selected aggregated food groups.

Table 3.5 Total Municipal Food Demand, Calgary

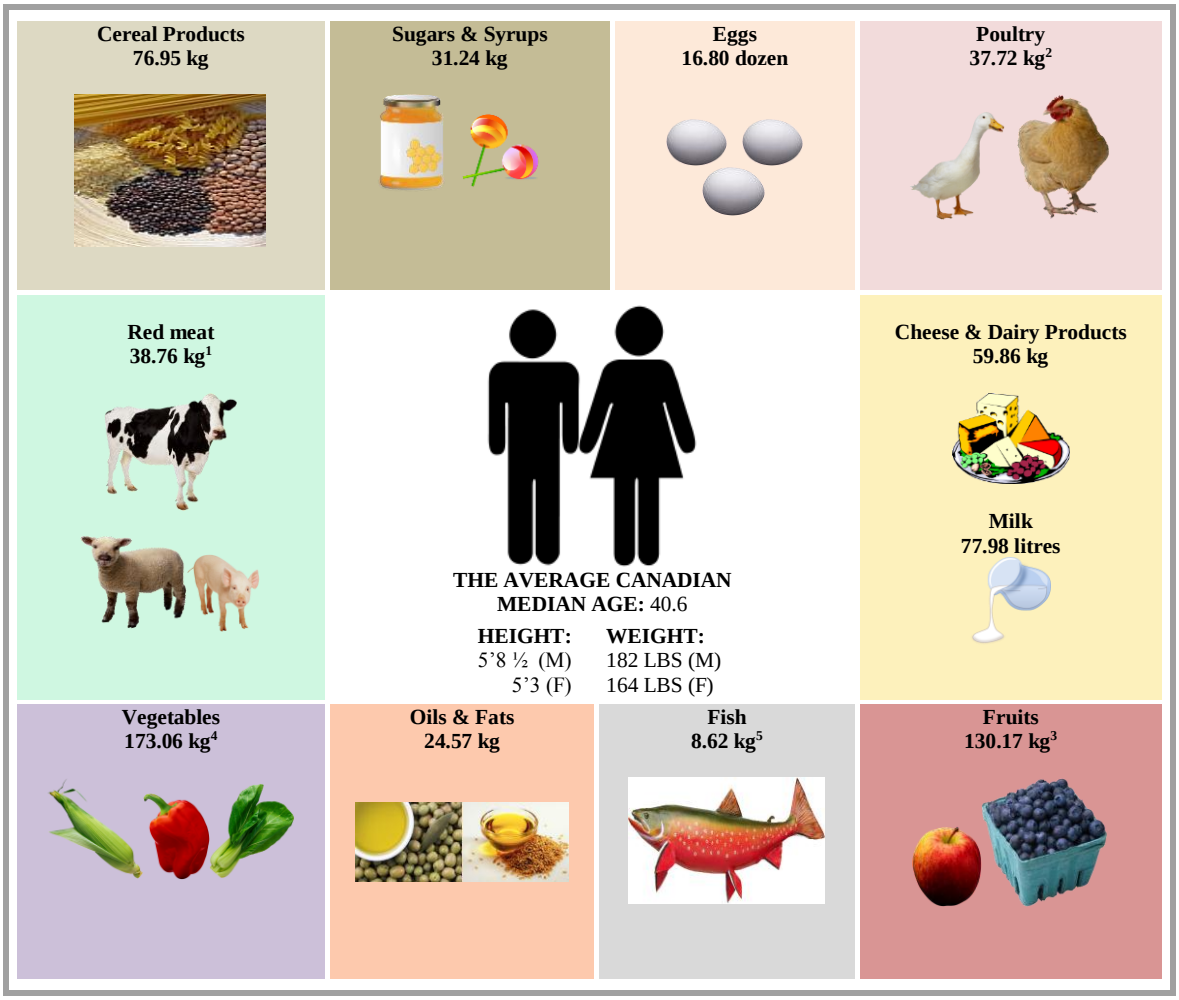
Selected Food Groups	Estimated Total Food Consumption*, 2011	Projected Total Food Consumption*, 2037
Cereal products	84,400	120,242
Oils and fats	26,840	38,393
Total Milk and Dairy	151,189	215,389
Red meats, carcass weight	42,500	60,566
Poultry, live weight	41,400	58,941
Eggs (dozens)[1]	18,426,794	26,251,680
Vegetables	189,829	270,424
Total Fruits	142,775	203,404
Sugars and syrups	34,265	48,816

Source: Statistics Canada (2011) Table 002-0019: Food available by aggregated food groups in kilograms per person, per year in Canada. Does not adjust for losses, such as waste and/or spoilage, in stores, households, private institutions or restaurants or losses during preparation. Total Consumption converted to tonnes and may not be exact due to rounding.

*Total fruits and vegetables include fresh, processed, and greenhouse production data.

[1]Eggs are estimated in dozens consumed per annum

The national per capita food consumption estimates for the nine aggregated food groups in this research are presented in Figure 3.4.



Notes: Food consumption per person was based on food availability data from Statistics Canada, 2011 (CANSIM Table 002-0019). Does not adjust for losses, such as waste and/or spoilage, in stores, households, private institutions or restaurants or losses during preparation. Amounts are in carcass weight unless specified otherwise. Average median age in Canada based on Statistics Canada census profile, 2011. Average Canadian height and weight provided by Statistics Canada 2005, Canadian Community Health Survey 3.1.

1. In carcass weight unless otherwise specified.
2. In eviscerated weight unless otherwise specified.
3. Includes fresh fruits, processed fruits in fresh equivalent and fruit juices in fresh equivalent.
4. Includes fresh vegetables, processed vegetables in fresh equivalent and tomato juice in fresh equivalent
5. In edible weight

Figure 3.4 Per Capita Annual Food Consumption in Canada, 2011

Chapter 4: Food Production

The following chapter describes the methods used in the literature to estimate food production with the capacity to meet the food needs of an urban population or a percentage thereof. The most appropriate method of estimating local production for the purpose of the foodshed model are discussed. The method adopted in this thesis to estimate local food production is applied to the Calgary case. Specific details to calculate food production by type and quantity in the Calgary context are described in this chapter.

4.1 Estimating Local Production

There is no standard method in the literature for estimating the quantity and diversity of crops and livestock produced locally. The literature identifies different metrics that have been employed to measure farmland production such as raw weight or farm-gate wholesale or market value (CagaryEats, 2012; Gerbens-Leenes, 2001) and the actual land area used in food production (Giombolini 2010; Forkes, 2011). Common methods found in the literature for estimating food production, are farm sales and land use. Generally, land-use methods include estimating potential land capability (agro-ecology) or by estimating actual farmland production from empirical sources.

Farm Sales Approach

The farm sales approach uses wholesale or market values to determine production. The advantage of using wholesale or market values is that data is readily available and that product sales are easy to compare to consumer food expenditure data. Furthermore, there are fewer complexities in calculations of the overall output compared to other methods in which individual products are usually measured by weight; their varying densities make measuring overall agricultural output difficult. However, production estimates using this method also have disadvantages (BC's Food Self-Reliance, 2006). For example, using wholesale value does not link food production to an agricultural land base and typically does not account for

imports and exports, or include direct sales from suppliers such as farmers markets or small independent grocers. Imports wholesaled locally could lead to an overestimate of production whereas lack of reporting from smaller independent grocers and farmers market, potentially underestimates production. Farms cash receipts between commodities or provinces may contain inconsistencies due to the quality and lack of available data sources at the Provincial level (Statistics Canada, 2010). Furthermore, as Gerbens-Leenes (2001) points out, the yields of individual commodities that contribute to products in the local food system may be difficult to measure and assumptions may have to be made to determine the percentage of food produced for local and non-local use.

Agro-ecological Land-Use Approach

The agro-ecological land-use approach calculates the production potential of the agricultural land. The United Nations Food and Agriculture Organization (FAO) have developed an agro-ecological zoning system (AEZ) to help analyze the appropriateness of various types of agriculture in specific regions. Using this method, estimates for crop production are based on a range of ecological variables, including soil quality, land elevation and slope, temperature and temperature variability, precipitation, and access to water. These ecological variables are analyzed to define agro-ecological zones from which the suitability for specific crop production within each zone can be estimated to meet local consumption. This method has been used by Johansson 2005; Mertens and Silverman, 2005 and 2007 and is useful for estimating the impacts to crop yields over time at different scales, including national, regional or municipal. However, estimates by agro-ecological methods are theoretical in that they result in an assessment of the types of foods that *could* be grown and produced in a particular area rather than an estimate of the types and foods that *are* grown and produced in that area.

Actual Land-Use Approach

A more realistic calculation of local area production comes from empirical production data published every year at Provincial and sub-Provincial levels in Canada, or at the State level, in

the case of the United States of America (U.S.). Empirical estimates can eliminate some of the challenges encountered in a wholesale value approach to foodshed analysis. Significantly, empirical production data eliminates the need to address imports and exports as they net out on a weight basis (BC's Food Self-Reliance, 2006). One of the challenges with the agricultural data is that crop yields may vary significantly from year to year and production values may depend on both yields and market prices. Another challenge is the use of various units of measure used in crop production, such as bushels, acres and tonnes, which are not used equally across all food types and are not always directly comparable to consumption metrics. For example, some crops are reported by the number of bushels, some by centum weight or tonnes, and others by the number or acres planted and harvested. Eggs are reported by the dozen or number of flats, livestock by the number or head, and milk by volume in litres. Consequently, data gathered by this method may require more calculations and mathematical conversions to establish comparable units of measure than one that is comparable with demand.

4.2 Method Choice

The empirical data associated with the Actual Land Use approach was considered the most appropriate source of production information for the purpose of the foodshed model, in spite of the unit conversion challenges to compare it to demand. Unlike farm sales, which do not provide location-specific production information, empirical data provides the location and number of hectares in use for pasture or permanent crops at the smallest sub-regional geographic scale available, which can be spatially mapped – a pre-requisite of the foodshed mapping process – and aids in the policy decision-making process for future land use changes. The empirical data is preferred to the theoretical agro-ecological data because the intent of this thesis is to provide a baseline foodshed based on existing production. Those wishing to use the model to assess what might be possible could substitute theoretical data instead.

Ultimately, the results from all approaches are approximations in so far as none considers economic or social factors influencing global and local food production. Morrison (2011) and Mertens, (2007) point out that the consumption of food products outside of a local production area often drive the types and quantities of crops planted locally. Therefore, local populations

may not always be the primary beneficiaries of high yields. The logical starting point for calculating local food production using empirical data is the province within which a city resides because that it the level at which agricultural production is collected and published and the level at which food policy is set. Further, consumers identify local products with provincial boundaries and starting with the province provides a database of production information that all other cities in the same province may use. This can be more complicated for cities that lie on or very near to a provincial boundary, such as Ottawa, Ontario, where two provincial jurisdictions (Ontario and Quebec) might be considered local. A limitation of food production assessment using provincial data is that annual production estimates do not consider the seasonal availability of crops that may only be grown at certain times of the year, as the data is reported on an annualized basis and thus assumed to be available year-round. This seasonality factor may result in an overestimation of the amount of local demand that can be met with local fruit and vegetable production: some of these crops might be produced in excess of local demand in seasonal months, yet need to be imported from elsewhere to meet local demand during the off-season, which might not be apparent when the total annualized production is compared to the total annualized demand.

Calculations about exports are not factored into this study. Instead, it was assumed that all food production would be available for consumption within the region it was produced. Ignoring exports is intentional as it is important to have a baseline of production on which to base discussions and decisions. In this sense, using actual production is still another form of estimating the land production *potential* to address local food needs, based on the potential to divert export crops to local markets, rather than being based on the potential to change the crops grown *and* the markets they serve.

4.3 Baseline Assessment

To create a baseline, calculations, described in this chapter, are made to compare empirical food production and consumption data to determine whether or not provincial production is sufficient to meet food demand. Quantitative assessments of local food production capacity enhance the ability of policy makers to develop innovative local policy and implement local food goals. Methods to create the baseline used federal census and provincial agricultural

datasets for a Canadian province. In North America, these datasets are commonly available across all provinces and States in the case of the United States (U.S.) and methods are applicable to other provinces and states.

The amount of production potentially available to support municipal food demand is quantified and used to determine whether or not provincial production is sufficient to meet 100% food demand or a percentage thereof. As mentioned above, data gathered by this method may require more calculations and mathematical conversions to establish comparable units of measure than one that is comparable with demand. The supply of production potentially flowing into one urban centre was estimated as a per capita share of production in the starting region. Once this initial baseline is created, it serves as the benchmark from which future food needs can be measured and determines whether or not the starting region for production needs to be enlarged.

Since future food production is sensitive to various aspects of global and environmental change, such as land-use policies, soil degradation, diminished water availability and climate change on the one hand, and new technologies and improved management on the other, this research cannot state with any certainty that food supply will meet expected demand in the future. Therefore, it was assumed that food production patterns were constant in the study years with the only changes being an increase in the population in the future. It was further assumed that local and regional land use plans were constant in the future. No other components such as food processing and manufacturing, production methods and agricultural practices were included in the analysis. Essentially, this research explored the capacity of local area production to meet current and future food needs of an individual city in the context of commonly used definitions of local.

4.4 Production Surrounding Calgary

The following section describes the method used in this study to establish a baseline of local food production surrounding the city of Calgary. The starting point for assessing current local food production was the province of Alberta. The majority of production data used for

Calgary calculations was sourced from agricultural census data available from Statistics Canada (2011) and the annual Alberta Agriculture and Rural Development Yearbook (AARD, 2011). Additional information for beef production was obtained from the Alberta Beef Producers website (www.albertabeef.org).

It was assumed that provincial production in Alberta would be distributed equally between all population centres within the province. Given that Calgary's population is approximately one third of Alberta's population, it was therefore assumed that the supply of provincial production available for consumption in Calgary is equivalent to 1/3 of Alberta's total production. For simplicity of method design, fruits and vegetables grown in LMS, Okanagan and Kootenay regions of the province of BC were calculated by the same proportional distribution, rather than by a provincial per capita share for the population in BC. Based on statistical data, this was a conservative assumption for the quantity of fruits and vegetables that BC might export given that approximately 53% of vegetables and over 90% of fruits in 2011 were exported from BC in 2011 (BC Agri-food Industry Report, 2011).

For Calgary, production data from the Alberta Agriculture and Rural Development Yearbook (AARD, 2011) was compiled at the sub-provincial level for a selection of aggregated food groups in order to estimate local area production capacity. Although fish production was originally selected as a food group for analysis, local fish farming data in Alberta were not available in the statistics, and therefore were excluded from the analysis.

For ease of calculations different units of measure were converted to tonnes for all crops and livestock, In reality, much of Alberta's production is exported to non-local markets; however, as discussed above, estimates were based on the assumption that locally produced foods would be available to meet or not meet the supply-demand ratio of the local population. The maximum percentage that can be met, up to a maximum of 100%, is calculated. This provides a quantitative baseline for assessment of local food self-sufficiency, and indicates whether the starting region needs to be enlarged. In the case of Calgary, this type of baseline assessment had not been previously done.

Table 4.4 summarizes the production estimates for the selected food groups in Alberta before and after calculating the equitable per capita distribution of food within the province. Details of the methods used to estimate production by individual food group are contained in Sections 4.4.1 to 4.4.9. Detailed food production tables at the Census Consolidated Sub-division (CCS) level are available in Appendix A.

Table 4.4 Alberta Food Production Estimates, 2011

Food Groups	Estimated Total Production	Estimated Production After Equitable Per Capita Distribution
Wheat	8,909,300	2,969,767
Oils and fats[1]	5,300,000	1,766,666
Total Dairy	669,563	223,188
Red meats[2]	748,600	249,533
Poultry[3]	141,427	47,142
Eggs (dozens)	50.053,000	16,684,333
Total vegetables[4]	41,431	13,810
Total fruit[5]	284	95
Sugars and syrup[5]	703,103	234,368

*Production estimates are in tonnes. Amounts are not exact due to rounding.
[1]Oilseed production is based on refined production of flaxseed and canola only.
[2]Production is for carcass weight beef only and does not include other livestock.
[3] Eviscerated weight, chickens and turkeys only
[4]Estimates include fresh processed and green house vegetables for major commercial vegetables in AB only.
[5]Estimates include fresh fruit and nuts and processed fruits.
[6] Unrefined weight

4.4.1 Wheat

Total production of principal field crops in Alberta, including major/specialty crops and forages, was estimated at 31.5 million tonnes (Statistics Canada, AARD 2011). One of the limitations in the analysis of this food group was that with the exception of wheat, no information was found to determine the proportion of grains and cereal crops that are processed into the vast array of products we consume. Therefore, the analysis of production in this food group is based on wheat production only.

According to *Wheat Sector, An Overview of Wheat Sector in Manitoba,* 67 (1 kg) loaves of bread, 36 (1 kg) boxes of wheat flake breakfast cereals or 19.05 kg of pasta can be produced from one bushel of wheat. Multiplying the weight of the three processed foods by the number of bushels in a metric tonne (36.743) found that a tonne of raw wheat is required to produce

the equivalent of roughly 1.5 tonnes of the breads, pastas and some of the processed cereal products that we consume at the end of the food chain.

Total wheat production in Alberta reached for 8.9 million tonnes in 2011 or 2.97 million tonnes after adjusting the total amount for an equitable distribution of wheat to other populations in Alberta. Based on these estimates the wheat produced and grown within Alberta could potentially meet 100% of Calgary's 2011 demand and 100% of the projected demand in 2037 for breads, pastas and wheat based processed cereal products. Further research to understand how wheat and other grains are processed into food for human consumption or used indirectly for livestock feed and industrial purposes would be useful for a more meaningful analysis of local wheat production.

4.4.2 Oils and Fats

In Alberta, canola, flaxseed, soybeans and sunflower seeds are commercially grown oilseeds and processed into cooking oils, personal care products, or grown for industrial uses and animal fodder. While a portion of corn may also be processed into corn oil for human consumption, in this study, the statistical data generally categorized corn production under cereals, forages or specialty crops. Therefore, it was considered a grain and was not assessed for its potential to provide corn oil. Future research would be useful to determine the portion of corn production that is processed into corn oil, other manufactured goods and livestock feed.

Alberta is a major exporter of oilseeds in both raw and manufactured state. Production data for sunflower and soybeans was reported by the number of acres planted and harvested rather than by weight, and therefore not accounted for in the calculations for oilseeds. However, provincial production of canola and flax seed totalled approximately 5.3 million tonnes (AARD, 2011). Divided by 3 to permit an equitable provincial distribution of canola seed to other population centres, approximately 1.7 tonnes of canola seed could potentially be processed to meet Calgary's food needs.

Canola seeds are generally refined into oil for human consumption and meal for livestock feed (Manitoba Canola Growers, March 15, 2014. n.d). It takes about 2.4 tonnes of canola seed to produce one tonne or 1,090 one-litre bottles of canola oil (Casseus, 2009). Using this ratio, useable production equated to approximately 736,111 1-litre bottles of canola oil. This amount exceeded 100% of oil needs for Calgary in 2011 by more than 2700% and by almost 2000% for 100% of Calgary's projected need in 2037.

4.4.3 Dairy

Statistics Canada reported 80,694 dairy cows in Alberta in 2011 and a total of 650,061,000 litres of milk produced (669,563 tonnes of milk solid equivalent). In order to calculate dairy production, fluid milk production required a conversion of fluid litres to milk solids per person. According to the International Farm Comparison Network, the density of milk is 1030 kg/m3; therefore, the volume in litres was converted to kilograms by multiplying the number of litres by the multiplier 1.03 (IFCN, n.d.)

By dividing milk production by the total number of dairy cows in Alberta, it was estimated that each milk-producing cow produced an average of 8.3 tonnes of milk solid equivalent per year. Based on this estimate, approximately 18,220 dairy cows were needed to meet the 2011 milk and dairy demand and almost 26,000 dairy cows would be needed to meet 2037 dairy consumption levels.

In spite of milk production levels declining steadily since 2006 (Statistics Canada, 2011), total milk and dairy production in Alberta exceeded 100% of 2011 demand for milk and dairy products by more than 148% even after adjustments were made for a proportional distribution to Calgary. If milk production rates were to remain unchanged, milk and dairy production in Alberta could also meet the 2037 demand for milk; however, given the declining trend, production would likely fall short of 100% of future demand and may negatively impact the food goal in 2037. Given this model assumes constant production yields in the future, and assuming current trends continue, future dairy production would be slightly overestimated. Moreover, no assessment was made of the amount of milk required to produce the vast array of dairy products consumed in the market and therefore, these estimates likely result in an

overestimation of actual dairy production relative to local consumption.

4.4.4 Beef and other Red Meats

Statistical data for livestock is disseminated by farm type, farm size, and number of head rather than the amount of meat by edible weight. The variety of livestock in Alberta includes cattle, sheep and lambs, goats, pigs, boars, bison, elk and deer; however, due to limited data available on many of these animals, calculations for production of red meats were based on beef cattle only.

Livestock estimates involve several calculations and conversion factors to account for inedible portions of meat. Each of these calculations is dependent upon the weight of a cow at slaughter, which is further determined by the breed, meat grade and method of farming. For example, in the case of beef, cattle producing higher-grade beef may not be slaughtered before 1400-1800 lbs. and grass-fed cattle take longer to reach heavier weights than feedlot cows.

As of 2011, Alberta cattle and calf slaughter data is no longer available from Statistics Canada due to confidentiality. However, the Alberta Beef Producers Association (www.albertabeef.org) reported the slaughter of 1.9 million head in the province in 2011. A typical animal at 1,400 lbs. live weight will produce 868 lbs. (394 kilograms) carcass weight beef (Canadian Cattlemen's Association, n.d). Carcass weight refers to the weight after the removal of inedible or undesirable parts of the animal but includes cartilage, bones to maintain body structure. After calculating the per capita share of beef production for Calgary, production exceeded 100% of 2011 demand by 587% and could potentially exceed 100% of 2037 demand by 412%.

4.4.5 Poultry and Eggs

Alberta produced, 141,427 tonnes of poultry, eviscerated weight, from of chickens, turkeys, Cornish and stewing hens in 2011 (AARD, 2011). Eviscerated weight accounts for the removal of inedible portions and transformations that occur in food processing. Once total

production was reduced to 47,142 tonnes to account for an equitable per capita distribution of poultry within the province, production exceeded 100% of poultry demand in 2011 by 114% and met 80% of total poultry demand in 2037.

Egg production is reported in layers or dozens of eggs in the statistical data. Alberta produced over 50 million dozens of eggs in 2011 of which approximately 7.2 million were sold for hatching, consumed on the farm or lost due to breakage and leakage. After considering these losses and an equitable distribution, local production of eggs was found sufficient to meet 78% Calgary's 2011 demand and 54% of its demand for eggs in 2037.

4.4.6 Vegetables

The quantity and diversity of vegetables produced around Calgary is limited and without greater analysis, the statistical data alone can provide a misleading picture of local production. Data were available for a list of major commercial vegetables grown in Alberta that included: beans (green or wax), beets, broccoli, cabbage, carrots, corn, cucumbers and green peas. While other vegetables are grown in the province, limited or no production data were found for the quantity of other vegetables grown in Alberta and seasonal variation in was not accounted for in production estimates. The incompleteness of statistical production data and inconsistencies in average crop yields for individual vegetables in various production zones created several challenges.

Since agricultural crop yields vary significantly with physical geography it is not possible to estimate the area of production by multiplying an average or standard crop yield as this may result in over or underestimations of true production. Additionally, small-scale producers provide a greater variety of vegetables than the list reported in the statistical data, but types of crops and production yields from these growers were not available. A complete list of average yields for vegetable crops grown in the ground in Alberta would be beneficial for future research. The variety of locally grown vegetables for which there was no available production data includes:

Asparagus	Leeks	Rutabagas
Beans	Leaf & head lettuce	Rhubarb
Brussel Sprouts	Onions	Shallots
Cauliflower	Parsley	Spinach
Garlic	Parsnips	Squash
Celery	Pumpkins	Tomatoes
Gherkins	Peppers	Turnips
Green Onions	Radishes	Zucchini

Given Alberta's limited growing season, it is important to understand how consumption and production are distributed across the year. For example, the presence or absence of seasonal eating patterns can clearly influence the ability of agriculture to meet demand. Alberta is known for having a relatively short growing season, a cold dry climate, high elevation and warm Chinook winds in winter that can be detrimental to dormant plants. For crops grown in the ground the vegetable season typically starts at the beginning of June and ends at the beginning of October. Figure 4.4.8 illustrates the seasonal production limits for a variety of vegetables produced in Alberta and in British Columbia (BC).

Furthermore, vegetable production levels have been in steady decline since 2006 with the exception of 2011, when production increased by 27% over the previous season. Reasons for the decline include annual differences in harvested areas and lower yields to challenging climatic conditions such as flooding during a particular season. Table 4.4.6.1 provides the fluctuation in vegetable yields for these crops since 2006.

Table 4.4.6.1 Major Commercial Vegetable Production (Alberta) 2006-2011

Production	2006	2007	2008	2009	2010	2011
Total Production - tonnes	38,959	26,706	26,220	25,142	14,907	20,431

Statistics Canada, Census of Agriculture. Includes: beans (green or wax), beets, broccoli, cabbage, carrots, corn, cucumbers and green peas.

4.4.6.1 Greenhouse Vegetables

In Alberta, the greenhouse vegetable industry involves the production and marketing of tomatoes, cucumbers, peppers and lettuce crops although production technology by this

method can be very efficient for certain field crops. Unlike commercially grown vegetables, greenhouse vegetables grown in Alberta are primarily for domestic consumption. Estimates for total greenhouse vegetable production equated to approximately 21 tonnes (21,025 kg) excluding lettuce, which was not included in the statistical data (2011). Table 4.4.6.2 provides production and land requirement of local greenhouse production from in the statistical data.

Table 4.4.6.2 Greenhouse Production and Area in Use 2011

Geography	Commodity	Production	Estimates	2011
Alberta	Greenhouse tomatoes	Area harvested	Square metres	131,134
		Production	Kilograms	7,182,871
	Greenhouse cucumbers	Area harvested	Square metres	282,474
		Production	Kilograms	11,676,847[r]
	Greenhouse lettuce	Area harvested	Square metres	F
	Greenhouse peppers	Area harvested	Square metres	92,485
		Production	Kilograms	2,165,130

Statistics Canada. *Table 001-0006 - Production and value of greenhouse vegetables, annual,* CANSIM (database).
[r] Revised
[F] Too unreliable to be published
[E] Use with caution
X Suppressed to meet the confidentiality requirements of the Statistics Act

Combined, greenhouse and major commercial vegetable production provided approximately 41,431 tonnes of vegetables, which was insufficient to meet demand for vegetables in either 2011 or 2037. Results indicate that all vegetable crops produced within Alberta would meet just 7% of 2011 demand and 5% of 2037 demand. Furthermore, the limited variety of vegetable crops grown in Alberta under existing conditions and current farming practices is unlikely to meet the nutritional needs in Calgary.

While potatoes and greenhouse lettuce and cucumbers are available at essentially all times of year, other vegetables grown in the ground are not. Greenhouse production does help to circumvent seasonality issues in regions with short growing seasons and cold climates to some degree however; greenhouse crop data was available for only 3 crops (peppers, tomatoes and cucumbers).

Potatoes

Potatoes were excluded from list of vegetables as Alberta is considered a major potato producer and exporter and potato yields were reported on separately in the statistical data. In 2011 Alberta's total maximum production of potatoes was 751,343 tonnes, which on its own would provide Calgary with almost four times the quantity of its total vegetable demand. Including production of this crop with other fresh commercial vegetables would have skewed the production results resulting in an overestimation of vegetable production.

4.4.7 Fruits

Discrepancies were found in the reported number of fruit farms in Alberta in the statistical data. *The Statistical Overview of the Canadian Fruit Industry – 2011*, published by Agri-Food Canada, claims 532 fruit farms in Alberta whereas the AARD Yearbook (2011) reported 151 fruit and tree nut farms and over 172,126 fruit trees and small fruit bushes. Neither source contained complete production data by weight; however, from the available data, total production for cherries, raspberries, strawberries and Saskatoon berries was estimated at just 284 tonnes. Calculations of the available data indicated that production of those 4 berries was sufficient to meet 1% of 2011 fruit needs in Calgary and less than 1% of the fruit needs in 2037.

Although no other fruit production data was found, we can assume that actual amounts may be higher as some small fruits were included in the categories of "specialty crops" and "other crops" in the statistical data. Other fruits grown in Alberta include: apples, blueberries, both sweet and sour, cranberries, grapes, pears, plums and prunes. Like all crops grown in the ground in Alberta, most types of locally grown fruits would only meet demand for fruits at certain times of year. Seasonal availability can influence the imports of cheaper fruits from elsewhere during the off-season even if local production could meet 100% of fruit consumption patterns.

4.4.8 Fruit and Vegetable Production in BC

Where local demand exceeded production within the starting region (i.e., province), as determined by the baseline assessment, it was necessary to explore adjacent regions to identify the nearest production areas outside the province. In the case of Calgary, based on the data used, fruits and vegetables had insufficient production levels in Alberta to meet Calgary's local food consumption goal. Since it was determined that bioclimatic conditions restrict the production of fruits and vegetables to the north of Calgary and soils south and east of Calgary were more suitable to the production of grains and livestock, fruit and vegetable crops grown in the Kootenays, Central and Northern Okanagan and the Lower Mainland South (LMS) regions of BC were included in Calgary foodshed calculations. Further, production zones for fruits and vegetables in the adjacent Province of BC are closer to Calgary than some of the agricultural areas in the northern part of the Alberta where the current and potential for crop production of any type is limited or non-existent. One of the weaknesses of this research is that no assessment was made to determine the per capita share of local fruit and vegetable demand in BC. Therefore, production estimates for these crops likely resulted in an overestimation of supply. An assessment of per capita share of fruits and vegetables in BC would add a greater level of accuracy to the results.

Table 4.4.8 provides the estimated production of selected fruits and combined in-the-ground and greenhouse vegetables grown in the province of BC (BC Ministry of Agriculture 2011). Detailed production tables at the Census Consolidated Sub-division (CCS) level for fruits and vegetables grown BC are available in Appendix B.

Table 4.4.8 BC Fruit and Vegetable Production Estimates, 2011

Food Groups	Estimated Total Production (tonnes)
Total vegetables[1]	268,000
Total fruit[2]	221,000

Source: *British Columbia Agrifood Industry* | Year in Review, 2011
[1]Estimates include fresh processed and green house vegetables.
[2]Estimates include fresh fruit and nuts and processed fruits.

Given that approximately 61% of Alberta is covered in forested, non-agricultural land, greater efficiencies and a smaller foodshed may be possible by considering production zones that are close to Calgary but outside of provincial borders and produce a greater amount and diversity of fruits and vegetables. Moreover, many of the fruits and vegetables at Calgary's local farmer's markets originate from BC and thus, for all practical purposes, form part of the local buying practices of Calgarians.

Agricultural production in BC is highly regionalized (AgriCensus BC Highlights, 2011). The majority of tree fruits are produced in the Okanagan, and the major production area for small fruits and vegetables is in the LMS (BC's Food Self Reliance, 2006). The LMS, including the Fraser Valley, Greater Vancouver, Squamish-Lillooet and Sunshine Coast regional districts accounts for 84% of BC's total greenhouse area (AgriCensus BC Highlights, 2011). Therefore, it was assumed that any provincial fruit and vegetables potentially flowing into Calgary from BC were coming from these regions. According to the statistical data, BC produces a similar variety of vegetables and fruits as Alberta but also produces peaches, nectarines and apricots and grapes. While large quantities of fruits and vegetables are grown in these regions of BC, the availability of a specific crop in any given year is also determined by demand and other factors. Additionally, seasonality issues would not be significantly relieved from an additional supply of fruits and vegetables from BC since the extended seasonal availability in BC is largely due to greenhouse production rather than in-the-ground field crops. So while the production of vegetable and fruit production from these production zones in BC could potentially increase the supply of fruits and vegetable to Calgary, the variety would not change significantly.

Figure 4.4.8 provides a comparison of the seasonal production limits for the fruits and vegetables produced in Alberta and in BC adapted from Metro VAN seasonal guidelines available on the www.farmfolkcity.ca website. The chart is based on an average crop season, but climate differences from year to year and between different regions will determine whether crops are available sooner or later than indicated.

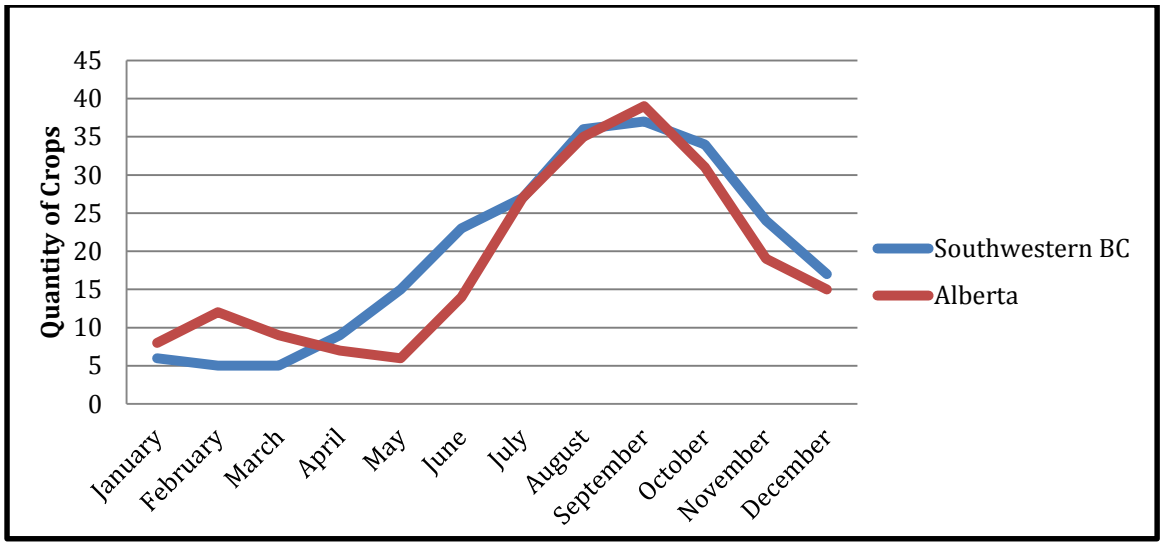


Figure 4.4.8 Seasonal Availability of Vegetables

For the sake of simplicity, calculations for fruit and vegetable production were based on total quantities produced in the LMS and Okanagan regions without any adjustment for per capita demand in BC. Although it is unrealistic to assume that 100% fruits and vegetables grown in the LMS and Okanagan regions of BC would flow into Calgary, based on the empirical data, the addition of total harvest of those food groups combined with a per capita proportion of fruit and vegetable production in Alberta would permit Calgary to meet 100% of its food goal in both 2011 and 2037. If instead we assumed that 30% of the total quantity of fruits and 25% of vegetables produced in BC could flow into Calgary, 52% of Calgary's 2011 fruit needs and 36% of its 2037 fruit needs could potentially be met from those fruit bearing zones within 938 km from of Calgary, exceeding the local food consumption goal by 6%. Still, this is likely an overestimation of supply given that production estimates on BC did not consider an equitable per capita share of fruits for the population in BC.

The results of a BC Food Self-Reliance Assessment (2006) found that BC was 159% self-reliant in fruits grown in BC in 2001, so assuming the supply-demand ratio has not changed, it is reasonable to assume that a portion of surplus fruits grown in BC could potentially flow into Calgary to meet a percentage of fruit needs there without impacting local demand in the Central And Northern Okanagan and the LMS regions of BC.

BC's Food Self-Reliance Assessment (2001) found that BC is only 43% self-sufficient in vegetables; it is nonetheless likely that at least some of that production would flow to Alberta. For example, BC vegetables are currently being sold in Calgary's farmer's markets. Assuming availability of BC production, 43% of Calgary's 2011 vegetable needs and 30% of 2037 vegetable needs could potentially meet with an additional 25% of all vegetables grown in BC flowing into Calgary. Furthermore, the distance food travels between Calgary and the the Central And Northern Okanagan and the LMS regions of BC production zones are in many cases shorter than distances to production zones within Alberta, and offer a greater supply, thus reducing the overall foodprint for the city. However, as with fruits from BC, no assessment was made for per capita demand in BC. Thus, the results are likely to overestimate supply.

4.4.9 Sugars and Syrups

The bulk of refined sugars and syrups are produced from cane sugar rather than sugar beets. Since sugar cane is not produced in areas near to Calgary, Calgary's demand for sugars and syrups could potentially be supplied from three other sources: sugar beets, honey and maple syrup. Alberta produced 14,439 tonnes of honey in 2011 and 703,100 tonnes of sugar beets in 2011. No data were available for maple syrup production in Alberta.

Sugar beets require processing to be turned into refined sugars and syrups. Based on the assumption that it takes roughly 7700 tonnes of sugar beets to produce one tone of refined sugar (Morrison, 2008), raw sugar beet production in Alberta could provide approximately 91.3 tonnes of refined sugar.

After-processing sugar beet production and honey were added; then divided by 3 to estimate an equivalent amount of usable sweeteners and syrups from local production. This resulted in approximately 35,246 tonnes of sugar beets and honey, which would be sufficient to meet 100% of the 2011 demand and 70% of the 2037 demand for sweeteners and syrups in Calgary, which is sufficient to meet Calgary's future local food consumption goal. Because corn was considered a grain it was not included in this food group. However, corn syrup could potentially be processed from corn.

An assessment of the potential for corn to be processed into corn syrup for human consumption, thus adding another source of supply in this food group would be useful.

Table 4.4.9 Alberta Sugar Beet Production, 2006-2011

Farms Reporting	2011
Total Production (Tonnes)	703,100

Statistics Canada, Census of Agriculture, 2011.

Table 4.4.10 Apiculture, 2011

Region	Number of colonies	Total production (tonnes)
Alberta	272	14,439
BC	38,159	829

Statistics Canada Cat No. 23-221-X, "Production and Value of Honey and Maple Products" and B.C. Ministry of Agriculture, Feb 2012

While honey production generally occurs wherever cropland exists, local sugar beet production only occurs in the Taber region, approximately 461 km southeast of Calgary if travelling by road. Table 4.4.9 provides the total sugar beet production estimates before refining calculations. Table 4.4.10 provides provincial production estimates for honey in 2011. Honey production estimates were not adjusted for processing or refining.

4.5 Summary of Local Production

Starting at the provincial level, empirical food production data was gathered for nine food groups for ease of comparison to food demand. Since local food policy would have to address food needs of the province and not just the population of one locality, adjustments to total production were made to reflect an equitable per capita distribution of production. In Calgary, it was assumed that the supply of provincial production potentially available is 1/3 of the total since Calgary's population is approximately 1/3 of the provincial population. While no assessment was made to determine the amount of fruits and vegetables required feed the population in BC sharing the same agricultural area, calculations for 30% of BC fruit and 25% of BC vegetables flowing into Calgary illustrate one potential scenario. Further research would be useful to determine the per capita share of food demand in BC and the proportion of production that actually remains in the local area in both provinces.

Calculations were then made to determine whether or not production in the starting region was sufficient to meet demand. The maximum percentage of food demand that could be met, up to 100%, was calculated. This provided a quantitative baseline for an assessment of local food self-sufficiency, and indicated whether or not the starting region needed to be enlarged to meet demand. In the case of Calgary, the starting region was insufficient to meet demand for two food groups – fruits and vegetables. This baseline production assessment was not previously available for Calgary.

Figures 4.5 and Figure 4.6 illustrate the percentage of Calgary's food needs that could be met from food production in the starting region (Alberta) for the selected food groups to a maximum of 100%. All production estimates were based on a per capita share of provincial production to allow for an equitable distribution of food to all population centres in Alberta sharing the same production area.

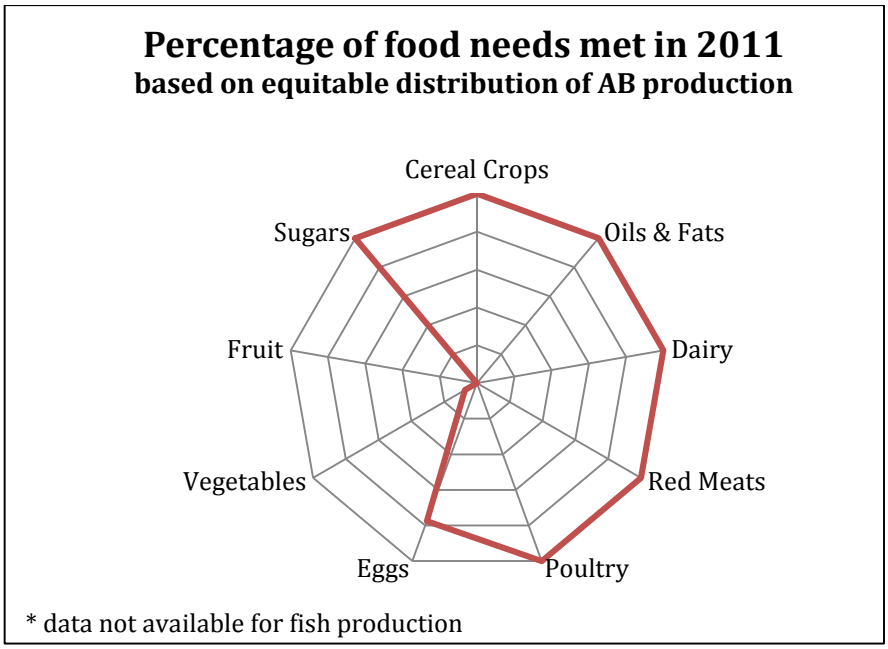


Figure 4.5 Percentage of food needs met in Calgary in 2011

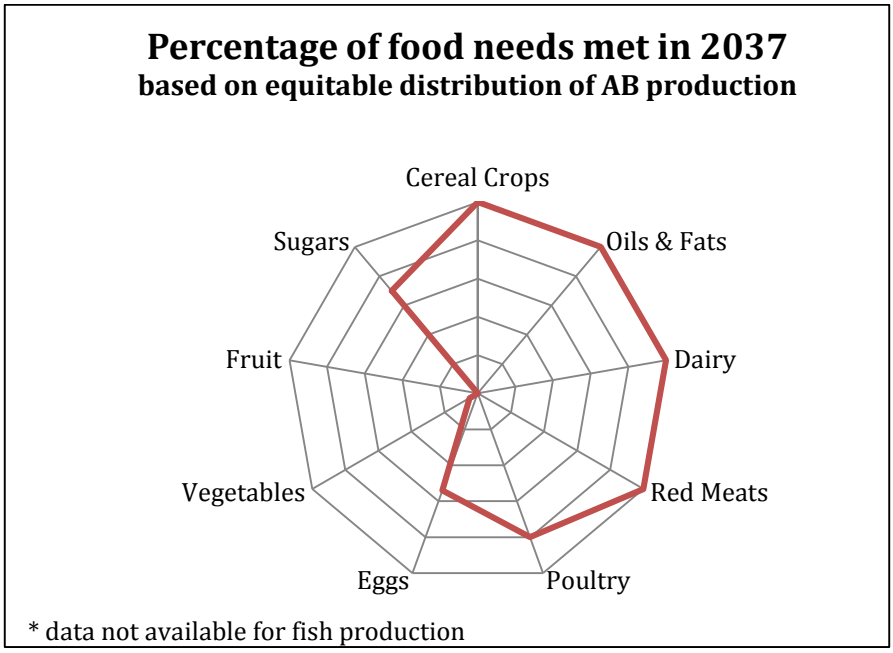


Figure 4.6 Percentage of food needs met in 2037

Figure 4.7 illustrates the percentage of Calgary's food needs that could be met in 2037 for the selected food groups to a maximum of 100%, based on a an equitable per capita distribution of food in Alberta and a proportional share of total fruits and vegetables produced in the Kootenays, Central and Northern Okanagan and the LMS regions of BC. No assumptions of per capita fruit and vegetable demand in BC were made.

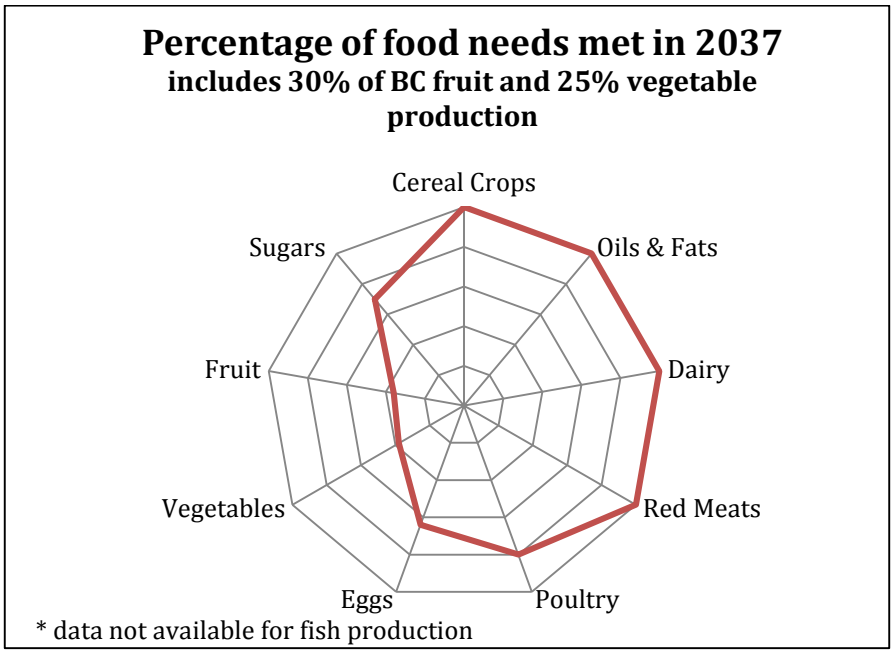


Figure 4.7 Percentage of food needs met in Calgary in 2037 with 30% of BC fruit and 25% vegetable production

Chapter 5: Determining the Foodshed

Determining a local foodshed enables anyone interested in local food or the distance food travels to see the geographic extent of local food production. This chapter discusses the methodology used to map a local foodshed with the capacity to satisfy food demand, or a percentage thereof, based on a stated municipal food goal. Methods used in this research contribute to better understanding a context specific definition of local and how to set and define food goals by providing a visual mapping of the distances and areas involved. Methods were applied to the City Of Calgary's local food consumption target outlined in the "imagineCALGARY" Plan (2007). Figure 5.1 and all foodshed maps in this research and were produced in GIS by Jeff Wielke.

5.1 Mapping the Foodshed

To begin the foodshed mapping process, food production data by food group at the smallest geographic scale available (CCS) is entered into a geographic information system (GIS) to spatially plot the food supply in the starting region. Similar to the work of Peters, Bills, Lembo, Wilkins and Fick (2008), GIS is used because it is able to compile land-use criteria and empirical production data and produce a simple map displaying food production by food type nearest the population and is therefore, an appropriate tool for this exercise.

Next, foodshed maps for each of the different food groups are generated using the approach of starting with the nearest food production area and increasing the local production area in nearest land increments until local food demand is met. The aggregated area that meets demand forms the foodshed for each individual food group. Overlaying the foodsheds for individual food groups creates a composite foodshed for the city.

Regional land use patterns including pastureland, cropland, water bodies, developed and forested land are investigated using a geographic information system (GIS) to identify the production areas in the starting region for each food group with the capacity to meet the needs of the population or a designated portion thereof. Production capacity is averaged over each

land unit, and adjusted to reflect the per capita share available to the city. Without any additional information, it was assumed from the Statistics Canada data that the production across any one region for a specific food type was evenly distributed at the sub-provincial census-consolidated subdivision (CCS) level.

A dasymmetric mapping technique is commonly used to realistically distribute population density data over geography. Similarly, the dasymmetric mapping technique was used in this research to distribute the food production to areas that more accurately represent the potential for producing that particular food type. For example, it is assumed that livestock are raised on pastureland, crops are grown on cropland and no production occurs in water bodies. Knowing where the pastureland is located in each CCS allows the production of beef to be distributed evenly across only the pastureland, as opposed to the whole CCS. Since it was assumed that dairy cows were also raised on pastureland, the production of dairy can be distributed evenly across only the pastureland, as opposed to the whole CCS. The same assumption was held for poultry. If beef, dairy and poultry were raised on pastureland, and there was no further information to distinguish pastures for beef and dairy from pastures used for poultry, in this model, they are raised in exactly the same locations.

A maximal boundary, (defined as 100% of demand or the largest portion of food obtainable locally and a local food goal boundary, defined as the closest production area that meets the designated 30% food goal) is created for each food group. The footprint for each food group is mapped where the food produced and the food consumption goal is eventually met, to a maximum of 100%. Aggregating the food production in tonnes (aggregating the one hectare grid cells) as the distance is stepped out from a city by road networks; a balance between the food produced and the food consumed is eventually met.

A foodshed is the area of the production zone and distance is the minimal distance that food travels to satisfy the food goal. In some ways boundaries are irrelevant and distance is the furthest point one must go to meet consumption. Distance is useful for comparisons between food groups and among composite foodsheds at various times, or between cities, but can be

misleading when used alone as the distance could be misinterpreted as the radius of a circular foodshed, which is not the case.

5.2 Methods

Provincial food production is mapped for selected food groups. Production zones are incrementally added in an outward fashion until the baseline or target demand could be met in each food group. The aggregated area that meets the demand forms the foodshed for the individual food group. In-so-doing, the total land requirement and the corresponding outer boundary for each food group is identified such that the distance food must travel is minimized. By overlaying the individual foodsheds, an overall local foodshed can be created. The advantage of this approach is that it enables a local foodshed to be determined for food goals of any size and for any variety of food groups.

In order to be consistent with land cover data, the dasymmetric method of distributing food production values across each CCS was performed for the province in one-hectare grid cells. Other methods were considered such as dot density and gravity modelling; however, it was felt that the former technique was less compatible with the land cover data, and the latter technique required significantly more data on the demand side and would result in a less comprehensive baseline of local food resources. Distance by road was calculated to find the travel distances between food production and the population. A road network reflects the way food would most likely travel to a city and is therefore a more realistic assessment of travel distances than commonly used Euclidean distances, which are straight-line measurements that one would calculate "as the crow flies."

With the exception of poultry and eggs, food production data at the CCS level was disseminated by the number of hectares used in farming and number of farms. The GIS model is designed to assume that the larger the area of pastureland or cropland in use for a particular food, the larger the production output of that food. In this way, the distance food travelled could be more accurately reflected since it is possible for one large farm to produce as much or more than several smaller farms, and therefore, the number of farms were not considered

indicative of the quantity of local production.

One of the challenges with this method of analysis is accounting for incomplete census data. Statistics Canada suppresses data to protect the privacy of respondents in cases where census data are sparse. Data suppression can result in an overestimation of the size of the production area and an underestimation of production in spatial distributions because in reality, production may actually occur in areas with incomplete data, which are excluded from the model.

In cases such as fruit, where data was missing at the CCS-level but available at the larger Census-division level, averaging assumptions were made to estimate to some degree what the production in those areas might be. In this way, the size of the foodshed more accurately reflects provincial estimates. This method results in fewer gaps in the data, but more assumptions were made. Furthermore, while results may be more accurate over the larger census-division, locally, they may not. The error on a local scale would have higher variability in those areas that have no data, but the big picture provides a better reflection of production. Where local demand exceeded production in the starting region, as determined by the baseline assessment, adjacent regions were explored to identify the nearest production areas outside the province.

For Calgary, production zones to the south and east of Calgary were excluded from the analysis since plant hardiness and soil suitability maps indicated that soils to the east and south of Calgary were best suited to the production of grains and livestock. Since the northern half of Alberta is largely covered by forested non-agricultural land where production capacity is severely restricted by bioclimatic conditions, it was assumed that production capacity in the Green Area would be limited or non-existent. Therefore production zones west of Calgary (in BC) were explored for the two food groups (fruits and vegetables) with insufficient levels of production in the starting area to meet demand.

Figure 5.1 visually captures the distance by road that food would have to travel to meet food demand based on current available production data and farming practices. Figure 5.1 also shows that wheat and oilseed crops dominate regional production in Alberta and BC. Significantly, at the distance of approximately 600 kilometres from Calgary, BC produces greater amounts of fruits and vegetables at closer distances to Calgary than some production areas in Alberta where production of those foods is limited or does not exist at all. Because of the highly regionalized nature of farming in BC, distribution to the Calgary population may be favoured over some of the more distant populations in BC, as a more accurate reflection of local need.[1]

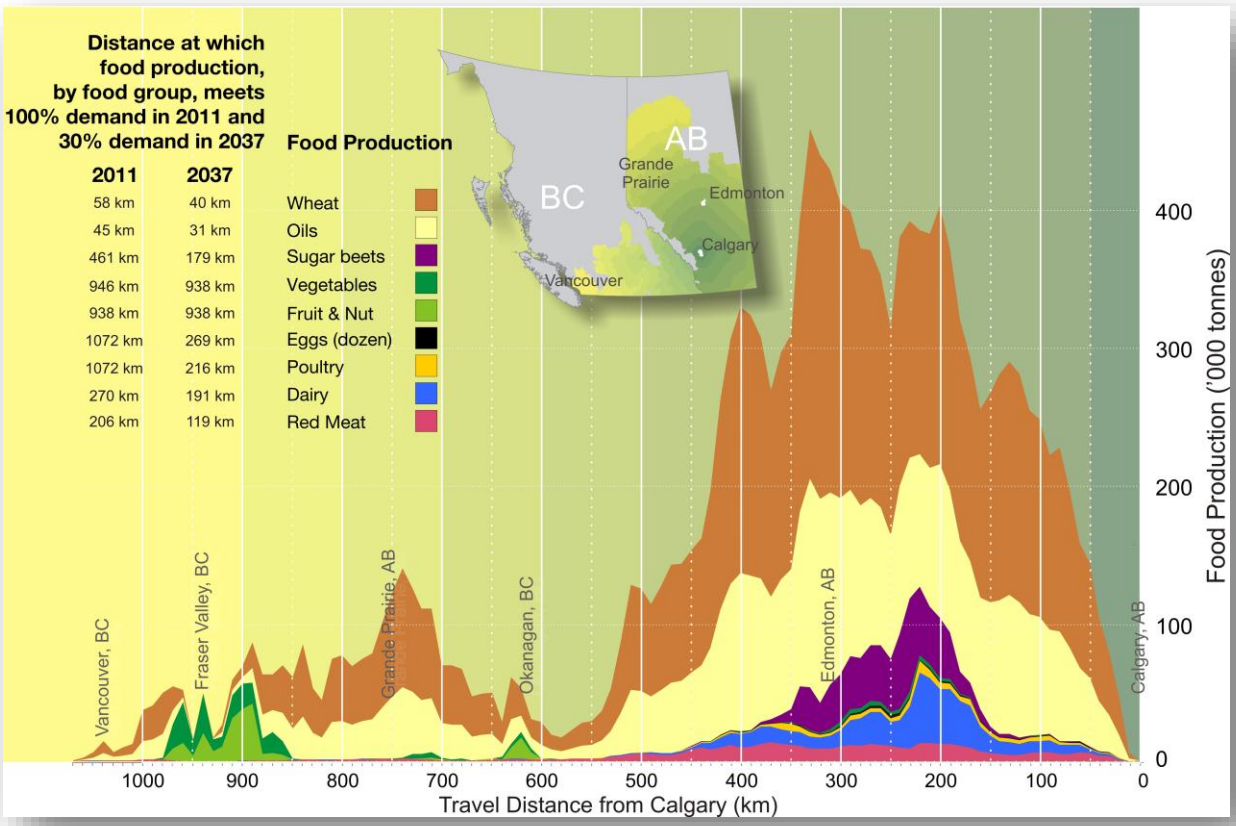


Figure 5.1 Distance from Calgary at which food production occurs by food group

[1] If jurisdictional borders were ignored, it would be possible to identify the local food demand catchment area for each production area, which is essentially the inverse of this study.

5.3 Key Assumptions & Limitations

The intent of this research was to spatially map food production nearest a population with the capacity to meet current and future food demand. Similar to Peters, (2008) production, consumption and distance were the only variables considered. Rather than a predictive model, the geographic foodshed was examined from the perspective of creating a baseline based on existing food production capacity to meet current and future local consumption. Given the uncertainties and complexity in determining trends in climatic conditions, natural resource availability, agricultural technologies, ethnic compositions, eating habits, and the feedback between food supply and demand (local and global), this methodology does not attempt to factor in changes in future food production, availability or eating habits. The assumptions inherent in predictive food demand and supply models can be quite contentious, and the uncertainties involved introduce just another potential source of estimation error. Moreover, data on these trends is less readily available, which may limit the localities and organizations that can use the model. Finally, there are advantages to having the "do nothing" starting scenario or "no change" base case from which to start an assessment and discussion. It is possible to build on this baseline model, if desired, to create a more predictive model and test new assumptions. The following sub-sections highlight the major assumptions and limitations embedded in the results.

5.3.1 Key Assumptions

Fixed Consumption Patterns

The GIS output model was designed to assume current consumption patterns for the population even in future years (2011 and 2037 in the case of Calgary). Only the number of people being fed changed, based on official population projections for the city. In reality, eating patterns in the future may be influenced by a variety of factors including dietary changes, economic circumstances, incidence of food deserts and demographics, which can be applied to the method as the information becomes available.

Consumption is met from Local Variety

Demand was considered met when quantities within each food group from local production of selected food groups. It was assumed that the demand for meat can be met from locally produced livestock, such as chicken and beef, and fruit and vegetable needs can be met with the local varieties. Where local produce is available, it was assumed that people will modify their consumption pattern to eat local first, and only supplement with non-local if it is not fully met. In reality, people consume a wider variety of products, which may result in an overestimation of local food demand.

Constant Production Levels

Production levels were assumed constant in both study years for reasons mentioned above. Future production levels may be influenced by a variety of factors such as land use changes, weather patterns and climate change, technological advances in farming methods and practices, economic drivers and consumption patterns. As a result, the farther forward the model looks in time, the less likely it is that it can accurately portray future food production levels.

Local Food Supply Availability

It was assumed that locally produced foods would remain in the local area and be available for per capita share consumption. In reality, much of the foods currently produced locally are produced for non-local consumption elsewhere.

Lack of Supply Constraints

Another key assumption embedded in the results is that there were no supply constraints on the farming inputs needed to produce foods, such as chemical fertilizers and water for irrigation. This study assumed that future resources will be readily available and that

production will occur under conditions and farming practices currently employed.

5.3.2 Key Limitations

BC Fruit and Vegetable Consumption and production

No assessment was made to determine the per capita share of demand in BC for fruits and vegetables grown in the Kootenays, Central and Northern Okanagan and the Lower Mainland South (LMS) regions of BC. This likely resulted in an overestimation of the percentage of fruits and vegetables harvested in BC potentially available to Calgary. An assessment of per capita share of fruits and vegetables produced in BC would add a level of accuracy to the results.

Missing and Incomplete Data

One of the limitations in this study was incomplete production data. Missing data or values in the agricultural statistics occurs when no data value is stored for the particular production variable. Missing data can have a significant effect on the production estimates and therefore, places limitations on the conclusions that can be drawn from the results. While every effort was made to accurately represent the data, some inaccuracies are likely to have occurred.

Scope

The goal of this study was to develop a method to determine the foodshed for a city from near-by agricultural production. While urban agricultural activities, such as community gardens, rooftop and backyard gardens may certainly contribute to local production; a lack of consistent statistical data was found and therefore urban agricultural activities were excluded from this study.

Lack of Comprehensiveness

The approach used in this study did not include an assessment of other elements influencing the ability a large city to meet a local food consumption goal such as agricultural specialization, economic factors, production methods, greenhouse gas emissions or energy inputs. Food systems do not operate in such a limited context, and distance alone is not an indicator of political will, level of interest or benefits from a localized food system. As a next step, additional food system elements could be applied to the model to enhance local foodshed analyses.

Food Processing

Little information exists on the ways in which raw grains are processed into the variety of food items we eat at the end of the food chain. Results of this research may underestimate the distance food travels since the route food takes is more likely to be indirect. Further, the demand for specific foods influences the size of the agricultural area required (Gerbens-Leenes 2001). Lack of information of how wheat and other grains are processed into the foods that we eat at the end of the food chain limits the accuracy local foodshed capacity.

Seasonality

Ignoring seasonality biases the results of this research because it assumes production capacity can be distributed over the year to meet annual demand. Ignoring seasonality of food production can overestimate the demand met for some crops if the production exceeds demand during the months that there is availability, but falls below demand during other months.

Locational Bias

Another limitation of this study is that it may result in larger foodsheds for locales that are

situated near their province's jurisdictional border (e.g., Saskatoon, Ottawa), as it effectively removes up to half of the potential production area for each additional distance increment added. Assuming equal production on the other side of the border, it would have the effect of almost doubling the foodshed. In such cases, the cities would either need to calculate food production in both provinces, or if the policy jurisdiction is important for achieving the target, at least flag this as a limitation.

5.4 Foodshed Maps

The local foodshed in the starting region assumes an equitable per capita distribution of provincial production to all other cities in Alberta and assumes that the per capita share of production is available for local consumption (i.e., local market is served before export markets). It is also assumed that fruit and vegetable production in the Central and Northern Okanagan and the Lower Mainland South (LMS) regions of BC would be available for consumption in Alberta. For simplicity of method design, fruits and vegetables grown in LMS, Okanagan and Kootenay regions of the province of BC were calculated by the same proportional distribution, rather than by a provincial per capita share for the population in BC. Based on statistical data, this was a conservative assumption for the quantity of fruits and vegetables that BC might export given that approximately 53% of vegetables and over 90% of fruits in 2011 were exported from BC in 2011 (BC Agri-food Industry Report, 2011).

Figure 5.4 provides the smallest composite local foodshed that could meet current food demand in Calgary to a maximum of 100% for the nine food groups analyzed based on the assumptions and limitations mentioned in Section 5.3.1 and 5.3.2. Figure 5.5 provides a map showing the smallest composite foodshed that could potentially meet a future 30% local food consumption goal for the population of Calgary in 2037. The distance to the outermost boundary edge is given in brackets.

The maps show that realistically, Calgary’s composite foodshed extends beyond provincial boundaries in both study years. Since some foods, such as fruits and vegetables would have to

travel approximately 938 kilometres to reach Calgary, it may be prudent for municipal policy makers to maximize production potential for a few individual food groups rather than for an overall local consumption goal. However, given that the province has active food policy programs in 16 municipalities, Metro Vancouver, local health authorities and the provincial government (R. Shore, 2013), no assessment was made to determine the per capita share of local demand in BC and therefore, production estimates are likely to result in an overestimation.

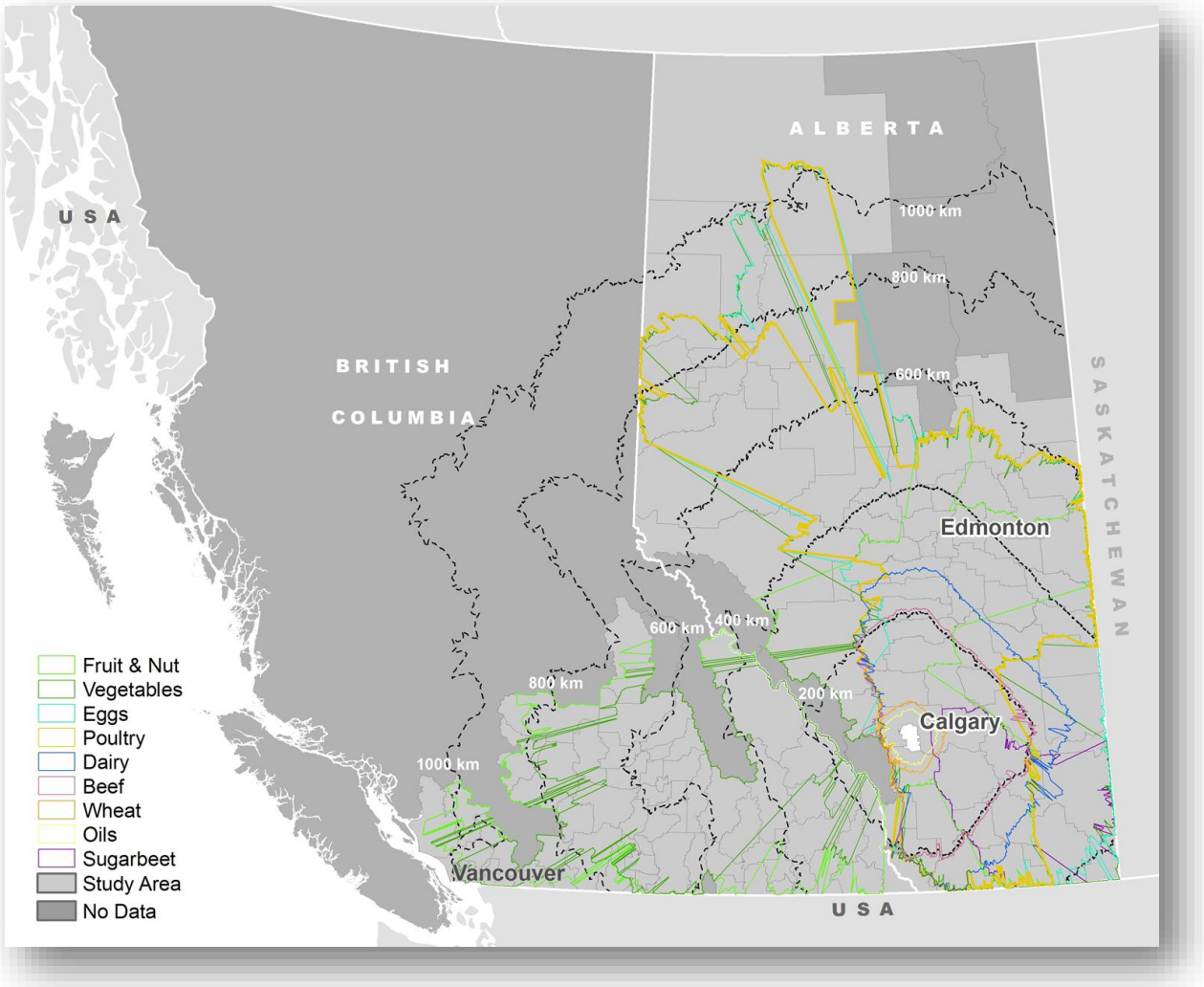


Figure 5.4 Calgary's Composite Local Foodshed by Food Group, to meet maximum local demand in 2011 (1072 km)

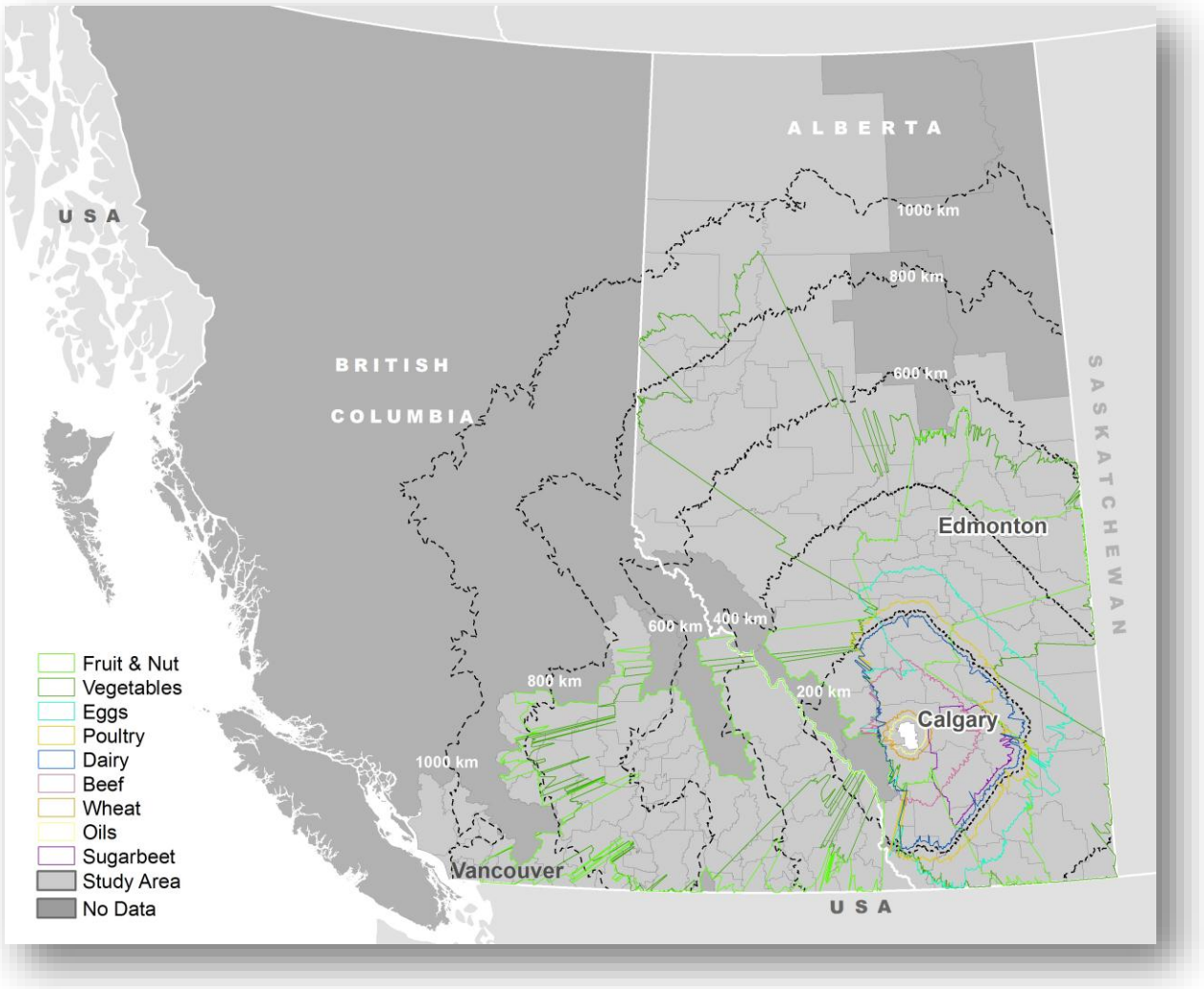


Figure 5.5 Calgary's Composite Local Foodshed, by Food Group, to meet 30% projected local demand in 2037 (938 km)

Foodshed Maps by individual Food Group

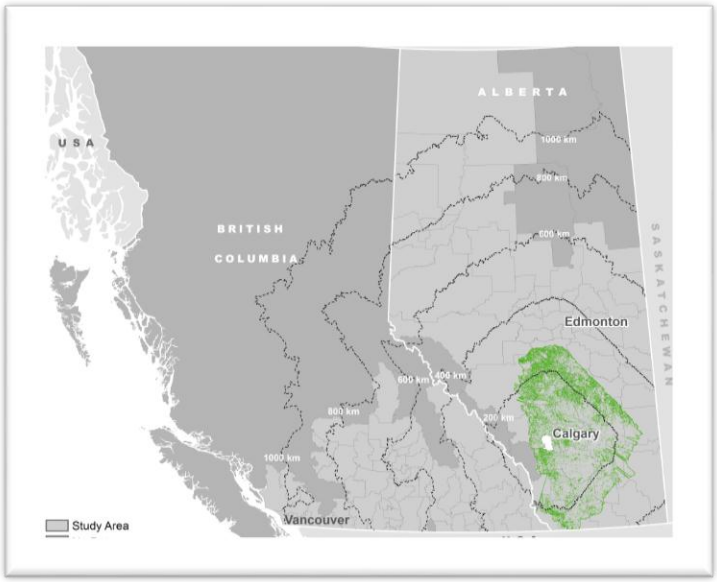
The following section provides a suite of foodshed maps delineating the smallest production area required to meet maximum local demand in 2011 and Calgary's 30% local food consumption goal in 2037 by individual food group. The distance to the outermost boundary edge for each individual foodshed is stated in brackets.

2011 – 100% Wheat Foodshed (58 km)

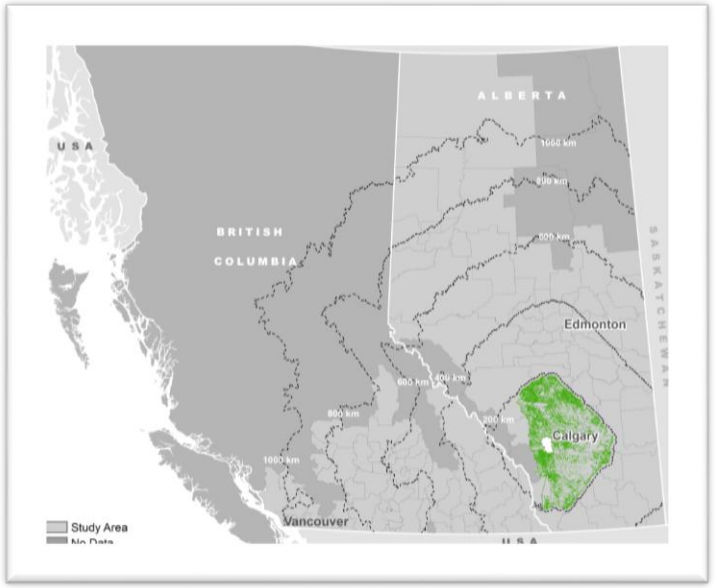
2037 – 30% Wheat Foodshed (40 km)

2011 – 100% Oilseed Foodshed (45 km)

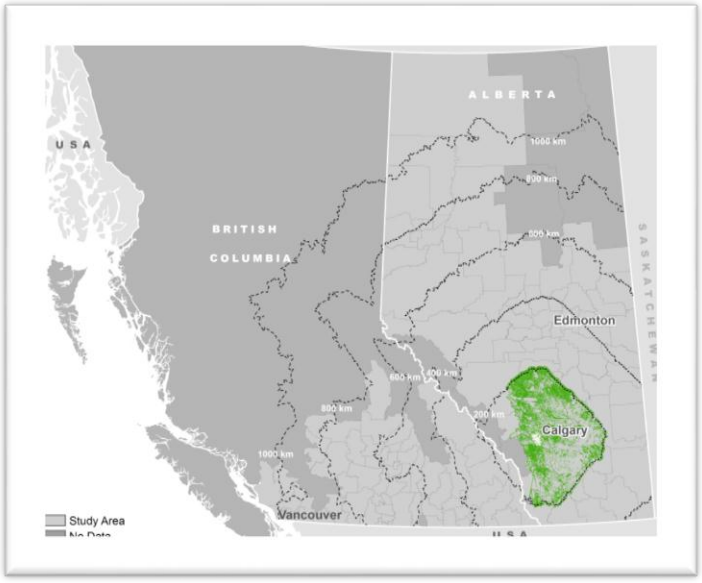
2037 – 30% Oilseed Foodshed (31 km)



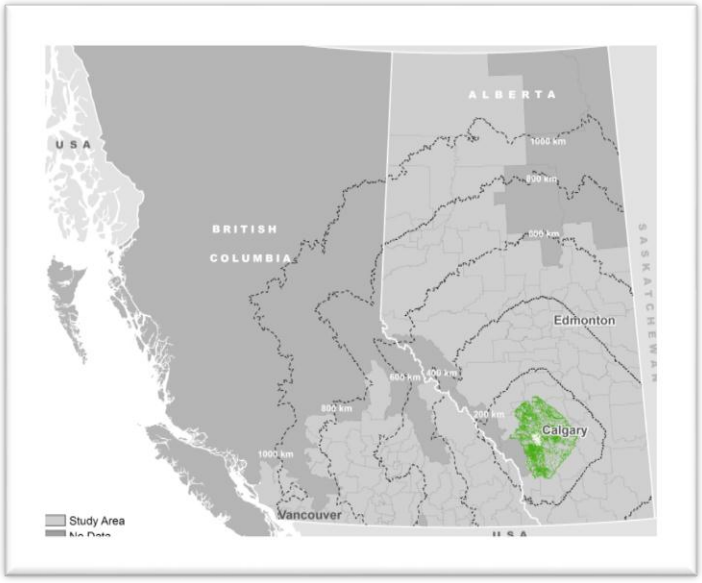
2011 – 100% Dairy Foodshed (270 km)



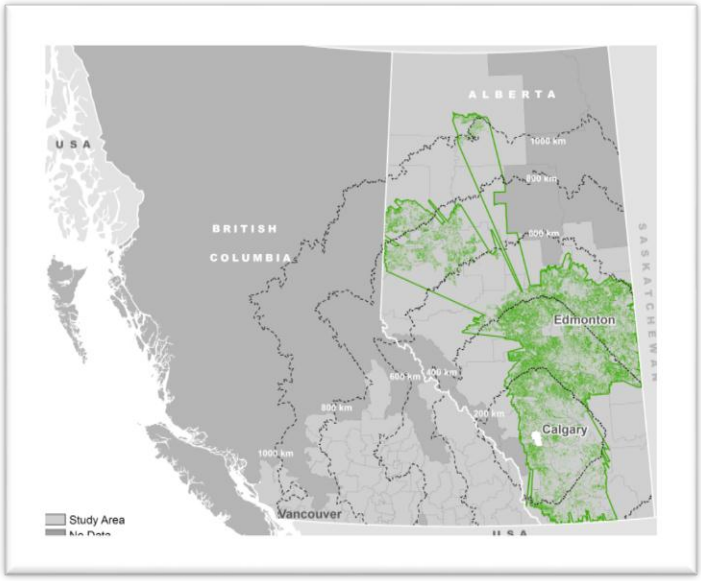
2037 – 30% Dairy Foodshed (191 km)



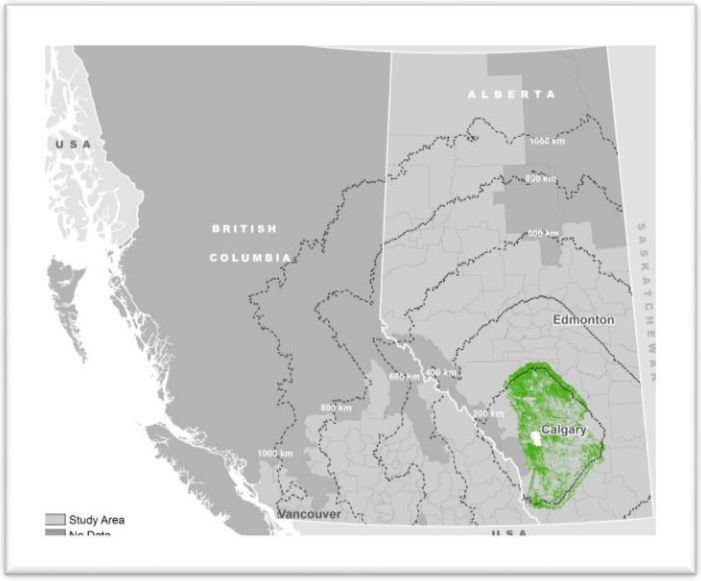
2011 – 100% Beef Foodshed (206 km)



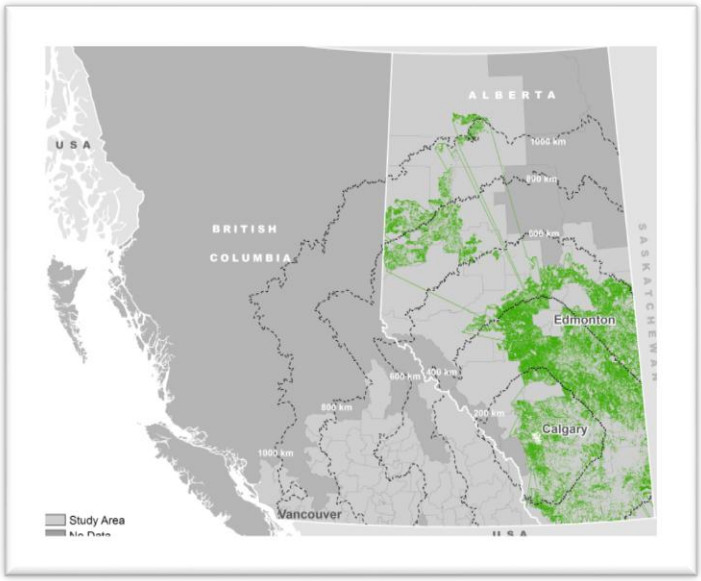
2037 – 30% Beef Foodshed (179 km)



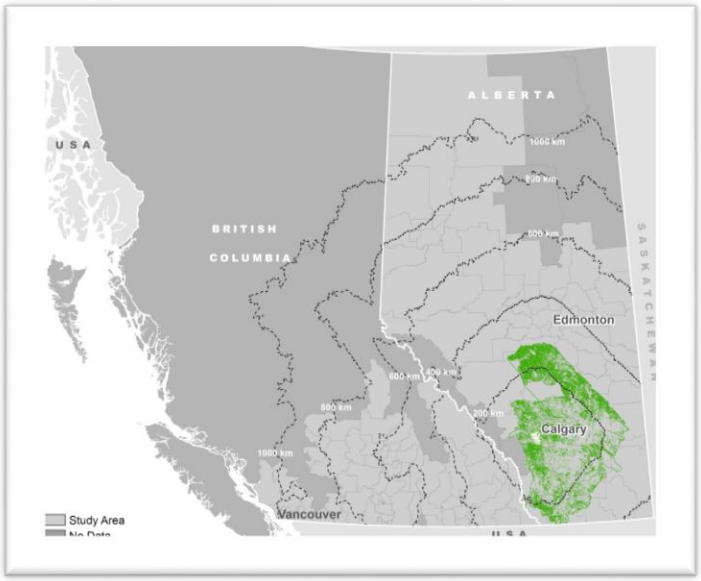
2011 – 100% Poultry Foodshed (1072 km)



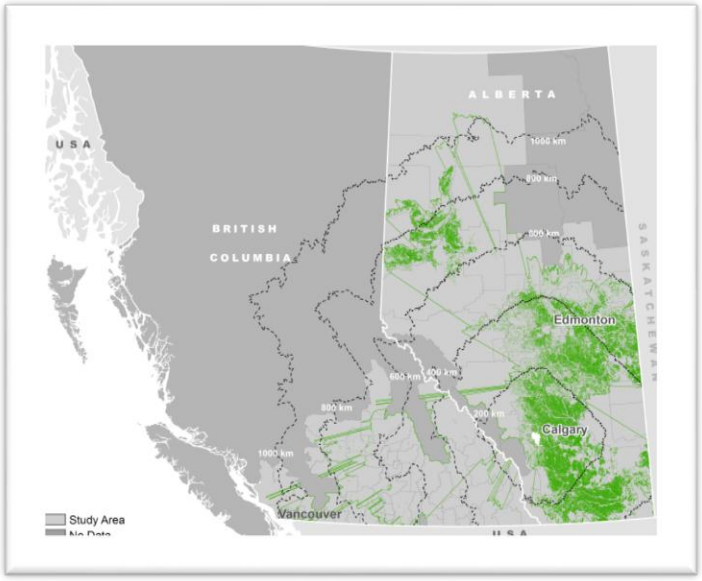
2037 – 30% Poultry Foodshed (216 km)



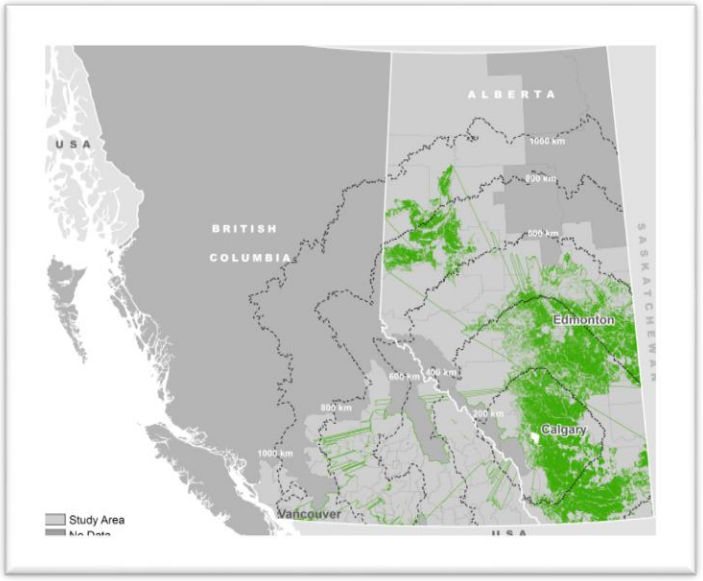
2011 – 100% Egg Foodshed (1072 km)



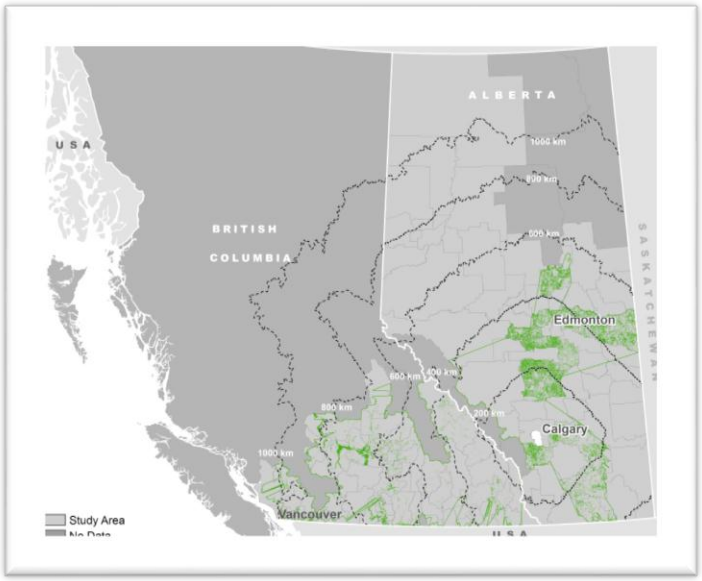
2037 – 30% Egg Foodshed (269 km)



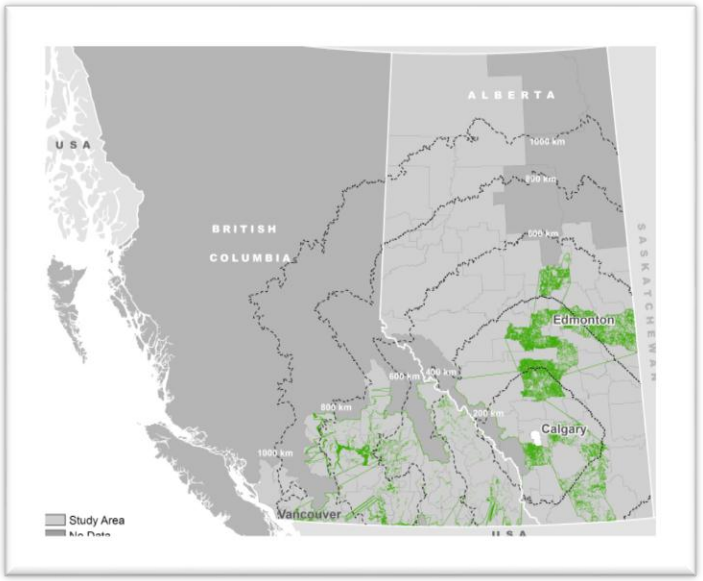
2011 – 100% Vegetable Foodshed (946 km)



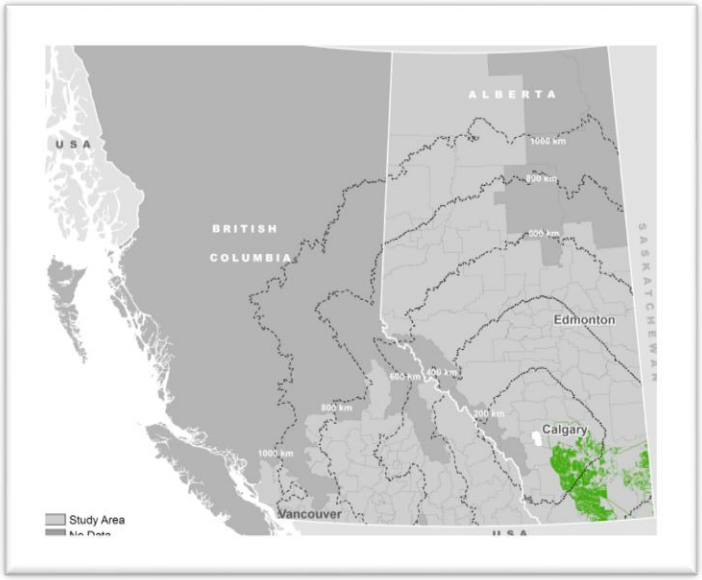
2037 – 30% Vegetable Foodshed (938 km)



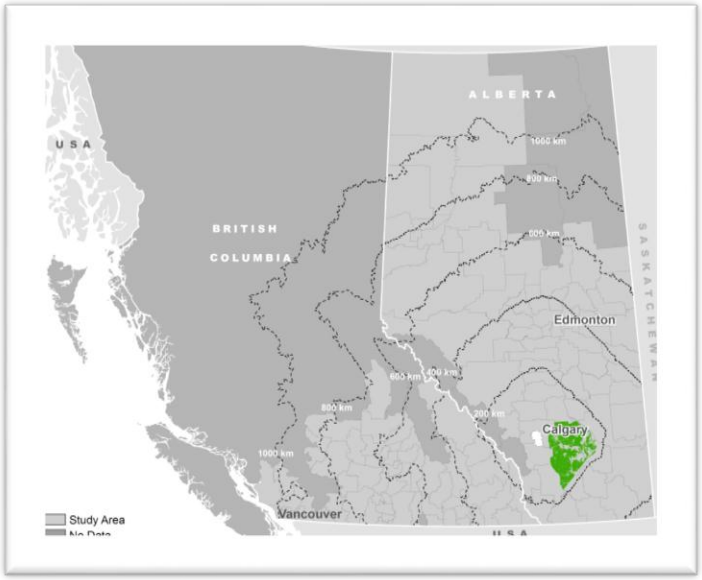
2011 – 100% Fruit tree & Nut Foodshed (All)



2037 – 30% Fruit Tree & Nut Foodshed (938 km)



2011 – 100% Sugar Beet Foodshed (461 km)



2037 – 30% Sugar Beet Foodshed (179 km)

Chapter 6: Results and Analysis

Foodshed maps for nine different food groups were generated for Calgary using the approach of increasing the local production area in nearest land increments until local food demand was satisfied. The results found that the per capita share of production in the starting region (Alberta) was insufficient to meet 100% of Calgary's food demand, but sufficient to meet demand for some of the food groups.

One of the advantages of the method developed in this research is that the distance food travels and the geography of food consumption can be spatially described concurrently from various perspectives. For example, individual foodshed maps can be overlaid or mixed and matched to illustrate a likely local foodshed relative to specific food and in this way provide insights into foodshed capacity. This method can contribute to better understanding a context specific definition of local and how to set and define food goals by providing a visual mapping of the distances and areas involved.

The quantitative baseline of production and consumption data for Calgary established in this study can also be used as a benchmark for monitoring and measuring the performance of local food goals. To provide a picture of local agricultural capacity relative to municipal food demand, simple food production and consumption estimates and calculations were made based on an assumption of equitable per capita distribution of provincial food production with the assumptions and limitations outlined in Chapter 5 (Section 5.3). Although the city of Calgary was used for demonstration purposes, the same method of calculation and mapping can be customized and used anywhere similar data are available.

6.1 Results

Foodshed maps show that the nearest production area with the capacity to meet demand may vary significantly for each food group. Maps also show where food is produced, which foods are grown closest to a population and which foods push the boundary furthest out. In this way, optimizing the foods that are produced closest to the city will have a significant impact of a

local food goal. Mapping out the actual spatial pattern of production has the advantage of identifying foodsheds based on food type at the landscape level and area and distance easily calculated. Where the local production of individual food groups meets food demand for a population, foodshed maps are able to illustrate the footprint of land required to support the city. Spatial plotting shows that the definition of local food will be unique to each city, particularly in regions with different bioclimatic conditions or in provinces such as BC with highly regional production.

Given the general overall nutrient-poor soil quality surrounding Calgary and the limiting nature of the regional climate; the use of empirical data to estimate production relative to demand was an effective method to measure local production capacity. The foodshed maps show that agricultural production is severely restricted in the northern half of the province where production capacity is limited by forest cover and or nutrient-poor soils. The maps further show that with the exception of sugar beets, which are only grown in one region in Alberta, the distribution of crops and livestock is spatially dispersed fairly evenly across the concentration of agricultural zones in the southern half of the province.

Within the context of this study the foods grown closest to Calgary are oilseeds and grains, followed by beef production. The foods pushing the overall local boundary farthest out are fruits and vegetables, followed by poultry, eggs and dairy. The quantity of food grown and produced in Alberta met 100% of Calgary's 2011 for oilseeds, dairy and beef within 270 km collectively. Production of those same food groups was found sufficient to meet Calgary's 30% local food consumption target in 2037 within 191 km collectively. Provincial poultry production met 100% of 2011 municipal demand and 80% of the projected demand km in 2037within 1,072 km. Egg production in Alberta was found sufficient to support 78% of municipal demand in 2011 within 1,072 kilometres and 54% of demand in 2037 within 269 kilometres of Calgary.

Wheat production was found sufficient to produce pastas, flaked wheat breakfast cereals and breads in sufficient quantities to meet municipal food consumption patterns in Calgary within 58 and 40 kilometres respectively for both study years. After refining and processing, local

sugar beet production was found sufficient to meet 100% of the 2011 demand for sugars and sweeteners within 461 km of the city and 70% of the 2037 demand within 179 km, exceeding the 30% local food goal of 30%. The foodshed specifically for honey was not calculated since generally, honey is found wherever crops are grown.

The baseline provided a quantitative assessment of provincial food production in Alberta, which was not previously available. One of the limitations of this study was that production levels and consumption patterns were assumed constant. Assumptions about future production capacity are limited to currently available production information on existing farmland under current land use policies, farming conditions and practices. Therefore, it is very difficult to realistically forecast or project future capacity for long term local food goals. To the extent that food production was under or overestimated, it is more likely underestimated in 2037 given that because of seasonal availability and lack of sophisticated consideration for export.

One of the opportunities coming from the results of this study is that the calculation and mapping methods used can be repeated over time to reflect changes over time resulting from land use changes, weather patterns and climate change, technological advances in farming methods and practices, and external economic drivers affecting local area production and consumption patterns.

It was not surprising that fruits and vegetables were identified as the two food groups with insufficient provincial production levels to meet 100% of current and 30% of future demand given the annual climatic conditions in Alberta. Based on data available and road network distance calculations, fruit production in Alberta, which is predominantly limited to berries, meets just 1% of 2011 fruit needs and would meet none in 2037. Similarly, fresh vegetables have to travel over 1,000 km to meet 7% of demand in 2011 and 5% of demand of 2037. With the exception of a few root vegetables which could be available year-round, the range and quantity of locally produced fresh fruits and vegetables is severely limited by seasonal constraints and limiting bioclimatic factors such as water and soil nutrient availability.

6.2 Discussion

The purpose of this research was to determine the capacity of local production to meet all, or a specified percentage of food demand of that city. Foodshed maps help us to visualize the geographic extent of a local food supply and maps for a specific food type or combinations of food types can assist municipal food planners and policy makers to visualize production areas and distances. This type of information can assist in establishing and managing municipal food policy goals and implementation strategies. For example, if the municipal food target is to minimize the size of its local foodshed, then information provided by the method described in this thesis could facilitate a discussion, or change perceptions, on what should be considered local and result in a strategy to maximize some parts of food consumption rather than diversify local production. In that way, Calgary could meet 30% of total food demand locally by maximizing local consumption of the foods produced nearby and aiming for less than 30% of other food groups, such as fruits, and vegetables, which would result in a much smaller local foodshed than if the goal was to meet 30% of every food group locally.

Where available production allocation is concentrated within a province, foodshed maps show that Provincial boundaries can burden a large city like Calgary with an unnecessarily large food footprint. The maximum distance from which Calgary's 30% local food consumption target could be met (for poultry and eggs) was a little over 1,000 kilometres, which may be contentious to those concerned with impacts from food miles. That said, even at the outermost parameter, these distances are considerably shorter than the often quoted 1,300 miles (2,080 kilometres) that food travels through the global food system (Peters, 2008). Studies have indicated that consumers prefer definitions of local based on proximity of production and the ability to trace food to its exact source and the results of this study show locally produced food has the potential to meet a percentage of food demand within significantly reduced travel distances.

Foodshed mapping can be a valuable tool in identifying and managing the reality of limited foodshed areas and capacities, and increase awareness among consumers who currently associate only in-province food production areas with local procurement. Similar to the Sheep

River Watershed in Alberta, which is a municipal water source for the towns of Turner Valley, Black Diamond, Okotoks, and a variety of acreages, farms and ranches (Bow River Basin Council, Canada, 2010), individual foodshed maps can help to identify which localities might participate in a multi-jurisdictional cooperative effort for foodshed policy, much like a watershed policy does towards the protection of a watershed.

Study results provide a spatial understanding of where food is produced, the types of food produced and a different way of thinking about the relationship between local food goal targets and foodshed production capacity. Foodshed maps add a level of detail to numerical calculations by visually illustrating crop diversity and the distance from a locality at which food production occurs by food group, and in this way, contributes to the discussion on proximity-based definitions of local. How far away can food be produced and still be considered local? Along with an assessment of local supply and demand, the answer to this question is critical to the success of local food targets.

Clearly, provincial farmland produces vast amounts of food, though it is limited in variety. Provincial productive capacity is restricted by soil capability and seasonal constraints. Since 1948, provincial policy has divided Alberta into the Green Area (58%) and White Area (42%). The Green Area includes forests along the eastern slopes of the Rocky Mountains and most of northern Alberta and does not make a significant contribution to agricultural food production (ESRD, 2011). Given this represents almost 60% of Alberta's Provincial land area, and there is no logical reason to assume the Green Area will ever be converted to cropland, greater efficiencies in the White Area representing less than half of the Province's land area will become increasingly necessary as Alberta's population continues to increase.

In spite of a large production capacity, the amount of local production that actually remains in the local area is unknown. Additionally, in 2009 the Alberta Beef Producers Association (2012) estimated that all but 15% of total beef production was exported to other domestic and international destinations. If similar assumptions were made about this local supply-demand ratio in 2037, carcass weight beef production within Alberta could supply just 88% of

Calgary's future demand. Results in this study are limited in that they do not include an assessment of declining trends nor the amount of production produced locally that stays within the local region. Further, seasonality biases the results because production capacity is not equally available at all times of year. Production estimates from this study likely overestimate the demand met for some crops during the months they there is no availability. However, these variables and others can be applied to the method developed in this research to build greater levels of detail into the analysis as the information becomes available.

For the city of Calgary, the baseline of empirical food production and consumption data provides an opportunity for the City to examine its municipal food goals as outlined in the imagineCALGARY Long Range Urban Sustainability Plan (2007) with the likelihood of meeting them through foodshed production capacity.

Chapter 7: Conclusions and Future Research

7.1 Conclusion

This thesis began with the province as the starting region for food production because the province is commonly used as a starting region in the literature and is widely accepted among practitioners. Additionally, surveys have shown that consumer perceptions of local are often aligned with jurisdictional boundaries. Since policies and decisions are made at the provincial level, this thesis provides a tool that several jurisdictions can use, which adds built in value to many communities.

Using the province as the starting point for collecting production data has the added benefit of providing a baseline of useful empirical production information to other communities in the same province. Once the foodshed is determined for one locality in the province, the GIS production database for the whole province is available so that other communities need only a modification to their per capita share of food to determine their own.

In addition to production and consumption data, the size of a local foodshed is also dependent upon how we interpret a local food consumption goal. Mapping production patterns by individual food group enhances the way municipalities can conceptualize local food goals. Foodshed maps create an opportunity for more informed discussion about the types and mix of types best suited to meeting local goals. Perhaps one could discuss the best local food mix, the way one talks about a sustainable local energy mix, based on the components that are most suited to the specific region. By virtue of its location, Calgary is surrounded by an agricultural land base that is well suited to the production of livestock, grains and legumes. Foodshed maps permit a more informed discussion of what 'local' means in terms of the distance food travels. Different localities may decide upon different distances depending on the production capacity in their immediate area, or reconsider whether provincial food that travels long distances should qualify. Mapping methods used in this thesis also allows flexibility and understanding to tailor policies and strategies by food group to meet those food goals.

Despite an increasing level of local food assessments, there is currently no standard method for evaluating the amount of food that might be considered as local in a given location. It is difficult to assess the degree of regional food self-sufficiency, identify existing opportunities, set goals, or to measure change in the absence of such basic information. The baseline and GIS database can be used by other cities in Alberta, adding value to other communities besides Calgary. Such a tool was not previously available. Methods used can be applied to cities and regions with local food consumption goals wherever agricultural census and survey data are available. Collecting food and food related data specific to local situations is critical in order to:

- Monitor and adjust to local changes over time,
- Set realistic goals for local food production and consumption,
- Identifying and answering relevant research questions
- Identifying jurisdictions involved who might participate in a specific local food strategy
- Evaluating, comparing, and contrasting the success and efficiency of alternative local food promotion programs.

Methods used in this study can be duplicated at various scales in other regions to evolve the discussion on the types of foods produced locally, what is meant by "local" and the distance at which food can travel and still be considered local. While recognizing limited available data, the intent was to use existing available data so as to use a tool to initiate discussions. It may even promote the collection of better data as people see the value.

7.2 Future Research

Lack of available data has been consistently cited as a limitation to accurate foodshed analyses. Information gaps that need to be filled in order to enable more accurate assessment of local food production identified through the course of this project are identified as follows.

1. Missing data or values in the agricultural statistics can have a significant effect on the

production estimates and therefore, place limitations on the conclusions that can be drawn from the results. More available production information is necessary to build a more accurate foodshed analysis.

2. Seasonal variation in production hinders the capacity of local area production to meet demand at all times of year and impacts the balance of exports and imports at certain times. An assessment of seasonal availability of food would provide a more accurate picture of the local foodshed and enhance consumer awareness of the seasonality of food.

3. Future consumption levels may be influenced by a variety of factors including dietary changes, economic circumstances and demographics (age, ethnicity, etc.). More research into local area consumption patterns and trends over time would be useful to forecast increased demand by food type.

4. While per capita available amounts of food, such as wheat, were readily available, how these raw materials are processed in the food system is less clear. Since people eat the end products of wheat and grains and not the basic grains themselves, the demand for specific foods influences the size of the agricultural area required (Gerbens-Leenes 2001). Information of how wheat and other grains are processed into the foods that we eat at the end of the food chain would be beneficial for a more accurate analysis of local foodshed capacity.

5. To monitor and gain a better understanding of the relationship between changing consumption patterns, and changing production patterns. Ultimately, as production becomes more tightly connected to local consumption, the food people eat determines the types of crops that are grown and therefore any changes in consumption patterns will have an impact on the size of a local foodshed.

6. Further research in declining trends and an assessment of the amount of production produced locally that stays within the local region is needed. Future production levels

may be influenced by a variety of factors such as land use changes, weather patterns and climate change, technological advances in farming methods and practices, economic drivers and consumption patterns. As a result, the farther forward the model looks in time, the less likely it is that it can accurately portray future food production levels.

7. Local food production does not always have to mean rural production. Future research on the potential contributions that community and household gardening and new urban farming technologies (such as rooftop gardening and vertical walls) could make to the local foodshed could be undertaken. This should also include an identification of the types and levels of skills necessary to undertake them.

8. Shorter travel distances may result in energy efficiencies such as lower emissions and fuel consumption for transport while shorter travel times may potentially minimize food waste due to spoilage. Shorter travel distances may also appeal more to consumers who prefer definitions of local based on proximity of production. Further research into the implications of these points would be beneficial to enhance land use planning and food policy decisions.

9. Finally, Calgary's local food goal is feasible when supply and demand are the only variables but food systems do not operate in such a limited context. Future foodshed analyses should examine a wider range of local food system components, such as processing, transportation, distribution, waste management and governance. Realistic objectives for local food production in 2037 can result from an investment in further research related to water and land use planning needs, economic influences and social ecological benefits and impacts.

   The scale of production and types of crops currently grown in some locations would make it cost-prohibitive to diversify and retarget production for local markets. For example, Figure 5.1 shows the intensity of grain farming relative to fruit and vegetable crops, which is driven by global market prices and non-local demand. Inversely, local

producers may be shut out of the export market if the interest in localism increases elsewhere (Chinnakonda, 2007).

7.3 Summing Up

This thesis developed a method for spatially mapping the local foodshed by individual food types and in aggregate to meet the maximum local demand or a specified local food goal. The method uses widely available data, so as to be easily adopted by other localities, but can also be customized to use more sophisticated datasets as they become available. As demonstrated in this thesis through the example of Calgary, the resulting foodshed maps are a powerful, visual tool to contribute to more informed discussions of what is local, and inform the development of local food goals, policies and strategies.

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Appendix A: Quantitative Agriculture Production Tables, Alberta 2011

Wheat Production

Census Agricultural Region (CAR)	Census Division	Census Consolidated Sub-division	County	Wheat Crops	
				No. of Farms	(ha)
Agricultural Region 1	**Division No. 1**	**CD 481001000**	**Medicine Hat**	**607**	**233,733**
		CCS 481001003	Cypress M.D. 1	253	79,038
		CCS 481001008	Forty Mile County 8	354	154,717
Agricultural Region 2	**Division No. 2**	**CD 482002000**	**Lethbridge**	**2,336**	**698,057**
		CCS 482002011	Lethbridge County	322	63,554
		CCS 482002031	Newell County 4	247	42,011
		CCS 482002021	Taber	325	90,909
		CCS 482002001	Warner County	244	102,373
Agricultural Region 3	**Division No. 3**	**CD 483000000**	**Pincher Creek**	**282**	**117,843**
		CCS 483003001	Cardston County	101	58,025
		CCS 483003011	Pincher Creek No. 9	32	16,143
		CCS 483003018	Willow Creek MD 26	149	43,675
			I.D.4	-	-
Agricultural Region 1	**Division No. 4 A**	**CD 484000000**	**Oyen/Hanna**	**1,078**	**297,690**
		CCS 481004004	Special Area 2	114	32,938
		CCS 481004012	Special Area 3	265	86,714
		CCS 481004020	Special Area 4	124	39,662
Agricultural Region 2	**Division No. 5**	**CD 482005000**	**Drumheller/Vulcan**	**1,198**	**399,210**
		CCS 482005041	Kneehill County	357	87,623
		CCS 482005031	Starland County	166	60,396
		CCS 482005001	Vulcan County (1)	341	133,789
		CCS 482005012	Wheatland County	334	117,402
Agricultural Region 3	**Division No. 6**	**CD 483006000**	**Calgary**	**521**	**117,843**
		CCS 483006016	Calgary	6	2,971
		CCS 483006001	Foothills No. 31	136	31,856
		CCS 483006028	Mountain View County	196	27,557
		CCS 483006014	Rocky View County	183	45,007
Agricultural Region 4A	**Division No. 7**	**CD 484007000**	**Wainwright/Stettler**	**1,078**	**297,690**
		CCS 484007031	Flagstaff County	395	111,378
		CCS 484007011	Paintearth County No. 18	136	39,372

Census Agricultural Region (CAR)	Census Division	Census Consolidated Sub-division	County	Wheat Crops	
		CCS 484007001	Provost No. 52	160	40,580
		CCS 484007019	Stettler County No. 6	183	46,687
		CCS 484007049	Wainwright No. 61	204	59,673
Agricultural Region 5	**Division No. 8**	**CD 485008000**	**Red Deer**	**623**	**82,451**
		CCS 485008022	LaCombe County	202	30,296
		CCS 485008001	Ponoka County	127	14,616
		CCS 485008001	Red Deer County	294	37,539
Agricultural Region 5	**Division No. 9**	**CD 485009000**	**Rocky Mountain House**	**22**	**2,802**
		CCS 485009002	Clearwater County	22	2,802
Agricultural Region 4B	**Division No. 10**	**CD 484110000**	**Camrose/Vermillion**	**1,833**	**368,911**
		CCS 484110016	Beaver County	286	63,885
		CCS 484110001	Camrose County	409	76,622
		CCS 484110058	Lamont County	266	40,053
		CCS 484110026	Minburn County No. 27	288	59,325
		CCS 484110048	Two Hills County No. 21	207	43,719
		CCS 484110036	Vermillion River County	377	85,308
			I.D. #13	-	-
Agricultural Region 5	**Division No. 11**	**CD 485011000**	**Edmonton**	**837**	**120,765**
		CCS 485011032	Brazeau County	11	504
		CCS 485011061	Edmonton	9	1,596
		CCS 485011012	Leduc County	259	30,198
		CCS 485011034	Parkland County	67	8,489
		CCS 485011052	Strathcona County	82	17,586
		CCS 485011059	Sturgeon County	240	39,524
		CCS 485011001	Wetaskiwin County No. 10	169	22,868
Agricultural Region 6	**Division No. 12**	**CD 486012000**	**Bonnyville/ St. Paul**	**279**	**38,299**
		CCS 486012004	Bonnyville No. 87	60	7,760
		CCS 486012037	Lac La Biche County (2)	19	2,731
		CCS 486012022	Smokey Lake County	83	11,845
		CCS 486012014	St. Paul County No. 19	117	15,963
Agricultural Region 6	**Division No. 13**	**CD 486013000**	**Barrhead/ Athabasca**	**666**	**91,291**
		CCS 486013001	Athabasca County	105	16,418
		CCS 486013018	Barrhead County No. 11	150	19,299
		CCS 486013001	Lac Ste. Anne County	48	5,604
		CCS 486013036	Thorhild County No. 7	107	13,684
		CCS 486013028	Westlock County	239	34,942
		CCS 486013029	Woodlands County	17	1,342

Census Agricultural Region (CAR)	Census Division	Census Consolidated Sub-division	County	Wheat Crops	
Agricultural Region 6	**Division No. 14**	**CD 486014000**	**Edson**	**31**	**3,990**
		CCS 486014003	Yellowhead County	31	3,990
		-	I.D. 25	-	-
Agricultural Region 3	**Division No. 15**	**CD 483015000**	**Mountain Parks Region**	**0**	**0**
		CCS 483015015	Bighorn MD No. 8	0	0
		CCS 483015045	Ranchland No. 66 66	0	0
		CCS 483015037	Improvement District # 12	0	0
Agricultural Region 6	**Division No. 16**	**CD 486016000**	**Fort McMurray**	**0**	**0**
Agricultural Region 7	**Division No. 17**	**CD 487017000**	**Fort Vermillion**	**539**	**111,724**
		CCS 487017027	Big Lakes	46	10,092
		CCS 487017062	Clear Hills	66	17,898
		CCS 487017033	Lesser Slave Lake No. 124	16	1,308
		CCS 487017095	Mackenzie County	212	23,523
		CCS 487017076	Northern Lights County	125	36,745
		CCS 487017026	Northern Sunrise County	74	22,158
Agricultural Region 7	**Division No. 18**	**CD 487018000**	**Valleyview**	**84**	**24,750**
		CCS 487018015	Greenview No. 16	84	24,750
Agricultural Region 7	**Division No. 19**	**CD 487019000**	**Grande Prairie/ Fairview**	**886**	**253,860**
		CCS 487019049	Birch hills County	140	45,213
		CCS 487019066	Fairview No. 136	103	29,500
		CCS 487019006	Grande Prairie County No. 1	224	43,331
		CCS 487019071	Peace No. 135	58	15,011
		CCS 487019059	Saddle Hills County	130	36,310
		CCS 487019041	Smokey River No. 130	205	73,450
		CCS 487019054	Spirit River No. 133	26	11,045

Source: Statistics Canada, 2011 Census of Agriculture, Farm and Farm Operator Data, catalogue no. 95-640-XWE.

Total Beef and Dairy Production

Census Agricultural Region (CAR)	Census Division	Census Consolidated Sub-division	County	Milk & Dairy Farms		Beef Farms	
				No of Farms	No of Cows	No of Farms	No of Cows
Agricultural Region 1	**Division No. 1**	**CD 481001000**	**Medicine Hat**	**20**	**2,249**	**598**	**75,085**
		CCS 481001003	Cypress County	5	407	410	55,331
		CCS 481001008	Forty Mile County 8	15	1,842	188	19,754
Agricultural Region 2	**Division No. 2**	**CD 481002000**	**Lethbridge**	**118**	**13,842**	**1,012**	**120,631**
		CCS 482002011	Lethbridge County	67	8,840	216	16,066
		CCS 482002031	Newell County N0. 4	13	1,164	351	47,590
		CCS 482002021	Taber	17	1,884	246	29,382
		CCS 482002001	Warner County No.5	21	1,954	199	27,593
Agricultural Region 3	**Division No. 3**	**CD 483003000**	**Pincher Creek**	**46**	**3,185**	**953**	**112,027**
		CCS 483003001	Cardston County	22	1,654	282	33,088
		CCS 483003011	Pincher Creek No. 9	7	406	259	32,690
		CCS 483003018	Willow Creek No. 26	17	1,125	412	46,249
			I.D.4	-	-	-	-
Agricultural Region 1	**Division No. 4**	**CD 481004000**	**Oyen/Hanna**	**8**	**955**	**772**	**119,199**
		CCS 481004004	Special Area 2	4	350	332	54,629
		CCS 481004012	Special Area 3 (incl. Acadia)	3	X	241	X
		CCS 481004020	Special Area 4	1	X	199	X
Agricultural Region 2	**Division No. 5**	**CD 482005000**	**Drumheller/Vulcan**	**46**	**3,787**	**924**	**93,629**
		CCS 482005041	Kneehill County	8	872	254	21,410
		CCS 482005031	Starland County	10	425	147	13,920
		CCS 482005001	Vulcan County	19	1,478	224	26,112
		CCS 482005012	Wheatland County	9	1,012	299	32,187
Agricultural Region 3	**Division No. 6**	**CD 483006000**	**Calgary**	**60**	**4,037**	**1,632**	**119,782**
		CCS 483006016	Calgary	0	0	5	326
		CCS 483006001	Foothills No. 31	8	251	422	33,947
		CCS 483006028	Mountain View County	38	3,086	727	43,729
		CCS 483006014	Rocky View County	14	700	478	41,780
Agricultural Region 4	**Division No. 7**	**CD 484007000**	**Wainwright/Stettler**	**45**	**3,522**	**1,484**	**148,224**
		CCS 484007031	Flagstaff County	12	393	277	22,371
		CCS 484007011	Paintearth County No. 18	6	457	279	28,438
		CCS 484007001	Provost No. 52	3	23	256	38,822
		CCS 484007019	Stettler County No. 6	18	1,905	416	37,546
		CCS 484007049	Wainwright No. 61	6	744	256	27,047
Agricultural Region 5	**Division No. 8**	**CD 485008000**	**Red Deer**	**176**	**23,712**	**1,640**	**121,084**

Census Agricultural Region (CAR)	Census Division	Census Consolidated Sub-division	County	Milk & Dairy Farms		Beef Farms	
				No of Farms	No of Cows	No of Farms	No of Cows
		CCS 485008022	LaCombe County	65	9,720	440	31,602
		CCS 485008001	Ponoka County	67	8,698	541	42237
		CCS 485008001	Red Deer County	44	5,294	659	47245
Agricultural Region 5	**Division No. 9**	**CD 485009000**	**Rocky Mountain House**	**23**	**1,073**	**594**	**34,026**
		CCS 485009002	Clearwater County	23	1,073	594	34,026
Agricultural Region 4	**Division No. 10**	**CD 484110000**	**Camrose/Vermillion**	**64**	**3,112**	**2,005**	**146,430**
		CCS 484110016	Beaver County	12	615	305	18,208
		CCS 484110001	Camrose County	18	1,463	375	22,771
		CCS 484110058	Lamont County	8	232	278	14,954
		CCS 484110026	Minburn County No. 27	11	386	247	19,447
		CCS 484110048	Two Hills County No. 21	6	204	269	18,658
		CCS 484110036	Vermillion River County	9	212	531	52,392
			I.D. #13	-	-	-	-
Agricultural Region 5	**Division No. 11**	**CD 485011000**	**Edmonton**	**142**	**13,399**	**1,774**	**90,901**
		CCS 485011032	Brazeau County	7	227	228	12,352
		CCS 485011061	Edmonton	0	0	5	75
		CCS 485011012	Leduc County	71	5,706	450	21,137
		CCS 485011034	Parkland County	13	1,661	317	17,601
		CCS 485011052	Strathcona County	9	587	152	5,127
		CCS 485011059	Sturgeon County	16	1,719	218	9,293
		CCS 485011001	Wetaskiwin County No. 10	26	2,499	404	25,316
Agricultural Region 6	**Division No. 12**	**CD 486012000**	**Bonnyville/ St. Paul**	**20**	**470**	**1,138**	**86,014**
		CCS 486012004	Bonnyville No. 87	7	111	368	26,508
		CCS 486012037	Lac La Biche County	4	X	128	X
		CCS 486012022	Smokey Lake County	2	X	238	X
		CCS 486012014	St. Paul County No. 19	7	213	404	33,322
Agricultural Region 6	**Division No. 13**	**CD 486013000**	**Barrhead/ Athabasca**	**66**	**5,953**	**859**	**117,199**
		CCS 486013001	Athabasca County	9	485	306	20,577
		CCS 486013018	Barrhead County No. 11	26	3,568	313	20,946
		CCS 486013001	Lac Ste. Anne County	11	358	488	30,214
		CCS 486013036	Thorhild County No. 7	3	X	194	X
		CCS 486013028	Westlock County	14	1,310	354	24,369
		CCS 486013029	Woodlands County	3	X	143	X
Agricultural Region 6	**Division No. 14**	**CD 486014000**	**Edson**	**13**	**859**	**330**	**18,969**
		CCS 486014003	Yellowhead County	13	859	330	18,969
		-	I.D. 25	-	-	-	-

Census Agricultural Region (CAR)	Census Division	Census Consolidated Sub-division	County	Milk & Dairy Farms		Beef Farms	
				No of Farms	No of Cows	No of Farms	No of Cows
Agricultural Region 3	**Division No. 15**	**CD 483015000**	**Mountain Parks Region**	**0**	**0**	**52**	**8,249**
		CCS 483015015	Bighorn MD No. 8	0	0	21	2,907
		CCS 483015045	Ranchland No. 66	0	0	31	5342
		CCS 483015037	Improvement District No. 12	0	0	-	-
Agricultural Region 6	**Division No. 16**	**CD 486016000**	**Fort McMurray**	**0**	**0**	**0**	**0**
Agricultural Region 7	**Division No. 17**	**CD 487017000**	**Fort Vermillion**	**57**	**978**	**819**	**47,015**
		CCS 487017027	Big Lakes	2	X	173	X
		CCS 487017062	Clear Hills	8	101	172	9,469
		CCS 487017033	Lesser Slave Lake No. 124	1	X	77	X
		CCS 487017095	Mackenzie County	35	X	210	X
		CCS 487017076	Northern Lights County	8	10	142	8,740
		CCS 487017026	Northern Sunrise County	3	X	45	X
Agricultural Region 7	**Division No. 18**	**CD 487018000**	**Valleyview**	**12**	**173**	**272**	**16,920**
		CCS 487018015	Greenview No. 16	12	173	272	16,920
Agricultural Region 7	**Division No. 19**	**CD 487019000**	**Grande Prairie/ Fairview**	**31**	**388**	**821**	**55,007**
		CCS 487019049	Birch hills County	5	X	84	X
		CCS 487019066	Fairview No. 136	2	X	73	X
		CCS 487019006	Grande Prairie County No. 1	12	31	396	23,360
		CCS 487019071	Peace No. 135	1	X	68	X
		CCS 487019059	Saddle Hills County	10	116	152	12,628
		CCS 487019041	Smokey River No. 130	1	X	35	X

Source: Statistics Canada, 2011 Census of Agriculture, Farm and Farm Operator Data, catalogue no. 95-640-XWE.

Total Poultry and Egg Production

Census Agricultural Region (CAR)	Census Division	Census Consolidated Sub-division	County	Poultry Production*		Egg Production	
				No of Farms	Kg	No of Farms	Dozens of Eggs
Agricultural Region 1	**Division No. 1**	**CD 481001000**	**Medicine Hat**	**9**	**X**	**27**	**3,420,786**
		CCS 481001003	Cypress County	3	X	10	X
		CCS 481001008	Forty Mile County 8	6	X	17	X
Agricultural Region 2	**Division No. 2**	**CD 481002000**	**Lethbridge**	**67**	**29,706,718**	**77**	**8,503,678**
		CCS 482002011	Lethbridge County	**39**	18,833,087	27	174,218
		CCS 482002031	Newell County N0. 4	6	X	17	1,908,027
		CCS 482002021	Taber	9	3,955,700	11	1,525,120
		CCS 482002001	Warner County No.5	13	X	22	4,896,313
Agricultural Region 3	**Division No. 3**	**CD 483003000**	**Pincher Creek**	**29**	**2,588,431**	**53**	**4,773,001**
		CCS 483003001	Cardston County	13	335,416	22	2,676,094
		CCS 483003011	Pincher Creek No. 9	6	838,577	14	360,519
		CCS 483003018	Willow Creek No. 26	0	1,414,438	17	1,736,388
			I.D.4	-	-	-	-
Agricultural Region 1	**Division No. 4**	**CD 481004000**	**Oyen/Hanna**	**5**	**X**	**7**	**1,677,009**
		CCS 481004004	Special Area 2	4	X	3	X
		CCS 481004012	Special Area 3 (incl. Acadia)	1	X	3	X
		CCS 481004020	Special Area 4	0	0	1	X
Agricultural Region 2	**Division No. 5**	**CD 482005000**	**Drumheller/Vulcan**	**74**	**13,003,970**	**54**	**7,120,457**
		CCS 482005041	Kneehill County	35	7,702,481	17	1,514,030
		CCS 482005031	Starland County	8	596,845	5	1,427,785
		CCS 482005001	Vulcan County	15	X	17	2,427,998
		CCS 482005012	Wheatland County	16	2,036,807	15	1,750,644
Agricultural Region 3	**Division No. 6**	**CD 483006000**	**Calgary**	**57**	**10,566,657**	**105**	**2,600,764**
		CCS 483006016	Calgary	0	0	1	X
		CCS 483006001	Foothills No. 31	9	2,544,388	34	302,618
		CCS 483006028	Mountain View County	25	7,909,340	37	X
		CCS 483006014	Rocky View County	23	112,929	33	2,264,875
Agricultural Region 4	**Division No. 7**	**CD 484007000**	**Wainwright/Stettler**	**50**	**3,483,689**	**40**	**3,709,618**
		CCS 484007031	Flagstaff County	10	2,322	8	X
		CCS 484007011	Paintearth County No. 18	10	36,867	7	1,109,636
		CCS 484007001	Provost No. 52	3	X	5	X
		CCS 484007019	Stettler County No. 6	15	645,294	14	1,292,794

Census Agricultural Region (CAR)	Census Division	Census Consolidated Sub-division	County	Poultry Production*		Egg Production	
				No of Farms	Kg	No of Farms	Dozens of Eggs
		CCS 484007049	Wainwright No. 61	12	2,760,711	6	X
Agricultural Region 5	**Division No. 8**	**CD 485008000**	**Red Deer**	**63**	**22,067,851**	**72**	**X**
		CCS 485008022	LaCombe County	26	939	23	1,246,509
		CCS 485008001	Ponoka County	19	10,880,843	27	17,462
		CCS 485008001	Red Deer County	18	X	22	X
Agricultural Region 5	**Division No. 9**	**CD 485009000**	**Rocky Mountain House**	**7**	**10,720**	**18**	**X**
		CCS 485009002	Clearwater County	7	10,720	18	X
Agricultural Region 4	**Division No. 10**	**CD 484110000**	**Camrose/Vermillion**	**103**	**17,601,919**	**70**	**2,091,064**
		CCS 484110016	Beaver County	17	1,721,393	17	442,039
		CCS 484110001	Camrose County	36	11,612,224	13	552,385
		CCS 484110058	Lamont County	6	X	7	4,793
		CCS 484110026	Minburn County No. 27	10	X	9	645,899
		CCS 484110048	Two Hills County No. 21	12	1,528,614	12	X
		CCS 484110036	Vermillion River County	22	1,335,649	12	X
			I.D. #13	-	-	-	-
Agricultural Region 5	**Division No. 11**	**CD 485011000**	**Edmonton**	**113**	**24,322,782**	**128**	**5,410,030**
		CCS 485011032	Brazeau County	3	X	13	26,422
		CCS 485011061	Edmonton	1	X	0	0
		CCS 485011012	Leduc County	26	1,559,217	36	1,062,016
		CCS 485011034	Parkland County	15	11,570	25	178,912
		CCS 485011052	Strathcona County	10	X	18	X
		CCS 485011059	Sturgeon County	36	18,711,555	14	X
		CCS 485011001	Wetaskiwin County No. 10	22	4,148,610	22	X
Agricultural Region 6	**Division No. 12**	**CD 486012000**	**Bonnyville/ St. Paul**	**31**	**526,973**	**30**	**X**
		CCS 486012004	Bonnyville No. 87	9	1,429	11	16,328
		CCS 486012037	Lac La Biche County	1	1,104	4	876
		CCS 486012022	Smokey Lake County	8	15,985	10	X
		CCS 486012014	St. Paul County No. 19	13	X	5	5,952
Agricultural Region 6	**Division No. 13**	**CD 486013000**	**Barrhead/ Athabasca**	**43**	**2,259,608**	**72**	**X**
		CCS 486013001	Athabasca County	6	X	11	12,702
		CCS 486013018	Barrhead County No. 11	10	1,259,111	9	1,100,951
		CCS 486013001	Lac Ste. Anne County	2	X	20	23,856
		CCS 486013036	Thorhild County No. 7	6	X	8	X
		CCS 486013028	Westlock County	16	2,947	15	1,297,754
		CCS 486013029	Woodlands County	3	3,692	9	3,096

Census Agricultural Region (CAR)	Census Division	Census Consolidated Sub-division	County	Poultry Production*		Egg Production	
				No of Farms	Kg	No of Farms	Dozens of Eggs
Agricultural Region 6	**Division No. 14**	**CD 486014000**	**Edson**	**14**	**7,157**	**24**	**14,805**
		CCS 486014003	Yellowhead County	14	7,157	24	14,805
		-	I.D. 25	-	-	-	-
Agricultural Region 3	**Division No. 15**	**CD 483015000**	**Mountain Parks Region**	**0**	**0**	**4**	**1,476**
		CCS 483015015	Bighorn MD No. 8	0	0	2	X
		CCS 483015045	Ranchland No. 66	0	0	2	X
		CCS 483015037	Improvement District No. 12	0	0	0	0
Agricultural Region 6	**Division No. 16**	**CD 486016000**	**Fort McMurray**	**-**	**-**	**0**	**0**
Agricultural Region 7	**Division No. 17**	**CD 487017000**	**Fort Vermillion**	**48**	**46,426**	**78**	**80,152**
		CCS 487017027	Big Lakes	6	X	9	6,645
		CCS 487017062	Clear Hills	8	X	9	5,339
		CCS 487017033	Lesser Slave Lake No. 124	0	0	6	3,361
		CCS 487017095	Mackenzie County	33	28,555	47	61,957
		CCS 487017076	Northern Lights County	0	0	5	X
		CCS 487017026	Northern Sunrise County	1	X	2	X
Agricultural Region 7	**Division No. 18**	**CD 487018000**	**Valleyview**	**5**	**651,011**	**19**	**70,358**
		CCS 487018015	Greenview No. 16	5	651,011		
Agricultural Region 7	**Division No. 19**	**CD 487019000**	**Grande Prairie/ Fairview**	**24**	**640,795**	**54**	**1,411,983**
		CCS 487019049	Birch hills County	2	X	3	X
		CCS 487019066	Fairview No. 136	2	X	2	X
		CCS 487019006	Grande Prairie County No. 1	13	4,870	30	137,152
		CCS 487019071	Peace No. 135	0	0	3	434
		CCS 487019059	Saddle Hills County	6	241	12	3,439
		CCS 487019041	Smokey River No. 130	1	X	4	X
		CCS 487019054	Spirit River No. 133	0	0	0	0

Source: Statistics Canada, 2011 Census of Agriculture, Farm and Farm Operator Data, catalogue no. 95-640-XWE.

Total Fruits and Vegetable Production

Census Agricultural Region (CAR)	Census Division	Census Consolidated Sub-division	County	Fruits & Tree Nut Farms, Berries		Vegetables	
				No of farms	(Ha)	No of farms	(Ha)
Agricultural Region 1	**Division No. 1**	**CD 481001000**	**Medicine Hat**	**7**	**X**	**22**	**X**
		CCS 481001003	Cypress County	4	0	14	X
		CCS 481001008	Forty Mile County 8	3	X	8	X
Agricultural Region 2	**Division No. 2**	**CD 481002000**	**Lethbridge**	**13**	**5**	**73**	**3,000**
		CCS 482002011	Lethbridge County	6	X	21	327
		CCS 482002031	Newell County N0. 4	4	0	10	121
		CCS 482002021	Taber	1	X	30	2,520
		CCS 482002001	Warner County No.5	2	X	12	31
Agricultural Region 3	**Division No. 3**	**CD 483003000**	**Pincher Creek**	**6**	**X**	**12**	**17**
		CCS 483003001	Cardston County	3	X	5	7
		CCS 483003011	Pincher Creek No. 9	3	X	3	X
		CCS 483003018	Willow Creek No. 26	0	0	4	X
			I.D.4	0	0	0	0
Agricultural Region 1	**Division No. 4**	**CD 481004000**	**Oyen/Hanna**	1	**0**	**2**	**X**
		CCS 481004004	Special Area 2	0	0	0	0
		CCS 481004012	Special Area 3 (incl. Acadia)	1	0	2	X
		CCS 481004020	Special Area 4	0	0	0	0
Agricultural Region 2	**Division No. 5**	**CD 482005000**	**Drumheller/Vulcan**	**14**	**X**	**25**	**29**
		CCS 482005041	Kneehill County	4	X	4	X
		CCS 482005031	Starland County	0	0	1	X
		CCS 482005001	Vulcan County	1	X	7	8
		CCS 482005012	Wheatland County	9	2	13	18
Agricultural Region 3	**Division No. 6**	**CD 483006000**	**Calgary**	**25**	**X**	**29**	**29**
		CCS 483006016	Calgary	3	0	2	X
		CCS 483006001	Foothills No. 31	10	10	5	6
		CCS 483006028	Mountain View County	8	X	15	15
		CCS 483006014	Rocky View County	4	X	7	X
Agricultural Region 4	**Division No. 7**	**CD 484007000**	**Wainwright/Stettler**	**12**	**X**	9	**15**
		CCS 484007031	Flagstaff County	4	X	6	4
		CCS 484007011	Paintearth County No. 18	3	0	1	X
		CCS 484007001	Provost No. 52	1	0	0	0
		CCS 484007019	Stettler County No. 6	3	0	2	X

Census Agricultural Region (CAR)	Census Division	Census Consolidated Sub-division	County	Fruits & Tree Nut Farms, Berries		Vegetables	
				No of farms	(Ha)	No of farms	(Ha)
		CCS 484007049	Wainwright No. 61	1	X	0	0
Agricultural Region 5	**Division No. 8**	**CD 485008000**	**Red Deer**	**36**	**75**	**41**	**71**
		CCS 485008022	LaCombe County	8	X	16	14
		CCS 485008001	Ponoka County	6	X	5	8
		CCS 485008001	Red Deer County	22	55	20	49
Agricultural Region 5	**Division No. 9**	**CD 485009000**	**Rocky Mountain House**	**3**	**X**	**4**	**6**
		CCS 485009002	Clearwater County	3	X	4	6
Agricultural Region 4	**Division No. 10**	**CD 484110000**	**Camrose/Vermillion**	**12**	**2**	**41**	**68**
		CCS 484110016	Beaver County	0	0	6	9
		CCS 484110001	Camrose County	3	X	11	39
		CCS 484110058	Lamont County	3	X	8	7
		CCS 484110026	Minburn County No. 27	4	0	3	1
		CCS 484110048	Two Hills County No. 21	1	X	7	6
		CCS 484110036	Vermillion River County	1	0	6	6
			I.D. #13	0	0	0	0
Agricultural Region 5	**Division No. 11**	**CD 485011000**	**Edmonton**	**61**	**X**	**84**	**256**
		CCS 485011032	Brazeau County	5	X	3	2
		CCS 485011061	Edmonton	1	0	8	85
		CCS 485011012	Leduc County	15	2	14	64
		CCS 485011034	Parkland County	11	1	20	19
		CCS 485011052	Strathcona County	10	X	7	31
		CCS 485011059	Sturgeon County	14	7	18	36
		CCS 485011001	Wetaskiwin County No. 10	5	X	14	19
Agricultural Region 6	**Division No. 12**	**CD 486012000**	**Bonnyville/ St. Paul**	**11**	**5**	**20**	**X**
		CCS 486012004	Bonnyville No. 87	4	X	7	3
		CCS 486012037	Lac La Biche County	1	0	4	4
		CCS 486012022	Smokey Lake County	2	X	7	15
		CCS 486012014	St. Paul County No. 19	4	X	2	X
Agricultural Region 6	**Division No. 13**	**CD 486013000**	**Barrhead/ Athabasca**	**17**	**X**	**39**	**57**
		CCS 486013001	Athabasca County	5	2	8	8
		CCS 486013018	Barrhead County No. 11	6	X	7	5
		CCS 486013001	Lac Ste. Anne County	2	X	9	X
		CCS 486013036	Thorhild County No. 7	0	0	3	6
		CCS 486013028	Westlock County	2	0	10	30
		CCS 486013029	Woodlands County	2	X	2	X
Agricultural Region 6	**Division No. 14**	**CD 486014000**	**Edson**	**5**	**X**	**6**	**X**

Census Agricultural Region (CAR)	Census Division	Census Consolidated Sub-division	County	Fruits & Tree Nut Farms, Berries		Vegetables	
				No of farms	(Ha)	No of farms	(Ha)
		CCS 486014003	Yellowhead County	5	X	6	X
		-	I.D. 25	0	0		0
Agricultural Region 3	**Division No. 15**	**CD 483015000**	**Mountain Parks Region**	**1**	**0**	**0**	**0**
		CCS 483015015	Bighorn MD No. 8	0	0	0	0
		CCS 483015045	Ranchland No. 66	1	0	0	0
		CCS 483015037	Improvement District No. 12	0	0	0	0
Agricultural Region 6	**Division No. 16**	**CD 486016000**	**Fort McMurray**	**0**	**0**	**0**	**0**
Agricultural Region 7	**Division No. 17**	**CD 487017000**	**Fort Vermillion**	**7**	**X**	**17**	**23**
		CCS 487017027	Big Lakes	0	0	4	3
		CCS 487017062	Clear Hills	0	0	2	X
		CCS 487017033	Lesser Slave Lake No. 124	0	0	4	15
		CCS 487017095	Mackenzie County	2	0	1	X
		CCS 487017076	Northern Lights County	3	X	4	2
		CCS 487017026	Northern Sunrise County	2	X	2	X
Agricultural Region 7	**Division No. 18**	**CD 487018000**	**Valleyview**	**3**	**X**	**4**	**8**
		CCS 487018015	Greenview No. 16	3	X	4	8
Agricultural Region 7	**Division No. 19**	**CD 487019000**	**Grande Prairie/ Fairview**	**9**	**X**	**17**	**60**
		CCS 487019049	Birch hills County	0	0	2	X
		CCS 487019066	Fairview No. 136	1	X	4	9
		CCS 487019006	Grande Prairie County No. 1	3	0	7	41
		CCS 487019071	Peace No. 135	2	X	2	X
		CCS 487019059	Saddle Hills County	1	0	0	0
		CCS 487019041	Smokey River No. 130	2	0	1	X
		CCS 487019054	Spirit River No. 133	0	0	1	X

Source: Statistics Canada, 2011 Census of Agriculture, Farm and Farm Operator Data, catalogue no. 95-640-XWE.

Total Sugar Beet Production

Census Agricultural Region (CAR)	Census Division	Census Consolidated Sub-division	County	Sugar Beets	
				No of farms	(Ha)
Agricultural Region 1	**Division No. 1**	**CD 481001000**	**Medicine Hat**	**2,707**	**2,707**
		CCS 481001003	Cypress County	2	2,707
		CCS 481001008	Forty Mile County 8	21	X
Agricultural Region 2	**Division No. 2**	**CD 481002000**	**Lethbridge**	**147**	**10,692**
		CCS 482002011	Lethbridge County	37	2,460
		CCS 482002031	Newell County N0. 4	8	X
		CCS 482002021	Taber	101	7,768
		CCS 482002001	Warner County No.5	1	X
Agricultural Region 3	**Division No. 3**	**CD 483003000**	**Pincher Creek**	**0**	**0**
		CCS 483003001	Cardston County	0	0
		CCS 483003011	Pincher Creek No. 9	0	0
		CCS 483003018	Willow Creek No. 26	0	0
			I.D.4	0	0
Agricultural Region 1	**Division No. 4**	**CD 481004000**	**Oyen/Hanna**	**0**	**0**
		CCS 481004004	Special Area 2	0	0
		CCS 481004012	Special Area 3 (incl. Acadia)	0	0
		CCS 481004020	Special Area 4	0	0
Agricultural Region 2	**Division No. 5**	**CD 482005000**	**Drumheller/Vulcan**	**3**	**83**
		CCS 482005041	Kneehill County	0	0
		CCS 482005031	Starland County	0	0
		CCS 482005001	Vulcan County	2	X
		CCS 482005012	Wheatland County	1	X
Agricultural Region 3	**Division No. 6**	**CD 483006000**	**Calgary**	**0**	**0**
		CCS 483006016	Calgary	0	0
		CCS 483006001	Foothills No. 31	0	0
		CCS 483006028	Mountain View County	0	0
		CCS 483006014	Rocky View County	0	0
Agricultural Region 4A	**Division No. 7**	**CD 484007000**	**Wainwright/Stettler**	**0**	**0**
		CCS 484007031	Flagstaff County	0	0
		CCS 484007011	Paintearth County No. 18	0	0
		CCS 484007001	Provost No. 52	0	0
		CCS 484007019	Stettler County No. 6	0	0
		CCS 484007049	Wainwright No. 61	0	0
Agricultural Region 5	**Division No. 8**	**CD 485008000**	**Red Deer**	**0**	**0**

Census Agricultural Region (CAR)	Census Division	Census Consolidated Sub-division	County	Sugar Beets	
				No of farms	(Ha)
		CCS 485008022	LaCombe County	0	0
		CCS 485008001	Ponoka County	0	0
		CCS 485008001	Red Deer County	0	0
Agricultural Region 5	**Division No. 9**	**CD 485009000**	**Rocky Mountain House**	**0**	**0**
		CCS 485009002	Clearwater County	0	0
Agricultural Region 4B	**Division No. 10**	**CD 484110000**	**Camrose/Vermillion**	**0**	**0**
		CCS 484110016	Beaver County	0	0
		CCS 484110001	Camrose County	0	0
		CCS 484110058	Lamont County	0	0
		CCS 484110026	Minburn County No. 27	0	0
		CCS 484110048	Two Hills County No. 21	0	0
		CCS 484110036	Vermillion River County	0	0
			I.D. #13	0	0
Agricultural Region 5	**Division No. 11**	**CD 485011000**	**Edmonton**	**0**	**0**
		CCS 485011032	Brazeau County	0	0
		CCS 485011061	Edmonton	0	0
		CCS 485011012	Leduc County	0	0
		CCS 485011034	Parkland County	0	0
		CCS 485011052	Strathcona County	0	0
		CCS 485011059	Sturgeon County	0	0
		CCS 485011001	Wetaskiwin County No. 10	0	0
Agricultural Region 6	**Division No. 12**	**CD 486012000**	**Bonnyville/ St. Paul**	**0**	**0**
		CCS 486012004	Bonnyville No. 87	0	0
		CCS 486012037	Lac La Biche County	0	0
		CCS 486012022	Smokey Lake County	0	0
		CCS 486012014	St. Paul County No. 19	0	0
Agricultural Region 6	**Division No. 13**	**CD 486013000**	**Barrhead/ Athabasca**	**0**	**0**
		CCS 486013001	Athabasca County	0	0
		CCS 486013018	Barrhead County No. 11	0	0
		CCS 486013001	Lac Ste. Anne County	0	0
		CCS 486013036	Thorhild County No. 7	0	0
		CCS 486013028	Westlock County	0	0
		CCS 486013029	Woodlands County	0	0
Agricultural Region 6	**Division No. 14**	**CD 486014000**	**Edson**	**0**	**0**
		CCS 486014003	Yellowhead County	0	0
		-	I.D. 25	0	0

Census Agricultural Region (CAR)	Census Division	Census Consolidated Sub-division	County	Sugar Beets	
				No of farms	(Ha)
Agricultural Region 3	**Division No. 15**	**CD 483015000**	**Mountain Parks Region**	**0**	**0**
		CCS 483015015	Bighorn MD No. 8	0	0
		CCS 483015045	Ranchland No. 66	0	0
		CCS 483015037	Improvement District No. 12	0	0
Agricultural Region 6	**Division No. 16**	**CD 486016000**	**Fort McMurray**	**0**	**0**
Agricultural Region 7	**Division No. 17**	**CD 487017000**	**Fort Vermillion**	**0**	**0**
		CCS 487017027	Big Lakes	0	0
		CCS 487017062	Clear Hills	0	0
		CCS 487017033	Lesser Slave Lake No. 124	0	0
		CCS 487017095	Mackenzie County	0	0
		CCS 487017076	Northern Lights County	0	0
		CCS 487017026	Northern Sunrise County	0	0
Agricultural Region 7	**Division No. 18**	**CD 487018000**	**Valleyview**	**0**	**0**
		CCS 487018015	Greenview No. 16	0	0
Agricultural Region 7	**Division No. 19**	**CD 487019000**	**Grande Prairie/ Fairview**	**0**	**0**
		CCS 487019049	Birch hills County	0	0
		CCS 487019066	Fairview No. 136	0	0
		CCS 487019006	Grande Prairie County No. 1	0	0
		CCS 487019071	Peace No. 135	0	0
		CCS 487019059	Saddle Hills County	0	0
		CCS 487019041	Smokey River No. 130	0	0
		CCS 487019054	Spirit River No. 133	0	0

Source: Statistics Canada, 2011 Census of Agriculture, Farm and Farm Operator Data, catalogue no. 95-640-XWE.

Total Honey Production, Alberta

Census Agricultural Region (CAR)	Census Division	Census Consolidated Sub-division	County	Honeybee Colonies
				No. of Farms
Agricultural Region 1	**Division No. 1**	**CD 481001000**	**Medicine Hat**	**4**
		CCS 481001003	Cypress M.D. 1	3
		CCS 481001008	Forty Mile County 8	1
Agricultural Region 2	**Division No. 2**	**CD 481002000**	**Lethbridge**	**12**
		CCS 482002011	Lethbridge County	7
		CCS 482002031	Newell County 4	6
		CCS 482002021	Taber	2
		CCS 482002001	Warner County	2
Agricultural Region 3	**Division No. 3**	**CD 483003000**	**Pincher Creek**	**16**
		CCS 483003001	Cardston County	6
		CCS 483003011	Pincher Creek No. 9	2
		CCS 483003018	Willow Creek MD 26	8
			I.D.4	X
Agricultural Region 1	**Division No. 4**	**CD 484000000**	**Oyen/Hanna**	**1**
		CCS 481004004	Special Area 2	0
		CCS 481004012	Special Area 3 (incl. Acadia)	0
		CCS 481004020	Special Area 4	1
Agricultural Region 2	**Division No. 5**	**CD 482005000**	**Drumheller/Vulcan**	**22**
		CCS 482005041	Kneehill County	6
		CCS 482005031	Starland County	4
		CCS 482005001	Vulcan County (1)	7
		CCS 482005012	Wheatland County	5
Agricultural Region 3	**Division No. 6**	**CD 483006000**	**Calgary**	**37**
		CCS 483006016	Calgary	7
		CCS 483006001	Foothills No. 31	10
		CCS 483006028	Mountain View County	10
		CCS 483006014	Rocky View County	10
Agricultural Region 4A	**Division No. 7**	**CD 484007000**	**Wainwright/Stettler**	**14**
		CCS 484007001	Provost No. 52	1
		CCS 484007011	Paintearth County No. 18	5
		CCS 484007019	Stettler County No. 6	3
		CCS 484007031	Flagstaff County	2

Census Agricultural Region (CAR)	Census Division	Census Consolidated Sub-division	County	Honeybee Colonies
				No. of Farms
		CCS 484007049	Wainwright No. 61	3
Agricultural Region 5	**Division No. 8**	**CD 485008000**	**Red Deer**	**26**
		CCS 485008001	Red Deer County	10
		CCS 485008022	LaCombe County	8
		CCS 485008001	Ponoka County	8
Agricultural Region 5	**Division No. 9**	**CD 485009000**	**Rocky Mountain House**	**6**
		CCS 485009002	Clearwater County	6
Agricultural Region 4B	**Division No. 10**	**CD 484110000**	**Camrose/Vermillion**	
		CCS 484110001	Camrose County	9
		CCS 484110016	Beaver County	4
		CCS 484110026	Minburn County No. 27	5
		CCS 484110036	Vermillion River County	4
		CCS 484110048	Two Hills County No. 21	5
		CCS 484110058	Lamont County	11
			I.D. #13	..
Agricultural Region 5	**Division No. 11**	**CD 485011000**	**Edmonton**	**71**
		CCS 485011001	Wetaskiwin County No. 10	10
		CCS 485011012	Leduc County	10
		CCS 485011032	Brazeau County	6
		CCS 485011034	Parkland County	12
		CCS 485011052	Strathcona County	12
		CCS 485011059	Sturgeon County	11
		CCS 485011061	Edmonton	10
Agricultural Region 6	**Division No. 12**	**CD 486012000**	**Bonnyville/ St. Paul**	**24**
		CCS 486012004	Bonnyville No. 87	7
		CCS 486012014	St. Paul County No. 19	10
		CCS 486012022	Smokey Lake County	6
		CCS 486012037	Lac La Biche County (2)	1
Agricultural Region 6	**Division No. 13**	**CD 486013000**	**Barrhead/ Athabasca**	**34**
		CCS 486013001	Lac Ste. Anne County	9
		CCS 486013018	Barrhead County No. 11	6
		CCS 486013028	Westlock County	11
		CCS 486013029	Woodlands County	0
		CCS 486013036	Thorhild County No. 7	3
		CCS 486013001	Athabasca County	5
Agricultural Region 6	**Division No. 14**	**CD 486014000**	**Edson**	**8**
		CCS 486014003	Yellowhead County	8
		-	I.D. 25	..

Census Agricultural Region (CAR)	Census Division	Census Consolidated Sub-division	County	Honeybee Colonies
				No. of Farms
Agricultural Region 3	**Division No. 15**	**CD 483015000**	**Mountain Parks Region**	**1**
		CCS 483015015	Bighorn MD No. 8	0
		CCS 483015045	Ranchland No. 66 66	1
		CCS 483015037	Improvement District # 12	0
Agricultural Region 6	**Division No. 16**	**CD 486016000**	**Fort McMurray**	**0**
Agricultural Region 7	**Division No. 17**	**CD 487017000**	**Fort Vermillion**	**22**
		CCS 487017026	Northern Sunrise County	5
		CCS 487017027	Big Lakes	11
		CCS 487017033	Lesser Slave Lake No. 124	0
		CCS 487017062	Clear Hills	2
		CCS 487017076	Northern Lights County	2
		CCS 487017095	Mackenzie County	2
Agricultural Region 7	**Division No. 18**	**CD 487018000**	**Valleyview**	5
		CCS 487018015	Greenview No. 16	5
Agricultural Region 7	**Division No. 19**	**CD 487019000**	**Grande Prairie/ Fairview**	40
		CCS 487019006	Grande Prairie County No. 1	13
		CCS 487019041	Smokey River No. 130	10
		CCS 487019049	Birch hills County	3
		CCS 487019054	Spirit River No. 133	1
		CCS 487019059	Saddle Hills County	6
		CCS 487019066	Fairview No. 136	3
		CCS 487019071	Peace No. 135	4

Source: Statistics Canada, 2011 Census of Agriculture, Farm and Farm Operator Data, catalogue no. 95-640-XWE

Appendix B: Quantitative Agriculture Production Tables, British Columbia, 2011

Fruit and Vegetable Production In The Lower Mainland-Southwest, Thompson-Okanagan And Kootenay Regions, 2011

Census Division	Census Consolidated Sub-division	Region/County	Fruits & Tree Nut Farms, Berries		Vegetables (excluding greenhouse vegetables)		Greenhouse Vegetables	
			No of farms	(Ha)	No of farms	(Ha)	No of farms	(Square Metres)
Division No. 2	CAR 590200000	**Lower Mainland-Southwest**	**1496**	**13312**	**32894**	**4711**	**140**	**2632358**
	CD 590209000	**Fraser Valley**	**719**	**5381**	**175**	**2199**	**47**	**X**
	CCS 590209016	Fraser Valley B	7	39	3	2	0	0
	CCS 590209034	Fraser Valley D	27	191	13	15	4	X
	CCS 590209036	Fraser Valley E	134	642	69	902	17	18667
	CCS 590209052	Abbotsford	490	4189	78	1274	21	734669
	CCS 590209060	Fraser Valley F	42	153	8	4	5	X
	CCS 590209062	Fraser Valley G	19	167	4	2	0	0
	CD 590215000	**Greater Vancouver**	**720**	**7881**	**328**	**2451**	**79**	**1848391**
	CCS 590215001	Langley	221	1306	83	158	23	443975
	CCS 590215004	Surrey	165	1187	68	839	12	140613
	CCS 590215011	Delta	55	902	45	989	12	1135628
	CCS 590215015	Richmond	109	1488	46	312	10	35755
	CCS 590215020	Greater Vancouver A	44	123	19	15	6	X
	CCS 590215022	Vancouver	7	7	12	6	1	X
	CCS 590215025	Burnaby	5	5	25	97	6	X
	CCS 590215070	Pitt Meadows	80	2800	6	9	7	X
	CCS 590215075	Maple Ridge	34	64	24	27	2	X
	CD 590229000	**Sunshine Coast**	**28**	**14**	**29**	**16**	**9**	**8090**
	CCS 590229018	Sunshine Coast A	28	14	29	16	9	8090
	CD 590231000	**Squamish-Lillooet**	**29**	**35**	**30**	**46**	**5**	**X**
	CCS 590231021	Squamish-Lillooet D	19	21	23	40	5	X
	CCS 590231034	Squamish-Lillooet B	10	15	7	5	0	0
Division No. 3	**CAR 590000000**	**Thompson-Okanagan**	**1976**	**9598**	**23718**	**886**	**62**	**58365**
	CD 590300000	**Okanagan-Similkameen**	**1095**	**5511**	**177**	**259**	**20**	**X**
	CCS 590307022	Okanagan-Similkameen A	132	805	16	22	6	X
	CCS 590307026	Okanagan-Similkameen B	77	X	39	67	3	X
	CCS 590307028	Okanagan-Similkameen C	298	2080	52	111	5	X
	CCS 590307047	Okanagan-Similkameen D	147	631	17	8	3	650
	CCS 590307049	Okanagan-Similkameen E	145	431	5	2	0	0
	CCS 590307051	Okanagan-Similkameen F	196	639	15	5	1	X

Census Division	Census Consolidated Sub-division	Region/County	Fruits & Tree Nut Farms, Berries		Vegetables (excluding greenhouse vegetables)		Greenhouse Vegetables	
			No of farms	(Ha)	No of farms	(Ha)	No of farms	(Square Metres)
	CCS 590307053	Okanagan-Similkameen G	99	577	29	42	1	X
	CCS 590307055	Okanagan-Similkameen H	1	X	4	1	1	X
	CD 590333000	**Thompson-Nicola**	**93**	**80**	**99**	**214**	**12**	**X**
	CCS 590333008	Thompson-Nicola M	1	X	2	X	0	0
	CCS 590333012	Thompson-Nicola N	2	X	3	2	0	0
	CCS 590333032	Thompson-Nicola E (Boneparte Plateau)	4	5	3	X	1	X
	CCS 590333037	Thompson-Nicola I (Blue sky County)	25	30	22	98	0	0
	CCS 590333039	Thompson-Nicola J (Copper Desert Cty)	3	2	4	4	0	0
	CCS 590333044	Thompson-Nicola P (Rivers & the Peaks)	26	24	27	67	4	X
	CCS 590333060	Thompson-Nicola L	19	13	20	31	6	X
	CCS 590333068	Thompson-Nicola A (Wells Gray Cty)	8	2	6	4	1	X
	CCS 590333070	Thompson-Nicola B (Thompson Headwaters)	0	0	0	0	0	0
	CCS 590333072	Thompson-Nicola O (Lower North Thompson)	5	2	12	6	0	0
	CD 590335000	**Central Okanagan**	**572**	**3409**	**17**	**163**	**8**	**1435**
	CCS 590335012	Central Okanagan	498	2797	88	148	5	1127
	CCS 590335020	Central Okanagan J	74	612	19	15	3	308
	CD 590337000)	**North Okanagan**	**150**	**482**	**96**	**174**	**6**	**X**
	CCS 590337017	North Okanagan B	90	412	34	46	1	X
	CCS 590337022	North Okanagan D	10	X	9	12	1	X
	CCS 590337023	North Okanagan E	2	X	5	2	0	0
	CCS 590337024	Spallumcheen	29	34	31	99	2	X
	CCS 590337041	North Okanagan F	19	25	17	15	2	X
	CD 590339000	**Columbia-Shuswap**	**66**	**116**	**58**	**77**	**16**	**3412**
	CCS 590339011	Columbia-Shuswap A	4	2	4	1	1	X
	CCS 590339037	Columbia-Shuswap C	15	18	12	17	6	X
	CCS 590339039	Columbia-Shuswap D	36	88	30	51	6	X
	CCS 590339043	Columbia-Shuswap E	7	6	6	3	1	X
	CCS 590339044	Columbia-Shuswap F	4	3	6	4	2	X
Division No. 4	**CAR 590400000**	**Kootenay**	**194**	**356**	**879**	**157**	**43**	**12224**
	CD 590401000	**East Kootenay**	**17**	**10**	**23**	**18**	**13**	**X**
	CCS 590401017	East Kootenay A	2	X	2	X	2	X
	CCS 590401019	East Kootenay B	3	2	2	X	1	X
	CCS 590401035	East Kootenay C	3	1	8	4	3	X
	CCS 590401037	East Kootenay E	4	3	1	X	3	1367
	CCS 590401046	East Kootenay F	2	X	5	4	2	X
	CCS 590401048	East Kootenay G	3	1	5	6	2	X
	CD 590209000	**Central Kootenay**	**146**	**311**	**95**	**115**	**22**	**6691**