FINDING FOOD DESERTS: A SPATIAL ANALYSIS OF FOOD SECURITY IN NORTHWESTERN ONTARIO (1996 – 2006)

By

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A thesis submitted in partial fulfillment
of the requirements for the degree of
Masters of Environmental Studies in Northern Environments and Cultures
Lakehead University
2010

Your file Votre référence
ISBN: 978-0-494-71967-1
Our file Notre référence
ISBN: 978-0-494-71967-1

ABSTRACT

The purpose of this study is to examine the state of food security in Northwestern Ontario communities by identifying food deserts, or neighbourhoods with high levels of social deprivation and limited access to nutritious food. This objective was achieved through mapping out socio demographic and economic data with the location of food retail outlets. Using a quartile analysis, many socio-demographic factors shown in the literature to affect community food security were combined into one value to be shown on one map. The resulting food desert maps were created for the years 1996, 2001 and 2006 in order to determine whether temporal trends of increasing or decreasing food security could be observed. Results show that in most communities food desert propagation follows socio-demographic and economic trends and food security was therefore inferred to be improving with a marked decrease in food deserts overall. Thunder Bay was found to be an interesting combination of the factors that have contributed to food desert proliferation in the United States with the social facets that have kept them from becoming too drastic a problem in Canada thus far. To date, these are believed to be the smallest communities examined for food desert identification.

ACKNOWLEDGEMENTS

Thesis Advisor: Dr. Bradley A. Wilson
Thesis Committee: Dr. Robert Stewart and Dr. Connie Nelson
External Reviewer: Dr. Roger Delaney

Many thanks for your guidance, comments and revisions!

To Lakehead University and the Food Security Research Network for your support in funding this research and for ample opportunities to present my work in a public setting.

My gratitude goes out to Mr. Tomislav Sapic and Mr. Jason Freeburn for all of their help. They answered questions, debated results and inspired ideas.

To my colleagues from the department, cheers to all of you. Your humour and words of understanding were needed so many times! Thanks for being there.

Finally, to my family and friends. To my Dad who talked me through rough patches, my Mom for her visits to the city for relief time, my Sister who reminds me that the world is a fun place despite looming deadlines! To Byron, one patient guy. To all of my friends, for all of the words of encouragement. Thanks to all for the pats on the back.

Table of Contents

List of Tables and Figures

Tables

Figures

CHAPTER ONE

Introduction

The concept of food security was first coined in the mid twentieth century as a staple issue in international development. Its main tenet of "every person having access to adequate food at all times for a healthy, active lifestyle" was adapted into the outlines of development and aid programs worldwide. While defined with respect to the struggles of developing nations and the eradication of hunger worldwide, food security came to take a broader approach in the Western world, namely in identifying the physical and economic barriers that inhibit communities from being food secure. Although food insecurity in North America rarely attains the dramatic degree of the developing world, the concept of "hunger amidst the plenty" is commonplace (Anderson and Cook, 1999).

In the Canadian context, the concept of food security has evolved from trying to meet the short-term, immediate needs of the hungry into an idea of sustaining communities as a whole. Canada has adopted the formal definition of food security set by the 1996 World Food Summit, stated as:

> *Food security exists when all people, at all times, have access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.* (Agriculture and Agri-Food Canada, 1998, p.9)

This approach has been integrated into Canadian policy and charters but little action has been accomplished federally. For example, the Food Security Bureau at the federal level was closed in 2006 (Power, 2007). National food insecurity rates in Canada are nearly 10%, with some inherently vulnerable groups having rates nearly twice that of the national average (Che and Chen, 2001; Power, 2007; Damman *et al*, 2008). This equates to approximately 3 million people across the country, a number that may be rising given current trends of increasing food bank usage and growing unemployment rates (Riches, 2002; Damman *et al*, 2008; Spence, 2009). Because of the lack of federal action, the United Nations has recommended that Canada implement immediate steps to address the issue (TBEJC, 2007).

Food security can be studied at many levels, from the international scale right down to that of neighbourhoods and households. While studies at the neighbourhood level have been conducted in other developed nations including Scotland, England and the United States, comparative research in Canada has been limited (CCSD, 2007). Analyzing the geographic factors of food security on the neighbourhood level within a city is important, as studies have indicated that neighbourhoods are dynamic environments that tend to conglomerate people of the same living condition (Hyman *et al*, 2005). Individual households within impoverished or food vulnerable neighbourhoods often experience similar

challenges in attaining food security (Petrucci *et al,* 2003). Therefore, identifying these regions can help planners and policy makers geographically locate and target certain areas for social aid and welfare programs. These impoverished neighbourhoods with low access to food retail outlets have come to be known as 'food deserts' and their identification has come to play an important role in the study of urban food security.

This research project was conducted to meet several objectives. Primarily it focuses on creating food desert maps for the city of Thunder Bay, Ontario and for the smaller northwestern Ontarian towns of Dryden, Kenora, Fort Frances, Sioux Lookout and Atikokan and to examine changes in these from 1996 to 2006. Secondly it explores a new approach on mapping food deserts using a methodology that incorporates many ideas in mapping schemes that have been employed by other food desert studies in Canada (Smoyer-Tomic *et al,* 2006; Apparicio *et al,* 2007; Larsen and Gilliland, 2008). It is hoped that the results of this study will be easily interpretable food desert maps that can be used in a public education setting. It is the belief that to date these are the smallest Canadian communities for which food desert identification research has been conducted.

The first chapter of this thesis introduces the concept of food security and defines several key terms and tools used to meet the research objectives detailed below. The second chapter outlines published research conducted in this field and aims to explain some of the underlying social facets that affect community food security in developed nations such as Canada. These social facets identified in the literature are used as indicators of food insecurity risk that form the backbone of the

methodology used for food desert mapping. The third chapter of this document describes the study area and identifies key challenges to food security experienced by communities in Northern environments. The research methodology is outlined in the fourth chapter, with the research results following in the fifth chapter. The sixth and final chapter discusses the results and applications of this research and outlines areas for improvement and further research possibilities.

1.1 Research Objectives

The specific research objectives of this project include:

- to use available census data to create a measure of food security at the neighbourhood level that encompasses many of the influencing social facets and phenomenon into one value (or one map);
- to use this new food security measure combined with food retail location information to map food deserts for the years 1996, 2001 and 2006 in six northwestern Ontario communities;
- to examine how changing location of food retail stores over the given temporal scale affects the occurrence of food deserts and to identify if any geographic areas in these six communities emerge as being consistently prone to food insecurity risk; and
- to present and distribute these maps to each community as a first step in helping to bring about awareness of food security issues and to build food secure neighbourhoods and communities in northwestern Ontario.

1.2 Definition of Terms

1.2.1 *Food Insecurity*

Food insecure neighbourhoods are often used as proxies of hunger rates in a region (Power, 2007). Canadian studies have defined homes to be food insecure if within the past year members have expressed uncertainty in acquiring safe, nutritious and culturally acceptable food, have compromised the quality or quantity of their diet or have experienced hunger to any degree (Che and Chen, 2001; Tarasuk, 2001). Studies have shown that food insecurity does not only plague the homeless or those of low income as middle-class families have acknowledged uncertainty in acquiring food in the past (Clifton, 2004). Food insecurity has been linked to many social and health problems such as delayed mental and physical development in children as well as compromised immune systems, malnutrition or, paradoxically, obesity (Che and Chen, 2001).

1.2.2 *Food Security*

The four pillars of food security as defined by the United Nations and ratified by the Canadian government are access, availability, stability of supply and utilization (Power, 2007). A household's access to food is determined by its ability to overcome potential economic and physical barriers to attaining food. Research on the pillar of access therefore has focused on the role of income and transportation in defining household security, where families in the low-income bracket or without a reliable means of transportation would be more likely to experience food insecurity. Studies on the availability of food have identified changes in the current food system

(See Section 1.2.3) and limitations in agricultural production as main factors in a region's food security. Based on these criteria, many regions in Canada with limited agricultural productivity would be considered food insecure.

The pillars of accessibility and availability equally tie in the role that food retailers play in food security as the number and type of stores in a community directly affects the food security of its inhabitants (Kirkup *et al*, 2004). The concept of food supply stability is a main concern in discussions regarding the food security of Northern communities. In many Canadian regions agricultural production is limited by a shortened growing season due to climatic and geographic factors including the temperature, amount of daylight and precipitation. Therefore, many Canadian cities rely on imported foodstuffs, particularly those in Northern climates. The majority of Northern households are therefore vulnerable to this aspect of food security as any disruption in food import from Southern latitudinal areas, such as extreme weather events for example, would cause serious health and survival concerns (Power, 2007). The stability of a region's food supply can also be affected by its price. This has been apparent in developing nations where price increases on staple foods due to fluctuating economies and harvests have led to hunger and food riots.

The final pillar of food security is utilization, which focuses on the role that food security plays in individual health through selection and preparation. The Canadian government has focused on this facet of food security through programs that aim to bring healthy foods and knowledge of healthy preparation techniques into school lunches, neighbourhoods and workplaces. Utilization links together

accessibility and availability in that house holds can only buy healthy food if it is available to them and if they have adequate access to it. Furey *et al* (2001) therefore notes that selection can greatly impact a household's food choices.

1.2.3 *Changing North American Food Systems*

Food security is a multi-faceted and complex social issue with many intertwining factors that can affect the ability of individuals to properly feed themselves. One of the main factors influencing food security in North America has been the rapid change in its food system over the past 40 years (Hinricks and Lyson, 2007). This change is characterized by the commoditization of food and the concentration of large-scale food retailing stores. Bringing food into an economic market has created unprecedented lower prices but with the cost of eliminating most locally owned and operated stores and farms. Supercenters and large grocery outlets have the capital to procure large quantities of food and therefore sell them at a low price. As smaller food outlets or locally owned outlets do not have the advantage of large capital and buying power, they have largely succumbed to the competitive prices of larger centres (Dunkley *et al*, 2004). Consequently, while there has been a net increase in global food production, there has been a net decrease in food outlets (Clifton, 2004).

In the United States, large chain supermarkets and superstores accounted for 89.8% of all grocery sales while the number of food stores and outlets has declined over 5% in the past 40 years (Hinricks and Lyson, 2007). Similar observations have been made in the United Kingdom where retail restructuring has nearly mirrored

that occurring in the United States (Cummins and MacIntyre, 1999). Though studies focusing on changes in Canadian food retail have been limited they have largely been found to follow suit with trends observed in the UK and the USA (Smoyer-Tomic *et al*, 2006; Larsen and Gilliland, 2008). Agriculture and Agri-Food Canada (1998) has said that Canadian cities have gone through a period of history where mergers, leverages and buy-outs have resulted in examples of low-income neighbourhoods where smaller grocery stores have closed and newer stores have opened in the suburbs.

Changes in food retail can have profound effects on the health and economies of communities as market forces, planning and zoning regulations and demographics underlie the decisions of where supermarkets are located rather than population need (Smoyer-Tomic *et al*, 2006). Some neighbourhoods and families are faced with the loss of their main source of food with the closure of local, centrally located grocery stores. In some instances, households relying on the closed grocery stores are left without any retail alternatives. This is supported by a study in Northern Ireland that found that 70% of people living in the low-income bracket shopped in the town center or closer to home (Furey *et al,* 2001). Hinricks and Lyson (2007) therefore posit that in North America the predominant food security issue is not a lack of food but rather a lack of access to quality food; the closest food retail outlets to the majority of inter-city dwellers are convenience marts. While these outlets are geographically more dispersed and often more accessible to food insecure individuals, they typically do not offer adequate food for a complete and nutritious diet (Hinricks and Lyson, 2007; Smoyer-Tomic *et al,* 2006). These changes

in the food system have therefore rendered vehicle ownership nearly essential for adequate access to food; by 2002 approximately 77% of the population in the UK used a car to get to the grocery store (Whelan *et al*, 2002).

1.2.4 *Food Deserts*

The spatial implications of changing food retail outlet locations have led to the development of the term *food deserts* or populated areas in a community with little to no access to full-service food retail provision (Cummins and MacIntyre, 1999). Smoyer-Tomic *et al* (2006) describes food deserts as populated areas with limited available food services and notes that these regions are generally low-income. Furey *et al* (2001) discuss a food desertification model that describes the two extremes experienced by households in a given community's neighbourhoods. The first extreme is defined by households with assured food security, having high and disposable income and several available vehicles. The opposite end is characterized by those at high risk of experiencing food insecurity. These individuals are without access to vehicles and live far away from the nearest grocery store with very limited income. Because the majority of neighbourhoods are believed to lie somewhere in the continuum defined by these extremes, identifying and addressing the existence of food deserts characterized by the poorest neighbourhoods can be a complicated, yet important, undertaking for a community.

People residing in food deserts are subjected to a range of negative effects. Primarily, their existence suggests that urban inequality may exist in a community, inferring that some community members may be struggling to meet the

requirements for a healthy life on a daily basis (Stephens, 1996). The definition of a food desert brings about questions based in social theories, rights and ethics. The universal declaration of human rights, for example, lists that access to safe, nutritious food as a fundamental principle, bringing into question the concept of ethical retail placement (Furey *et al*, 2001). By all counts, food deserts are areas of social exclusion as residents are not able to fully participate in the social, cultural and economic aspects of their community. Past research in Ireland discussed how participants in focus groups living in food deserts commiserated over missing out on the social aspect of food shopping in their neighbourhoods. A food desert may therefore have bigger and more profound effects than a lack of food access, but are also areas of worrying social isolation (Reisig and Hobbiss, 2000; Furey *et al*, 2001).

1.2.5 *GIS and Food Security Studies*

Geographical Information Systems, or GIS, is a term that encompasses a powerful geographic tool and map-making software that allows researchers to explore and visually represent spatial and social phenomenon. GIS helps researchers to overcome the obstacle of how to best communicate their results and to make them tangible and real to members of the general public (Kelly and Becker, 2000). Individuals outside of the realm of a study are often uneducated on its principles, but most people can easily identify and interpret maps, particularly if they are familiar with the landscape that the map represents. Researchers for the World Bank have toted GIS as being the "single most important tool for analyzing a wide range of geographic and socio-economic data..." (Bigman and Fofack, 2000, p. 132).

GIS can play a crucial role in analyzing spatial information as it can break down a large volume of information into relevant categories and can allow a researcher to identify trends, clusters and areas of concern in a community; alternatively they can confirm the absence of these (Kelly and Becker, 2000; Cromwell and McLafferty, 2002).

GIS has been used successfully in the realm of poverty mapping and food security studies in developing nations such as India, South Africa, Brazil and Mexico. These studies have used GIS to target areas in need of improved social infrastructure, to monitor the progress social programs and to give insight on the geographical and social factors that exacerbate poverty and food insecurity in the study regions (Bigman and Fofack, 2000; Antin and Hora, 2005; Hyman *et al*, 2005; Minot-Baulch, 2005). Despite its successes, however, Hyman *et al* (2005) note that GIS techniques for exploring geographical factors have not yet been widely applied in developing nations to map poverty and its effects.

CHAPTER TWO

Literature Review

At the heart of community food security issues is an inherently flawed food system that focuses greatly on the commoditization of cheap and abundant food (Hinricks and Lyson, 2007). Food security issues are difficult to address because they do not fit neatly into any one branch of governance. Due to its role in our everyday lives and survival, food is a topic that has become nobody's responsibility yet is everyone's business. The food system is understood differently by every one of its shareholders, ranging from the government to industry leaders to the average consumer (Rex and Blair, 2003). Two social branches largely govern what we eat, namely the food system and the retailing system, which in turn influence and interact with each other. These two branches are regulated and influenced by interplaying factors such as socio-cultural norms, food culture, economies, the environment and health. It is easily concluded that food plays into nearly every aspect of the human existence, making it difficult to categorize and govern. Politically, food can fall into many agendas including those governing health, the economy and culture (Reisig and Hobbiss, 2000). Because of its multi-faceted

nature, the food system has gone through rapid changes with little governance, leaving many people in its wake without adequate access to food and living in a state of food insecurity.

The obstacles that make food security issues difficult to govern also make it a complex topic of study. Research on the topic is integral, however, to the health and survival of a community as food security is often used as a determinant of social health (Power, 2007). Hinricks and Lyson (2007) point out that food endeavours are often regarded as engines of local economic development and are integral to the social and cultural fabric of a community. Petrucci *et al* (2003) expand upon this concept in identifying the importance of studying food security from a spatial point of view, noting that wide spatial variability exists in food security over a region. Community food security can be studied on several scales, from an entire country to the individual level (Power, 2007).

Defining whether a community is food secure revolves around the study of several determinants including the quality and availability of safe foods, the completeness of household food stores, the social acceptability of food sources and measured anxiety about the availability of food (Anderson and Cook, 1999). Developing a list of factors that affect food security and social well-being has been the focus of research in several countries over the past two decades as an increasing number of international agreements have been signed that bind nations together in addressing issues that are common to both developing and developed nations (Cicone *et al*, 2002). Collectively this research has produced a broad spectrum of measurable factors that are used in the spatial study of food security; these can be

classified in three main categories including socio-economic and demographics, location, mobility and transportation and, lastly, agricultural factors. Measuring these characteristics of a region allows food security researchers to identify vulnerabilities in local food systems and helps to inspire dialogue about how best to address and find solutions to local food security issues (Hinricks and Lyson, 2007).

2.1 Socio-economics and Demographics

Identifying the socio-demographic factors that affect the food security of a region can often help pinpoint the barriers that a community faces in achieving the tenets of food security. This broad category of factors can be further broken down into two sub-categories of demographic factors and economic factors. Demographics describe a population, from its internal make-up to its layout over a landscape. The demographic make-up of a community can play a large role in determining its state of food security with variables often discussed including minority populations, age structures, family structures and disability. These factors are often studied in conjunction with economic variables including average family income, expenditures and unemployment rates (Che and Chen, 2001; Furey *et al*, 2001; Wrigley *et al*, 2002; Hinricks and Lyson, 2007).

The social facet of food security has been overlooked in some studies that focus primarily on community members' physical access to food; however the role that socio-demographics and economics play is equally important. Wrigley *et al* (2002) note, for example, that for many low-income households physical access to a

nearby grocery store does not necessarily ensure that food needs are being met. Supporting this example are several authors that note the probability that North Americans face more economic rather than physical barriers to acquiring food. They suggest, therefore, that socio-economic and demographic constraints be incorporated into food security research (Furey *et al*, 2001; Kirkup *et al*, 2004).

Demographic groups likely to experience food insecurity are those that are constrained by various caring responsibilities, those with mobility concerns such as the elderly or disabled, and families of ethnic minority (Whelan *et al*, 2002). Single parent families, for example, are more likely to experience food insecurity than their two-parent counterparts. Single parents are often highly constrained when it comes to the physical and temporal aspects of grocery shopping and may have increased difficulty marshalling financial resources. Food security is therefore an issue for this demographic group, observed in that single mothers are frequent users of food banks (Riches, 2002). In a study conducted using focus groups, Whelan *et al* (2002) showed that single mothers had an "eat to live" attitude and many compromised their own diets to ensure that their children were well fed. Additional results from that study indicated that young, single mothers bought the least expensive food available, often resulting in less healthy diets overall. Other coping strategies used by single parents to ensure their families are being fed may involve relying on their social networks of friends and family for support. This support includes actions such as helping conduct trips to grocery stores or in providing meals for their families (Antin and Hora, 2005).

The influence of age on food security is seen over several studies, from parents purchasing food of questionable nutritious value for children's tastes to the evolved diet requirements of the elderly. Research in Scotland has showed that as people age, their food consumption priorities reshape (Whelan *et al*, 2002). Elderly persons have been found to prioritize convenience and ease of food preparation and consumption over price. Additionally, elderly individuals may have jeopardized access to food with concerns ranging from getting to grocery stores and also with getting around stores and having to maneuver aisles and crowds. In support of these findings overseas a 2002 Canadian study found that 6% of food bank users were seniors (Riches, 2002).

Economic access is considered one of the most important factors in determining adequate food security (McEntree and Agyeman, 2010). It is widely acknowledged that households in low-income brackets are those most likely to experience food insecurity (Whelan et al, 2002; Kersetter and Goldberg, 2007). In Canada, 35% of homes classified as being 'low income' have expressed experiencing food insecurity to some degree (Che and Chen, 2001). Poverty, however, is a highly heterogeneous social phenomenon in Canada and shows wide spatial variability. The Canadian Council on Social Development (CCSD) (2007) explains that neighbourhoods in Canada tend to have mixed income profiles and that overall the poverty clusters that have been seen to develop in the urban centres other countries are rarely observed. Despite this heterogeneous nature, however, it is important to find neighbourhoods where significant numbers of low-income families are residing (Cicone *et al*, 2002; Riches, 2002).

Canadians generally rely on a mix of income generated from sources such as employment, income security programs, child support, severance pay, and investment income (CCSD, 2007). While households with two employed parents are those least likely to experience food insecurity, it has been noted that these families are not completely immune to food security issues, particularly in families of limited means (Clifton, 2004). In families barely making ends, expenditures for rent, utilities, amenities and emergencies may result in food security issues, particularly in the event of sudden income loss or unemployment (Vozoris *et al*, 2002).

People may be unemployed or under-employed for many reasons including disability and sickness or being laid off in uncertain economies. In Canada, these individuals are often compensated for their income loss, however the amounts distributed by the government are largely found to be inadequate in helping individuals and families meet their daily needs. In Ontario specifically, Vozoris *et al* (2002) and TBFAN (2004) elaborate that the amounts supplied by Ontario Works (or the provincial 'welfare' system) do not meet the minimal income requirements for individuals, particularly with respect to attaining a healthy, nutritious diet. In 2002, for example, the income supplied by Ontario Works was far below the low income cut off designated by Statistics Canada for lone parent families, couples and individuals. The inadequacy of welfare-supplemented income is not unique to Ontario, however, as residents of British Columbia experience similar struggles (Kersetter and Goldberg, 2007).

Other income supplements supplied by the Canadian federal government include the federal child benefits, composed of a base benefit and additional

supplement. Many low income families in Canada use these benefits as a source of income and models increasing their amounts have showed beneficial results for nearly all Canadian family structures, allowing them more disposable income and better options for procuring food (Kersetter and Goldberg, 2007).

Low-income shoppers experience complex barriers to attaining a healthy diet beyond their economic means that may extend into their mindsets and livelihoods. Wrigley *et al* (2002) alludes to a "low income shopper mindset" whereby shoppers in this bracket will avoid large grocery stores to defend themselves against exposure to the variety in these spaces and the temptations to stray from an already tight food budget. The decisions of where to shop are governed and constrained by an individual's specific condition. Accordingly, low-income shoppers tend to shop in stores that they perceive as being affordable, however these retail outlets can include convenience shops, frozen food outlets and gas stations that often have lower-quality food that does not meet healthy-living guidelines established by nations worldwide. Whelan *et al* (2002) has found that the staple foods procured by low-income shoppers, including pasta, potatoes, rice and processed meat, tend to be calorie-dense but nutritionally void. This finding is supported by studies in the United Kingdom that have found a correlation between socio-economic deprivation and below-average fruit and vegetable consumption. In this way, personal factors such as motivation, education and lifestyles interact with economic factors, affecting neighbourhood food security in communities (Reisig and Hobbiss, 2000).

Overall, food security plays a large role in the debate of urban inequality, a topic that is discussed broadly by Stephens (1996). In her paper, the author suggests

that urban inequality is embodied by the idea that not all of a community's members enjoy equal living conditions. She states that disparities in living condition contribute to feelings of vulnerability and disempowerment which promote the creation of social and political poverty in addition to lack of wealth. This is particularly true in the cities of developed nations where wealth polarization has been increasing steadily for several decades. She concludes that addressing issues that exacerbate all of these levels of poverty in a community can only contribute to the health and general well being of all its citizens, while at the same time creating equitable living conditions. Addressing the struggles of the more deprived groups in a community in procuring food can therefore be a step in promoting urban equity.

2.2 Mobility/Transportation and Location

Many of the physical barriers that community residents experience with respect to food security are based around the indicator group of location and transportation or mobility. This not only includes the location of neighbourhoods and individuals themselves, but also where the nearest food retailers are found and the type of store that can be accessed (Anderson and Cook, 1999). Additionally, different modes of transportation affect how people access food and the type of food they procure. For example, a study found that in the United Kingdom 77% of main food shopping trips were done by personal vehicle (Whelan *et al*, 2002). Comparatively, the study found that 68% of households in the low-income rental bracket could not afford a personal vehicle, indicating that mobility issues could be

restricting their access to safe and adequate food. These findings are indicative of how socio-economic and physical barriers to accessing food are inextricably linked and demonstrate how these barriers can affect an individual's options and health.

Mobility and location have become increasingly referenced obstacles towards attaining community food security, especially given the restructuring of the food retailing system as discussed in Section 1.2.3. Cummins and MacIntyre (1999) describe this restructuring as a "Store Wars" era whereby incoming large-scale food retail outlets have established themselves along a community's peripherals, providing large quantities and varieties of food for inexpensive prices. This era has been compounded by changes in local markets and population structures, resulting in the closure of many locally-owned and operated grocery stores. While this restructuring has been beneficial to the diets and budgets of many consumers, it is most advantageous to affluent, mobile and car-owning community members.

This change in the food retail system has left a tier of disadvantaged consumers in its wake, primarily those with mobility issues including the elderly, the disabled, the sick and infirm and those without personal vehicles. Transportation has become a major barrier to food security and is a problem that has been largely ignored in the literature. Understanding the role that location and transportation play in local food systems is therefore vital to social planners attempting to tackle hunger problems in their community (Clifton, 2004).

Adequate physical access to food for those without access to a personal vehicle is defined throughout the literature with respect to distance. In many

studies, a distance of 500 metres is considered to be acceptable for people to walk to procure food (Furey *et al*, 2001; Cromwell and McLafferty, 2002; Larsen and Gilliland, 2008). Donkin *et al* (1999) elaborate that if average walking speeds for men and women are taken into account, this distance (there and back) represents a travel time of approximately 17-20 minutes on foot. This travel time, however, represents a walk with relative ease and may be adjusted accordingly for individual factors including disability, children in tow, the state of the pavement and the presence or absence of sidewalks. Another factor when considering acceptable distance is the load of the purchases themselves, as outlined by Rex and Blair (2003). Their research found that if an average family of four attempted to follow the health recommendations of eating 4-5 servings of fruits and vegetables daily, a week's worth of produce alone would weigh 28 lbs, a weight that would need to be carried home by mobile-restricted consumers. A short walking distance could therefore be integral to the diet, nutrition and overall health of these consumers (Wrigley *et al*, 2002).

In support of this conjecture, travel distance, perceived as a main factor in convenience, is listed as one of the main factors influencing where low-income consumers choose to shop (Handy and Clifton, 2001; Antin and Hora, 2005). The food choices that people can make are often shaped by the availability and affordability of food locally (Wrigley *et al*, 2002). The limited geographical range set by mobility constraints therefore makes those of low-income less selective consumers, as they often have to rely on what is readily available to them. Low-income shoppers tend to take a longer time to get to a food retail outlet and thus will

shop at the closest available store, including convenience marts and gas stations despite the double burden of limited stock and elevated prices. Consumers using these shops are often those with a nutritionally deficient diet. This is supported by results from a before-and-after study by Wrigley *et al* (2002) whereby the opening of a large food-retail outlet improved the fruit and vegetable consumption in socio-economically deprived neighbourhoods.

There are several compounding factors influencing the stock decisions of smaller food outlets away from fruits and vegetables necessary for a healthy lifestyle. Produce is highly perishable and very difficult to manage, resulting in limited returned income for shop owners. Furthermore, some shoppers are reluctant to buy produce at these outlets because of the appearance of the shop and their own perceptions about the quality of food available there (Rex and Blair, 2003). Research in other countries has found that the cost penalty in shopping at these retail outlets as opposed to a full-service food retailer ranges from 6-23% in elevated prices, particularly if these shops are not in close proximity to a competitor (Furey *et al*, 2001; Dunkley *et al*, 2004).

Work by Kirkup *et al* (2004) has revealed aspects of the shopping experience that consumers take into consideration when selecting a food-retail outlet. Results by this study have shown that some of the top-most important considerations by shoppers include the ability to shop in bulk, available deals and coupons and quality produce. To take advantage of these criteria and avoid shopping at convenience stores, a food insecure family may need to solve the issue of limited mobility.

Outside of the 500-metre walking distance zone, motorized transportation is required because of time and energy constraints and to get purchases home easily.

Clifton (2004) found that alternate mobility strategies included borrowing a vehicle or asking for rides. This type of mobility allows a low-income consumer to save money by pursuing lower prices, sales and by buying in bulk and may be an ideal strategy for those unable to afford the long-term upkeep of a vehicle. Borrowing a car or asking for a ride, however, requires a social support network that may not be available to every immobile family and has associated time constraints such as waiting for the vehicle to be available and working with the schedule of its owner. Through interviews with low-income shoppers, Whelan *et al* (2002) found that those without family support felt more vulnerable to food insecurity and had resentful feelings towards the lack of help available to them. Altogether, these two options may create an air of dependency, something many low-income individuals may be uncomfortable with and thus may not choose to employ them.

Other transportation options include public transit and taxis. Taxis offer storage space necessary for shopping bags and can bring an individual straight to their destination, but can be expensive to use and take money from a household's food budget (Rex and Blair, 2003; Clifton, 2004). Advantages of public transit, such as buses and the metro, are that it is inexpensive and reliable. Its use is conditional, however, on the proximity of a household to a public transit station. Additionally, it may be difficult to maneuver on public transit after bigger shopping trips and several stops and transfers may be necessary. Focus groups with low-income single

mothers have revealed that the bus system is perceived as a negative and impractical means of transportation given the necessity to manage shopping bags and children in a crowded space. Similarly, elderly persons expressed concerns with their access to and from bus stops and with the inaccessible design of the buses themselves. Many elderly individuals feel intimidated by the hurried schedules and attitudes of the drivers and had low confidence in their ability to get on and off the bus expediently (Whelan *et al*, 2002; Antin and Hora, 2005). Given the considerations and trade-offs associated with getting to a grocery store, transportation is understandably the second most cited reason for food insecurity itself and is tightly linked to the idea of personal income and welfare or wellbeing (Anderson and Cook, 1999; Dunkley *et al*, 2004).

2.3 Agricultural Production

Agricultural production is considered a natural indicator of local food security as a region's ability to be self-sufficient lies largely in its production (Christiaensen *et al*, 2000). The type and amount of agricultural production in an area can give inference of its vulnerability to future food security, exemplified by its use as an early warning indicator of famine in developing countries requiring food aid (Christiaensen *et al*, 2000; Petrucci *et al*, 2003.). Its reliability as an early warning indicator comes from its ability to accurately reflect current food insecurity and predict future shortfalls in production. Agricultural production is highly variable across national landscapes due to different agroclimatic conditions (growing season

length, temperature precipitation and seasonal distribution), terrain, access to arable lands and other resources, historical conditions and facets of national public policy (Bryant *et al*, 2000; Petrucci *et al*, 2003). In this way, people living in regions without ideal agricultural environmental conditions are more susceptible to food insecurity and generally must rely on food imports rather than their own production.

Northern regions like northwestern Ontario are an example of areas with minimal agricultural production due to unviable environmental conditions. In general, northern environments have fewer frost-free days and lower mean temperatures than their southern counterparts, though precipitation in these regions is variable (Brklacich and Smit, 1992). Therefore, net agricultural production and agricultural diversity may be limited temporally by environmental conditions. Food security in any region with respect to its local agricultural production can be described in measuring its food balance (Cicone *et al*, 2002). The food balance of a region is determined by comparing its annual agricultural production to the annual nutritional requirements of the people living there. Regions with a food balance deficit have higher consumption requirements than can be produced by local agriculture. This is characteristic of communities in northern latitudes that therefore rely on imported cash crops such as grain, wheat, corn and soybean as well as produce and other products to supplement their limited agricultural supply.

In Canada, well maintained road systems and subsidized or inexpensive transportation to some Northern regions combined with the development of large

full-service retail grocers has allowed for communities to meet consumption requirements year-round. These conditions, however, have resulted in limiting markets supporting local farming enterprises and have brought many farmers off the land, exacerbating regional food deficits (Bryant *et al*, 2000). This raises questions regarding the sustainability and future of food security in Northern communities. Anderson and Cook (1999) raise the question of whether a region with adequate capital to import a variety of healthy, nutritious food but with limited local agricultural production can be considered food secure. They argue that these urban centres are subject to financial and environmental variables that could render them food insecure in the future.

Agricultural diversity is an important food security indicator that gives insight on general environmental and community health. Varied production has been shown to help regions better cope with environmental stresses that limit food production and can help communities to become more self-reliant in solving nutritional problems (Christiaensen *et al*, 2000; Wenhold *et al*, 2007). In studies on urban food security and food desert locations, however, local agricultural production is often disregarded as a contributing factor. This is due to the general market change that has resulted in many farmers planting cash crops that do not provide a diverse diet or completely moving off the land.

Christiaensen *et al* (2000) explain that the association between household food production and household food security is weakened as families begin to derive the majority of their income from off-land activities and begin to buy a substantial share of the food they consume as opposed to growing or raising it. Their study

looked at the applicability of agricultural production to infer household food security and in fact concluded that cereal production was a poor predictor at the household level. Therefore, while agricultural production may provide insight on regional food security, more research is required to model its impacts on community members' diets before it can be used as a general indicator of urban food security.

2.4 Food Deserts

Despite extensive retail development in urban centres over the past several decades meant to ease and simplify daily activities, social and economic stress is a part of everyday life for many residents, including anxiety of procuring food and senses of food insecurity (Stephens, 1996; Kirkup *et al*, 2004). Identifying food deserts, or regions with high social deprivation and low access to full-service food retailers, is an effective way to study a community's state of food security with an area-based approach and perspective. Food desert identification highlights the fact that access to food is a function compounded by a multitude of factors that extend beyond geography and location. Food desert studies do not involve asking residents direct and sensitive questions, yet they determine the types of food-retail outlets that are available to neighbourhoods, what the level of accessibility to healthy, nutritious food is for locals and if there are regions where both physical and economic barriers may be restricting the health and diet of residents (Donkin *et al*, 1999). Finding these regions is important in ensuring that the basic needs for human welfare are being met in a community (Furey *et al*, 2001). Consumers are

experiencing the impacts of rapid retail system change in a variety of ways, depending on their neighbourhood and individual circumstances (Kirkup *et al*, 2004). Identifying the pockets of disadvantage that are emerging through food desert studies can therefore give a base and framework for politicians and planners to take action in alleviating barriers to community food security (Reisig and Hobbiss, 2000).

When families experience a shortage in resources to procure food, a community's food assistance or emergency food programs can sometimes step in to mediate the effects of food insecurity (Smith and Morton, 2009). Overall, however, it is preferable to plan a community so that citizens are provided for and do not have to consider these measures to feed their families. The study of food deserts is therefore an important first step in addressing questions about society's values, ethics and priorities in how they relate to food.

The effects of living in a food desert are varied and often serious. Several studies have shown that individuals living in food deserts have significantly lower consumption of fruits and vegetables than other residents of the same community, inferring that food deserts result in compromised diets (Donkin *et al*, 1999; Smith and Morton, 2009). This aspect may be troubling when the diets of children are compromised as childhood eating habits can extend into adulthood. Thus, if a family is unable to procure and prepare healthy food for their children at a young age, it is unlikely that they will grow into adults that are knowledgeable in healthy eating, possibly creating cyclic poor health in subsequent generations. An individual's diet can also be compromised by the quantity of food consumed, with results from focus

groups in Northern Ireland showing that 2% of respondents admitted to having lost weight due to the inaccessibility of food. In Canada the individual health effects of malnutrition, including decreased resistance to infection, longer hospital stays, compromised immune function, delayed physical and mental development, exhaustion and disability, are felt at the community level via stresses on the health care system.

Further repercussions of living in a food desert are increased costs to eat healthfully. This has been supported in the literature by research that has found the price of buying items in governmental-deemed healthy diets, namely the 'healthy food basket' (UK), 'nutritious food basket' (CAN) or 'thrifty food plan' (USA) (all of which list national standards for a low-cost but nutritionally adequate diet) in a food desert to be comparatively high to other neighbourhoods. Studies examining price disparities have found that those living in food deserts pay 26% more than those living outside of one (Chung and Myers, 1999; Donkin *et al*, 1999; Furey *et al*, 2001; Wrigley, 2002; Short *et al*, 2007; Smith and Morton, 2009).

Often the most accessible stores to households living in food deserts are small grocers or convenience marts, both of which have been found to charge higher prices due to higher operation costs, decreased market power and capital and lower sales projections (Chung and Myers, 1999). Studies on food retail locations have found that it is unlikely to have a large supermarket locate in a low-income neighbourhood for many reasons. Obstacles cited by retail owners against establishing themselves in food deserts include the reduced buying power and low-volume purchasing habits of the poor. Additionally, street crime rates, zoning laws,

inadequate space, lack of financing and parking restrictions may hold a supermarket back from erecting in deprived neighbourhoods (Wrigley, 2002; Rex and Blair, 2003; Short *et al*, 2007). Altogether, studies have shown that the price of healthy food is lower in chain food outlets than in non-chains, in the suburbs rather than inner cities and in non-poor neighbourhoods as opposed those considered to be affluent. In some countries, the price of eating healthfully in a food desert amounted to nearly 50% of the income of those on welfare or low-income support.

One of the most disconcerting effects of living in a food desert is the social exclusion experienced and expressed by community members. Social exclusion in the UK is defined as "the inability of society to keep all groups and individuals within reach of what is expected by society" (Furey *et al*, 2001, p. 448) and can be considered as an example of increasing population polarization happening in urban centres worldwide (Stephens, 1996; Wrigley, 2002). People living in social exclusion are therefore outside of the sphere of daily community activities, life and culture.

Feelings of social exclusion have been found in focus groups to exacerbate the widening social and income gaps in the UK, with respondents affirming that the lack of food shops in their neighbourhoods proliferated feelings of being the 'have not's' in their community. Feelings of social exclusion can weigh heavily the general mental health and well-being of residents, an effect that can be aggravated by a lack of daily interaction in a community setting, such as during a grocery shop (Reisig and Hobbiss, 2000). In Canada, Che and Chen (2001) explain that 31% of people living in food insecure households reported experiencing distress, with 14% revealing symptoms of having experienced a major depressive episode. In all, those

living in food insecure households were three times more likely to experience depression or other mental-health related problems than those living in a state of food security.

Identifying food deserts can be accomplished by several research methods that combine data on food retail locations with a population's socio-economic make up. Merging these two factors gives a broader view of a community's food system and of the choices available to residents. For example, a community member living in an affluent neighbourhood without a car could feasibly feel worse off in terms of food choices available to them than a family living in a poorer neighbourhood with a food retail outlet nearby (Kirkup *et al*, 2004). In Glasgow, Scotland, Cummins and MacIntyre (1999) took a broad approach to identifying food deserts by assigning a deprivation score (DEPCAT) from 1-11 to each district in the region. This deprivation score was based on routine census data such as degree of overcrowding, male unemployment, low social class and low car ownership. They then matched up this score with the density of grocery stores in each district to find food deserts on a regional scale. Their study concluded that no food deserts existed in the region, however, the scale that they used was identified as a limitation to the study and the researchers conceded that food deserts might have been identified had the mapping been conducted at a smaller scale.

Similarly, a study based on a deprived region in London, UK, found no food deserts due to their criteria concerning what food retail outlets to include on their maps (Donkin *et al*, 1999). When all food retail outlets were included in the analysis, regardless of the quantity or quality of food being sold, no neighbourhoods were

found to be without access to food, highlighting the need to discern specific criteria to only include those stores selling adequate, nutritious food. For example, subsequent analysis in the London research using food lists as criteria for grocery store inclusion yielded improved results. Other research that focuses on food desert identification has used grocery store criteria such as store size, capital, employee base and food lists to help narrow down on outlets likely to sell nutritious, adequate food (Cummins and Macintyre, 1999). While this approach is useful for large cities with enumerable food outlets, it may overlook the role that smaller full-service retail food stores can play in a local food system (Short *et al*, 2007).

2.5 Mapping Food Security: The Role of GIS

Studies on community food security have been undergone in many countries, both developed and developing. Tackling the study of food security can be accomplished in both qualitative and quantitative manners. The former frequently uses methods such as surveys and diaries that are completed by a household's most knowledgeable member regarding the types and amounts of food consumed by a family over a given time period. Studies focused on food insecurity specifically tend to focus primarily on household consumption habits such as how often meals are skipped, the frequency at which nutritionally sub-standard food has to be served, how often individuals go hungry or have to eat smaller portions, and how often a head of household feels anxious about how to procure enough food to feed family members adequately (Christiaensen *et al*, 2000).

Qualitative methods have the advantage of attaining first-hand, detailed information regarding perspectives on food security from the community members themselves. Obtaining this information, however, comes with financial and temporal costs. Often, the first step in a study on food security is to use quantitative methods to get a general sense of the degree of struggle being experienced by certain neighbourhoods in obtaining food then following up on this information with qualitative methods to expand the knowledge base (Cicone *et al*, 2002; Short *et al*, 2007). Studying food security quantitatively can be accomplished using geospatial indicators and GIS.

GIS is being used increasingly in public health research to bridge the gap between the social experience and neighbourhood-level information (McEntree and Agyeman, 2010). In developing countries, regional geospatial indicators comparing agricultural capacity like vegetative cover and precipitation can be weighed against factors inferring inherent vulnerability such as road access and population density to effectively predict regions where food emergency events may occur. This type of broad spatial analysis would have been impossible to accomplish only several decades ago, demonstrating the power of GIS and its potential for use in the study of spatial phenomena. In developed nations, GIS has shown to be successful in studying food security in many communities across the globe.

Mapping out food security indicators has proven to be essential in studying community food security because it can provide information on factors and relationships that raw census data and qualitative surveys can miss (Hyman *et al*, 2005). There are two general GIS-centric approaches to studying community food

security (Cromwell and McLafferty, 2002; McEntree and Agyeman, 2010). The first focuses on mapping food retail outlets and using a distance model to identify areas where food retail outlets are lacking. The second approach incorporates additional information, for example about food prices and nutrient availability, and uses a statistical analysis to correlate variables like physical distance and socio-economic status. Studies throughout the literature have used these two general approaches and expanded upon them to suit their individual studies and landscapes. In the American city of Baltimore, for example, the use of GIS was said to have powerfully illustrated the relative lack of food resources in low-income areas of the city by visually representing the relationship between these areas and the locations of food retailers (Antin and Hora, 2005).

On a regional scale, studying food security can be accomplished by mapping out the grocery store density in whole counties and relating it to social deprivation, as was done in Glasgow, Scotland (Cummins and MacIntyre, 1999). Again, the scale used in this research may have been too large as the results found that grocery retailers were adequately serving all counties. The study therefore did not give a basis for identifying and proactively addressing issues concerning neighbourhood food security. Research by Sheppard *et al* (1999) on environmental equity using GIS supported this notion when they found a stronger relationship between exposure to environmental toxins and minority populations could be delineated based on the scale used. In their discussion they explained that too coarse a scale might homogenize a population and cover up possibly meaningful relationships.

Donkin *et al* (1999) used a unique mapping approach to find food deserts in a deprived region in London. Using GIS software they mapped out the locations of food stores throughout the region and bolded the segments of the road network that fell within a 500m walking distance from each food store. This approach helped the researchers to quickly identify street sections and portions of neighbourhoods that were susceptible to food insecurity. This methodology, applied by Rex and Blair (2003), proved to be equally successful in Sandwell, UK where neighbourhoods outside of reasonable access to grocery stores were clearly identified. The study in Sandwell also showed that access to unhealthy, convenience foods was higher than that to healthy foods, particularly in low-income neighbourhoods.

GIS mapping of food retail outlets in the San Francisco Bay area highlighted the advantages that GIS has in quickly applying differential symbology. There, researchers used different symbols to represent different sizes of grocery stores, highlighting the role of small-service food outlets in the local food system (Short *et al*, 2007). Overall, Kirkup *et al* (2004) concluded their study on food security perspectives in the United Kingdom by saying that the merits to taking a micro-scale approach, ideally at the smallest level of geography available, in studying inequalities of food retail provision are highly beneficial to a community. This type of research can be easily accomplished using GIS.

2.6 The Canadian Food Desert Debate

The study of urban food security has been most extensive in the United Kingdom and the United states; comparative studies in Canada have been limited and research on the topic has only recently appeared in peer-reviewed literature. While Canada shares some similarities with these counterpart nations, its geography, demographic, political and economic characteristics suggest that the experiences of its citizens may be unique (Smoyer-Tomic *et al*, 2006). Notably, studies on food desert identification have been completed for the cities of Edmonton, Alberta in 2006, Montreal, Quebec in 2007 and London, Ontario in 2008. Each of these studies used distinct approaches in conducting their research and have cited mixed results on the existence of food deserts in Canadian cities.

In Edmonton, Alberta, Smoyer-Tomic *et al* (2006) used data from the 1999 Edmonton Civic Census to coordinate their research. Armed with several hypotheses that a) supermarket accessibility would be lower in the inner-city than in suburban areas and, b) accessibility would be limited in areas of high-need, they created descriptive maps of the city that linked together the location of grocery retail outlets with socio-economic data at the neighbourhood level. Specific criteria employed in this research included only listing grocery stores that offered a full range of grocery items and had more than ten employees and using a mean distance of 1km to determine acceptable walking-distance or access to the stores. Furthermore, they decided to use network analysis, which follows road networks, rather than Euclidean distance to "better represent travel distance" (p. 310). Vulnerable sub-groups within the population that were analyzed to determine relative social need

included those with low-incomes, the elderly and those without a personal vehicle. The researchers took a detailed look at the accessibility of neighbourhoods falling within the upper-most quartile for two or more of the variables.

The results of this study yielded surprising results that seemed to dismiss the hypotheses of the researchers. Broadly, areas classified as being in the highest 'need' bracket, found in the inner city, were also those with "substantially better" (p. 313) access to supermarkets; conversely the suburbs were found to be lacking in nearby food retail outlets. Pockets of disadvantage were found, however, when the map symbology was narrowed down. To accomplish this, the researchers eliminated all neighbourhoods deemed to have good accessibility from the map's legend, leaving these areas blank and those with low accessibility coloured - only then including the variables representing 'high need' in the analysis. This approach revealed six neighbourhoods in total with 'unsupportive local food environments' that could be considered food deserts. Overall, the study concluded that in 1999 there was relatively good access to supermarkets in Edmonton's inner city with isolated neighbourhoods in older, low-income neighbourhoods that were hesitantly considered to be food deserts.

In 2007, Apparicio *et al* focused on the city of Montreal for food desert identification. Scorning the simplicity of other food desert studies conducted in other countries, the researchers sought to refine a methodology that would incorporate several demographic factors plus several levels of access to supermarkets, as opposed to using a simple distance model. Similarly to the study in Edmonton, Apparicio *et al* (2007) began their research with the hypothesis that low-

income or inner city census tracts would have lower accessibility to food retail outlets than other neighbourhoods in the city. The socio-demographic factors that they chose to incorporate into their study were low-income population and a social deprivation factor. The social deprivation factor was created by the researchers by including data on lone-parent families, unemployment rates, low levels of schooling and recent immigration and standardizing these variables onto a scale ranging from 0-5. This scale, representing low deprivation to high deprivation respectively, allowed the identification of census tracts where multiple variables affecting social deprivation were accumulating.

To round out their study of food deserts, Apparicio *et al* (2007) used three measurements of accessibility to food retail outlets. The grocery stores they included in their analysis were those related directly to major chains located in Quebec. Access to grocery stores was measured by 1) immediate proximity or the distance to the nearest grocery store in each census tract, 2) the number of grocery stores within a 1000 m buffer from the centroid of each census tract in the city, and finally, 3) the diversity of grocery stores, or the mean distance to three supermarkets owned by three different companies. The amount of data in the study yielded complex results, with 8 different 'types' of census tracts with respect to accessibility and deprivation.

This Montreal study concluded with similar results to that in Edmonton, specifically that inner-city (and the most socially deprived) neighbourhoods had the highest degree of accessibility to the nearest grocery store. Apparicio *et al* (2007) sought to explain this result by positing that suburban development is, on principle,

less dense and preferred by middle-income families that own personal vehicles. Thus, supermarket chains tend to build fewer, but larger stores in these areas and establish more, smaller stores in the high-density urban cores. Overall, this study concluded that geographic accessibility to food was not a pressing social issue in the city, claiming that currently Montreal has no food deserts.

The most recent Canadian study on food desert identification took place in 2008 in London, Ontario and was conducted by Larsen and Gilliland. This study was unique in that it focused on a smaller population (375 000 in London vs. 1.8 million in Montreal) and applied a temporal analysis, studying the change in the presence of food deserts and location of food retailers over a period of 40 years. The objectives of this study were threefold; 1) to determine whether spatial inequalities in access to supermarkets exist, 2) to assess whether spatial inequalities have increased or decreased over time and 3) to determine the level of socioeconomic inequalities that exist with respect to supermarket access. This study used two measurements of access, namely walking distance and proximity to public transportation. Like the Edmonton study by Smoyer-Tomic *et al*, (2006), these researchers opted to use network analysis to determine a 500m and 1000m 'service area' for each of the grocery stores in their city rather than using walking distance.

When coupled with socioeconomic data including variables such as low educational attainment, single parent families, low-income and unemployment, the researchers were able to create maps for both 1961 and 2005 to compare how access to supermarkets in the city has changed over time. Their analysis concluded that while access to food retail outlets was poor for the majority of the city, several

large areas that had been adequately served in the 1960's emerged as suffering in 2005 with respect to food access. Additionally, they found that when public transit routes were not considered, low-income neighbourhoods had the worst access to food retail outlets in the city. These findings in general supported food desert theories throughout the literature and are strikingly different than those found in Edmonton (Smoyer-Tomic *et al,* 2006) and in Montreal (Apparicio *et al,* 2007).

2.7 Food Deserts in Northwestern Ontario Communities

Throughout the literature it has become evident that identifying places where social deprivation is elevated and access to healthy and varied food is questionable has become important to the development of sustainable, food secure communities. The effects of food deserts on community and individual health have been well documented in research conducted in cities the world over (See Section 2.4). Conducting food desert identification research in Northwestern Ontario may provide insight on the state of food security in a different setting than the typical study. While most food desert research has been conducted in large city centres (see Furey *et al,* 2001; Whelan *et al,* 2002; Smoyer-Tomic *et al,* 2006; Apparicio *et al,* 2007; Short *et al,* 2007) the following research examines smaller urban centres in a remote, Northern setting. It is believed that this research focuses on the smallest urban centres examined in Canada, if not of all developed nations with published food desert research. Comparing the results of this research to that presently available in Canada (Smoyer-Tomic *et al,* 2006; Apparicio *et al,* 2007; Larsen and

Gilliland, 2008) will yield interesting results and will give insight on retail food networks and how they serve their respective communities, big or small. Results from this study could be a microcosm of the food retail realities in larger centres. Additionally, the results of this research could lend to discussion in communities that may be inherently vulnerable to food insecurity on how to best promote and implement solutions.

CHAPTER THREE

Study Area

The province of Ontario has been experiencing recent economic hardships with a dwindling primary resource sector accompanied by cutbacks, layoffs and job losses (Spence, 2009). This decrease in economic security has been accompanied by a rise in hunger and need (Laurie and Spence, 2009). The Ontario Association of Food Banks has calculated that food bank usage in Ontario has risen 19% from 2008 to 2009, amounting to 375,000 individuals and suggesting that food insecurity in the province is on the rise (Spence, 2009). The province has had difficulties keeping up with the needs of recently unemployed individuals and their families, resulting in a poverty gap that is ever widening. This provincial trend is highlighted in the city centres, particularly those that have already faced economic adversity in the last decade such as communities in the Northwestern region of the province.

Northwestern Ontario (Figure 3.1) is a region described as running from the Eastern Manitoba border east to the city of Sault Ste. Marie. The geography of Northwestern Ontario is based on pre-Cambrian Canadian Shield and defined by the presence of expansive Boreal forests and many of the province's 250 000 lakes. The region accounts for 86% of the province's land mass but is home to only 10% of its

population. Northwestern Ontario is known as a region of water, woods and rugged wild beauty and bountiful wildlife (Virtual North, 2010). Given its large area, this study will focus specifically on the region from Thunder Bay west to Manitoba.

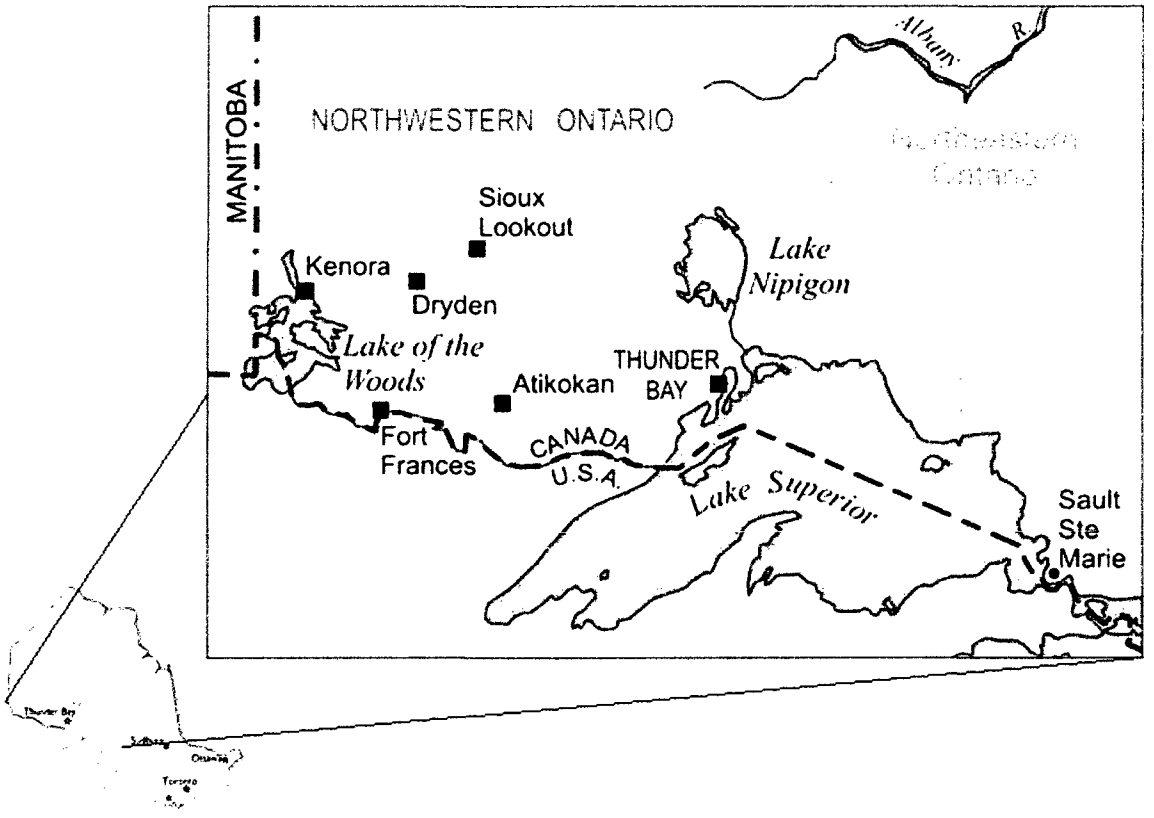


Figure 3.1 Map of Northwestern Ontario featuring the six study communities. Ontario inset gives perspective on the area's location within the province

Remote, urban centres in Northwestern Ontario were founded based on their proximity to Lake Superior and for their rich natural resource bases. Established cities, towns and municipalities in this region therefore have resource-based economies that are subject to fluctuating markets. Northwestern Ontario has a variable climatic range with extreme temperatures recorded between -47°C in the

winter to 38°C in the summer. This variable climate, dominated by the cold season, results in a fairly short growing season of 120 days (Ontario, 2008) and thus limits regional agricultural production. Lack of agricultural productivity therefore rends urban Northwestern Ontario centres dependent on food production and import from southern latitudinal areas (TBFAN, 2004).

Like in many other remote urban centres, the transportation of food over long distances via air and road results in elevated prices (Hinricks and Lyson, 2007). Citizens of Northwestern Ontario have been found to pay an additional $60 more per week on food and sundries than their Southern Ontario counterparts (TBEJC, 2007). The remote rural locations coupled with a strong dependence on lower latitudinal areas for food and resource markets make cities in Northwestern Ontario inherently food vulnerable.

3.1 Thunder Bay, Ontario

Unless otherwise stated, the information stated in this and subsequent sections has been excerpted from the community profiles of the 807-area-code regional phone book (Crewson, 2002; Crewson, 2007)

Thunder Bay is a remote, urban city on the west coast of Lake Superior in Northwestern Ontario and at the base of the Nor'Wester mountains. With a population of just over 100,000 it is the biggest metropolis centre in Northwestern Ontario accounting for 50% of the region's residents. With a diversified economy based on the industries of pulp and paper, manufacturing, telecommunications,

research and development, mining, tourism and retail, Thunder Bay has a myriad of skilled workers that contribute to the health and economy of the city and region.

Thunder Bay has medical, educational and business resources such as the Thunder Bay Regional Health Centre, government centres, Lakehead University, Confederation College and large retail super stores that are unavailable in surrounding smaller communities. These resources bring disadvantaged citizens such as the sick, the poor and the disabled from surrounding regions to the city to make use of them or to look for lifestyle alternatives (TBFAN, 2004). Thunder Bay has an extensive census metropolitan area, or a rural outlying population dependent on the urban core (TBEJC, 2007). This concentration of vulnerable people creates a social prerequisite for food insecurity.

Recent reports support this conjecture by showing that food bank usage in Thunder Bay has raised by 46% in the last year, the highest rate of change for the province of Ontario (Spence, 2009). Additionally, the Urban Poverty Project found that Thunder Bay was included in the list of cities in Ontario with a large proportion of households having to pay more than 30% of their income on shelter costs (CCSD, 2007). While these findings are not directly indicative of food insecurity rates in Thunder Bay, they do suggest an increase in the presence of individuals facing difficulties in attaining food.

3.2 Smaller Northwestern Ontario Communities

3.2.1 *Dryden, Ontario*

The city of Dryden is situated along the Trans-Canada highway, directly between the cities of Thunder Bay, Ontario and Winnipeg, Manitoba. It is surrounded by the Wabigoon River system and lies alongside Wabigoon Lake. Although originally founded to explore its agricultural potential, Dryden's main industrial activity surrounds forestry and pulp and paper. Dryden annually welcomes over 300 000 tourists who come to take advantage of its lake systems and outdoor recreation opportunities. Though a small city with a population fluctuating from 9100 to 7500, Dryden still considers itself to be a unique and progressive hub community for smaller rural towns and its two adjacent First Nation communities.

3.2.2 *Fort Frances, Ontario*

Fort Frances is a small Northwestern Ontario city with a population of 8,130 located on the shores of Rainy Lake and lying alongside Rainy River. It is situated directly on the border between Ontario and Minnesota, USA, with over 500 000 people crossing through annually. Fort France's major industries include the pulp and paper sector, agriculture and tourism. Additionally, due to its position as a border town, Fort Frances is home to several customs brokers and several government service providers.

3.2.3 *Kenora, Ontario*

Although the city of Kenora was at one time renowned for its large flourmills, the city's early economy depended largely on its surrounding resource base including timber, fish and minerals. Kenora is located only 100km from the Eastern Manitoba border and is established along the northern shores of the extensive Lake of the Woods system. This location has promoted a now well-established tourism industry, resulting in the town's population of 15 177 doubling every summer. In 2000, Kenora amalgamated with its surrounding townships of Jaffray Malick and Keewatin, increasing its population and economic base.

3.2.4 *Sioux Lookout, Ontario*

Though located north of the 60th parallel, the town of Sioux Lookout is still a busy hub. Located off of Highway 72 and along Pelican Lake and with access to Lac Seul and the English River system, Sioux Lookout serves as a "last-stop" before many remote, Northern communities and reserves. This status has resulted in the Sioux Lookout airport being the fourth busiest in all of Ontario. With its foundation on traditional Ojibwe lands, residents of Sioux Lookout are often regarded as leaders in developing positive race relations with Aboriginal communities and the town is home to several First Nations agencies. In 1998, the town of Sioux Lookout amalgamated with the surrounding townships of Alcona and Hudson, expanding its population and economic base. Main industries in the town include forest products and sawmills and a diverse tourism industry including outfitters and lodges.

3.2.5 *Atikokan, Ontario*

The town of Atikokan is located South of the Trans-Canada Highway, founded for its mining opportunities and boasting a population of 4 332 in 1996. The past decade, however, has brought many changes for the town with the closure of the mine that was the mainstay of the local economy and subsequent job loss. Atikokan has now redefined itself as a recreation-based community and proclaims to be the canoeing capital of Northwestern Ontario. The community is surrounded by more water than land and has become a research hub for Quetico Provincial Park and Turtle River-White Otter Wilderness area. While new industries in Atikokan have steered towards recreation with canoe builders and energy-bar makers, traditional industrial activities still persist in the forestry sector, thermal generation and energy production.

CHAPTER FOUR

Methodology

This chapter describes the methodology used to meet the objectives of this research on food security in Northwestern Ontario. The first section details the steps taken to accrue the data necessary to create the census databases for the province of Ontario that formed the backbone of a new food security indicator. Secondly, the use of a multivariate statistical test to reduce redundancies in the dataset is discussed. Subsequent sections outline the development of the food security indicator, termed an Accumulated Risk Factor, and explain its use in mapping and the steps necessary to complete the food desert maps for Thunder Bay and other Northwestern Ontario cities. Steps taken throughout the methodology aim to meet the research objectives of creating easily interpretable maps of food insecurity risk that encompass many interacting social facets under one value.

4.1 Canadian Census Dataset Construction

One focus of this research is to identify neighbourhoods prone to food insecurity risk in Thunder Bay and other small urban centres in Northwestern

Ontario for the Canadian Census years of 1996, 2001 and 2006. The methodology of this research has therefore been based on finding food deserts, or neighbourhoods with high levels of social deprivation and limited physical access to food (see Section 2.0). This process began by identifying socio-economic factors from the literature that characterize food insecurity. These indicators are community-level factors that influence neighbourhood-level food security (Anderson and Cook, 1999). Secondly, a dataset based on these indicators was compiled using data from the Canadian Census. The resulting list of food security indicators presented in Table 4.1 was used in this study and represents the factors that were both commonly used in the literature and available in the Canadian Census for 1996, 2001 and 2006.

The data for this study was supplied free-of-charge by three main sources including the former Internet Database Library System (IDLS) maintained by the University of Western Ontario, from CHASS, the Canadian census analyzer maintained by the University of Toronto and by the Lands Information Ontario database maintained by the Ontario Ministry of Natural Resources. Working with census data is advantageous to researchers as it provides a huge range of information that is broken down into relevant categories. Additionally, censuses provide data that covers a large time span (Kelly and Becker, 2000).

In Canada the smallest sampling area for which information is available changed from the enumeration area (EA) in 1996 to the dissemination area (DA) in 2001. EAs and DAs represent approximately 300-500 people, and are used in studies to convey and analyze a city neighbourhood. Analysis at the neighbourhood level within a city is important, as previous studies have indicated that neighbourhoods

are dynamic environments that tend to conglomerate people of the same living condition (Hyman *et al*, 2005).

The census data obtained for each EA and DA was first cleaned in a spreadsheet to identify inputs that may have misled the results or caused general errors during mapping and interpretation. Although census data has been shown in previous studies to accurately give unbiased estimates of poverty, working at the neighbourhood level may cause over or underestimations of actual conditions (Minot and Baulch, 2005). Furthermore, errors and omissions frequently occur during census data collection for reasons such as attitudes and perceptions towards the collection of personal data, budget restraints and human error (Hull, 2000). Therefore, all data entries were visually inspected and inputs that may have caused errors (such as unnecessary zeroes or blank sections) were changed or eliminated from the dataset. This step was very important as it eliminated errors that could have potentially been difficult to account for later in the analysis stage. Once the databases had been compiled, cleaned and assembled for all three years of analysis they were subjected to a multivariate statistical test that helped to eliminate any redundancies in the dataset.

Table 4.1 Socio-Demographic Indicators of Food Security

Indicator	Scale	Source and Calculation
Average familial income	EA/DA	Average familial income as detailed in the Canadian census
Income per family member	EA/DA	Average household income/average household size
Percent of households spending more than 30% of income on shelter	EA/DA	Number spending >30% on shelter as detailed in the Canadian census
Percent of population under age of 15	EA/DA	Number of individuals under 15/total population
Percent of population over age of 65	EA/DA	Number of individuals over 65/total population
Number of single parent families	EA/DA	Number of single parent families as detailed by the Canadian census
Number of female-led single parent families	EA/DA	Number of female-led single parent families as detailed by the Canadian census
Population with low-education	EA/DA	Number of individuals with less than grade 9 education as detailed by the Canadian census
Unemployment rate	EA/DA	Unemployment rate as detailed by the Canadian census
Individual use of alternative transportation	EA/DA	Use of alternative transportation, as detailed by the Canadian census

4.2. Principal Components Analysis

Once the three datasets for the province of Ontario at the level of EA and DA were assembled, they were subjected to principal components multivariate statistical analysis (PCA) using SPSS 17.0™ statistical software. This statistical test is

used to identify data redundancy and is particularly applicable for large datasets with multiple variables. One of the primary functions of PCA is to help simplify a dataset by identifying variables that are highly correlated with 'r' values exceeding 0.8 (Hinton *et al*, 2004). Redundancies occur in a dataset when one variable can be predicted by the value of another; PCA helped to eliminate that possibility from this study (Shlens, 2005). The number of indicators used in the final assessment of food security patterns in Northwestern Ontario was therefore modified according to the PCA output.

The applicability of a PCA for a dataset can be confirmed by Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. This test confirms the absence of multicollinearity in a dataset, which renders the results of a PCA useless. Multicollinearity is a data phenomenon where two variables are so highly correlated that they cannot be distinguished apart by the statistical software (Hinton *et al*, 2004). A KMO value of 0.5 or higher confirms that a principal components analysis is suitable for the given dataset. Additionally, Bartlett's test of sphericity can be used to identify whether a relationship exists between the variables. If the output of Bartlett's test is greater than 0.05 it can be confirmed that the sample size was large enough to render significant results. Both KMO and Bartlett's tests run for 1996 (KMO=0.543, Bartlett's=26 243.678, df=28, $p<0.001$), 2001 (KMO=0.602, Bartlett's=17 807.151, df=28, $p<0.001$) and 2006 (KMO=0.651, Bartlett's=49 864.336, df=28, $p<0.001$) affirmed the use of PCA for the datasets.

The result of the PCA was a matrix that showed the correlation between the original 10 variables that had been selected for this study. Indicators showing a high

degree of correlation ($r > 0.8$) were tested further and considered for possible elimination. A subsequent PCA was then run with one of the variables from the highly correlated pairs deleted. When determining which indicator to delete from the highly correlated pairs, their correlation to the remaining indicators was taken into account so that the indicator showing the highest degree of correlation overall with the other variables could be deemed the best candidate for elimination. In all cases, however, the correlation of both variables to the other remaining indicators was very similar. The variables kept in the dataset were therefore those that were used the most as indicators of food insecurity in the literature (Whelan *et al*, 2002; Wrigley, 2002; Apparicio *et al*, 2007).

For all datasets, the variables for single parents and female-led single parent households showed among the strongest degree of correlation ($r = .962, .951$ and $.975$ for 1996, 2001 and 2006 respectively; $p<0.001$), indicating that in a single parent family, the head-of-household was most often female. Additionally, the variables for average income per family member and average familial income showed high degrees of correlation for all three years ($r = .965, .874$ and $.966$ for 1996, 2001 and 2006 respectively; $p<0.001$). The results from the PCA helped to streamline the socio-economic and demographic dataset, eliminating redundancies and reducing the number of values used to create the Accumulated Risk Factor. This resulted in the following eight variables used in the next stage of research (see Table 4.2).

Table 4.2 Final List of Socio-Demographic Indicators used for the ARF Mapping

Indicator	Scale	Source and Calculation
Average familial income	EA/DA	Average familial income as detailed in the Canadian census
Percent of households spending more than 30% of income on shelter	EA/DA	Number spending >30% on shelter as detailed in the Canadian census
Percent of population under age of 15	EA/DA	Number of individuals under 15/total population
Percent of population over age of 65	EA/DA	Number of individuals over 65/total population
Number of single parent families	EA/DA	Number of single parent families as detailed by the Canadian census
Population with low-education	EA/DA	Number of individuals with less than grade 9 education as detailed by the Canadian census
Unemployment rate	EA/DA	Unemployment rate as detailed by the Canadian census
Individual use of alternative transportation	EA/DA	Use of alternative transportation, as detailed by the Canadian census

4.3 Accumulated Risk Factor Mapping

One of the goals of this study was to cartographically represent food security in a simple form that could be easily understood and interpreted, specifically by the general public. Amalgamating the eight indicators of food security (Table 4.2) under one value that could adequately represent the information provided by the socio-demographic data therefore became a main focus of the methodology. Other

Canadian urban food studies reviewed in Chapter 2.0 used factors detailing each neighbourhood's level of social deprivation to map food deserts in their respective cities. A similar approach was therefore decided upon for this study. This methodology was developed with the aim of incorporating all eight of the food security indicators into an Accumulated Risk Factor (ARF) using a quartile analysis. The decided approach was to tally the number of times an EA or DA fell into the highest risk quartile for each of the eight indicators. A scale of 0-8 was therefore developed to represent the degree of social deprivation or accumulated risk for each EA and DA. This approach was meant to be intuitively understood and quickly readable for maximum impact in a public education setting.

The following methodology was applied to each of the census datasets for 1996, 2001 and 2006. Food security indicators were put into individual spreadsheets so that the quartile intervals could be calculated and the 'highest risk quartile' could be identified. Depending on the individual indicator, the highest risk quartile was deemed either the highest or lowest quartile. For example, the lowest quartile would be used for income whereas the highest would be used for unemployment. Once this had been completed for all eight indicators a tally was done, thus indicating a neighbourhood's level of accumulated risk. Threshold values for food insecurity risk were determined to be 0-2 for low risk, 3-4 for medium risk and 5 and above for high risk.

An intuitive colour gradient ranging from dark green (low number of risk factors) to bright red (high number of risk factors) was used. This process helped in meeting the research objective of creating an indicator of food security that uses

many of the influencing social facets and combines them under a single value (or single map). It is hoped that upon looking at an ARF map, a user can intuitively understand a neighbourhood's level of social deprivation, and thus accumulated risk for food insecurity, with a quick glance. The methodology was repeated for each of the six communities studied for all three years of census data.

4.4. Food Desert Mapping in Urban Centres

Completing the food desert maps required that databases outlining the locations of all full-service grocery stores selling safe, nutritious food from all four food groups be created for each community for each of the three years of study. This information was collected through several means, primarily by scanning through phone books for each community for each specific year. Each time a business that had a name suggesting food retail was found its address and phone number was recorded. These retailers were then directly contacted by telephone and, in the case of Dryden and Thunder Bay, in person, to confirm their selection of food for sale and self-designation. For example, if a shop keeper did not classify their store as being a full-service grocer or admitted to having inadequate supply of one food group (often fresh produce) then it was not included on the list. In many instances, colleagues and acquaintances that are long-term residents in one of the communities were contacted for confirmation of the final lists' applicability.

Once each community's list of available grocery stores in each of the census years was confirmed, the addresses of the food-retailers were geocoded into the GIS.

The location of each of the grocery stores on the maps was confirmed using local road maps, phone books and MapQuest, an online mapping system. The grocery store locations were created as another GIS layer which was overlaid on top of the accumulated risk factor maps for quick assessment of neighbourhoods that may be experiencing food insecurity in each of the communities. Lastly, a 500 metre buffer was created around each of the grocery stores to represent what is deemed in the literature as an acceptable walking distance to procure food (Donkin *et al*, 1999; Larsen and Gilliland, 2008). Though other studies have used 1000 or 750 metre buffers to rapidly assess the neighbourhoods in highest distress, this study assumed that 500 metres accurately represents the distance that inherently vulnerable groups such as the elderly, disabled or single parents could conceivably walk on a regular basis, particularly in harsh Northwestern Ontario winters.

4.5 Research Limitations

This research is limited in that it only focuses on one aspect of a community's food system, access to full service retail food outlets. Community food systems are often more complex than what is represented by this research, however, to simplify for this assessment outlets such as farmer's markets, food banks and wild foods were purposely left out.

Further limitations of this study include differences in census data availability throughout all the years of study. For example, some indicators present in the literature could not be used because they were not available in all three years of census data or not at the DA/EA scale. Additional data availability issues included

differences in collection over the three census years covered, for example the change from enumeration area to dissemination area between 1996 and 2001. This change by Census Canada slightly altered the boundaries of these areas; however they still represent similar population sizes. Building on data availability differences, some regions in the communities, for example Fort William First Nation in Thunder Bay, had data available in one of the census years but not another. For this reason, these areas have been left out of analysis. Lastly in some map layers for lakes and roads, changes in sizes, positions and presence are different in some of the communities throughout the three years of study. This is attributed to how the creators of the data layers chose to draw these features and does not affect the output of this research.

Finally, the socio-demographic and economic analysis of these communities has only been conducted on a broad community scale using the community profiles available from Statistics Canada. Given the small population sizes of these communities, analysis on the neighbourhood level was not deemed to be appropriate to protect the privacy of inhabitants.

CHAPTER FIVE

Results

One of the main objectives of this study was to analyse food security in Northwestern Ontario communities by first mapping the neighbourhood level of food insecurity risk and then by identifying food deserts in each community and examining their locations over the decided time scale. In order to map the complexity of food security risk factors, eight commonly used indicators (see Table 4.2) were classified into quartiles and the number of times a DA or EA was in the worst quartile was tallied (i.e., the accumulated risk factor (ARF)). A neighbourhood with low food insecurity should have a low ARF value and a neighbourhood with high food insecurity should have a high value. Once the neighbourhoods with a high number of risk factors had been mapped, the distance from each DA or EA to a full service grocer was examined. This second stage of analysis identified neighbourhoods that have a high number of risk factors and poor access to a diverse nutritious food source. This chapter presents the results of the methodology followed to achieve these objectives.

The first section of this chapter focuses on the first step in food desert identification by examining the socio-demographics and economics of the

communities through the Accumulated Risk Factor (ARF) maps. A strong focus of Section 5.1 is to identify neighbourhoods in each community that have consistently high ARF values, or high levels of social deprivation, in 1996, 2001 and 2006. Using general Statistics Canada community profiles, an analysis of potential underlying socio-demographic and economic trends is explored to give depth and understanding to the visual trends observed on the maps. Finally, this chapter closes with Section 5.2 where the ARF maps were combined with the geographic location of food retail outlets in order to create a second set of maps with the objective of identifying food deserts. The food deserts found in this section are neighbourhoods characterized by a high degree of social deprivation that are located outside of a reasonable walking distance to full-service grocery stores.

These maps help to meet the research objectives of using the ARF value in order to create a visual representation that encompasses many food security indicators and combines them with the physical locations of food retail outlets. These maps were created for all three years of the study and some temporal trends of social deprivation and food desertification are identified. The results from this section have the potential to help public planners and social analysts to identify neighbourhoods in Northwestern Ontario that require improved social infrastructure.

5.1 Accumulated Risk Factor Mapping

The accumulated risk analysis conducted for each of the Northwestern Ontario communities was based on the list of indicators presented in Table 4.2 with the idea of creating a single value, coined an 'Accumulated Risk Factor' (ARF) that amalgamated all the information provided by the eight individual indicators of food insecurity risk. This value could then be used to create a single map of food insecurity risk for each year.

Creating this value began by applying a quartile analysis to determine the highest-risk quartile for each indicator, as detailed in Section 4.3. The final ARF indicates the state or complexity of deprivation being experienced by residents in a DA. As there were 8 indicators evaluated a given DA could therefore have an accumulated risk factor of 0 to 8. The maps reveal this scale of deprivation on a detailed level by using a range of colours; however in discussing the results generalized terms from low to high risk are used. For this study, values ranging from 0-2 (dark to light green) were deemed 'low risk', those from 3-4 (light green to yellow) were 'mid risk' and DA's with values larger than 5 (orange to red) were considered to be at 'high risk' of food insecurity. The resulting maps are presented in the form of case studies for each urban centre and are found in Sections 5.1.1 to 5.1.6.

5.1.1. *Accumulated food insecurity risk maps – Thunder Bay case study*

The Northwestern Ontario city of Thunder Bay was the first focus of this research. Figure 5.1 serves as a reference map for the city, showing its five main city districts, Current River, Port Arthur, the Inter-Core area, Fort William and Westfort. Additionally, the Thunder Bay expressway/Highway 11-17 is shown in red. The blue lines delineating the boundaries of these areas have been drawn approximately to represent the informal boundary lines that have been historically accepted by long-term residents of the city. All of these locations will be used as points of reference in describing the ARF and food desert maps.

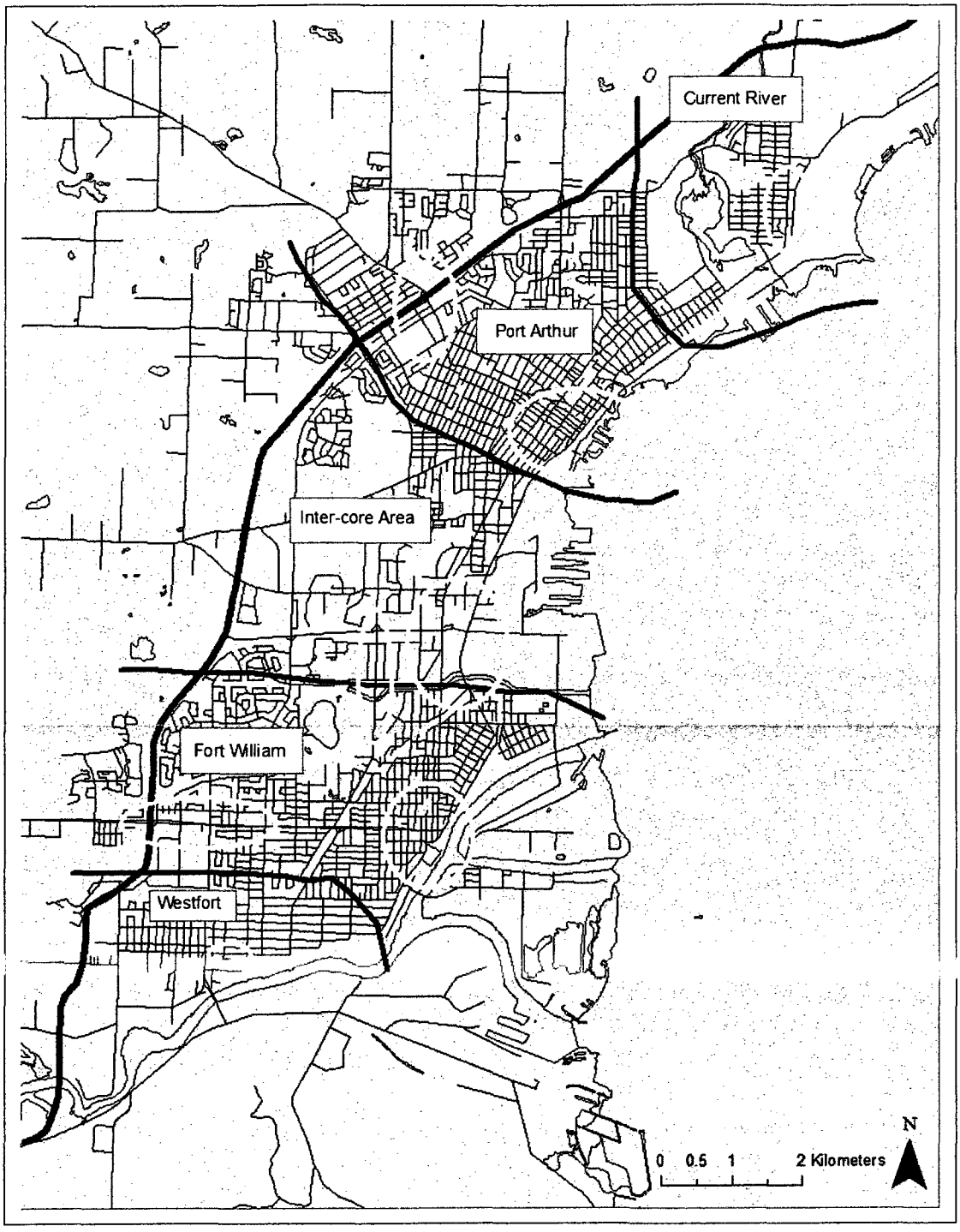


Figure 5.1: District map for the city of Thunder Bay. The blue lines indicate the separation zones for the five main city districts, which are labeled in green boxes. The yellow ovals show where the city's business districts are found, as defined by the Thunder Bay visitor's guide. Finally, the Thunder Bay expressway (Highway 11/17) is shown in red.

Figure 5.2 shows the accumulated risk factors for neighbourhoods of the city of Thunder Bay at the enumeration area (EA) level. At quick glance it is obvious that widespread high levels of social deprivation are evident in the year 1996. Enumeration areas with accumulated risk factors from 5-7 are found in all five main city districts. Notably, many of them are found close to the main business districts of the city. A large portion of the land lying alongside the Thunder Bay expressway in Current River is designated as having an ARF value of 5. This value extends into the Port Arthur city centre at the Red River/Junot intersection and on the Northwest side of the expressway. Other areas of concern in the Port Arthur city centre are found in the centre/interior of the area and down along the shoreline near the Cumberland business district. Examining southward, regions of high concern found in the Inter-Core area are along Balmoral Street in its centre. Enumeration areas in Fort William with high ARF values are located both along the shoreline near Simpson Street. Additionally there is an area lying just east of the expressway, found north of the Arthur Street business district. Finally, the Westfort city centre has two areas of concern, found in its far Southwest corner and along its Northeastern boundary.

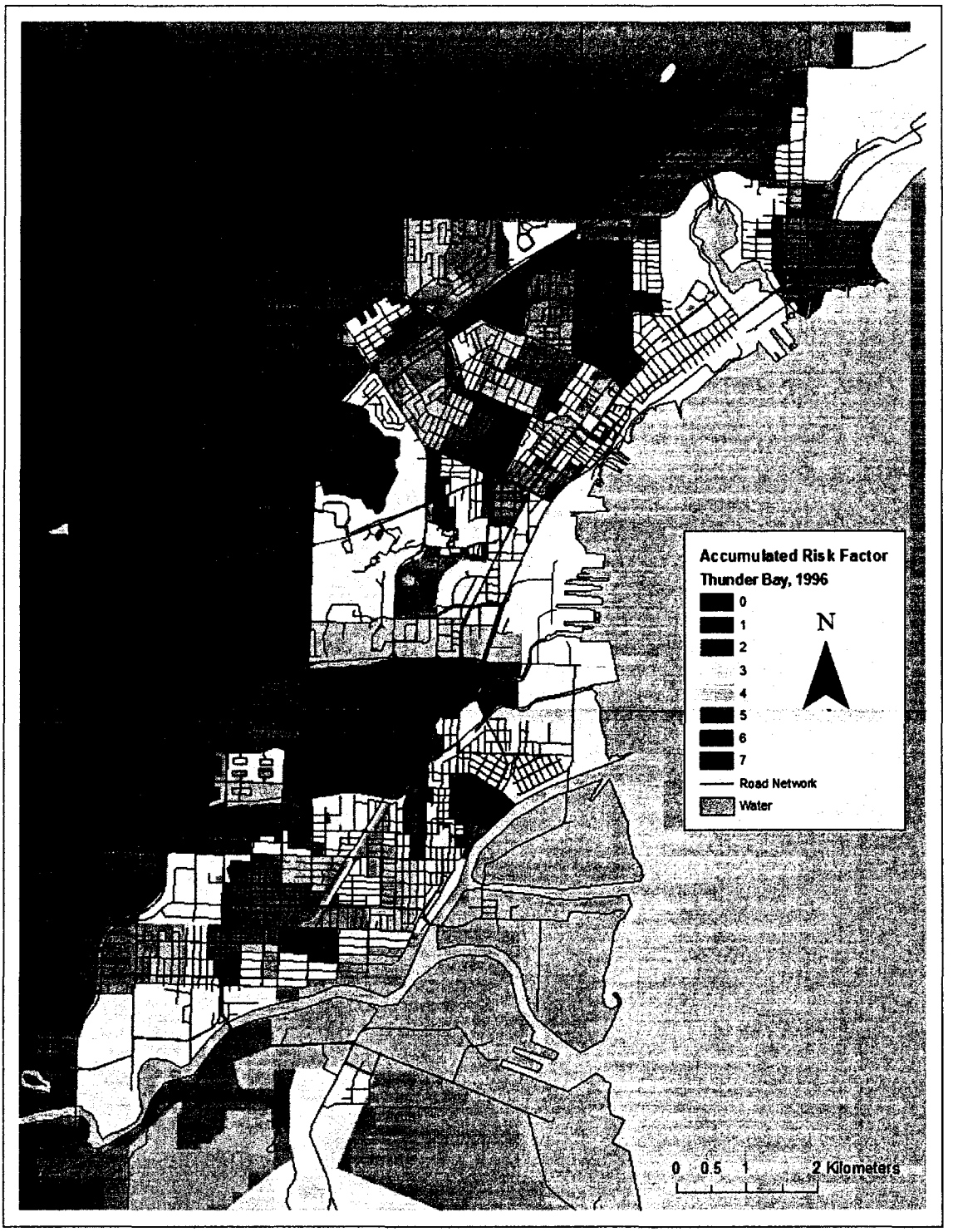


Figure 5.2: The 1996 accumulated risk factor map for Thunder Bay at the level of enumeration area. This map shows that in 1996 there were many neighbourhoods classified as having a high degree of social deprivation, or at a greater risk of being food insecure. While neighbourhoods at high-risk are spread over all five main regions of the city, those at the highest risk are found in Fort William. Many of the high-risk areas are found near the main business districts of the city.

The 2001 census was the first year that Census Canada collected information at the DA level as opposed to EA, as shown for Thunder Bay in Figure 5.3. Notably there are few DAs in 2001 assigned an ARF value designating high risk of food insecurity (i.e., ARF of 5 or higher). Only two of the five main city centres have DAs with high ARF values, namely Port Arthur and Fort William. Areas of high-risk in Port Arthur are found in the Northwestern corner at the Red River Road/Junot Avenue intersection, alongside the Thunder Bay Expressway and in the Southeastern corner of the city centre, along the shoreline and in the Cumberland business district. In Fort William, the areas of high risk are found in the Northern corner, east of the Thunder Bay Expressway. Other high-risk DAs are found along the interior of the city centre, just west of the lakeshore and Simpson Street. The remaining city centres of Thunder Bay are characterized as having DAs with low-to-mid range accumulated risk factors.

In 2006, Thunder Bay had several high risk DAs spread over four of the five main city centres (Figure 5.4). In Port Arthur, neighbourhoods with high ARF values were found alongside the Thunder Bay Expressway at the Red River Road/Junot Avenue intersection. Also in Port Arthur, DAs designated as high-risk were located along the city's Northeastern shoreline, near the Cumberland business district. In the Inter-Core Area several DAs with high-risk values are located along Balmoral Street in the city centre's interior. In Fort William, two neighbourhoods on opposite ends of the city centre were found to have high ARF values. These areas specifically lie to the Northeast, alongside the Thunder Bay expressway and also just West of Simpson Street along the city's shoreline. Westfort was found to have one

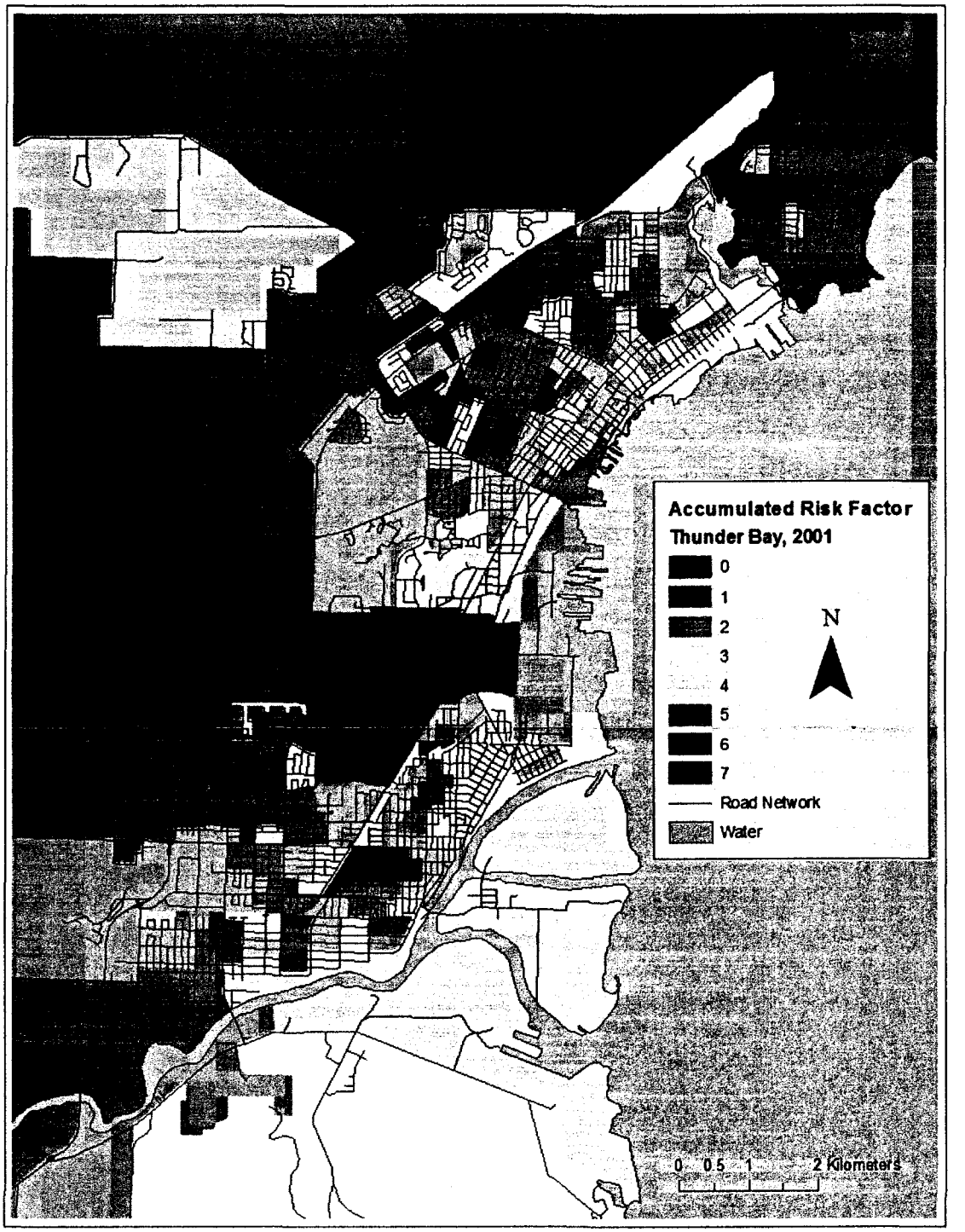


Figure 5.3: The 2001 accumulated risk factor map for Thunder Bay at the level of dissemination area. This map shows that in 2001 there were several neighbourhoods classified as having a high degree of social deprivation, or at a greater risk of being food insecure. The neighbourhoods with the highest risk classification, or having the highest degree of social deprivation, are found in the city centres of Port Arthur and Fort William. DAs in the other three city centres do not attain the highest levels of risk.

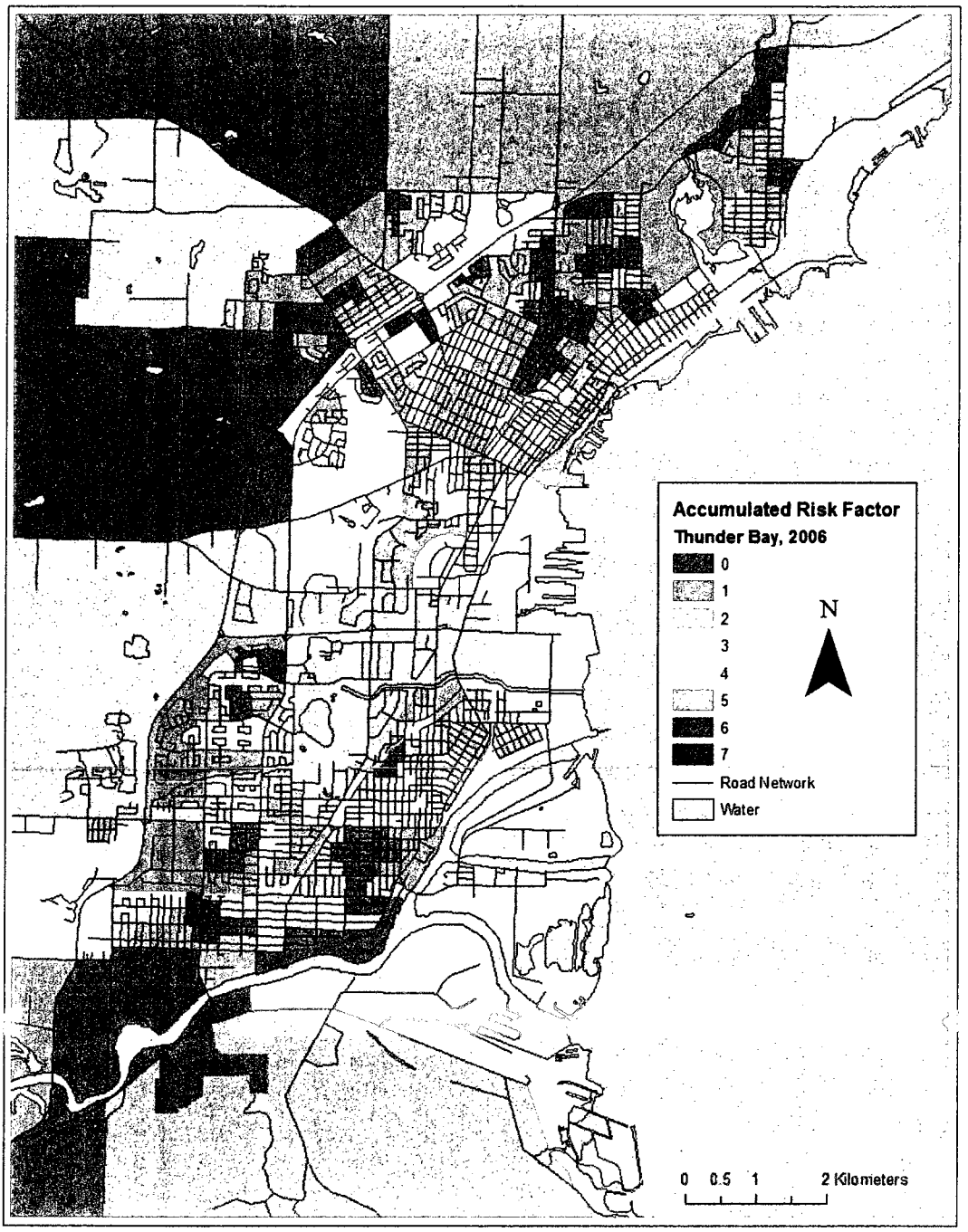


Figure 5.4: The 2006 accumulated risk factor map for Thunder Bay at the level of dissemination area. This map shows that in 2006 there were several neighbourhoods classified as having a high degree of social deprivation, or at a greater risk of being food insecure. The neighbourhoods with the highest risk classification, or having the highest degree of social deprivation, are found in four of the main city centres; Port Arthur, the Inter-Core area, Fort William and Westfort. Current River solely has disseminations areas in the low-risk categories. Many of the high-risk areas are found along the city's main business districts.

main area of high-risk, found in its southernmost neighbourhoods. Of the five main city centres, only Current River had DAs with ARF values solely in the low-to-mid range.

Examining the three accumulated risk factor maps for Thunder Bay for the years 1996, 2001 and 2006, several trends become apparent. Primarily there are several neighbourhoods that show chronically high ARF values, indicating that for the 11 years examined, these areas have been consistently at a high risk for food insecurity. Locating these neighbourhoods on the ARF maps was the first step in identifying food deserts. In Port Arthur, these include the DAs in the Northwest corner near the Red River Road/Junot Avenue intersection and the areas on the east shoreline along the Cumberland business district. In the 2006 census these two DAs represented 625 and 1,162 individuals respectively. In the Inter-Core area, a large area along Balmoral Street and extending down Beverly Street is classified as being at high risk for food insecurity. The 2006 census population for this area was 1,913 people, confirming that these are not simply commercial or industrial sites but primarily residential areas.

The Fort William city centre had two neighbourhoods that had consistently high ARF values over the three years of the study. These DAs were again on opposite sides of the city centre, one near the eastern shoreline, lying just inwards of Simpson Street and the other in the Northwest corner lying just east of the Thunder Bay Expressway. The total population for these areas according to the 2006 census was 1,066 individuals. Lastly, the Westfort city centre had two neighbourhoods in its southernmost end that had high ARF values for 1996 and 2006, but not in 2001. The

2006 population represented by these DAs was 1,242 people. Altogether, the population represented by DAs at high risk for food insecurity was 6,008 people (2006 Census Canada). These numbers indicate that 5.5% of the 2006 population may have been at a high risk of experiencing food insecurity to some degree.

Over all three years of study it appears that there has been a net decrease in the number of DAs with high-accumulated risk factors. One explanation for this trend may be the decreasing unemployment rate in the city from 10.6% in 1996 to 7.2% in 2006. Additionally, the 1996 Thunder Bay community profile shows a high percent of the population with low educational attainment, showing 35% of the population aged 15 and over without a high school diploma. This value drops dramatically to 25% in 2006 (Statistics Canada, 1997, 2002 and 2007). The demographics of Thunder Bay changed considerably between the years 1996 to 2006. The population decreased with accompanying falls in the number of youth and elderly. While the average income fluctuated, dropping between 1996 and 2001 and increasing again in 2006, the number of single parent families increased. All of these trends may lend to the changes observed in the ARF maps of Thunder Bay over the three years of study.

5.1.2 *Accumulated food insecurity risk maps – Dryden case study*

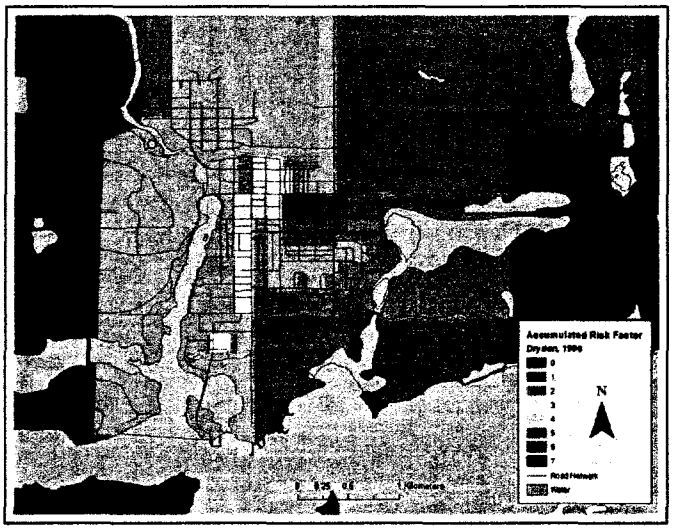
Figure 5.5 shows the ARF maps for the city of Dryden in the years 1996 (A), 2001 (B) and 2006 (C). In 1996, high ARF values infer that the city's areas of greatest concern for food insecurity risk lie along its southeastern perimeter, extending outwards to more rural zones. The remaining DAs of the city are found to

have low or mid-range accumulated risk factors. The 2001 ARF map shows that small, centrally located DA's in Dryden are at the highest risk of food insecurity. Additionally, a large portion of the Western edge of the city's perimeter is designated as having mid-range ARF values. These high ARFs indicate that individuals in these regions may be at risk of experiencing food insecurity. In 2006 DAs encompassing a large portion of the city's Northwest corner have high ARF values, indicating a high degree of social deprivation in these neighbourhoods. The remaining DAs in the city have low-range values only.

The temporal trend of Dryden over the three years shows a migration of high-risk areas from the Southeastern corner of the city's perimeter, through its core and finally establishing in the far Northwest. Very few DAs appear to have high-risk values for all three years; however, some regions do appear to maintain mid-to-high range values for at least 2 of the 3 years. These include the DAs lying due west of the Wabigoon River and neighbourhoods to the north of the city's downtown core. The 2006 population represented by these areas was 659, indicating that approximately 8.14% of Dryden's population could potentially be experiencing food insecurity. According to the Statistics Canada (1997, 2002, 2007) community profile, the city of Dryden experienced similar economical changes as Thunder Bay with a decrease in the unemployment rate (9.3% in 1996 to 5.9% in 2006). Additionally between the years of 2001 and 2006 the median income for individuals aged 15 and over rose from $25,333 to $29, 701. Looking deeper into the remaining socio-demographic factors making up the ARF values, while the population of Dryden remained fairly stable over the three census years, the number of youth dropped and the number of

elderly increased. Finally, while the number of single parent families remained stable, Dryden saw an increase in individuals with low educational attainment. These factors interacting may be lending to the changes in ARF values seen in Dryden between 1996 and 2006.

A



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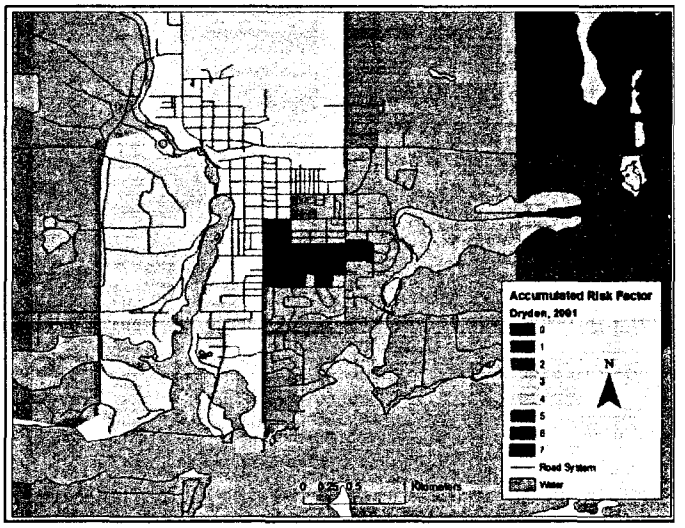

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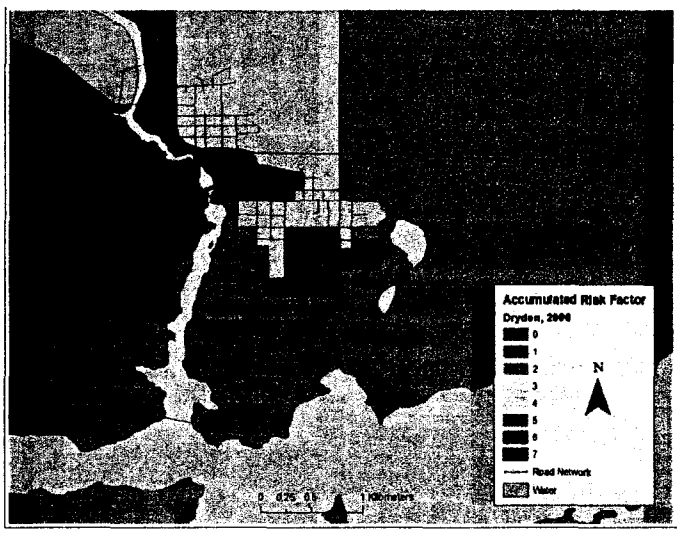


Figure 5.5: Accumulated risk factor maps for the city of Dryden for the years 1996 (A), 2001 (B) and 2006 (C). In 1996 much of the city's Southwestern side was classified as having high-accumulated risk values. Remaining areas in the city remained at low-to-mid ARF values. In 2001 dissemination areas in the town's core were classified as having high-accumulated risk values, or to be at highest risk of experiencing food insecurity. The remaining areas of the city were found to have low-to-mid ARF values. In 2006 an area encompassing much of the city's northern and westernmost neighbourhoods were classified as high-risk areas for food insecurity. The remaining areas of the city had low ARF values.

5.1.3 *Accumulated food insecurity risk maps – Fort Frances case study*

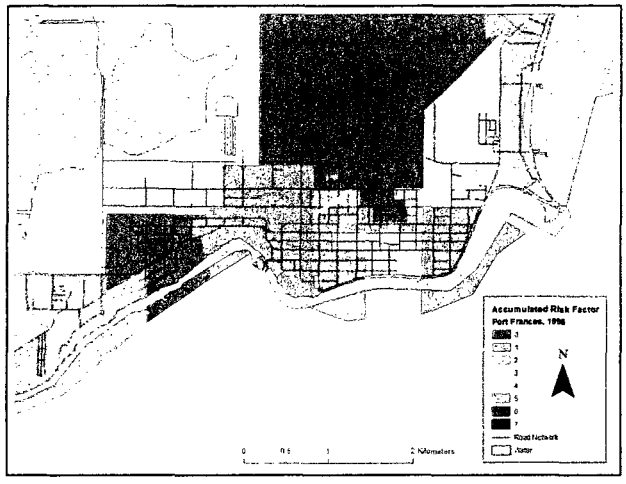
The accumulated risk values for DAs in the city of Fort Frances are shown in Figure 5.6. Maps highlighting areas of high risk for food insecurity are shown for the years of 1996 (A), 2001 (B) and 2006 (C). In 1996 Fort Frances appeared to have a high-risk dissemination area in the centre of its downtown core, extending southward towards Rainy River. Additionally, a large area at the city's Eastern edge had a mid-range ARF value. The remaining areas in the city were designated as having low risk of food insecurity.

In 2001 no areas with high-accumulated risk values were found in the city of Fort Frances. However, a large area encompassing the city's downtown core and eastern-most neighbourhoods had mid-range ARF values. In 2006 the entire city had low accumulated risk factors aside from one small DA to its far north, heading towards the rural regions lying outside of the city's boundaries.

Figure 5.6 shows a clear decrease in accumulated risk for food insecurity in Fort Frances over the given time period, with decreasing ARF's from high to mid to low values. This trend is supported by the community profiles created by Statistics Canada (1997, 2002 and 2007) that show both a decrease in the unemployment rates of the city during this time period (10% in 1996 to 7.3% in 2006) coupled with a marked increase in median income between 2001 and 2006 for persons 15 years of age and over ($23 357 in 2001 to $29 998 in 2006). Also for 2001 and 2006, an increase in the median household income was reported, rising from $63 441 to $77 471. Although the number of single parent families increased slightly along with the elderly population, there was a decrease in individuals with low educational

attainment. All of these factors may have positively influenced the social state of Fort Frances to affect the range of ARFs observed.

A



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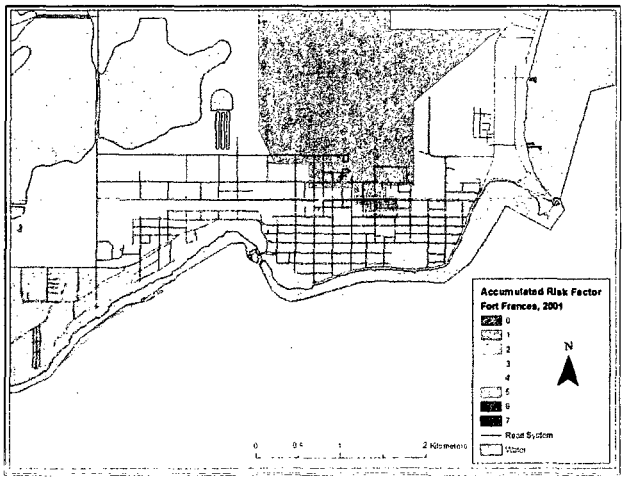

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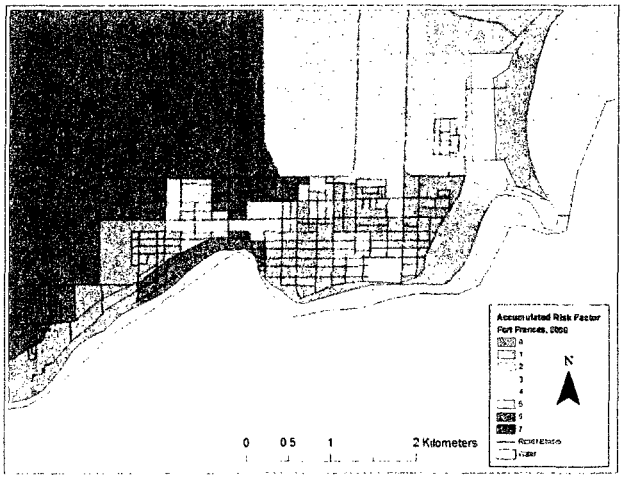

Figure 5.6: Accumulated risk factor maps for the city of Fort Frances for the years 1996 (A), 2001 (B) and 2006 (C). In 1996 several dissemination areas extending from the city's town core south towards the river were classified as having high-accumulated risk values. Remaining areas in the city remained at low-to-mid ARF values. In 2001 all of the city's dissemination areas were found to have low-to-mid ARF values. In 2006 the majority of the city's dissemination areas were classified as having low-to-mid ARF values, however a portion of the northernmost area of the city had values indicating high-risk of food insecurity.

5.1.4 *Accumulated food insecurity risk maps – Kenora-Keewatin case study*

The city of Kenora-Keewatin is mapped in Figure 5.7 showing its neighbourhoods' accumulated risk factors at the DA level. In 1996 (Figure 5.7a) the city centre of Keewatin to the far left of the map has low accumulated risk values, indicating it is at low risk of food insecurity. Kenora, to the right of the map, has a region of high-accumulated risk in its downtown core. A large area leading southeast of the high-risk neighbourhoods also shows mid-ARF values.

In 2001 (Figure 5.7b) the centre of Keewatin has low accumulated risk values. Kenora, however, has two DAs designated as being at a high risk of food insecurity. These regions of high risk are found in the city's downtown core and due north. Additionally, the areas surrounding these high-risk centres show mid-range ARF values. The resulting map shows that the majority of the city is characterized by mid-to-high ARF values with few of the remaining DAs being classified as low-risk. Kenora-Keewatin has a relatively stable low-accumulated risk value across its city boundaries in 2006 (Figure 5.7c). The map shows that there is one dissemination area northeast of the downtown core with a high-risk ARF value.

Over the three years covered by this study, the city of Kenora-Keewatin has shown an overall decrease in DAs designated as having high-accumulated risk factors indicating high risk of food insecurity. This trend is supported by the Statistics Canada community profiles for the city, which show a marked increase in median income from $25 333 in 2001 to $29 703 in 2006. All other factors remained relatively stable. There are no areas that appear to have high ARF values across all three years and only two DAs appear in 2 of the 3 years covered by the study. These

two high-risk regions represent 1 133 individuals or 7.5% of the population of Kenora-Keewatin that may be experiencing food insecurity to some degree.

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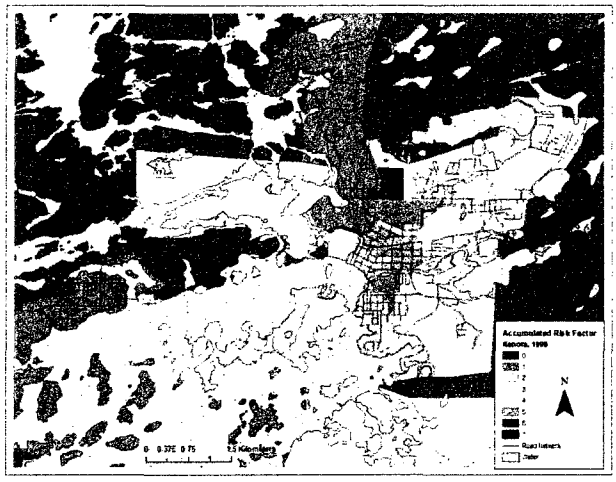

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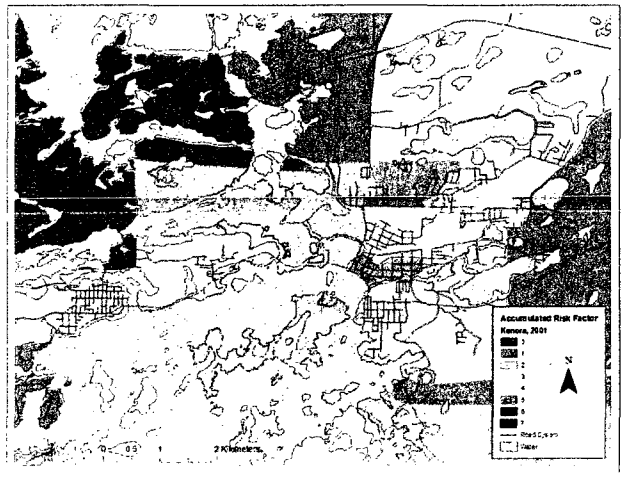

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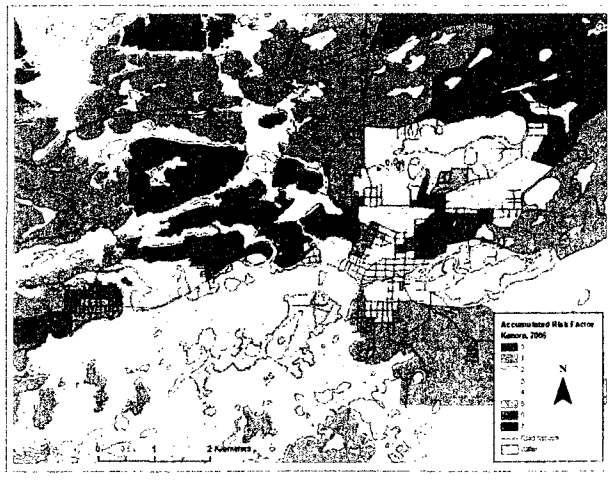

Figure 5.7: Accumulated risk factor maps for the city of Kenora-Keewatin for the years 1996 (A), 2001 (B) and 2006 (C). In 1996 Keewatin, found on the far left side of the city, had low ARF values. High ARF values in Kenora were found in dissemination areas forming the city's core. Remaining areas in the city remained at low-to-mid ARF values. In 2001 Keewatin dissemination areas had mid-range ARF values. In Kenora's core dissemination areas were classified as having high-accumulated risk values, or to be at highest risk of experiencing food insecurity. A large portion of the surrounding area to the town's core had mid-range ARF values. Additionally, dissemination values to the North of the core area were classified as having high ARF values. Very few areas of the city were found to have low ARF values. In 2006 only one small neighbourhood to the North had a high-accumulated risk factor value. The remaining areas of the city had low-to-mid ARF values.

5.1.5 *Accumulated food insecurity risk maps – Sioux Lookout case study*

Figure 5.8 depicts the accumulated risk values for the town of Sioux Lookout in 1996 (A), 2001 (B) and 2006 (C). The 1996 map shows that the north end of the town has ARF values that indicate high risk of food insecurity. All remaining DAs in 1996 were classified as having low-risk of food insecurity. The 2001 map for Sioux Lookout shows a marked increase in DAs with a mid-to-high range ARF value. The town's core is nearly entirely encompassed by areas indicating high risk for food insecurity. By 2006, all of Sioux Lookout's DAs have low ARF levels.

Over the three years of this study, the ARF values of DAs in Sioux Lookout have evidently fluctuated, ranging from highest risk to lowest risk. From 1996 to 2001 areas lying north of the town's core had consistently high values otherwise no striking pattern for the town has emerged. Closer examination of the community's Statistics Canada profile (1997, 2002 and 2007) may explain the sudden drastic reduction in ARF values in 2006 with a marked increase in median income. In 2001 the average familial income for the town of Sioux Lookout was $64 598, an amount that increased to $91 287 only 5 years later in the 2006 census. These 2006 values, coupled with a very low unemployment rate for the census year at 3.7% and a very high employment participation rate at 78.5%, could indicate that new, high-paying jobs were made available in or before this year. As all other ARF factors remained relatively stable over the time period, the positive changes in the economic variables may indicate that they played a large role in lowering the risk of food insecurity in the town.

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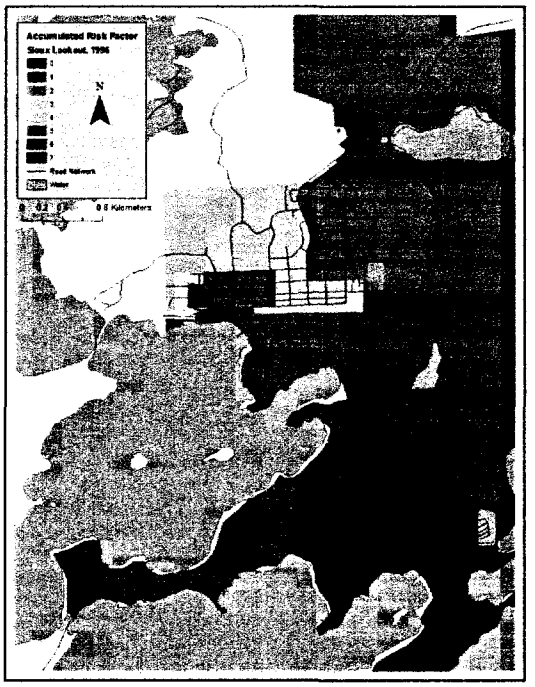

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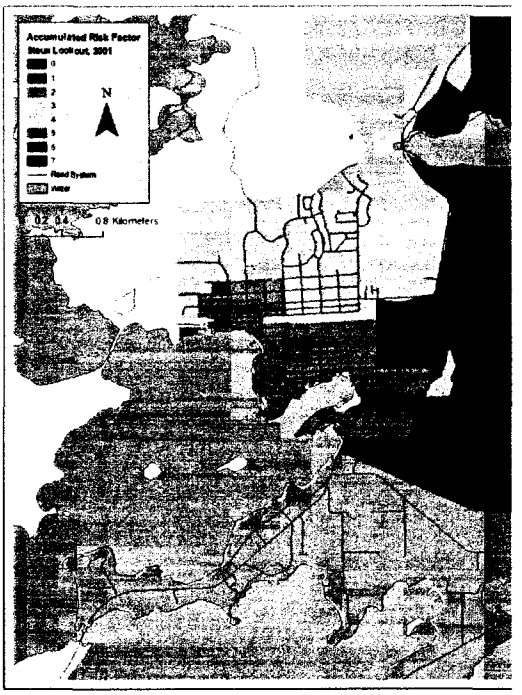

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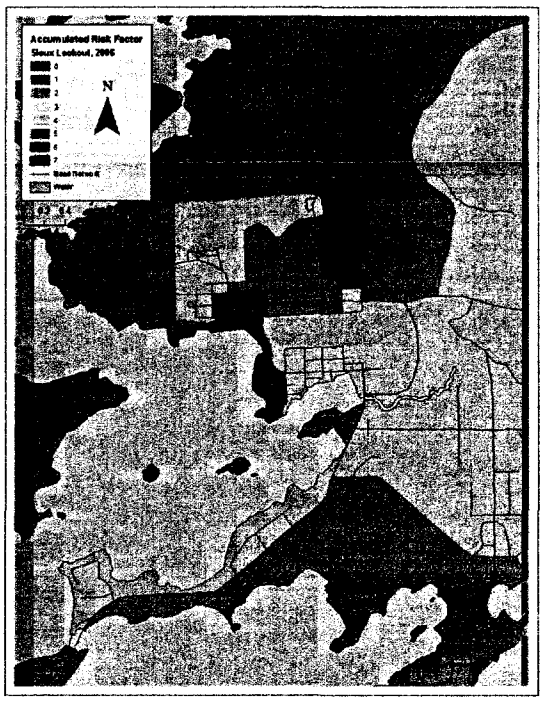

Figure 5.8: Accumulated risk factor maps for the town of Sioux Lookout for the years 1996 (A), 2001 (B) and 2006 (C). In 1996 much of the city was classified as having low-to-mid range accumulated risk values. Only one area of concern was detected in a dissemination area northeast of the town's core. In 2001 dissemination areas in the town's core were classified as having high-accumulated risk values, or to be at highest risk of experiencing food insecurity. Extending northeast from these high-risk neighbourhoods is a large area with mid-range ARF values. In 2006 all of the town's dissemination areas of the city had low ARF values.

5.1.6 *Accumulated food insecurity risk maps – Atikokan case study*

Accumulated risk factors for the town of Atikokan are shown in Figure 5.9 for the years 1996 (A), 2001 (B) and 2006 (C). In both 1996 and 2006 the town's DAs have very low ARF values and do not have any areas of concern for risk of food insecurity. The 2001 map, however, shows a dramatic difference with DAs encompassing the town's core having high ARF values, indicating a high degree of risk of food insecurity.

Referring to the Statistics Canada community profile for Atikokan (1997, 2002, 2007) reveals interesting data regarding the town's state over the years covered by this study. Atikokan is the only community examined in this study to show a 10% decrease in population for two census years in a row, with a net loss of children under 15 and adults between the ages of 25 and 44. The number of elderly persons, however, increased through all three census years, driving the percentage of people aged 65 and over to be much higher in 2001 and 2006. Interestingly enough, the unemployment rate decreased between the years 1996 (13.2%) and 2001 (11.9%) and the participation rate remained fairly uniform. The employment rate dropped even further to 9.0% in 2006 and was coupled by a higher median income than in 2001 with an increase from $57 049 to $62 867 for couples.

Other variables influencing the ARF values included single parent families, which remained consistent over the three census years and individuals with low education, which lessened over the time period. The factors of income and unemployment therefore may have been the cause for the accumulated risk factors to drop back to low values between 2001 and 2006.

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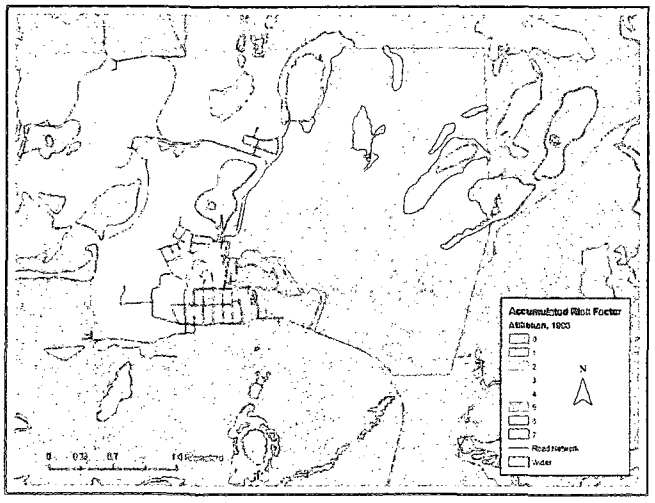

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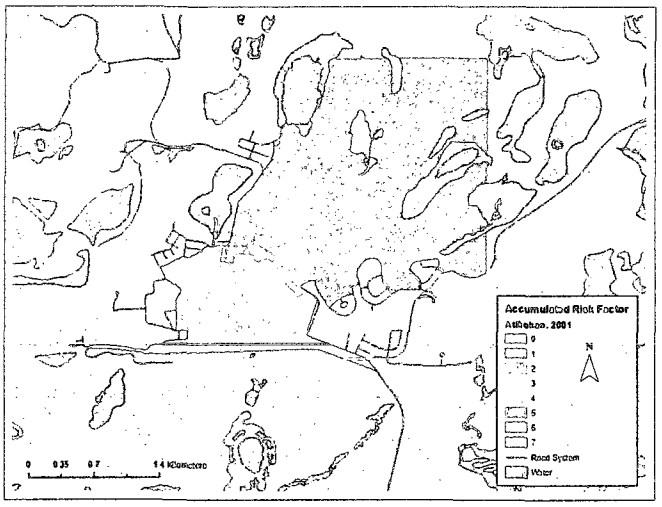

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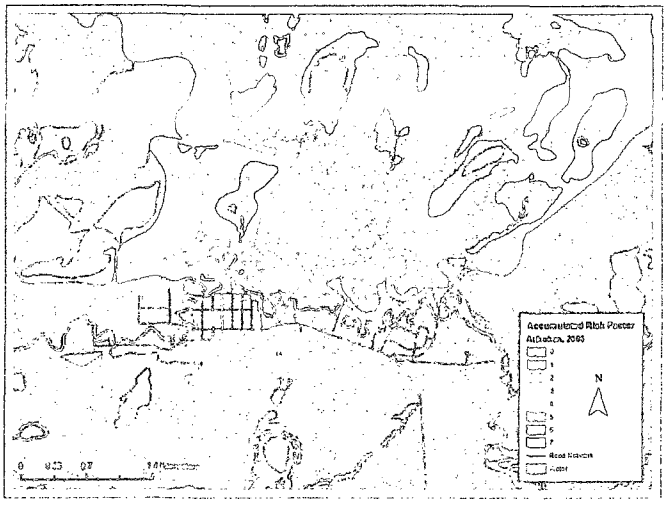

Figure 5.9: Accumulated risk factor maps for th town of Atikokan for the years 1996 (A), 2001 (B) and 2006 (C). In 1996 all dissemination areas in the town remained at low-to-mid ARF values. In 2001 dissemination areas in the town's core were classified as having high-accumulated risk values, or to be at highest risk of experiencing food insecurity. The majority of the surrounding area had mid-range ARF value: with very few dissemination areas in the low-range. In 2006 all of the town's dissemination areas had low ARF values.

This preceding section has therefore presented the maps for each of the six communities of study for the years 1996, 2001 and 2006 based on the Accumulated Risk Factor developed in Section 4.3. These maps represent the first step in meeting the research objective of analyzing the state of food security in Northwestern Ontario communities by identifying food deserts on maps. While the ARF maps show where neighbourhoods with the highest potential risk of experiencing food insecurity are located, their status of food deserts cannot be confirmed until this information is coupled with the geographic location of local food retailing outlets. The following section brings together all the steps in food desert mapping to achieve this research objective in full.

5.2 Food Desert Mapping

Food deserts are defined as regions that have a high degree of social deprivation that are outside of walking distance to full-service grocery stores, a delineation that is inherently spatial (Smoyer-Tomic et al, 2006). Mapping is therefore an effective and intuitive means of identifying these regions. Food desert maps for urban centres in Northwestern Ontario were created by combining the ARF maps from Section 5.2 with the location of grocery stores for the years of 1996, 2001 and 2006. Grocery stores were geocoded onto the road networks as points and were given 500 metre buffers to represent what is deemed in the literature to be an acceptable walking distance to acquire food (Donkin et al, 1999).

The resulting maps detail how neighbourhoods have changed with respect to their state of social deprivation and highlight how the location and number of grocery stores have changed over the ten-year span covered by this study. Finally, they show very clearly where food deserts have been located over the three years of census data and how they have changed over time. The food desert maps for the Northwestern Ontario communities are presented in the form of case studies and are found in Sections 5.3.1 to 5.3.6.

5.3.1 *Food Desert Mapping – Thunder Bay case study*

Maps used to identify food deserts in Thunder Bay are located in Figures 5.10, 5.11 and 5.12 for the years 1996, 2001 and 2006 respectively. In 1996, the city of Thunder Bay had twenty grocery stores available for the city's residents (Figure 5.10). Of these, none were located in Current River, eight were located in Port Arthur, two were found in the Inter-Core area, five were found in Fort William and three in the Westfort city centre.

The 500m buffer zones representing walking distance around each of the grocery stores has revealed that many of the DAs with high-ARFs were food deserts. In 1996, food deserts were found in all five of the city's main centres. In Current River, DAs next to the Thunder Bay Expressway were outside of walking distance to the nearest grocery stores. In Port Arthur, neighbourhoods lying northeast and southwest of the Red River Road/Junot Avenue intersection were both food deserts. Those regions with high ARF values lying along Memorial Avenue, however, were

found predominantly to have adequate access to retail.

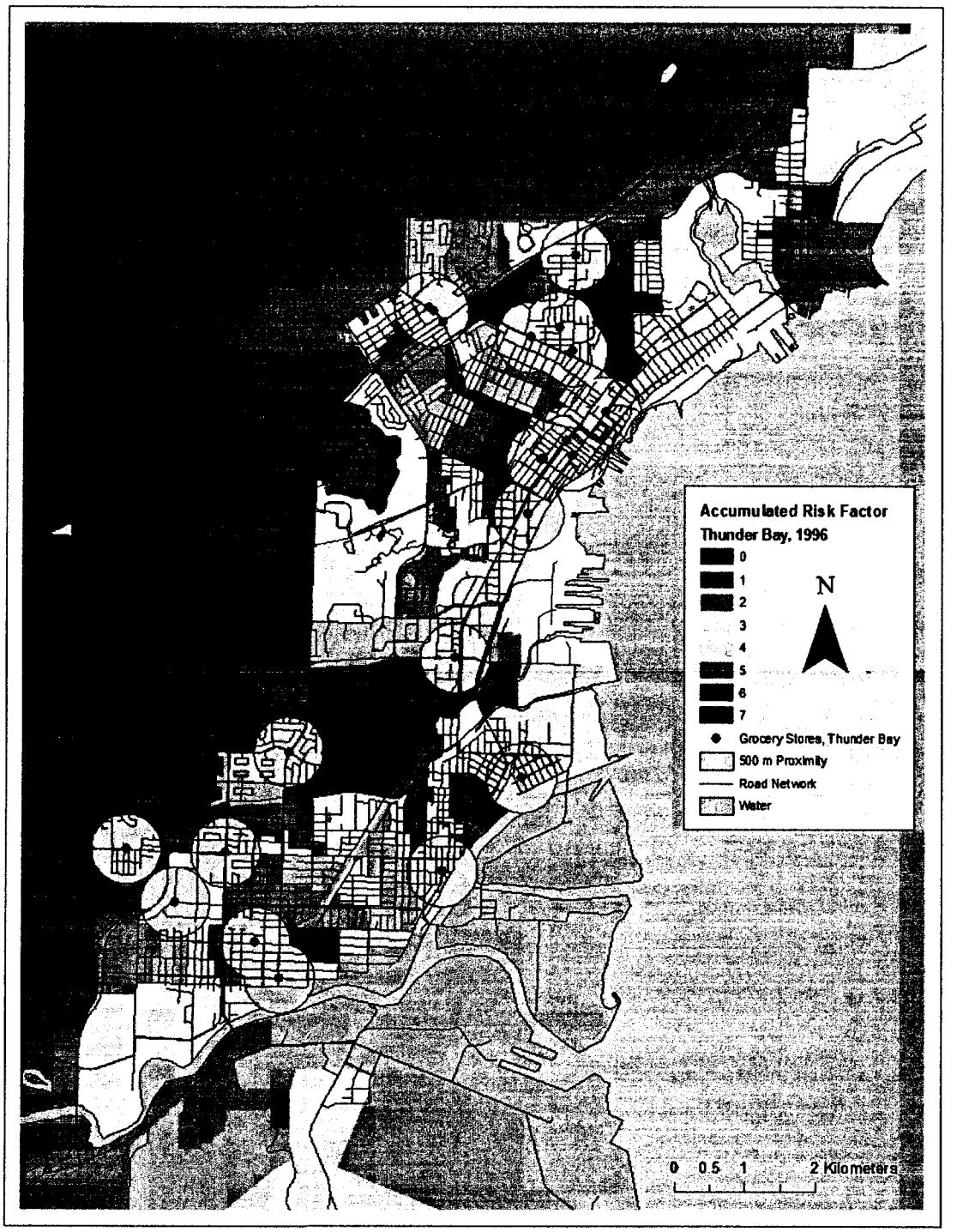

Figure 5.10: Food deserts in Thunder Bay in 1996 (coloured orange to red) are spread uniformly through the five main city centres. There were 20 grocery stores available to city residents in 1996: 0 in Current River, 8 in Port Arthur, 2 in the Inter-Core, 5 in Fort William and 3 in Westfort.

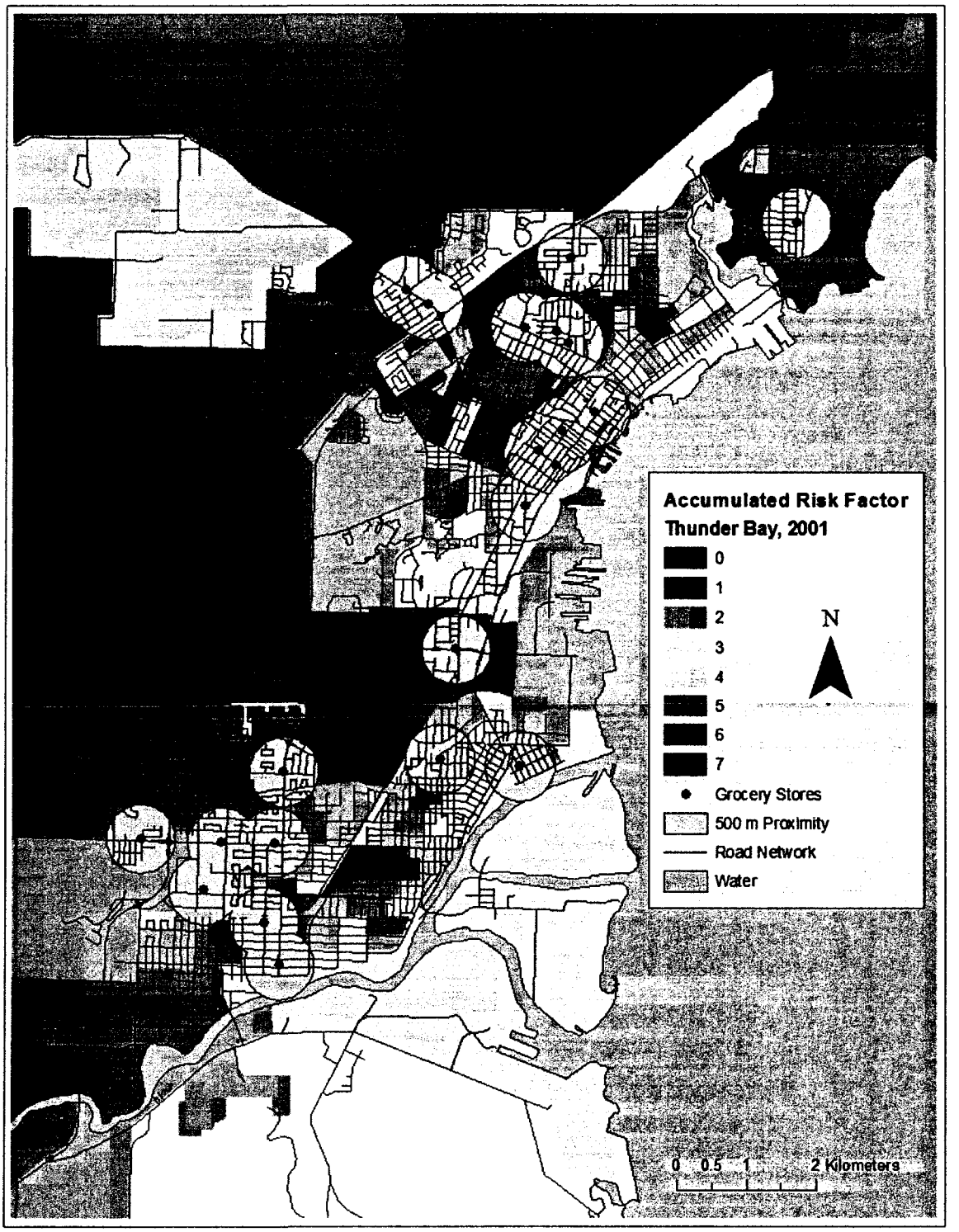

Figure 5.11: Food deserts in the city of Thunder Bay in 2001 are found only in the city centres of Port Arthur and Fort William. There were 22 grocery stores serving the city's population in 2001: 1 in Current River, 10 in Port Arthur, 2 in the Inter-Core, 6 in Fort William and 3 in Westfort.

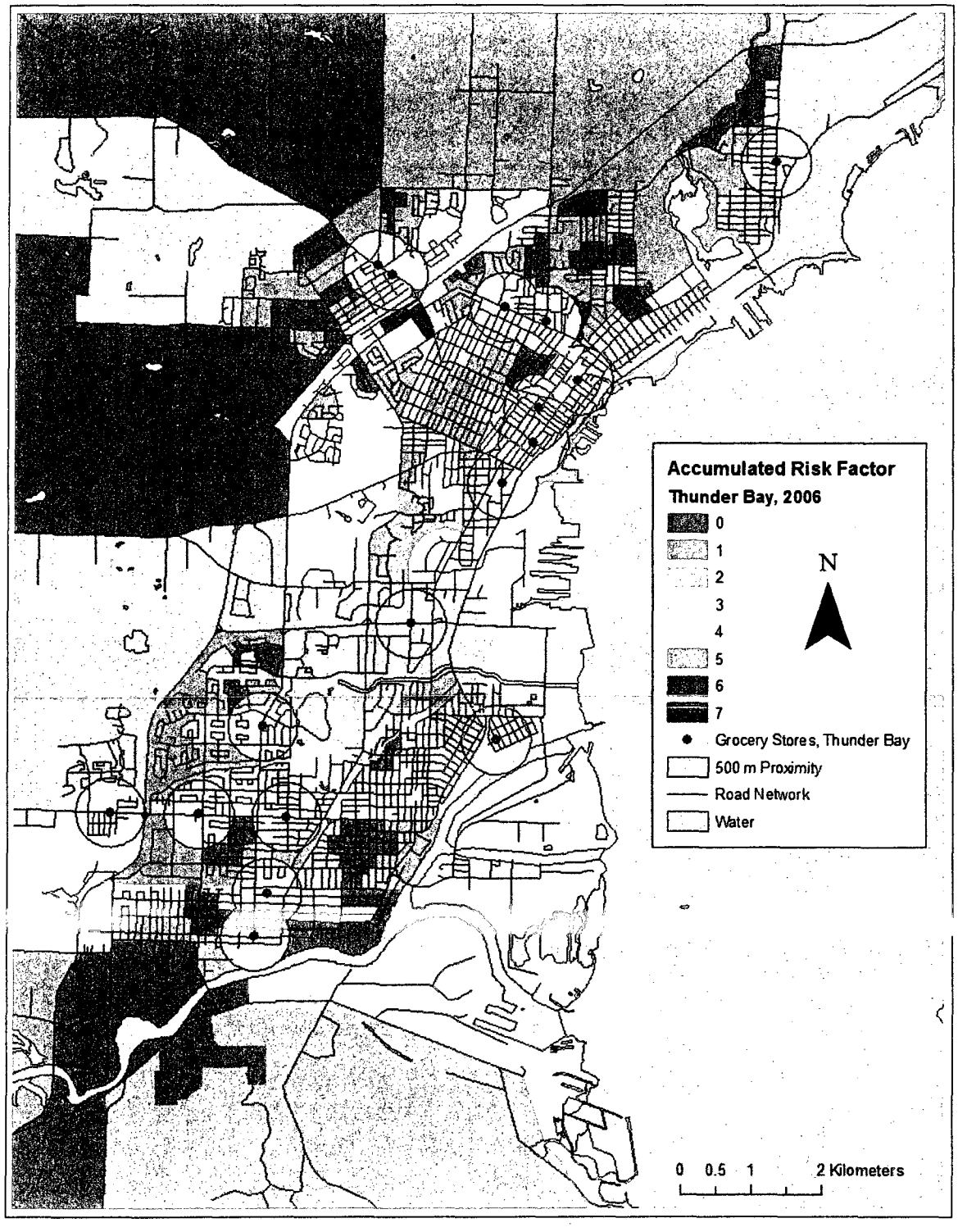

Figure 5.12: Food deserts in the city of Thunder Bay in 2006 were found in 4 of the 5 main city centres. There were 17 grocery stores identified in 2006: 1 in Current River, 7 in Port Arthur, 2 in the Inter-Core, 5 in Fort William and 2 in Westfort.

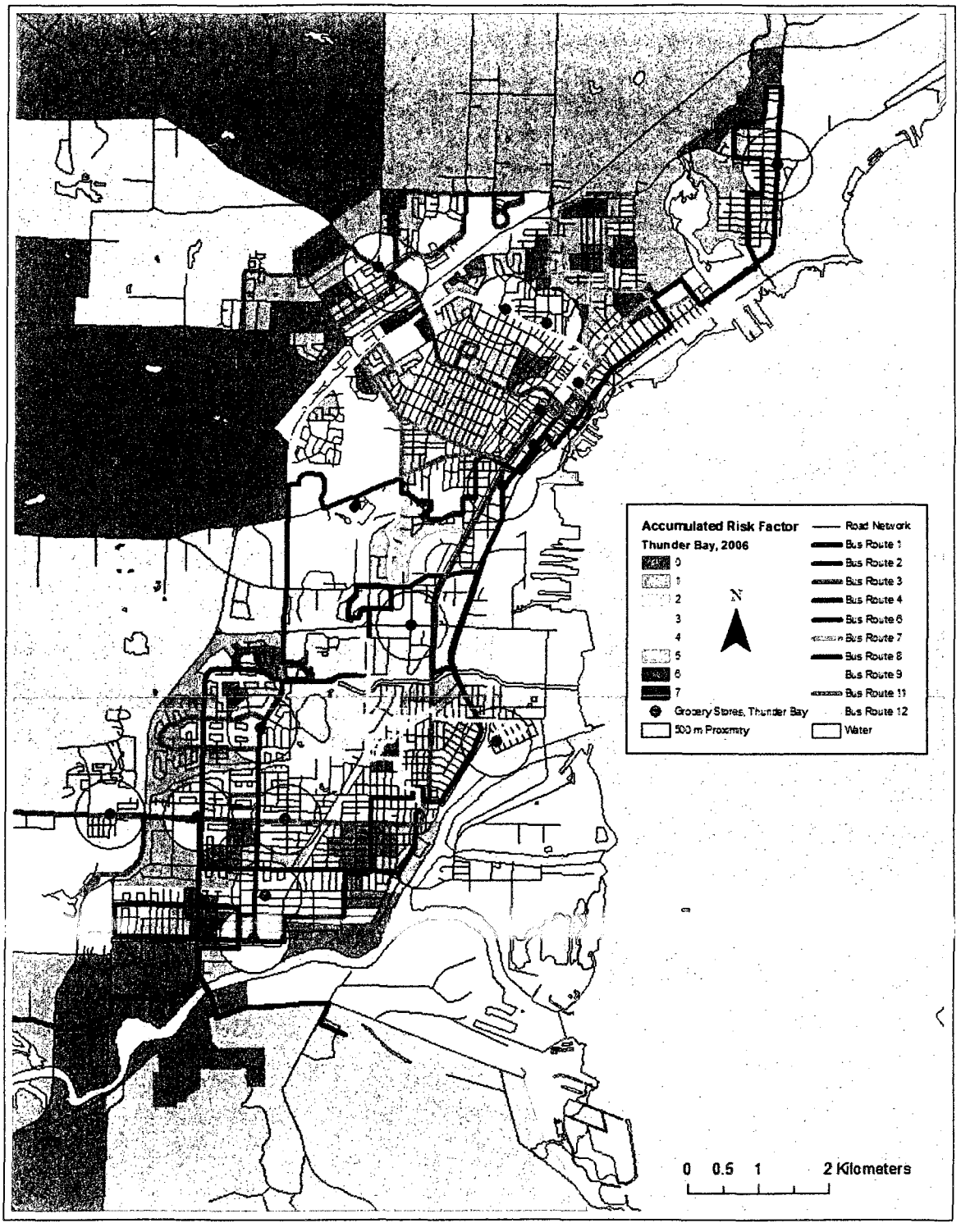

Figure 5.12b: the 2006 bus route map for Thunder Bay shows that all grocery stores are accessible within 500m of a main bus line. This can help mitigate the effects of living in a food desert.

In the Inter-Core area, residents in DAs lying next to Balmoral Street and down Beverly Street were living in a food desert. In Fort William, the DAs classified under the highest risk of food insecurity near the Thunder Bay expressway and lying along Simpson Street were also found to have inadequate access to food and were therefore food deserts. Lastly, DAs in central Westfort, as well as in its Southwest corner, were all found to be food deserts with the closest grocery stores located far more than 500m away.

In 2001 the city of Thunder Bay had 22 grocery stores spread throughout all five of its main city centres (Figure 5.11). One grocery store was located in Current River, ten were found in Port Arthur, two were located in the Inter-Core, six were found in Fort William and the remaining three were located in Westfort. Though there was an increase in the number of grocery stores, several food deserts were still identified in the city. These food deserts were found in two of the city's main centres. In Port Arthur, food deserts were identified in the Northwest corner near the Red River Road/Junot Avenue intersection, as well as on the eastern boundary near the Lake Superior shoreline on Cumberland Avenue. In Fort William a neighbourhood lying west of Simpson Street was identified as a food desert, as was a neighbourhood on the opposite side of the centre lying just east of the Thunder Bay expressway. Neighbourhoods in Current River, Westfort and in the Inter-Core area were all found to either be within a 500m walking distance to the nearest grocery store or had low accumulated risk of food insecurity.

In 2006, seventeen grocery stores were identified in the city of Thunder Bay (Figure 5.12). These retailers were located in all five of the main city centres with

one in Current River, seven in Port Arthur, two in the Inter-Core, five in Fort William and two in Westfort. The decrease of grocery stores in the city was coupled with an increase in the number of food deserts from 2001. Food deserts in the city of Thunder Bay in 2006 were located in four of the city's five main centres. In Port Arthur, DAs lying along the Red River Road/Junot Avenue intersection were found to be food deserts. The same classification was given to neighbourhoods lying on the eastern side of Port Arthur near the Cumberland business district and lying alongside the Lake Superior shoreline.

In the Inter-Core area, DAs lying along Balmoral Street and Beverly Street were identified as food deserts in that they had high accumulated risk factors and were located outside of a 500m walking zone from the nearest grocery store. In Fort William, DAs lying just west of the Thunder Bay expressway and inwards from Simpson Street on the eastern perimeter were identified as food deserts. Finally, in Westfort, one neighbourhood found in the far Southern end was identified as a food desert. While residents of these regions may be experiencing difficulties accessing healthy food, the city's bus routes could mitigate their struggles. Figure 5.12b shows the 2006 bus map for Thunder Bay and reveals that all grocery stores in the city are within 500m to a main bus line.

The maps depicting change over the ten years and three censuses covered by this study show that the city of Thunder Bay has had several neighbourhoods that are consistently food deserts and may require attention from the city's social planners. These neighbourhoods include those in Port Arthur lying near the Red River Road/Junot Avenue intersection, representing 625 people and along

Cumberland Avenue where DAs represent over 1100 people. Other regions in the Inter-Core area include the area lying east of Balmoral Street and along Beverly Street where nearly 2000 people live and may be struggling with having adequate access to food. In Fort William two DAs were consistently found to be food deserts over all three-census years, one lying just east of the Thunder Bay expressway and the other just west of Simpson Street. Together, these two regions represent 1066 people living in food deserts. Finally, neighbourhoods in the southern regions in the city centre of Westfort were found to be food deserts in two of the three census years, representing upwards of 1200 people that may be experiencing food insecurity.

The net change in grocery stores in Thunder Bay was a decline from 22 at its highest in 2001 to 17 at its lowest in 2006. Consistently, Port Arthur was the city centre found to have the majority of grocery stores through all three-census years. Conversations with shop owners and visual assessments throughout the city revealed that the majority of the lost grocery stores over the decade were small, local shops found in the city's former downtown cores. Interestingly, many of the shops are still open; however they changed the product on their shelves to draw a specific clientele looking for specialty items rather than the general public wanting to buy their groceries.

5.3.2 *Food Desert Mapping – Dryden case study*

Figure 5.5 detailed the movement of regions at high-risk of food insecurity in Dryden for the year's 1996, 2001 and 2006. In Figure 5.13, this information has been

combined with the location of grocery stores over this same time span to help identify where there are food deserts in the city. In 1996 (Figure 5.13a) there were four grocery stores in the city of Dryden, two of which were located in the city's downtown core and the other two located along Highway 17 that runs along the city's northern perimeter. The map reveals that the areas of highest risk of food insecurity discovered in Figure 5.5a are not being served within the 500m walking zones established around each of these grocery stores. In 1996 the city of Dryden had a very large food desert extending southeast where individuals would be most likely to experience food insecurity.

In 2001 (Figure 5.13b) there were three grocery stores serving the city's population, two located along Highway 17 and one in its downtown core. In Figure 5.5b several DAs in the city's downtown core were identified as being at high-risk of experiencing food insecurity, a large portion of which are found to be outside of the walking zones established around the full-serve grocery stores in Figure 5.13. Individuals living in this area are therefore living in a food desert and are at a high risk of experiencing food insecurity.

In 2006 there were three grocery stores serving the city of Dryden's population, two located along Highway 17 and one in its downtown core (Figure 5.13c). Several DAs were identified as being at high-risk of experiencing food insecurity along the town's northwestern corner and western perimeter. Figure 5.13c reveals that although two of the three grocery stores serving the town are located near or within these neighbourhoods at high-risk, a large portion of the population living in these DAs are still living outside of the established 500m

walking zone. These individuals are therefore living in a food desert and are at a high risk of experiencing food insecurity.

Dryden makes for an interesting case study regarding changes in the food systems and the phenomenon of large grocery stores out-competing their local counterparts (Hinricks and Lyson, 2007). In 1996, three of the four grocery stores were locally owned and operated. By 2001, two of the local stores had been outcompeted and succumbed to the opening of a new superstore along the highway. By 2006 all three grocery stores serving the town were corporately owned. Therefore while the number of grocery stores over the decade was only reduced by one, those that survived the time span were dramatically different than those that began it.

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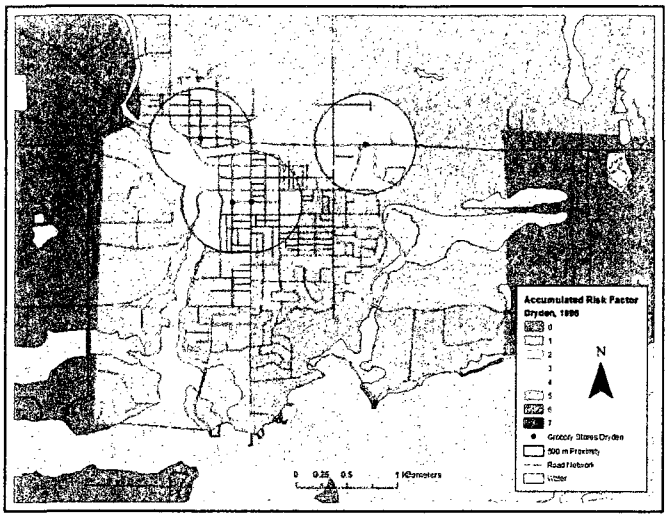

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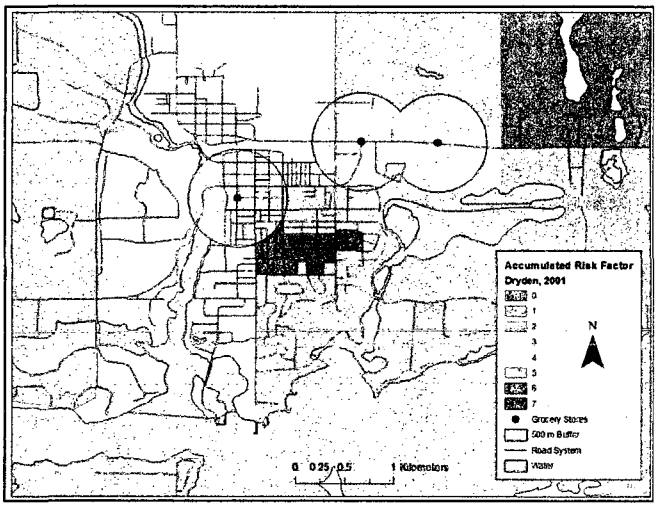

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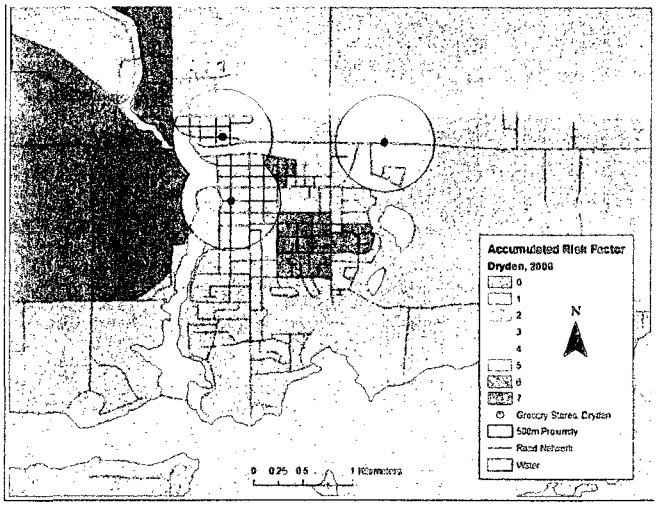

Figure 5.13: Food desert maps for the city of Dryden in 1996 (A), 2001 (B) and 2006 (C). In 1996 there were four grocery stores in the city all located in the downtown core and to the northwest. This map shows that the areas with high ARF values detected in Figure 5.5 were being highly underserved by grocers and were therefore food deserts. The 2001 map shows three grocery stores in the city, one located in the downtown core and two along the highway. The areas of high risk for food insecurity lie outside of the 500 walking distance to the nearest grocer, indicating that people living in these neighbourhoods are living in a food desert and are at a high risk of experiencing food insecurity. The 2006 map shows three grocery stores in the city, two on either side of the highway on the town's northernmost boundary and another in the downtown core. Much of the high-risk area detected in Figure 5.5 lies outside of the 500 m walking distance to these grocers, indicating that people living here are at high risk of experiencing food insecurity and may have difficulties attaining food.

5.3.3 *Food Desert Mapping – Fort Frances case study*

Food desert maps produced for Fort Frances are found in Figure 5.14 for the years 1996 (A), 2001 (B) and 2006 (C). In 1996 the city had one area that was considered to be at high risk for food insecurity, located in its downtown core and near its southern perimeter. There were three grocery stores serving the city of Fort Frances in this year, two of which were clustered in the downtown core. As a result, the 500m walking zones established around each of the grocers covered the majority of the high-risk DAs. Only a small portion of the high-risk area remained outside of the acceptable walking distance and was found across Rainy River, in the United States and therefore outside the scope of this study.

In 2001 there were six grocery stores open in Fort Frances, the majority of them clustered along the southern perimeter of the city. Figure 5.6b shows that there were no areas of high-accumulated risk of food insecurity in Fort Frances in 2001; therefore no food deserts have been identified for the city in this year. By 2006 the ARF values for the city had decreased even further and the residents of Fort Frances were therefore being adequately served by the four grocery stores open in the city at that time. In the far Northeast corner of the area, however, a high-risk zone had developed without any grocery stores remotely close to its borders. This appearance indicates the development of a peripheral food desert in the city, lying outwards of its city centre but still experiencing high levels of social deprivation and therefore at increased risk of food insecurity.

General trends in Fort Frances show that the community experienced a small period of time in 1996 where residents in its downtown core were living in a food

desert and potentially experiencing food insecurity to some degree, but the town has seemingly recovered from this development. Overall it appears that both social deprivation and access to grocery stores with safe and nutritious food improved over the decade spanning this study. The northeastern food desert, however, may be an alarming development to the city and this region should be monitored in following census years to determine whether residents there may be experiencing chronic food insecurity.

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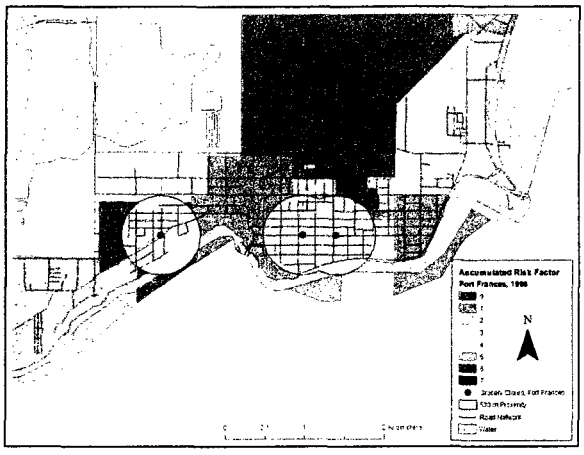

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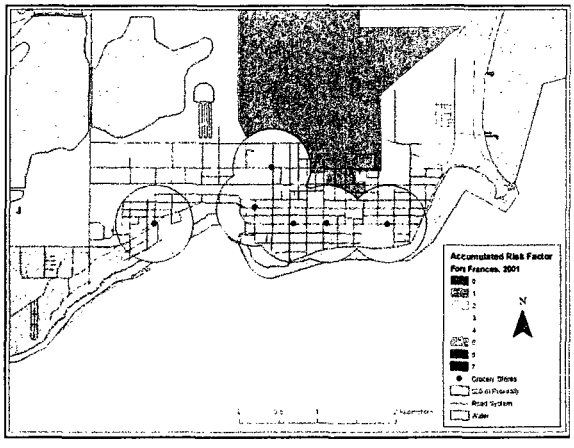

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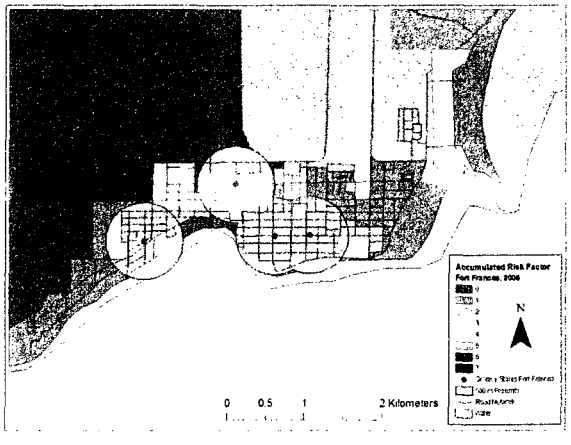


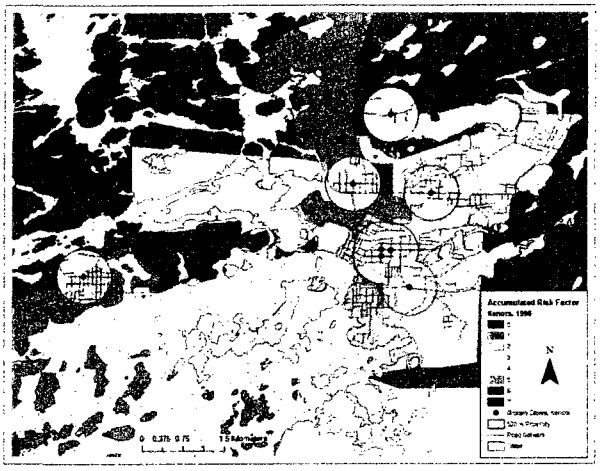
Figure 5.14: Food desert maps for the city of Fort Frances in 1996 (A), 2001 (B) and 2006 (C). In 1996 it appears that the majority of the dissemination area with the high ARF values found in Figure 5.5 was served adequately by its nearest grocery store. Almost the entire region is within the 500m walking zone buffers with the exception of one small section lying across the river. In 2001 there were nearly double the number of grocery stores in the city but no areas of concern detected and therefore no region that could be classified as a food desert. In 2006 several grocery stores appear to have closed, however there were no dissemination areas with high ARF values in the city's core. The northern section of the city with the high ARF value is lying outside of any of the 500m walking zones. It could therefore being considered a food desert as it has a high level of social deprivation and is being underserved by local grocery stores.

5.3.4 *Food Desert Mapping – Kenora-Keewatin case study*

The food desert maps for the city of Kenora-Keewatin are found in Figure 5.15 for the years 1996 (A), 2001 (B) and 2006 (C). The 1996 map reveals that there were eight grocery stores serving the population of Keewatin and Kenora. The city centre of Keewatin, located on the far left of the map, had no areas with high accumulated risk values and is therefore considered to be well-served by its single grocery store. The city centre of Kenora had seven grocery stores in this time, half of which were clustered in the downtown core. The walking distances around these grocery stores almost entirely cover the area identified in Figure 5.7 as being at high-risk for food insecurity. The small section remaining outside of the buffer zones could be identified as the sole food desert in Kenora for the year 1996.

Figure 5.7b shows that in 2001, Kenora had two regions designated as being at high-risk for food insecurity. One of these high-risk areas, located in the downtown core, is covered by the walking-distance buffers created around each of the 8 grocery stores serving the area and thus is not a concern for being a food desert. The other high-risk area, however, is located further north of the downtown centre and lies almost entirely outside of the 500m walking distances around each of the grocery stores. These DAs are therefore food deserts where individuals could be experiencing food insecurity and having difficulties attaining safe, nutritious and adequate food.

A



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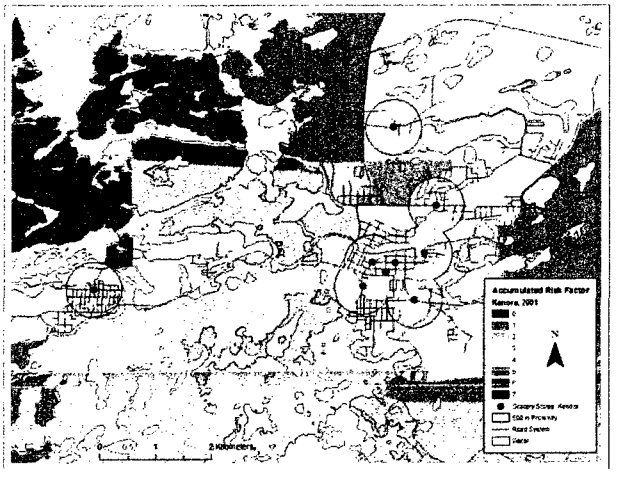

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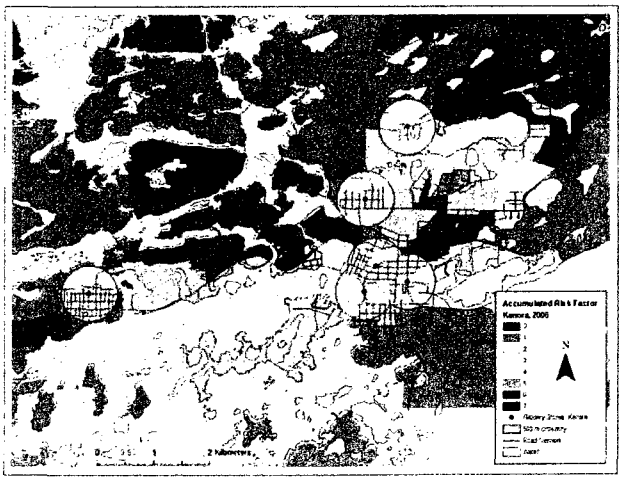

Figure 5.15: Food desert maps for the city of Kenora in 1996 (A), 2001 (B) and 2006 (C). In 1996 the city had 9 grocery stores, one that served the centre of Keewatin with the remaining 8 serving Kenora. Three of the grocery stores found in Kenora are clustered in its downtown core. Collectively, they appear to cover the majority of the high-risk area identified in Figure 5.7a, however, there is still a small patch that remains underserved. This small patch of the high-risk area is the only food desert found in 1996. In 2001 there were 9 grocery stores, the majority of which were found in the Kenora city centre. While the area of high-risk discovered in the downtown core is covered by the 500m walking zones, there appears to be a food desert in dissemination areas to the north. A large portion of neighbourhoods in this region are food deserts, lying outside of a 500m walking zone to the nearest grocery store and with a high level of social deprivation. In 2006 there are only 6 grocery stores identified in the city of Kenora-Keewatin. The majority of grocery stores in the city serve the Kenora city centre, unfortunately the only area of high-risk for food insecurity lies outside of the 500m walking zones. This dissemination area is therefore a food desert.

In 2006 the number of grocery stores serving Kenora-Keewatin dropped to six, five of which were found in the Kenora city centre. Although the majority of the region encompassed by the city's boundaries was found to have low levels of

accumulated risk of food insecurity (Figure 5.6c), one neighbourhood to the northeast had an ARF value indicating high risk. This neighbourhood has subsequently been identified as a food desert for the year 2006 as it lies outside of the 500m walking zone from its nearest grocery stores. It is likely that socially deprived individuals in this DA are experiencing food insecurity to some degree and having difficulties accessing food.

Over the decade spanned by this study, the city of Kenora-Keewatin appears to have fluctuated with respect to its accumulated risk factors. The number of grocery stores serving the region has also decreased over the three years of this study, alarmingly leaving a significant portion of the regions that were once under high risk of food insecurity without a grocery store within walking distance.

5.3.5 *Food Desert Mapping – Sioux Lookout case study*

Maps of food deserts for the town of Sioux Lookout are found in Figure 5.16 for the years 1996 (A), 2001 (B) and 2006 (C). The 1996 map reveals that the 500m walking zone buffers made around each of the two grocery stores located in the town's core do not offer adequate coverage for areas at the highest risk of experiencing food insecurity. The large area to the northeast of the town's core is therefore considered a food desert.

In 2001 a similar issue presents itself in that the number and location of grocery stores has not changed but the majority of the area of highest risk in the town is still outside of a 500m walking distance. Much of the town's core is considered to be a food desert, as are many of the neighbourhoods to its direct

south. The majority of the town's area has mid-to-high accumulated risk values and yet only a small number of people live within walking distance to a grocery provider. Interestingly, the entire situation is reversed by the year 2006 when all of the DAs in the town of Sioux Lookout are classified as being at the lowest risk of food insecurity. Therefore, although one of the grocery stores has closed, leaving the town with only one source of safe, nutritious and adequate food, no regions in the town are considered to be food deserts.

Over all three Canada census years covered by this study, a large portion of the DAs to the north of Sioux Lookout's town core are considered to be at mid-to-high risk of food insecurity. Given the sole grocery store in the town is located more than 500m from these areas, they should be monitored in subsequent census years to ensure that the people living there are not experiencing food insecurity to any degree.

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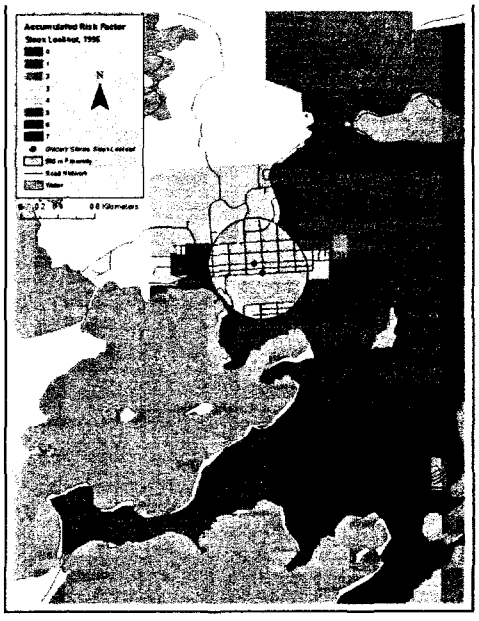

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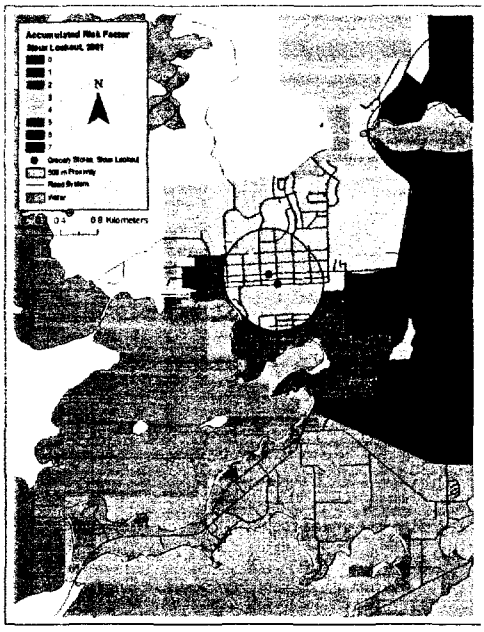

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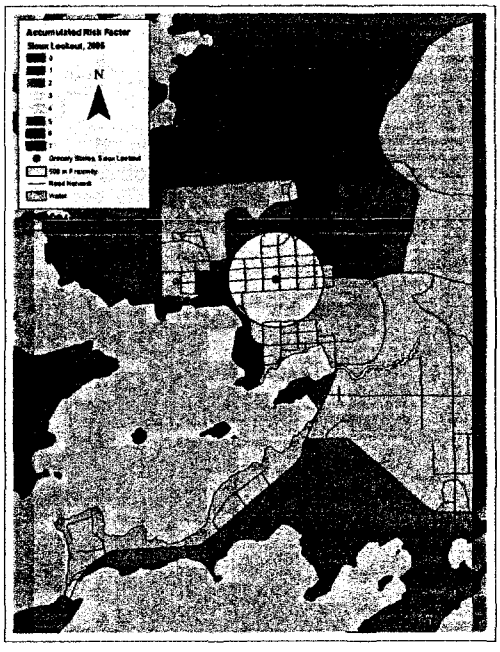


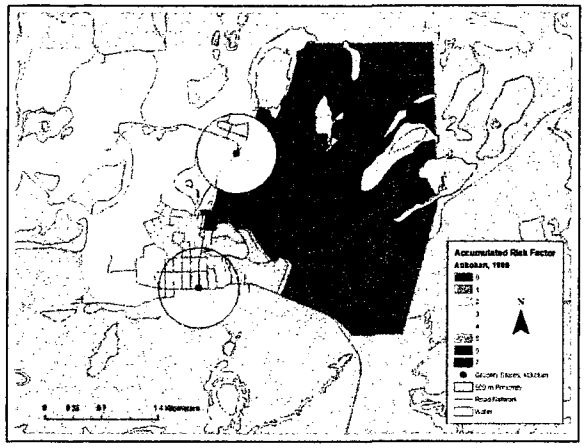
Figure 5.16: Food desert maps for the town of Sioux Lookout in 1996 (A), 2001 (B) and 2006 (C). In 1996 two grocery stores were identified for the town, both clustered together in the town's core. Unfortunately, the large region of high-risk for food insecurity is mostly outside of the 500m walking zone from these grocery stores, making it a food desert. In 2001 there were two grocery stores identified for the town. The clustering of the stores within the downtown core limits the area of their 500m walking zones and, consequently, a large portion of the area identified as being at high-risk of food insecurity in Figure 5.8b was identified as a food desert. In 2006 no food deserts were identified, as there were no zones with high ARF values. Notably, however, there is only one grocery store to serve the entire town and its surrounding region.

5.3.6 *Food Desert Mapping – Atikokan case study*

Maps highlighting food deserts for the town of Atikokan are found in Figure 5.17 for the years 1996 (A), 2001 (B) and 2006 (C). Despite only having two grocery stores available to the population in 1996, no food deserts were located in Atikokan due to its low levels of accumulated food insecurity risk. In 2001 two more grocery stores were open, one in the town's core and the other in its eastern peripheries. Despite this, however, several DAs classified as having high levels of social deprivation were still outside of the 500m walking distance zones from each of the grocery stores. These regions were therefore food deserts in the year 2001. Finally in 2006 all of the DAs in Atikokan were classified as being at low risk of experiencing food insecurity; therefore no food deserts were identified for 2006.

This results section has therefore achieved the research objective of highlighting which neighbourhoods in northwestern Ontario communities are food deserts. These maps have been used by several groups throughout the communities to help make decisions for placements of food distribution networks and in advocating local food market initiatives. It is hoped that these maps can further help community planners to identify where improved social infrastructure is required to help citizens meet their needs for a healthy livelihood.

A



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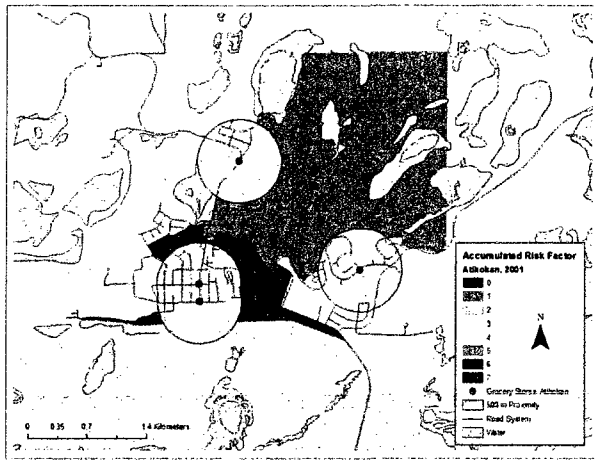

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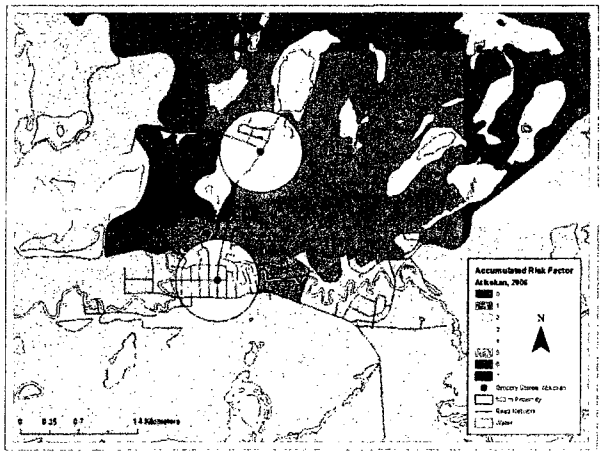

Figure 5.17: Food desert maps for the town of Atikokan in 1996 (A), 2001 (B) and 2006 (C). In 1996 no food deserts have been identified as none of the town's dissemination areas were classified as being at a high risk for food insecurity. In 2001 several dissemination areas were classified as being at a high risk. Although there are several more grocery stores open in the region, they unfortunately do not cover the entire region of high risk of food insecurity within their 500m walking zones. High-risk areas lying outside of these buffers are therefore considered food deserts. In 2006 no food deserts were identified in the town as all of its dissemination areas were classified as being at low-risk for food insecurity.

CHAPTER SIX

Discussion and Future Research

This research has begun to explore the different parameters that influence food security and grocery store access in northwestern Ontario. As explained earlier in this thesis, it is important to study and discuss food security for this northern region as its communities are vulnerable to food insecurity risk and have been experiencing recent economic hardships (Laurie and Spence, 2009; Spence, 2009). By drawing upon previous research, this study has systematically defined and mapped out food insecurity risk throughout cities and towns in the region by applying socio-demographic variables known to affect urban food security in an Accumulated Risk Factor. Food deserts in each community were then identified by examining neighbourhood access to a full service grocer both by walking and, in Thunder Bay, by means of public transportation. By performing these tasks for three different census years, food insecurity risk and food desert trends over the given time period were also identified. The results of this study infer that some areas in these communities are at a higher risk of experiencing food insecurity than others.

6.1 Food Desert Trends in Northwestern Ontario Communities

As with many other Canadian studies, this research found that spatial patterns of food deserts in the city of Thunder Bay resembled the mapping studies done in the United Kingdom, where poverty is widely distributed throughout the urban centre (Whelan *et al*, 2002). This differs from studies in the United States where strong social polarization and clustering of poverty is observed (Blanchard and Lyson, 2002; Smoyer-Tomic *et al*, 2006; Hinricks and Lyson, 2007). The food desert maps for Thunder Bay (Figures 5.10, 5.11 and 5.12) show strong evidence of the existence of food deserts in the city as several neighbourhoods were detected to have chronically high levels of social deprivation and limited access to food. These neighbourhoods were distributed across the city and were found in all five of its central districts. For example, neighbourhoods found in the Northwestern Port Arthur area along a well-known intersection between Red River Road and Junot Avenue were found to be food deserts over all three census years (Figures 5.10, 5.11 and 5.12). The same is true for a large section of land in the inter-core area where there is a high-density residential area. The trend of diminishing local grocery stores is common with studies done in the United States and United Kingdom (Whelan *et al*, 2002; Hinricks and Lyson, 2007).

Despite the trend of fewer grocery stores over time, food deserts have surprisingly been decreasing in Thunder Bay. These results have been contradictory to the research conducted by Larsen and Gilliland (2008) in London, whose work can be considered comparable to the research in Thunder Bay given the smaller population sizes of the cities. In London, the researchers' temporal approach led

them to conclude that despite an increase in food retail outlets, food access was poor throughout the city and has declined over the past four decades. The loss of five grocery stores in the city of Thunder Bay did not seemingly have a similar impact the level of access to food. The grocery stores that closed were located in areas where food outlets were already clustered such as Port Arthur and Westgate (Figures 5.10, 5.11 and 5.12). In fact, for the city district of Current River food access improved over the three census years: in 1996 there was no food retail outlet (Figure 5.10) but by 2006 one had opened (Figure 5.12).

In London Ontario, it was found through a correlation analysis that the poorest neighbourhoods in the city were those most likely to have poor access to supermarkets (Larsen and Gilliland, 2008). Although a similar correlation statistic is not reported in this research for Thunder Bay, uncovering food deserts, or neighbourhoods with high social deprivation, in four of the five city centres shows that food security issues may be prevalent in the city, particularly when the temporal aspect of the analysis supports that these regions have had consistently poor access to retailers over an entire decade. These results could indicate that social deprivation and food insecurity risk is a chronic issue for some neighbourhoods in Thunder Bay.

Smoyer-Tomic *et al* (2006) and Apparicio *et al* (2007) both concluded the exact opposite results to the study in London Ontario, in that poor neighbourhoods actually had the best access to food. They did find "food-unsupportive environments" that did not fully meet the criteria so as to be labeled food deserts. These results may be due to the higher populations and densities found in bigger

cities. Realistically, supermarkets rely on a customer base or population density threshold to establish confidently in a city. As was concluded for London (Larsen and Gilliland, 2008), the low population density of Thunder Bay and the other communities could account for the dispersed distribution of grocery stores over the landscape. Additionally, neighbourhood and inner city gentrification projects that are ongoing in these larger cities may dispel some of the obstacles reported by chain-supermarkets that stop them from opening in these regions. Similar gentrification projects in the city of Thunder Bay have been limited.

Research in the United States on food deserts has found strong evidence of their existence in some city centres (Blanchard and Lyson, 2002). Factors attributing to this have included poor public transportation systems, loose regulatory control between suburbs and inner cities and extreme social polarization (Smoyer-Tomic et al, 2006). Thunder Bay thus makes an interesting case study for a Canadian city for comparison to American studies. Firstly, the city has had a unique development from the two cities of Port Arthur and Fort William that were forced to amalgamate into one (Corporation of the City of Thunder Bay, 2010). The zoning and planning regulations that followed this change have led to oddly dispersed residential developments. Additionally, contrarily to the other Canadian cities studied for food deserts, Thunder Bay has fairly limited ethnic diversity with two main ethnic groups represented, namely Caucasians and First Nations (Statistics Canada, 2007). This lack of ethnic diversity may lead to stronger trends of social polarization. Finally, while public transportation in Thunder Bay offers good spatial coverage to the full-service grocery stores in the city (Figure 5.12b), its routes run every 30 minutes. By

some definitions in the literature (although clearer guidelines are required), this temporal spacing in bus arrival times may not be considered "good" access. Thus, overall, Thunder Bay may be a unique example of a hybrid city between conditions described in the United States that have led to the proliferation of food deserts with the policies and other variables that have seemingly kept food desertification from becoming too drastic a problem in the United Kingdom and Canada.

Studying small communities for food deserts shows how subtle or small economic and demographic changes can have profound effects on the vulnerability of neighbourhoods to food insecurity. For example, while a loss of 400 jobs or the closure of a company may not have a direct effect on finding food deserts in a metropolis like Toronto or Montreal, it was certainly reflected in the results for communities like Sioux Lookout (Figure 5.16) and Atikokan (Figure 5.17), both with populations of less than 4000 people. This observation is reflected in the maps of Atikokan (Figure 5.17), where the labour force dropped from 1,990 individuals in 1996 to 1,645 in 2006 with job losses in 6 of the 10 occupation categories designated by Statistics Canada (1997, 2002, 2007). These changes in the job market may have affected household incomes and expenditures, population make-up and numbers and neighbourhood unemployment rates, thus influencing the ARF maps in Chapter 5.0. Thus while the small town sizes could have been a limitation of this study, they rather have been a strength because they have provided a better understanding of the effects of small economic and demographic changes on the grand scheme of community food security. It has been difficult to find published research to compare the results for the smaller urban centres studied. It is the belief

that to date these are the smallest Canadian communities for which food desert identification research has been conducted.

In research focused on large cities often criteria such as store size, employee base and mean revenue have been used to discern whether a grocery store is included as a part of the food retail system or not. Notably, Apparicio *et al* (2007) state that smaller food outlets may have been missed in their analysis of Montreal. The small community sizes used in this study have again worked to the additional advantage of allowing for adequate coverage of the retail food system in Thunder Bay and its surrounding communities. The ability to visit, telephone and confer with storeowners directly limited the chances that a store or retail outlet would be missed or that a store with inadequate supply would be included in the analysis.

To date there has been very limited temporal research in the field of food desert identification, particularly in Canada (aside from Larsen and Gilliand, 2008). This study took a temporal approach and was thus able to try and make conjectures about whether the state of food security is increasing or decreasing in Northwestern Ontario. The advantage of taking a temporal approach to this study has been the creation of a historical record that shows where in the past areas have been most sensitive to economic decline and socio-demographic hardship. Thus, while the study indicates that overall food security seems to have increased for many of the towns between 1996 and 2006, the food desert maps show clearly to community members and planners where aid programs will be most required in years when local economies fluctuate downward or demographic dynamics change.

The food desert maps show that trends differed in several of the small communities examined in this study. For example, in the year 2001, Dryden (Figure 5.13), Fort Frances (Figure 5.14), Kenora (Figure 5.15), Sioux Lookout (Figure 5.16) and Atikokan (Figure 5.17) were presented with larger challenges to food security, as many of the neighbourhoods showed high levels of social deprivation and thus many were identified as food deserts. By 2006, the final year with census data available for this study, the food desert maps infer that the situation has reversed with very few neighbourhoods classified as having high deprivation levels and thus not at high risk for food insecurity. These trends could lend to the conclusion that food security in these small Northern communities has increased between the years of 1996 and 2006.

Results from the case studies in smaller Northwestern Ontario towns have shown evidence of the existence of food deserts, particularly during years of economic hardship. The inconsistencies of the existence of food deserts over all three years in these smaller towns, however, show that by definition a food desert can be a dynamic, ever-changing 'state' that is a location in both time and space. Food deserts in this study have been observed to be sensitive to socio-economic and demographic fluctuations that occur over the time span covered by the Canadian censuses.

In the US, Smith and Morton (2009) conducted a study on perceptions of food access in rural towns in Minnesota and Iowa. In their study, they identified full towns as being food deserts if they had a relatively high or increasing elderly population and had less than 3.8 grocery stores. This criterion is met by several of

the small towns examined in this study and could mean disconcerting future implications for food security in northwestern Ontario. For example, the percent elderly of the population is increasing in Dryden, which also had less than 3.8 grocery stores in 2006 (Figure 5.13). Additionally, the population of youth is dropping in the towns of Fort Frances, Sioux Lookout and Atikokan, all of which are maintaining their elderly populations (Statistics Canada, 1997, 2002 and 2007). The food security realities for the towns of Atikokan and Sioux Lookout are perturbing as these communities are located several hours off of the Trans Canada Highway and thus are the most remote of the small urban centres examined in this research. Additionally, they both have very few grocery stores to support their residents. Notably, when the economies of these towns face adversity (such as in 2001) the entire population is seemingly affected, reflected in both the ARF and food desert maps (Figures 5.8, 5.9, 5.16, 5.17). These results could indicate that these towns are particularly vulnerable to food insecurity and that preventative measures should be taken to address and mitigate potential future problems.

6.2 Applications and Solutions

The findings of this research are of specific interest to community and emergency planners, local food advocates and social justice campaigns. In the literature, there have been several approaches to solving the issues of inaccessibility to healthy food in inner city regions. In the UK, for example, specific planning policies were implemented to dissuade large grocers from being able to establish themselves in the peripheries of cities, nearly forcing them to find space and make

their businesses work in the core areas of the communities (Chung and Myers, 1999; Cummins and MacIntyre, 1999; Furey *et al* 2001; Reisig and Hobbiss, 2000). This approach brought the focus back on town centres and to a large degree has proven to be quite successful, often being attributed in several studies where food deserts were found to be minimal or non-existent. The advantages of this approach are that it promotes neighbourhood retailing and sustains a diverse number of stores, both locally and corporately owned. Neighbourhood retailing has been documented to improve individual and community health. It encourages social connectedness and physical activity by walking to and from the store, usually on a daily basis. Additionally, it reduces the numbers of cars on the roads as provisions are within walking distance from home. Finally, neighbourhood retailing is often also micro retailing and keeps local money and strengthens a community's economic foundation (Reisig and Hobbiss, 2000).

Other avenues that have been explored to incorporate access to healthy food in deprived neighbourhoods follow two general approaches: bring the people to the food or bring the food to the people (Reisig and Hobbiss, 2000; Short *et al*, 2009). The first approach can proactively involve the grocery retailers in being a part of the solution by encouraging them to offer free shuttle services from needy neighbourhoods to their establishment so that individuals can procure healthy food for fair prices. This strategy is relatively simple to implement and can partially dispel the assumption that large grocery retailers are profit-driven and insensitive to the needs of community members. Alternatively, car-pool initiatives can be organized to help bring people to the grocery store and back again.

Bringing food to the people has proven to be a far more complicated means of tackling food insecurity problems and has involved diverse methodologies covered relatively well in the literature. Programs implemented in some communities to promote access to healthy eating have included encouraging convenience and gas-marts to better stock their stores by subsidizing produce. Additionally, as mentioned above the in the UK, large retailers can be motivated to open up smaller, satellite stores in otherwise underserved neighbourhoods to better serve the community (Chung and Myers, 1999). While both of these aforementioned methods are policy or planning based, some grassroots initiatives have also been documented. In the Canadian city of London, for example, farmer's markets were brought into food deserts with the measureable successes of reducing the price of eating well by 12% and decreasing the distance to be walked for food (Larsen and Gilliland, 2009). Bringing local food into neighbourhoods supports local farmers and offers healthy alternatives to grocery stores such as community gardens, food baskets, freezers or food co-ops (Tarasuk, 2001; Short *et al*, 2009).

Anderson and Cook (1999) have stated that taking a community-based approach to solving food security issues is the best course of action as it promotes education on the topic and allows for citizens to make decisions concerning their own priorities and values with respect to food access. Community planning can be empowering and is a proactive means of building healthier and well-rounded cities (Short *et al*, 2009). The maps created through the process of this research could help with planning approaches at both the government and grassroots levels and can

encourage community dialogue on the best methods for resolving identified food scarcities.

While all of these solutions may be available to communities, they are best implemented after a comprehensive framework has been developed that lists all of the organizations and groups that are working on food security issues and the approaches they are employing (Reisig and Hobbiss, 2000). Documenting this type of network can reduce redundancies in projects being implemented, allows for collaboration between groups and allocates available funding to a greater diversity of projects. Kersetter and Goldberg (2007) offer this as a solution to tackling food security problems in British Columbia and also suggest potential policy changes that could be implemented specifically in Canada to help reduce the occurrence and effects of food insecurity. Policy changes mentioned in their analysis include increasing the child benefits distributed by the federal government or increasing the minimum wage. Additionally, supporting families by subsidizing daycare and shelter costs will help low-income families maintain a budget for healthy food. Finally, Kersetter and Goldberg (2007) have found the income assistance amounts distributed by the Canadian provinces to be inadequate and suggest that these amounts be augmented to help people live fuller and healthier lives. This suggestion is echoed at the federal level by Agriculture and Agri-Foods Canada (1999).

6.3 Future Research Recommendations

This study serves as a first step in defining and exploring neighbourhoods in northwestern Ontario urban communities that have poor access to diverse and nutritious food. Participatory research and the use of focus groups would be beneficial in rounding out knowledge of food systems and food access in Thunder Bay and the other small communities being studied. This work was done on behalf of the communities of Northwestern Ontario to bring about awareness on food security issues. These communities may have staff or budget constraints that would impede their ability to conduct such research, however local planners can now use these maps to help designate areas in need and to inspire dialogue on community perceptions of food security. It is expected that this information will be used to educate the public about how local economies can affect the ability of community members and neighbours to procure food.

Further research on this topic that has been identified in the literature and is required in the Northwestern Ontario region includes methods and projects that will give greater insight about the food system and the perceptions of community members about their own food security. Research on price disparities on purchasing food for a healthy diet inside and outside of food deserts in these communities is also required. Finally, looking at price disparities of healthy foods in Northwestern Ontario as opposed to Southern Ontario could also yield interesting results and bring attention to the specific struggles that the region faces with respect to having adequate access to food.

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