

**GEOGRAPHICAL IMPACTS OF BSE IN ALBERTA**

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## **ABSTRACT**

BSE was discovered in Canada in 2003. Research on the impacts of BSE indicates that cattle producers suffered significant economic losses, and that these may have reverberated into local communities, where industries connected to cattle production have sustained secondary impacts. Also, the desirability of different forms of agriculture may have shifted as a result of BSE. This study addresses the impacts of BSE in Alberta from a geographical perspective, examining the cattle industry, community economic structure, and regional agricultural economies. The spatial organization and structure of the cattle herd has changed as a result of BSE. Little evidence of a ripple effect was found in the geography of community economic structure. Spatial changes in regional agricultural economies may be tied to changes in the cattle industry resulting from BSE, but do not indicate significant agricultural restructuring. This study places limits on the spatial and economic impacts of BSE in Alberta.

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## **Chapter 1**

### **Introduction to Thesis**

On May 20, 2003, a single cow born on a farm in Alberta was diagnosed with bovine spongiform encephalopathy (BSE) (Auditor General of Alberta 2004). Governments in 34 countries, including the United States, responded by immediately establishing trade barriers prohibiting imports of Canadian cattle and beef products (Le Roy and Klein 2003). These trade bans had a tremendous impact on the cattle industry in Canada. Nearly half of the cattle produced in 2002 were exported, with 70 percent of these exports going to the United States (Grier 2005). Export generated revenues totaled \$4 billion in 2002 (Senate Committee 2004). The loss of this income created turmoil for the cattle industry in Canada.

Domestic slaughter capacity was limited due to a longstanding dependence upon access to beef production plants located in the United States (Senate Committee 2004). A resulting bottleneck situation saw domestic cattle numbers increase while prices plummeted (Forge and Fréchette 2005). Live cattle prices dropped from \$107 per 100 pounds, or hundredweight (cwt) to \$65/cwt and \$85/cwt in just a few weeks (Auditor General of Alberta 2004). In one particular auction, the price dropped from \$132/cwt to \$32/cwt on May 20, 2003 (Le Roy and Klein 2003). Mitura and Dipietro (2004) reported that from July to December of 2003, cash receipts for cattle and calves were 48% lower than they had been in the same period in 2002.

Much of the focus of the BSE situation has been in Alberta, where according to the Auditor General of Alberta (2004), 40% of cattle, 64% of cattle on feed, and 72% of

packing capacity in Canada is located. Additionally, of the 71,050 beef cattle farms in Canada, 37% are located in Alberta, accounting for 56% of the national value of production (Mitura and Dipietro 2004).

The Canadian and Albertan governments worked to alleviate the consequences of BSE by engaging in trade negotiations and implementing a number of financial assistance programs. The American embargo on Canadian cattle and beef began to decline with the admission of low-risk beef products on August 8, 2003, and in December of 2004 the United States announced that it would reopen its borders to live cattle under thirty months of age (UTM) as of March 7, 2005 (Le Roy and Klein 2003).

Physical science is the dominant lens through which BSE has been studied. Recent research concerning BSE in Canada has, however, concentrated on the consequences of the disease in economic and social spheres. One vein of current research addresses the economic consequences of the disease. A number of studies examine the impacts upon the cattle industry, detailing losses sustained by cattle producers and potential changes forthcoming within the industry (Serecon 2003; Mitura and Dipietro 2004; Forge and Fréchette 2005; Grier 2005; Carlberg and Brewin 2005). Additional research examines the efficacy of government policies, outlining directives that may serve to mitigate the consequences of animal diseases in Canada (Le Roy et al. 2007; Forge 2005). The impacts of BSE upon the broader economy, particularly upon industries with close links to cattle production, have also been reviewed (Serecon 2003; Senate Committee 2004; Wigle et al. 2006; Wigle et al. 2007). Studies on the consequences of BSE for the health and well-being of farmers are forthcoming.

Among the studies on BSE in Canada, there is little research on the geographical dimensions of the impacts of the disease. This thesis examines the impacts of BSE in Alberta through a geographic lens. The specific objectives of the thesis are as follows:

1. To examine the geography of the impact BSE has had upon the cattle industry in Alberta.
2. To examine the geography of the impact BSE has had upon community economic structure in Alberta.
3. To examine the geography of the impact BSE has had upon the economic composition of regional agricultural economies in Alberta.

## **Chapter 2**

### **Background**

#### **2.1 Introduction**

The scope of this thesis is broad, and there are a number of areas of pertinent background information to be addressed. Chapter two summarizes research relevant to this study, providing context for the methods and results which appear in chapters three through seven. BSE and the cattle industry are two central components to this thesis, and much of the necessary background information pertains to them. This chapter begins with a brief history of BSE outlining some of the characteristics of the disease, and detailing its manifestation in the United Kingdom. This background information provides context for the Canadian experience with BSE. The following section examines the impact of BSE in Canada, and details the expected impacts of the disease for each one of the objective areas of this thesis. The characteristics of the cattle industry in Alberta are then explored, followed by a discussion on the position of cattle production within the Canadian economy. This chapter concludes with a brief description of the government support programs aimed at mitigating the consequences of BSE.

#### **2.2 Brief History of BSE**

BSE is a degenerative disease affecting the central nervous system of adult cattle (Bervejillo and Jarvis 2003). The disease leads to the development of pores in brain tissue, causing brain function deterioration and eventually death (Lindenbaum 2001). First designated a reportable disease in Great Britain in 1986, BSE is the best known of a

group of similar diseases known as Transmissible Spongiform Encephalopathies (TSEs) (Bradley 1991). Other TSEs include scrapie in sheep and goats, chronic wasting disease (CWD) in elk and deer, and a human form of TSE known as Creutzfeldt-Jakob disease (CJD) (Spencer 2004). Research on the pathology, epidemiology, and physical as well as social consequences of TSEs is currently growing.

One theory regarding the origin of BSE posits that the disease can occur naturally and spontaneously as a result of a gene mutation (Lindenbaum 2001). Spontaneous generation, however, does not account for the spread of the disease. Recent theories propose that the recycling of infected cattle remains in cattle feed was the origin of the BSE epidemic in the United Kingdom (Lindenbaum 2001).

Rendering converts the offal and inedible waste remaining after cattle have been slaughtered into cheap high-protein animal feed supplements (Spencer 2004). The resulting “meat and bone meal” provides a means by which the inedible residue of cattle slaughter can be used. Prions, which are the specific proteins acting as the agents of infection for TSEs, remain infective through the rendering process (Lindenbaum 2001). In the United Kingdom, contaminated feed is believed to have facilitated the spread of the disease across the country, launching an epidemic that would peak in the mid-1980s (Lindenbaum 2001; Prusiner 1997). Thousands of cattle were infected before this error was discovered and corrected through the implementation of a feed ban prohibiting the distribution of meat and bone meal to ruminant livestock (Spencer 2004). Contaminated feed can be ruled out as a source of infection for only one of the 28,197 cases of BSE confirmed by May 10, 1991 (Bradley 1991).

The climax of the crisis occurred on March 20, 1996, when the Spongiform Encephalopathy Advisory Committee (SEAC) confirmed BSE to be a zoonotic disease capable of infecting humans (Bennett et al. 1999). A new variant of CJD (vCJD), a chronic and fatal neurodegenerative disease, began to infect people across the country. Following months of denial, officials admitted that the emergence of vCJD was likely to be linked to the consumption of beef infected with BSE (Bervejillo and Jarvis 2003). Although the number of vCJD cases in the UK was limited, extreme estimates placed the eventual total in excess of 100,000 (Spencer 2004: 4). Balter (2000) used a model to place the maximum possible total cases of vCJD at 136,000, but estimated that a realistic maximum would be closer to 10,000. As of 2004, fewer than 120 people had died as a result of definite or probable cases of vCJD (Spencer 2004). The implication of the disease for human health led the consequences of BSE in Great Britain to transcend the cattle and agriculture industries, igniting passionate public concerns over food safety, risk management, and the role of the government in monitoring these factors (Lindenbaum 2001).

One significant consequence of the BSE crisis in the UK came in the form of severe economic losses sustained by cattle producers. In August of 1988 a decision was made by the government to slaughter all BSE-infected cattle (Bervejillo and Jarvis 2003). An European Union Veterinary Committee prohibited British beef exports, further reducing the market value of cattle herds (Dnes 1996). In addition to trade barriers restricting access to foreign markets, consumers within the country avoided consuming beef (Caskie and Moss 1998). Cattle farmers either lost cattle, or saw substantial declines in the value of the cattle they retained resulting in economic turmoil among cattle producers.

Programs designed to mitigate the impact of BSE on farmers, and other support mechanisms implemented by the British government, cost an estimated £2 billion for 1996-97 alone (McDonald and Roberts 1998).

### **2.3 Lessons from the BSE Crisis in the United Kingdom**

The BSE crisis in the United Kingdom provides valuable insight that can help to interpret the Canadian experience with the disease. The BSE crises sustained by the United Kingdom and Canada have significant divergent characteristics, but the respective experiences with the disease have similarities as well. One of the strongest similarities lies in the economic consequences of the crises. Both were characterized by a substantial reduction in demand for beef, driving down beef and cattle prices. Stringent trade embargoes were largely responsible for this situation in Canada (Carlberg and Brewin 2005). Trade barriers played a prominent role in the United Kingdom as well, but the economic situation was heightened by the severity of the BSE epidemic itself and public safety concerns regarding vCJD (Smith et al. 2005; Burton and Young 1996). Despite their differing geneses, the economic consequences of these crises as experienced by cattle farmers were similar.

Concerns over community-level impacts abounded in both countries. Regional economies in the United Kingdom strained under the economic and social stresses imposed by the Mad Cow Crisis (Caskie et al. 1999). Concerns have been voiced about the potential for similar stresses upon communities closely tied to cattle production in Canada (Senate Committee 2004). Although publication is pending, researchers at the University of Ottawa are currently examining the psychosocial and socio-economic

consequences of BSE, and the resilience Canadian farmers have demonstrated. The results for this research are not available as of yet. Finally, an elemental connection lies in the fact that exactly the same disease is implicated in both crises. Zoonotic diseases like BSE are a new form of disease with consequences for realms beyond just agriculture (Mephram 2004). The demonstrated ability of BSE to shake consumer confidence, its status as a demand side crisis, and its low infection rate for humans, have combined to build a new and unique threat to agriculture in Canada. An examination of the consequences of BSE in the United Kingdom can help to better understand the developing situation in Canada. Research on the British experience with BSE has aided in developing the framework for the analysis undertaken in this study.

Compared to the physical sciences, there has been relatively little research into some of the social, cultural, economic, and spatial impacts of BSE in the United Kingdom. The research that is available can be divided a number of different categories. One area of research is concerned with consumer attitudes in response to the crisis. The zoonotic quality of BSE and its subsequent threat to the health of human populations has initiated rapid changes in consumption patterns. Demand for beef declined across Europe, while substitute meats rose to prominence in the eyes of consumers (Nardone 2003; Burton and Young 1996; Leeming and Turner 2004; Sanjuán and Dawson 2003; Harvey et al. 2001). Marketing strategies have evolved in response to new concerns over food safety and risk communications (Smith et al. 1999). The nature of these changes and their implications for societies depending on industrialized agriculture are major foci of this body of research. Risk communications itself constitutes another field of research (Little 2001). The government and media both play a role in the communication of risk to the public,

and the choices made by both bodies in disclosing the risks associated with BSE have been scrutinized (Harris and O'Shaughnessy 1997; Sturloni 2003). Among the topics included in this field of research are the definition of risk, the categorization of risk levels in conjunction with food safety, the clear communication of established risk levels, and the balance between credibility and persuasiveness in food safety communication strategies. Another area of social science research involves the regulation of risk by governments and other political bodies. In the context of food safety issues, the responsibility of governments to their citizens must be balanced against the food industry as well as the avoidance of public panic (Mephram 2004; Smith et al. 1999). The respective roles of politics and science with regards to food safety have been studied (Hinchliffe 2001). Another area of study concerns the spatial dynamics of BSE and other animal diseases from an epidemiological perspective, examining disease clusters, the spread of disease, and the spatial variability of the risk associated with animal diseases (Besag and Newell 1991; Abrial et al. 2003).

The final and most relevant of the BSE related studies from Great Britain are those concentrating on the economic consequences of the crisis. Two primary conclusions with particular relevance can be gleaned from these economic studies. The first involves the evidence supporting the presence of an economic distance decay function, or ripple effect. Such a ripple effect occurs when an economic shock is so severe that the financial duress endured by the implicated industry impacts secondary industries as well (Bennett et al. 1999; McDonald and Roberts 1998). In the United Kingdom, the industry sectors most closely linked to cattle production through input purchases and output sales suffered the most severe economic consequences stemming from BSE (McDonald and Roberts

1998). Cattle producers struggled to afford input purchases, and limited demand restricted output sales. Upstream and downstream industries suffered second degree impacts stemming from the initial crisis. Measuring labour and profit levels in a comparative Computable General Equilibrium (CGE) model, McDonald and Roberts (1998) identified the potential for decline was the strongest for the animal feedstuffs and agricultural inputs sectors. The study also showed that under varying conditions, some of the ancillary inputs and outputs associated with cattle production sustained economic impacts on a limited scale. For some industry sectors these changes in profit and labour levels were negligible, or even positive. The trend of decreasing economic consequences with increasing distance along the chain of industries connected to cattle production indicates the presence of a ripple effect. The economic consequences of BSE are the strongest at the industrial point of impact.

The second conclusion gleaned from the British experience with BSE is an indication that the agriculture sector underwent a period of restructuring in response to the crisis. Economic studies have examined changes in levels of demand initiated by the BSE crisis, and have analyzed subsequent changes in the economy. The decline in demand attributed to the beef sector was understandably balanced by an increase in demand for other types of meats (Burton and Young 1996). Poultry and pork and their respective processing sectors appear to have been the biggest beneficiaries of the calamity befalling the beef industry (Bennett et al. 1999; Caskie et al. 1999). The BSE epidemic in the United Kingdom created opportunities for agricultural practitioners in other sectors, which initiated a period of agricultural restructuring. Despite the differences in agriculture

between the United Kingdom and Canada, there is potential for a similar trend of restructuring in the Canadian agricultural sector.

Finally, British research illustrates that the economic impacts of BSE were not spatially homogenous. There is evidence pointing to regional variations in some of the ancillary impacts of the crisis (Bennett et al. 1999). Some regions experienced the consequences of the BSE crisis more severely than others. The impacts of the crisis should be expected to be greater in regions where cattle production is more prominent.

The United Kingdom has to a large extent already finished navigating its own BSE crisis. The outcomes of that crisis, despite its contrasts to the Canadian situation, support the framework for this examination of the Canadian response to BSE. There is evidence of the existence of all three components of this study to be found in the aftermath of the BSE crisis in the United Kingdom. Cattle farmers suffered economic losses as a result of BSE (Dnes 1996). A ripple effect was observed whereby the economic consequences of the initial shock reverberated through the broader economy (McDonald and Roberts 1998). The road was paved for agricultural restructuring, as demand patterns shifted, increasing demand for new agricultural products (Burton and Young 1996). Finally, there existed a spatial bias in the magnitude of these impacts on the basis of regional levels of specialization in cattle production (Bennett et al. 1999).

## **2.4 BSE in Canada**

The extent of the BSE crisis endured by the United Kingdom was not approached by the Canadian experience with the disease. International trade restrictions, feed bans, and other protective measures have ensured a BSE epidemic of such epic proportions is

unlikely to recur (Forge 2005). The significance of the disease today lies in its status as an animal health issue with implications for international trade, agricultural economies, and food safety. Fisher (1998) reported that modern communications and the pervasive nature of BSE have allowed its economic consequences to spread faster and more extensively than the disease itself. Mepham (2004) asserts that contemporary animal diseases, particularly zoonotic diseases afflicting farm animals, expose the links between agricultural and public spheres. The consequences of BSE in Canada conform to these conclusions, as significant social and economic consequences stemmed not from an epidemic, but from the discovery of a single case of the disease. As of the end of 2008, only 12 cases of BSE had been confirmed in Canadian cattle (World Organization for Animal Health 2008). During the same time period, not a single case of vCJD of domestic origin has been reported in Canada (Centers for Disease Control and Prevention 2008).

Contrary to the British experience with BSE, domestic consumption of beef did not waver in Canada, but rose by 5% as consumers rallied behind the beef industry in a demonstration of support (Senate Committee 2004). This display of consumer confidence, although well intentioned and appreciated by industry stakeholders, did little to alleviate the losses sustained by cattle producers.

## **2.5 Expected Impacts of BSE in Canada**

Within months of the discovery of BSE in Alberta, preliminary reports surfaced outlining some of the consequences of this event (Auditor General of Alberta 2004; Senate Committee 2004). These early reports assessed the developing situation and fielded

prognostications regarding the consequences of BSE. The facets of this research pertaining to the cattle industry, community economic structure, and regional agricultural economies in Alberta are important to the objectives of this thesis. The remainder of this section describes relevant research pertaining to each of the three objective areas.

### **2.5.1 Impacts of BSE on the Cattle Industry**

The cattle industry was the point of impact of BSE, and has sustained the most direct consequences of the disease. Within the entire beef production chain, including slaughter and packing facilities along with their employees and suppliers, the impacts of BSE fell most heavily on cattle producers (Wigle 2006).

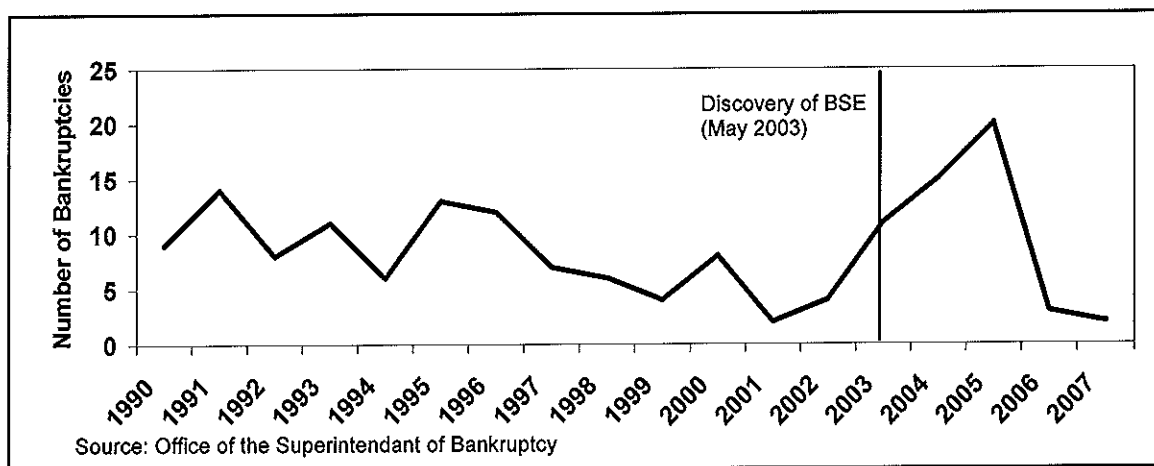
The impacts of BSE have both short and long term components. Short term impacts were characterized by an abrupt drop in cattle prices, a decline of almost 75% in extreme cases (Le Roy and Klein 2003). The closure of the American border created a barrier to the sale of a burgeoning supply of Canadian cattle. Cattle producers were faced with severe losses in cash and equity over a short period of time.

The long term impacts on farmers were tempered by diminishing trade restrictions. American embargoes on Canadian beef and cattle began to decline with the admission of low-risk beef products on 8 August 2003, and continued with the announcement in December of 2004 that the United States would reopen its borders to live Canadian cattle under thirty months of age (UTM) as of 7 March 2005 (Le Roy and Klein 2003). The incubation period for BSE appears to be no less than 4-5 years, so cattle under the age of thirty months (UTM) have been deemed safe for human consumption (Bradley 1991).

Export bans on UTM cattle have consequently been lifted in the United States and other countries consuming Canadian beef (Le Roy and Klein 2005).

Canadian beef exports by weight had already recovered to near pre-BSE levels by the end of 2003 (Grier 2005). Canadian cattle prices, however, took much longer to recover and match the American prices they typically mirror (Grier 2005). Despite depressed cattle prices, input costs did not waver. Farmers struggled to afford to feed cattle whose value could not overcome feed costs. The bankruptcy rate among cattle farms in Alberta was higher in 2003 and 2004 than in any other year since 1990 (Figure 2.1). Recovery programs implemented by the provincial and federal governments helped to mitigate the impacts on cattle producers (Auditor General of Alberta 2004).

Cattle producers responded to BSE in the short term by reducing expenses to help absorb the impact of the disease. As the situation became clearer, cattle producers began to pursue long term options for navigating the consequences of BSE. Two primary options chosen were to continue to feed cattle until prices increased, and to reduce inventory due to the uncertainty of the BSE situation (Auditor General of Alberta 2004).



*Figure 2.1: Cattle Farm Bankruptcies in Alberta 1990 – 2007*

The evolution of the American border status from prohibiting exports, to allowing certain cuts of meat, to allowing live animals under the age of thirty months, introduced a new state of affairs into the cattle industry. New government programs implemented in response to BSE accentuated this new state of affairs, and in response, primary producers have adjusted their patterns of factor usage and production (Le Roy and Klein 2005). These changes have been responsible for structural and geographic changes within the cattle industry (Auditor General of Alberta 2004; Serecon 2004).

The elevated number of bankruptcies among Albertan cattle farms in 2003 and 2004 demonstrates that the consequences of BSE have had an impact on cattle producers in the province. Although the peak is obvious, the twenty bankruptcies that occurred in 2005 are not substantial when compared to the over 32,000 cattle farms in Alberta as reported by the 2005 release of the Canadian Business Patterns. The long term impacts of BSE upon the cattle industry are more likely to be detected in structural changes within the industry than in the number of farms comprising it.

### **2.5.2 Impacts of BSE on Community Economic Structure**

The impact of BSE upon communities was of particular concern within the research done on the disease in Canada. Trade centres on the Canadian prairies have been subject to a trend of decline over recent decades, and outmigration of rural young people has increased, leading to concerns regarding the long-term viability of settlements in rural areas (Stabler and Olfert 2002; Bryant and Joseph 2001). BSE may further impair the sustainability of these settlements, hastening this trend of decline.

The 33% decline in average income predicted for families on beef farms has a negative implication for local communities (Mitura and Dipietro 2004). Additionally, one in three Canadian farm families derived over half of its agricultural income from cattle sales (Mitura and Dipietro 2004). Larger farms saw average income drop from \$69,000 to \$38,000 (Mitura and Dipietro 2004). The economic strains placed upon cattle producers, combined with the role the cattle industry plays in the Albertan economy, have severe implications for the economies of small towns and rural communities (Auditor General of Alberta 2004). As income levels decline, so does the amount of money spent on goods and services offered in local trade centres. The BSE induced knock-on effect, or ripple effect, sustained by businesses in local communities demonstrates the interdependence of urban and rural economic functions (Wigle 2006). The exogenous BSE shock has extended beyond cattle producers and reverberated into rural economies through forward and backward economic linkages with cattle production.

The Standing Senate Committee on Agriculture and Forestry (2004: 4) noted that the “impacts of this crisis [are currently being seen] in our businesses and in our towns and cities.” The Senate Committee furthermore reports that layoffs have been observed in the feedlot sector as well as in a number of service industries, and has expressed urgency in the need to assess and address the damages inflicted upon rural Canada by BSE. The implications of these secondary impacts upon rural Canada are more severe in the Prairie Provinces. A study on the consequences of a reduction of beef exports highlights Alberta as being the province most vulnerable to the secondary economic impacts, or ripple effects, of BSE (Wigle 2006).

The secondary impacts of the BSE shock may approach levels about 60-70% of those reached by the primary impacts (Serecon 2003). The severity of this economic ripple effect appears to vary according to industry. A group of specific industries has been singled out in the literature as being especially susceptible to the ripple effect of BSE. Included in this group of industries are animal slaughtering, rendering, meat processing, animal food manufacturing, livestock transportation, veterinary services, machinery dealers, and livestock equipment suppliers (Senate Committee 2004; Wigle 2006; Serecon 2003). All of these industries are closely tied to cattle production as important economic inputs or outputs, and will be the focus of the assessment of the impact of BSE upon community economic structure. Although additional understanding of BSE-related ripple effects could be determined by detailed studies of business establishments providing goods and services (central place functions) in small communities, this is beyond the scope of this thesis.

### **2.5.3 Impacts of BSE on Regional Agricultural Economies**

Evidence indicates that the consequences of BSE have permeated the agriculture sector. An input-output study reported notable output changes for agricultural products such as crops, poultry, feed grains, and other crops as a result of reductions in beef and cattle exports (Wigle 2006). The livestock sectors of dairy, pork, poultry, and sheep/lambs all saw uncharacteristic changes in their output levels following the BSE crisis (Wigle 2006). Concerns over TSEs may also be culpable, as they have initiated a number of changes to the animal food industry, including the implementation of more stringent controls over Specified Risk Materials (SRM), the anatomical components of slaughtered

cattle most likely to harbour infected prions (Forge 2005). Turbulent prices for animal feed and consumer products as well as limitations on slaughter capacities for various livestock types have also contributed to an atmosphere of change in the agriculture sector (Serecon 2003). These changes have provided the impetus for industrial restructuring within the agricultural sector, as many farmers creatively diversified their operations in response to evolving markets (Auditor General of Alberta 2004).

The consequences of the disease for cattle farmers led many to expect higher than normal levels of bankruptcy in the industry. Mitura and Dipietro (2004) estimated that about 8% of farm families specializing in beef production would be statistically reclassified as another farm type at the outset of the crisis. Oilseed and hay production topped the list of alternate opportunities turned to as compiled by Mitura and Dipietro (2004). Competing agricultural industries may have ascended to appropriate market shares abandoned by cattle production.

#### **2.5.4 Mitigating Factors**

Although there is ample evidence indicating that BSE may have had significant consequences for the cattle industry, community economic structure, and regional agricultural economies, there is also research contending that the impact of BSE may not have been as severe as originally projected. A study on BSE's impact in North Central Alberta has found little evidence of economic devastation in the region, suggesting that the dire portrayal of BSE in major newspapers may have been inaccurate (Broadway 2008). One of the circumstances possibly limiting the consequences of BSE on cattle producers, and subsequently limiting the ripple effect in other areas is the availability of

off-farm income (Broadway 2008; Auditor General of Alberta 2004; Mitura and Dipietro 2004). The level of economic growth tied to the oil industry in Alberta in the same time period as BSE asserts that ample non-agricultural jobs were available in 2003 (TD Economics 2003). Another theory suggests that the consequences of drought in the central regions of the province may have contributed to the impacts of BSE (Auditor General of Alberta 2004: 38). Evidence shows that in 2001 and 2002, some agricultural areas of Alberta experienced unprecedented levels of drought that had severe consequences for production and income in the agriculture sector (Wheaton et al. 2008; Wheaton et al. 2005). The availability of off-farm income and the presence of drought in Alberta are two factors that have served to mitigate the consequences of BSE.

## **2.6 Structure of the Cattle Industry**

The cattle industry can be divided into three general stages known as the cow-calf, backgrounding, and feeding stages (MacLachlan 2001). Each stage constitutes a unique part of the production chain, and has distinct objectives and methods of reaching them.

The cow-calf stage is the reproductive component of cattle production. Calves produced are weaned and sold before they are a year old. Most of the profit in this sector is derived from the sale of calves, but the sale of older culled cows contributes as well. Each year cows are either retained for further reproduction, or culled from the herd and sold for slaughter. Calves are typically sent to the backgrounding or feeding stages of cattle production.

Backgrounding is an intermediate stage linking the cow-calf and feeding stages of production. In this stage weaned calves are fed, often by grazing, until they have grown

enough to enter a feeding operation. The viability and profitability of backgrounding is influenced by the price and availability of feed.

The feeding stage constitutes the opposite end of the production chain. Weaned and backgrounded calves are fed with the intention of maximizing weight gain. Upon attaining an appropriate weight, fed cattle are sold to downstream processors and converted into beef products. The term “beef” as used in this thesis refers to processed cattle meat, while the term “cattle” refers to live animals.

The cattle industry can be highly integrated, with single operations in some cases spanning all three stages of production, making categorization difficult. The backgrounding stage in particular is often difficult to distinguish, as both cow-calf and feeding operations may engage in backgrounding as well.

A few notable differences distinguish the cow-calf and feeding stages from one another. Feeding operations are typically larger than cow-calf operations, acting as a destination for calves born on smaller farms. Calves converge in large feeding operations known as feedlots. Feedlots are more industrial in nature, specializing in feeding cattle, whereas cow-calf operations often constitute just one component of small mixed farming operations. On the input side, cow-calf operations often feed more fodder and forage crops, whereas feedlots use feed rations high in grains to maximize weight gains (MacLachlan 2001). On the output side, feedlots sell fed steers and heifers for slaughter, while young calves and older culled cows are the products of cow-calf operations.

The distinctions between the industrial components of cattle production are important considerations. Animal disease effects are typically felt beyond the marketing stage and in both the breeding and the growing stages of production (Pritchett et al. 2005). The

cow-calf and feeding stages comprise the breeding and growing stages of cattle production, and the specific responses of these stages to BSE are considered in this study.

## **2.7 Economic and Geographical Characteristics of Cattle Production**

Despite its political separation from the United States, Alberta is an integral component of the North American cattle feeding industry (Ross et al. 1990). Alberta's niche within this highly competitive North American industry lies in supplying cattle to markets in the northwestern United States. These markets have long been the onus for the growth of the industry in the province (Ross et al. 1990). The economic impetus provided by American beef markets has played a prominent role in shaping the geography of beef production in Canada and Alberta.

The Prairie Provinces are home to more cattle farms than the remainder of the country, and beef production is far more prominent in Alberta than any other province. Of the 71,050 beef cattle farms in Canada in 2000, 37% were located in Alberta, accounting for 56% of the national value of production (Mitura and Dipietro 2004). This concentration is evident at the other end of the beef production chain as well, as 71% of Canadian cattle slaughter was in Alberta in 2002 (Grier 2005). Average monthly beef exports in Alberta from January to April of 2003 were \$160 million per month, nearly \$100 million more per month than Ontario, the next biggest exporter at \$62 million per month (Poulin and Boame 2004). Alberta houses a large share of Canadian cattle and beef production facilities, and exports far more beef than any other province. The geography of cattle production in Canada is centered squarely on the province of Alberta.

Within the province of Alberta itself, the geography of beef production is subject to a number of spatial variations. Historically the location of agricultural practices has been associated with determinants of physical geography. The genesis of the cattle industry in Alberta is no different. Naturally favourable soil and climatic conditions in the central region of the province have made it conducive to cattle production (Ross et al. 1990). The development of irrigation has facilitated the growth of cattle production in the south by aiding in the growth of forage and feed grains and providing a source of water for cattle (MacLachlan 2001).

Before the discovery of BSE in 2003, roughly half of Canada's beef production was exported (Grier 2005). Of these exports, approximately 70% were destined for the United States. The beef sector has long been dependent upon export markets, with a very heavy emphasis on the United States. Proximity to the important American market for beef has further stimulated growth of the cattle industry in the southern portion of the province (Ross et al. 1990).

Cattle and beef production make significant contributions to the Canadian economy on an annual basis. The beef industry is one of the largest earners of foreign exchange in the agricultural sector, eclipsed only by exports of wheat (LeRoy and Klein 2003). One out of every three Canadian farm families garners over half of its agricultural income from cattle production (Mitura and Dipietro 2004).

The cattle industry is important to Alberta, and the profits earned by the industry trickle down through the province. The consequences of any adversity to befall cattle production in Canada will be far more acute in Alberta than elsewhere in the country. The consequences of the BSE crisis thrust upon Canada's cattle industry are thus likely to

be detected with more ease in Alberta than elsewhere in the country. In other words, the ripple effects of BSE are likely to be more pronounced in Alberta than elsewhere in the country. The prominent role Alberta plays within the national beef industry makes the province an ideal region within which to examine the economic ramifications of BSE.

## **2.8 Government Assistance**

Early projections of the consequences of BSE were bleak. Countervailing government support programs, however, helped to absorb some of the BSE shock. Although cattle producers deserve credit for their resourcefulness and resiliency in the wake of BSE, government support played a prominent role in navigating the consequences of the disease (Le Roy and Klein 2005).

Government programs aimed at mitigating the consequences of BSE had varying objectives and levels of success, but were instrumental in protecting cattle producers from the consequences of BSE. The most prominent of these programs was the Canada-Alberta BSE Recovery Program (CABSERP). The CABSERP was the only program instituted in Alberta to share funding with the federal government, which accounted for \$276 million of the roughly \$450 million in support provided (Le Roy and Klein 2003). The program aimed to reduce the oversupply of cattle in the country by offering taxpayer credits up to a reference price, raising the sale price of cattle to a more manageable level. Another program, the Alberta Fed Cattle Competitive Bid Program (BID), attempted to address the depressed prices resulting from the oversupply in cattle (Auditor General of Alberta 2004). One component of BID was the set-aside program which offered incentives to farmers to feed cattle longer, which kept them off of the market, reducing

immediate supply and raising prices. A number of smaller assistance programs aimed at helping other industries impacted by BSE. The targets of these programs include food processors, as well as managers of deer, elk, llama, and alpaca herds (Auditor General of Alberta 2004). The eight provincially funded programs covered 972,721 animals and 22,312 enterprises, costing the Alberta government \$402 million as of June 4, 2004 (Auditor General of Alberta 2004; Le Roy and Klein 2005). Government support has played a prominent role in determining the impact BSE has had upon cattle producers and industry stakeholders.

## **2.9 Conclusion**

The background provided in this chapter provides information that is important to accomplishing the objectives of this study. The history and epidemiology of BSE distinguish the disease from other zoonoses experienced in Canada in the past. BSE is new to Canada, and despite significant differences, the consequences of BSE in the United Kingdom provide a foundation for research on the disease in Canada. The cattle industry is the gateway through which the impacts of BSE spread into other spheres. Familiarity with the cattle industry in Alberta, including some of its structural, economic, and geographical characteristics, is important to understanding many of the consequences of BSE. Government support programs have also had a role in determining the consequences of the disease. BSE in Canada is a comprehensive topic, and the contribution of all of these areas of knowledge is required to foster a clear understanding of it.

## **Chapter 3**

### **Data and Methodology**

#### **3.1 Introduction**

Chapter three outlines the techniques and procedures used in this study. There are a number of components of this study for which theoretical and methodological background is required. This chapter begins with a review of Central Place Theory and its application to this thesis. The next section discusses quantifying the impacts of BSE. The third and fourth sections describe the Canadian Business Patterns and Census of Agriculture, two principal datasets used in this study. The fifth section outlines the interview process used in this study, focusing on the procedures used and the objectives sought. Chapter three concludes with a description of the derivation and use of two indices used later in chapter seven to assess agricultural diversity.

#### **3.2 Central Place Theory**

The breadth of research on the BSE epidemic in the United Kingdom illustrates the impact the disease has had upon dissimilar realms such as politics, economics, agriculture, human health, and government. One such connection existing in both Canada and the United Kingdom links BSE to the economic composition of small towns and rural communities closely associated with cattle production. Central Place Theory concerns the economic interactions between settlements and their surrounding hinterlands, and is a useful conceptual platform for describing these interactions.

Central Place Theory posits that when disregarding the influence of variations in physical geography, economic determinants are the driving factor in determining the number, size, and spacing of trading centres in a system of urban places (Marshall 1989). Every settlement offers a distinct range and composition of economic functions. Settlements are spatially arranged according to how their particular economic characteristics compare to the characteristics of other urban places within the system. A settlement pattern results in which cities with the largest and most diverse economies are centrally located within the trade centre system (Christaller 1966). Smaller towns and villages populate the remaining interstitial space, doing so according to the same principles. Of these remaining urban places, the largest and more economically diverse again assume the most central positions. This continues until the smallest and most economically specialized urban places occupy the last of the space. Although it is contingent on the classification scheme used, urban hierarchies are often organized into four or five distinct levels, with lower levels including more member settlements than the higher levels. Theoretically all of the settlements will be scattered across a plane with relatively equal spacing, and will do so according to this hierarchy based upon economic characteristics.

Each settlement, whether it is a city, town, or village, is known as a central place because it acts as a service center for its surrounding hinterland. It is a centrally located distribution point for a specific array of goods and services. The breadth of this service area is correlative to the quantity of goods and services available in the settlement, and is associated with the degree of economic specialization of the service center (Bourne and Flowers 1996). Larger and more diverse urban places typically have larger service areas.

Larger urban centers usually have lower order urban places enclosed within the borders of their service areas, as they are capable of offering higher order goods and services not available in smaller trade centres. The most basic components of an urban system are those small towns and villages at the very bottom of the urban hierarchy. The size of these places themselves and of their respective hinterlands limits the array of goods and services they are able to provide. The land encompassed in their service areas is solely rural land. The smallest trade centers supply for the needs of the primary producers inhabiting their rural hinterland, who are often agricultural practitioners. Rural inhabitants depend on small urban centres for the acquisition of the basic goods and services they require. The existence and viability of a small trade center is contingent on the dependence of rural inhabitants upon the economic functions it provides. Economic losses precipitated by an economic disturbance such as BSE may impair the economic functions of nearby settlements where rural inhabitants tend to spend their money. The economy of the urban place would thus suffer indirectly as a result of the strain upon its rural customers.

Given the preliminary analyses of the economic impact of BSE, and its implications for rural communities, Central Place Theory is a useful framework for interpreting the linkage between economic activities in settlements and the agricultural character of their hinterlands. The application of Central Place Theory to the Canadian urban system is demonstrated effectively by Bourne and Flowers (1996). Stabler and Olfert (2002) more specifically demonstrate its relevance on the Canadian Prairies.

Although animal production is largely a rural economic function, industries that feed into and flow out of animal production often have strong urban ties, and hence are often

located in central places rather than rural areas. The agriculture and livestock sectors are strongly integrated with the economic functions of smaller service centres whose hinterlands are primarily rural. For this reason, the consequences of modern animal diseases can break the rural barrier and enter the urban sphere (Scott et al. 2004). The susceptibility of small town and rural communities has been one of the major concerns associated with the consequences of BSE in Alberta, although no specific government policies directly addressing their financial losses has been found (Auditor General of Alberta 2004: 53). The brunt of the BSE situation has been concentrated on cattle producers themselves (Wigle 2006). Service centers depending upon the money cattle producers spend on goods and services sustain only a *secondary impact* from the initial shock. Economic distance from cattle production limits the impact of BSE on industries in a distance decay function, or ripple effect. The impact of this ripple effect is felt by industries whose viability is dependent upon cattle producers. Any business, however closely connected to the cattle industry, can experience this ripple effect to some degree. Even industries unrelated to cattle production may depend on cattle producers to consume any of a range of different goods and services from haircuts to construction services. The regional propensity towards cattle production and the level of specialization in the practice is likely related to the magnitude of the economic ripple effect of BSE impacting a trade centre.

Although Central Place Theory is primarily concerned with the analysis of the service centre functions of central places, it implicitly ties the economic structure of these places to a rural or agricultural hinterland. A thorough analysis of BSE-related changes in the central places of Alberta would require detailed studies of changes, or ripple effects, in

service sector functions in addition to those sectors that are key inputs and outputs to cattle production. Such a detailed analysis is beyond the scope of this thesis. Rather, this study adopts a broader conceptual interpretation of Central Place Theory and aims only to explore ways in which ripple effects are detectable in a selected set of key forward and backward linkages to cattle production.

Industry sectors closely linked to cattle production, directly selling inputs or purchasing outputs, are likely to be more rattled by the reverberations of the BSE shock than other industries. The connection between cattle production and its direct inputs and outputs impresses upon them a greater degree of sensitivity to such a shock (Mitura and Dipietro 2004). Specialized businesses which cater specifically to cattle producers may find themselves particularly vulnerable. Some examples of industries possessing a vulnerability to BSE include livestock transportation practices, livestock feed companies, animal slaughtering, rendering, meat processing, machinery dealers, and livestock equipment suppliers (Serecon 2003; Senate Committee 2004; Wigle 2006). A great deal of emphasis has been placed on the response of these upstream and downstream industries to BSE in agricultural regions.

### **3.3 Quantifying a Ripple Effect**

The reverberation of the consequences of BSE into communities and agricultural regions is an important consideration to this study. The presence of an economic ripple effect is hinted at by the BSE crisis in the United Kingdom, and forecast by early examinations of the disease in Canada. The economic consequences of BSE appear to have penetrated regional economies, touching a range of different industries. Detection of this ripple

effect is only one step in this analysis. Quantification of the ripple effect constitutes the next important step. The manifestation of the BSE ripple effect must be operationalized to produce measurable values regarding its impacts. There are two primary scales on which this ripple effect is examined: amplitude and wavelength.

The amplitude of the ripple effect can be understood as the severity of the consequences of BSE. The amplitude is measured by examining the degree to which local industries were impacted by the reverberations of the BSE shock. Changes in the number of businesses in small towns and rural communities can be indicative of a response to BSE. If the amplitude of the ripple effect has been substantial enough to initiate structural changes in regional economies, the composition of businesses within these economies will reflect these changes. The response of businesses closely connected to cattle production is important. The reaction of vulnerable industries, as measured by the number of businesses comprising them, is interpreted as the amplitude of the impact of BSE. The Canadian Business Patterns (CBP), discussed later, is used to measure changes in the number of business establishments in regions in Alberta. These changes provide an indication of the amplitude of the economic ripple effect stemming from BSE.

The wavelength of the ripple effect concerns the temporal dimension of the BSE shock. The wavelength of the ripple effect can be described as the length of time for which the reverberations of the shock remain detectable. The CBP has a six month temporal resolution, allowing for the detection of both short-term and long-term temporal variations. Any ripple effect with a wavelength exceeding six months can be detected using this data. The temporal peak of the ripple effect can be determined by assessing exactly when the greatest degree of economic impact occurs.

There are two caveats to the determination of the wavelength of the BSE ripple effect. The first is that the ripple effect may not yet have entirely transpired, making it difficult to quantify the wavelength. The second is that wavelength measurement is contingent on the detection of a ripple effect. If the amplitude is too small to be detected, the wavelength can not be determined.

A ripple effect can be quantified in a third context as well, the distance traveled before attenuation, which is a measurement of the extent of the penetration of the ripple effect into the economy. This can be ascertained by looking beyond directly linked industries to industries with weaker connections to cattle production. An economic ripple effect is experienced with the most severity by industries closer to point of impact. Industries with distant connections to the source will feel the effects with less intensity. If the impact of BSE is easily detectable in the number of businesses in closely linked industries, then it may be useful to search industries with weaker connections for evidence of a ripple effect.

The difficulty in measuring second order impacts is a major caveat to this component of analysis, and is the reason this thesis does not seek to quantify the distance travelled before attenuation. Industries positioned further away from cattle production are less likely to be impacted by BSE, and have a greater susceptibility to changes initiated by factors unrelated to BSE. Although it is possible to connect changes in distant industries to BSE through the use of comprehensive economic models, it is difficult to do. Such an analysis is beyond the scope of this thesis.

Scale is an important consideration to this study. Evidence indicates that a ripple effect of some magnitude likely exists. It is possible, however, that an existing ripple

effect is not substantial enough to be detected in the changing number of business establishments in small towns and rural communities. BSE may have caused businesses to struggle for a period of time before ultimately recovering. Smaller scale impacts will not be detectable through the use of business number data.

The business level is an appropriate scale at which to study the impacts of BSE. This study examines the ripple effect in the context of the settlement system. Economic changes are examined in the context of their impacts on the industrial structure of urban places. If an economic crisis is not severe enough to alter the composition of businesses in a community, then the crisis is not significant in the context of Central Place Theory. Therefore, any economic changes detected in changing business numbers are significant to this study.

### **3.4 Canadian Business Patterns Dataset**

Assessing the impact of BSE requires data that are organized at an effective spatial and temporal resolution. Data from the Canadian Business Patterns (CBP) and from the Canadian Census of Agriculture were used for this reason.

The CBP dataset delineates the number of businesses registered in Canada according to Canada Customs and Revenue Agency's (CCRA) Business Number account files. Any business that has either a minimum \$30,000 in annual sales, has filed a recent federal income tax form, or submits payroll remittances to CCRA is included in the database (Statistics Canada 2002). The CBP has a six month release schedule, and is released in June and December of each year. Every release of this dataset from 2001 to 2006 has been obtained.

The CBP dataset is organized according to industry and geography. The North American Industrial Classification System (NAICS) is used to categorize every business according to industry type. NAICS is organized in a hierarchical structure under which each industry is classified into one of twenty different industry sectors. A two digit numerical code identifies each industry sector. Industry sectors can be divided into more specific sets of industry subsectors which are identified by three digit numerical codes. The first two digits of this code designate the industry sector, while the third identifies the industry subsector. Industry subsectors can be further broken down into industry groups, industries, and national industries, which are designated respectively by four, five, and six digit NAICS identification codes. National industries are the smallest categories, and have the highest resolution. The two digit industries, alternately, are the largest and broadest categories. With each sequential disaggregation of the dataset, from an industry sector to a national industry, a digit is added to the identification code (Table 3.1). The position of any industry within the hierarchy can be determined by the number of digits in its specific NAICS code. It should be noted that the “industry” and “national industry” classifications are very similar to one another. National industries are an uncommon category which allows for the implementation of businesses in one country that may not exist in all countries that use the NAICS system.

*Table 3.1: NAICS Hierarchy*

| NAICS Code | NAICS Category    | Number of Categories | Example NAICS Code | Example NAICS Category                               |
|------------|-------------------|----------------------|--------------------|------------------------------------------------------|
| 2 digit    | Sector            | 20                   | 11                 | Agriculture, Forestry, Fishing, and Hunting          |
| 3 digit    | Subsector         | 99                   | 112                | Animal Production                                    |
| 4 digit    | Industry Group    | 321                  | 1121               | Cattle Ranching and Farming                          |
| 5 digit    | Industry          | 734                  | 11211              | Beef Cattle Ranching and Farming, including Feedlots |
| 6 digit    | National Industry | 921                  | 112110             | Beef Cattle Ranching and Farming, including Feedlots |

Industries, at the 6 digit level of aggregation, will be used in this study. The CBP dataset does not resolve industries down to the national industry level. Categories at the higher end of the hierarchy are defined too broadly to detect subtle industrial changes that may result from BSE. A very specific agricultural economy is under examination, and a concise industrial classification is necessary. General levels of classification are better suited for analysis of broader economies. The high resolution 6 digit classification allows for the detection of smaller scale economic change. The cattle industry is closely linked to only a few NAICS industries, and broad classification schemes may overwhelm and drown out the unique responses of these important industries.

The CBP is also organized geographically. The Business Register from which the CBP originates collects geographical data on each business included in the study. Postal code information is included among the data package delivered by each business to the Business Register. On the basis of these postal codes, the businesses in the dataset are arranged geographically (Statistics Canada 2002). The CBP data can be resolved at a Census Subdivision (CSD) level of geography. CSD units in Canada are generally equivalent to municipalities (Statistics Canada 2006). This geographical organization allows for an examination not merely at a sub-provincial scale, but across the 453 different CSDs, or municipalities, in Alberta. All of the businesses within a CSD eligible for registration in the CBP are categorized according to NAICS.

One problem with smaller scale geographic classifications is that many CSDs contain few, if any businesses at all. Many of these CSDs are in rural regions where smaller populations limit the development of higher order businesses. Differences in industrial composition among these rural CSDs can be substantial, as regional variations are

amplified by limited business numbers. Temporal changes can be amplified as well, as an increase of one business in a sparsely populated CSD is more significant than in a densely populated CSD.

Another issue with using CSD level data arises from the method of data collection utilized by the CBP. The spatial component of the data is allocated on the basis of the postal code to which a business is registered (Statistics Canada 2002). Data discrepancies can arise in cases where postal code regions do not perfectly align with the boundaries of a CSD (Statistics Canada 2002). Rural businesses that have head offices, or receive mail in urban centers beyond the boundaries of the CSD in which they are located can cause further data discrepancies. Business numbers in some regions are artificially inflated, while numbers in conjoining regions may appear lower than a ground survey would indicate.

Aggregating CSD level data into larger Census Consolidated Subdivision (CCS) regions helps to mitigate these of errors. These larger regions are composed of groups of adjacent CDSs which nest perfectly into CCS regions. CCS regions are smaller than county sized regions, but larger than municipality sized regions. With the help of an appropriate concordance table, CBP data for all of the CSD regions was aggregated into the 77 CCS regions in the province in 2006 (Figure 3.1). The 6 digit NAICS industries were examined according to the CCS regions in which they were located.

There are many different definitions for rural, and competing classifications can impede research (Keddie and Joseph 1991). The use of CCS regions allows the rural

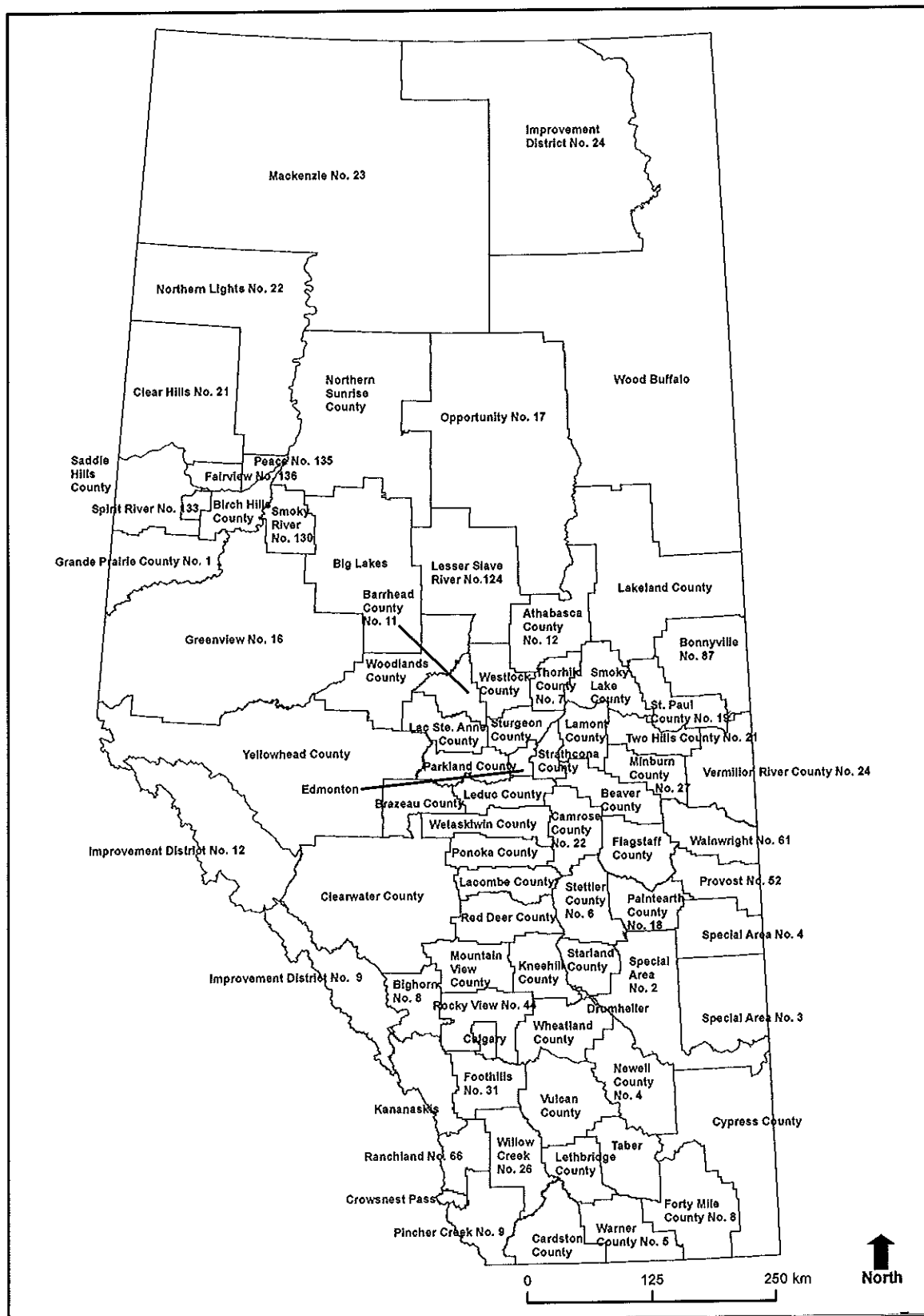


Figure 3.1: CCS Regions in Alberta; 2006

communities (and small towns contained within them) to be defined in this study as Functional Economic Areas (Stabler and Olfert 2002).

The CBP dataset has an additional feature which classifies all of the businesses registered according to eight different employment size ranges (Table 3.2). Inconsistency in the size ranges used, however, precludes the detection of subtle declines or increases in employment that might result from the BSE situation.

*Table 3.2: CBP Employment Size Ranges*

| Number of Employees |
|---------------------|
| 1 to 4              |
| 5 to 9              |
| 10 to 19            |
| 20 to 49            |
| 50 to 99            |
| 100 to 199          |
| 200 to 499          |
| 500+                |

A second reason to aggregate the CBP data to the CCS level relates to the second data source utilized by this study. The Census of Agriculture releases data at a spatial resolution no finer than the CCS level of geography. Converting the CBP data to this level of aggregation allows for the reconciliation of CBP data with data from the Census of Agriculture. Data from the two sources can thus be compared and contrasted at a common spatial scale. The Census of Agriculture has a number of components to it that can be useful in augmenting the CBP data.

Ideally the impacts of BSE would be viewed in the context of an entire economy. In this case, the effect on each industry would be examined iteratively, and the sum of the changes detected would represent the total economic impact. The breadth of the CBP dataset poses a challenge to such an approach. Examining all 921 of the industries defined at the 6 digit level would prove time consuming and impractical. Furthermore,

some of the subtle BSE-induced nuances would be overwhelmed by the magnitude and depth of broader changes in the economy.

Any economic ripple effects induced by BSE will be most easily detected in industries with close ties to cattle production (Midmore 1993). Economic activities that feed directly into, or flow directly out of the cattle industry are likely most susceptible to an economic shock sustained by cattle producers. Excluding industry sectors not closely related to cattle production will eliminate much of the noise obscuring the results. A subset of the CBP dataset comprised of NAICS sectors identified as the principal inputs and outputs to cattle production in Alberta will serve as the focus of the detection of an economic ripple effect induced by BSE. The derivation of these key economic sectors is described in chapter four.

### **3.5 Census of Agriculture**

The Census of Agriculture is released by Statistics Canada every five years in conjunction with the general census. This dataset outlines, at a CCS level geography, the agricultural characteristics of regions across the country. Components include items such as cropping practices, livestock quantities, expenses, as well as other information relevant to agricultural practices. The Census of Agriculture was released in both 2001 and 2006, a time period spanning the discovery of BSE in May of 2003. The temporal nature of this dataset allows for an examination of agricultural characteristics before and after BSE.

Cattle numbers in Alberta are the primary component of the Census of Agriculture used in this study. Tabulated numbers of cattle help to paint a picture of the spatial and structural organization of the cattle industry in Alberta. This information can be arranged

according to different types of cattle (Table 3.3). This range of categories allows for the examination of the cattle industry according to its constituent stages as described in chapter one. The cow-calf stage of cattle production will be represented by a combination of the beef cow and beef replacement heifer categories. Cows are females that have undergone at least one previous reproductive cycle, while heifers are females that have yet to undergo their first reproductive cycle. Replacement heifers are heifers that will replace older cows culled from cow-calf herds. Both beef cows and beef replacement heifers are used exclusively for reproduction, and thus can only be allotted to the cow-calf stage of cattle production.

*Table 3.3: Cattle Types in Census of Agriculture*

| Cattle Category                    | Abbreviated Name           |
|------------------------------------|----------------------------|
| Calves, under one year             | Calves                     |
| Steers, one year and over          | Steers                     |
| Heifers for slaughter or feeding   | Slaughter heifers          |
| Heifers for beef herd replacement  | Replacement heifers (beef) |
| Heifers for dairy herd replacement | Milk heifers               |
| beef cows                          | Beef cows                  |
| Dairy cows                         | Milk cows                  |
| Bulls, one year and over           | Bulls                      |

Slaughter heifers are heifers that are fed to be processed as beef. Steers are emasculated males that are also fed to be processed as beef. Steers and slaughter heifers will be combined to comprise the feeding stage of cattle production.

Although the dairy industry operates differently than the beef cattle industry, it is not completely isolated from the effects of the BSE shock. A dairy sector composed of milk cows and milk heifers will be constructed to facilitate an examination of any responses to BSE within this sector as well.

Bulls and calves less than one year of age have been omitted from the study (except in the case of calculating total cattle numbers). Due to the aforementioned ambiguity

associated with the backgrounding stage of production, an analysis of the location of calves is of limited value. The importance of breeding and genetics to the cattle industry is recognized, but for the purposes of this study examining the geography of their numbers would not be particularly useful.

### **3.6 Interviews**

An interview process was used to reduce the CBP dataset for the purposes of this study. It is difficult to obtain an objective list of industries that are key inputs and outputs to cattle production. The input-output model for the Canadian economy released in the System of National Economic Accounts produced by Statistics Canada is one option (Statistics Canada 2001). The coarseness of this dataset, however, limits its utility for the purposes of this study. Data are aggregated at national and provincial levels and does not capture local nuances in the economic flows surrounding cattle production in Alberta. Another weakness of the System of National Economic Accounts is that it divides the economy into industrial categories that are too broad to be integrated with the 6 digit NAICS industries used in this study.

A list of industries connected to cattle production as inputs or outputs was derived through consultation with individuals involved in the cattle industry. Local experts were queried regarding the position that beef production holds within the economy of Alberta. These consultations produced a set of upstream and downstream industries most closely connected to cattle production. The local expertise used ensures that the specific characteristics of the cattle industry at a sub-provincial level have been considered. Since the objectives of this study reach beyond farm-level impacts, the survey was broadened to

include industry stakeholders and key community members in addition to cattle producers. The broader sample set helps to examine the industry in the context of its position within the economies of trade centres serving cattle producers.

Eleven people were interviewed in the summer of 2007 (Table 3.4). Two of the community members interviewed were Chamber of Commerce presidents and one was an economic council member. Two of these community members were also owners of local businesses connected to cattle production, and were therefore industry stakeholders as well. The industry stakeholders included a feed mill operator, the owner of an electric company, and a credit union branch manager. Four of the cattle producers interviewed were feedlot owners/operators, while the remaining two were cow-calf producers. The feedlots ranged in size from small to very large. Nine of the participants were males, while the remaining two were married couples.

*Table 3.4: Interview Participants*

|    | Position                                | Location      |
|----|-----------------------------------------|---------------|
| 1  | Industry Stakeholder                    | Taber         |
| 2  | Community Member / Industry Stakeholder | Claresholm    |
| 3  | Cattle Producer                         | Claresholm    |
| 4  | Community Member                        | Claresholm    |
| 5  | Cattle Producer                         | Claresholm    |
| 6  | Cattle Producer                         | Picture Butte |
| 7  | Cattle Producer                         | Coaldale      |
| 8  | Community Member / Industry Stakeholder | Coaldale      |
| 9  | Cattle Producer                         | Picture Butte |
| 10 | Cattle Producer                         | Picture Butte |
| 11 | Community Member                        | Lethbridge    |

The primary objective of the interview process was to identify the specific industries in local trade centres that are most closely linked to cattle production. A secondary objective was to assess the perceived impact of BSE on cattle producers, related industry sectors, and communities as a whole. The primary yield of these interviews was the

derivation of a list of 6 digit NAICS industries identified as key inputs and outputs to cattle production.

Interview participants were chosen using a purposeful sampling method known as chain (or snowball) sampling. Under this method, the interviewer uses an existing contact (or contacts) to establish an initial interview. Subsequent participants are then selected on the basis of recommendation and referral from the initial participant.

Snowball sampling identifies cases of interest from people who know other people with relevant cases (Patton 2002: 237-8). This sampling method helps to ensure the value of interview participants to the objectives of the study. At the conclusion of each interview, once rapport had been developed, each participant was asked if he or she knew of somebody whose case would be of interest. All the suggested cases were pursued by the interviewer, yielding five of the eleven participants. Two additional participants were contacted on the basis of their membership in local chambers of commerce.

Interviews were constructed in a semi-structured format, under which a firm schedule is developed to cover all of the main objectives while remaining flexible enough to accommodate the introduction of new ideas and expansion upon topics of particular interest (Dunn 2005: 88). The flexibility of a semi-structured interview format is its major strength, as it allows participants to include new and relevant information without compromising the accomplishment of established objectives.

The interview schedule had two components which paralleled the objectives of the interview process. The first part of each interview focused on the derivation of a list of industries identified as key inputs and outputs to cattle production in Alberta. The interview schedule extracted this data by means of an interviewer-assisted examination of

a list of potentially relevant industries. Although a list of the entire NAICS series was available, for the sake of brevity an abbreviated version was used which excluded industries plainly having limited interaction with cattle production. Each of the sectors included in this abbreviated list was considered iteratively. The participant was asked whether the sector in question was linked to beef production as either an input or an output, and to gauge the importance of its interactions with beef production. For those sectors recognized as being significant, the participant was asked to describe the impact of BSE on that industry. The economic shock may have, for example, increased or decreased the level of interaction with certain upstream and downstream industries as cattle producers reduced input expenses, and market conditions restricted output transmissions. After an examination of the entire list, participants were given the opportunity to identify any important industries that had not yet been considered. Finally, participants were invited to discuss their perspectives on the economic consequences of BSE. The media attention garnered by BSE and its contemporary nature have made it a rather “hot topic,” particularly among those most intimately aware of its impacts. As a result, most interview participants were willing to discuss their experiences with BSE.

### **3.7 Agricultural Diversity**

Agricultural diversity is used in this thesis to assess changes in the composition of regional agricultural economies. This section describes the measures of diversity used in this thesis. Agricultural diversity measures are derived from the NAICS farm type data available through the Census of Agriculture. This component of the census divides all

agricultural activities into shares according to ten different categories. Each farm type is equivalent to a 4 digit NAICS industry group (Table 3.5). The number of farms reported to be in each of these ten categories is the basis for the measures of specialization and diversification utilized in this study.

*Table 3.5: NAICS Farm Types (Census of Agriculture: Statistics Canada)*

| NAICS Code | Farm Type                                       |
|------------|-------------------------------------------------|
| 1111       | Oilseed and grain farming                       |
| 1112       | Vegetable and melon farming                     |
| 1113       | Fruit and tree nut farming                      |
| 1114       | Greenhouse, nursery and floriculture production |
| 1119       | Other crop farming                              |
| 1121       | Cattle ranching and farming                     |
| 1122       | Hog and pig farming                             |
| 1123       | Poultry and egg production                      |
| 1124       | Sheep and goat farming                          |
| 1129       | Other animal production                         |

Two different measures will use these ten farm types to quantify the level of agricultural diversity in each CCS community in Alberta: the Index of Farm Type Diversity (IFTD) and the Gini Index of Specialization.

### **3.7.1 Index of Farm Type Diversity**

The IFTD is an absolute measure of agricultural diversity. This index is derived from an ethnic diversity index used to evaluate the degree of diversity among neighbourhood populations (Ray 1977). In the case of the IFTD, different forms of agriculture, rather than ethnic groups, are used.

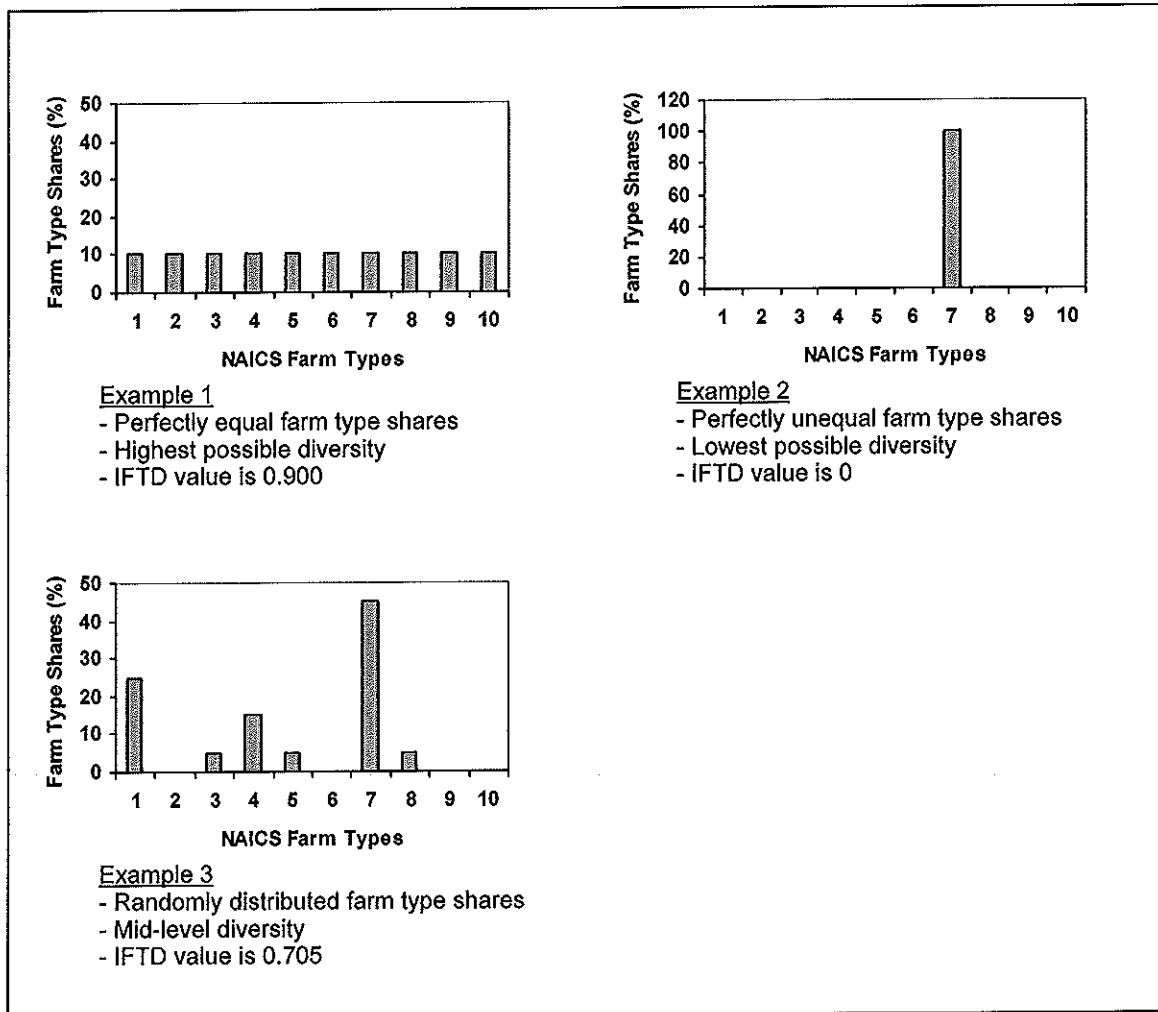
The level of diversity calculated for each agricultural community (or CCS) compares the regional composition of the ten NAICS farm types to an *objective* base profile. The base profile used represents a theoretically diverse economy in which each farm type occupies an equal share of the entire agricultural economy. A region found to be

perfectly diverse by the IFTD will have each of the ten farm types occupying exactly 10% of the agricultural economy. Conversely, a community that is completely specialized will have all of its agricultural industries within a single category.

Equation 3.1 
$$\text{IFTD} = 1 - \sum_{i=1}^n p_i^2$$

Equation 3.1, where  $p_i$  is equal to the proportion of a CCS's farms that are classified as being a part of the  $i$ th farm type, describes the calculation of IFTD values. The proportion of the region agricultural economy occupied by each particular industry sector is squared, and the sum of these squares is then subtracted from 1 to determine the IFTD value. The range of obtainable values is dependent upon the number of categories incorporated into the calculations. In this particular case, the upper limit is 0.90, and the lower limit is 0. The most diverse agricultural communities score close to 0.90, while the most specialized communities score close to 0 (Figure 3.2).

One drawback of the IFTD is that it is an absolute measure. A perfect diversity score can be obtained only when the ten NAICS farm types each comprise an equal share of the economy. In Alberta this is a very unlikely occurrence, as cattle ranching and farming, as well as oilseed and grain farming, are almost universally more prominent than the other NAICS farm types. The values obtained are generally low because the typical agricultural community in Alberta has an economic base profile that is quite different from the IFTD definition of perfect diversity. For this study IFTD values are compared only within Alberta, and since all the CCS regions have similar agricultural compositions, the index remains useful in comparing them. The efficacy of the IFTD may decline in the case of regions with unique agricultural compositions, which in Alberta may mean a base profile



*Figure 3.2: Diagram Illustrating IFTD Derivation*

that is closer to equality. The IFTD will interpret such a case as being more diverse than others. In reality, however, within the system of agricultural production in Alberta, such a region might be considered specialized, given the lack of production in those other farm types throughout the rest of the province. The Gini Index accounts for some of these issues.

### 3.7.2 Gini Index of Specialization

The Gini Index assesses regional levels of economic specialization. Gini Index values are therefore opposite to the IFTD values that measure diversity. The Gini Index measures specialization according to a *subjective* base profile which is determined by levels of production within an enclosed system.

Gini Index values are based upon location quotients, measures used to assess how the prominence of an industry in a particular region compares to prominence of that industry within the entire system in which that region resides. The share of an industry within a regional economy (in this case a CCS region) is compared to the share of that same industry within a larger economy (in this case the province of Alberta). Location quotients are used to assess regional economies in the context of the national economies containing them.

Equation 3.2 
$$LQ_i = \frac{b_i}{B_i}$$

Equation 3.2 outlines the calculation of a location quotient, where  $b$  is the proportion of businesses engaged in industry  $i$  within a CCS region, and  $B$  is the proportion of businesses engaged in industry  $i$  for the entire province (Marshall 1989). Location quotients are based upon a ratio and are dimensionless numbers. Interpretation is simple, as a value greater than one indicates the share of the regional economy comprised by industry  $i$  is greater than the share of the provincial economy comprised by that same industry. In other words, the regional economy is specialized in terms of industry  $i$ . Values below one indicate that industry  $i$  takes up a smaller share of the regional economy than would be expected based on its share of the provincial economy. Calculating the location quotient values for all of the industries in each CCS region of the

province provides an indication of how these regional economies compare to the provincial economy.

The provincial base profile used by the Gini Index is determined by the shares occupied by each of the ten NAICS farm types at a provincial level. The base profile can be understood to be the industrial composition of the average community in Alberta. The Gini Index is a relative measure of diversity, and is applicable only to regions whose economic characteristics have contributed to the base profile, and lie within the area for which the base profile has been constructed. The advantage of using the Gini Index for this study is that the base profile applies specifically to the province of Alberta. Calculated levels of specialization thus take into account the specific economic attributes of the agricultural economy of Alberta.

An array of location quotients describing the economic profile of each CCS region in the province is developed. The provincial economy has the average, or “expected” industrial composition, and is the economic base profile to which the regional economies are compared. Each industry therefore has a location quotient value of 1 at the provincial level. The Gini Index measures the deviation of regional location quotient values from the provincial base profile. Regions that tend to parallel the base profile have Gini Index values close to 0 (Figure 3.3). These regions are considered to be diverse because their industrial shares are similar to those of the provincial economy. Regions deviating from the base profile obtain Gini Index values close to 1. These regions are considered to be specialized owing to the fact that some farm types occupy larger than expected shares of the economy at the expense of other farm types.

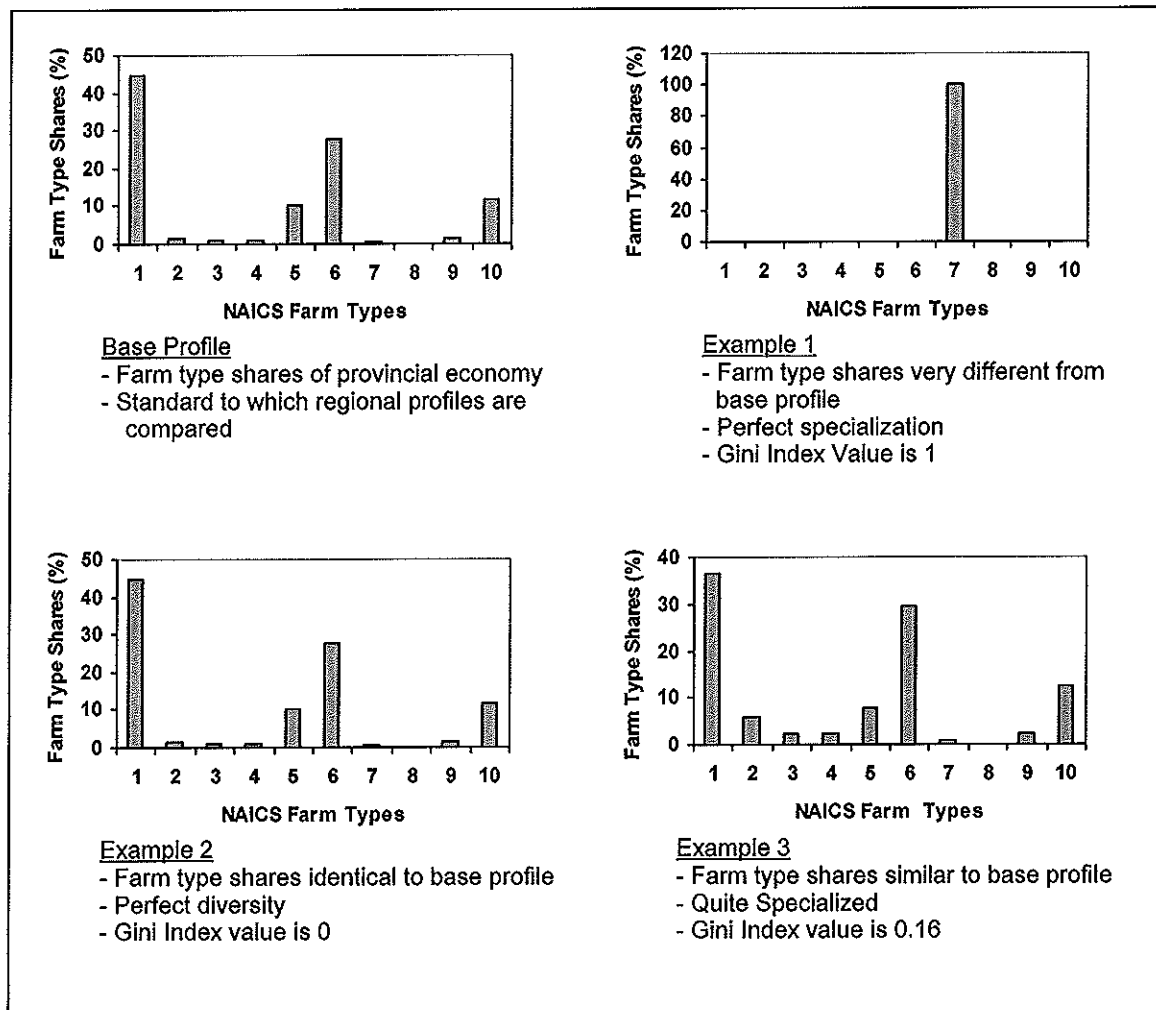


Figure 3.3: Diagram Illustrating Gini Index Derivation

Equation 3.3

$$Gini = 10^{-4} \sum_{i=1}^{n-1} |x_i y_{i+1} - x_{i+1} y_i|$$

Before calculating the Gini Index, location quotients must be ranked in either ascending or descending order according to absolute magnitude. Cumulative percentage values based upon each industry's share of the economy are then calculated while maintaining the ranking order. The Gini Index can then be calculated according to Equation 3.3, where  $X_i$  is the previously determined cumulative percentage values for the region, and  $Y_i$  is the cumulative percentage values calculated for the province.

### **3.8 Data Limitations**

There are limitations to the data used in this study. The two primary datasets used were the CBP and Census of Agriculture. One major limitation of the CBP dataset is that it resolves industrial information at a business establishment level. This may be too coarse of a measure to detect some consequences of BSE which may not have been substantial enough to impact the number of business establishments. A lack of change in business establishment numbers does not mean that there have not been smaller impacts upon industries. Declines in profit or employment are examples of economic indicators of a higher resolution.

The NAICS classification also limits the resolution of the data used in this study. NAICS industrial classifications may be too coarse to allow for the detection of responses in specific industries, or in specific components of industries which the NAICS system does not resolve any further. The NAICS limitations apply to both the CBP and Census of Agriculture Data. Another concern with the NAICS system concerns the NAICS farm types obtained from the Census of Agriculture. The classification scheme is mutually exclusive, meaning that a farm can be classified in only one category. In the case of mixed farms, any component of the enterprise comprising greater than half of total production determines the classification. NAICS farm types therefore do not perfectly represent agricultural production.

### **3.9 Interview Process Limitations**

One of the limitations imparted by the interview results concerns the number of people interviewed. Although the interviews were largely qualitative in nature, the quantitative

component of the study would be strengthened by a larger sample size. The geographical dimension of the interviews conducted also limits the strength of the results obtained. All of the interview participants lived in the southern portion of Alberta. Even though the participants spanned three counties, this is a relatively small geographic area. A broader and more comprehensive sample size would strengthen the results of the interview process.

### **3.10 Conclusion**

Central Place Theory is the platform for the analysis in this study. All of the data examined is done so from the perspective of Central Place Theory. The quantification of the ripple effect of BSE allows its impact upon the communities defined by Central Place Theory to be measured. The CBP and Census of Agriculture datasets were chosen because of the economic and industrial information they contain. These two datasets were also chosen because they are arranged according to CCS regions, which represent agricultural communities. Interviews were conducted to reduce these datasets to a more manageable level by identifying industries closely connected to cattle production. Finally, the IFTD and the Gini Index are used to assess regional levels of agricultural diversity.

## **Chapter 4**

### **Interview Results**

#### **4.1 Introduction**

The interview process was used to capitalize on local expertise regarding the impact of BSE upon cattle producers, industry stakeholders, and community members in Alberta. This chapter describes the results of this interview process. The first section concerns the primary goal of the interview process, which was the derivation of a list of the industries most closely connected to cattle production. The following section describes some of the experiences with and responses to BSE shared by the interview participants.

#### **4.2 Derivation of Key Input and Output Industries**

The fundamental product of the interview process was a list of 6 digit NAICS industries identified as key inputs or outputs to cattle production (Table 4.1). Industries chosen to represent key sectors were those with the highest frequency of acknowledgement as such throughout the interview process. The results were consistent enough that any industry acknowledged as a key input or output by more than one person was included in the final model.

By combining the frequency of recognition with the emphasis placed on particular sectors by interview participants, insight can be gained into the economic position of cattle production in small towns and rural communities. Although no industry was universally identified as a key input or output (likely owing to the diverse backgrounds of the interview participants), the recurring identification of three specific sectors warrants

their designation as primary inputs and outputs. Animal (except Poultry) Slaughtering (NAICS code 311611), agricultural chemical and other farm supplies wholesaler-distributors (418390), and agricultural feed wholesaler-distributors (418310) were noted more frequently and emphasized as key industries more often than other industries and were thus designated primary inputs and outputs to beef production.

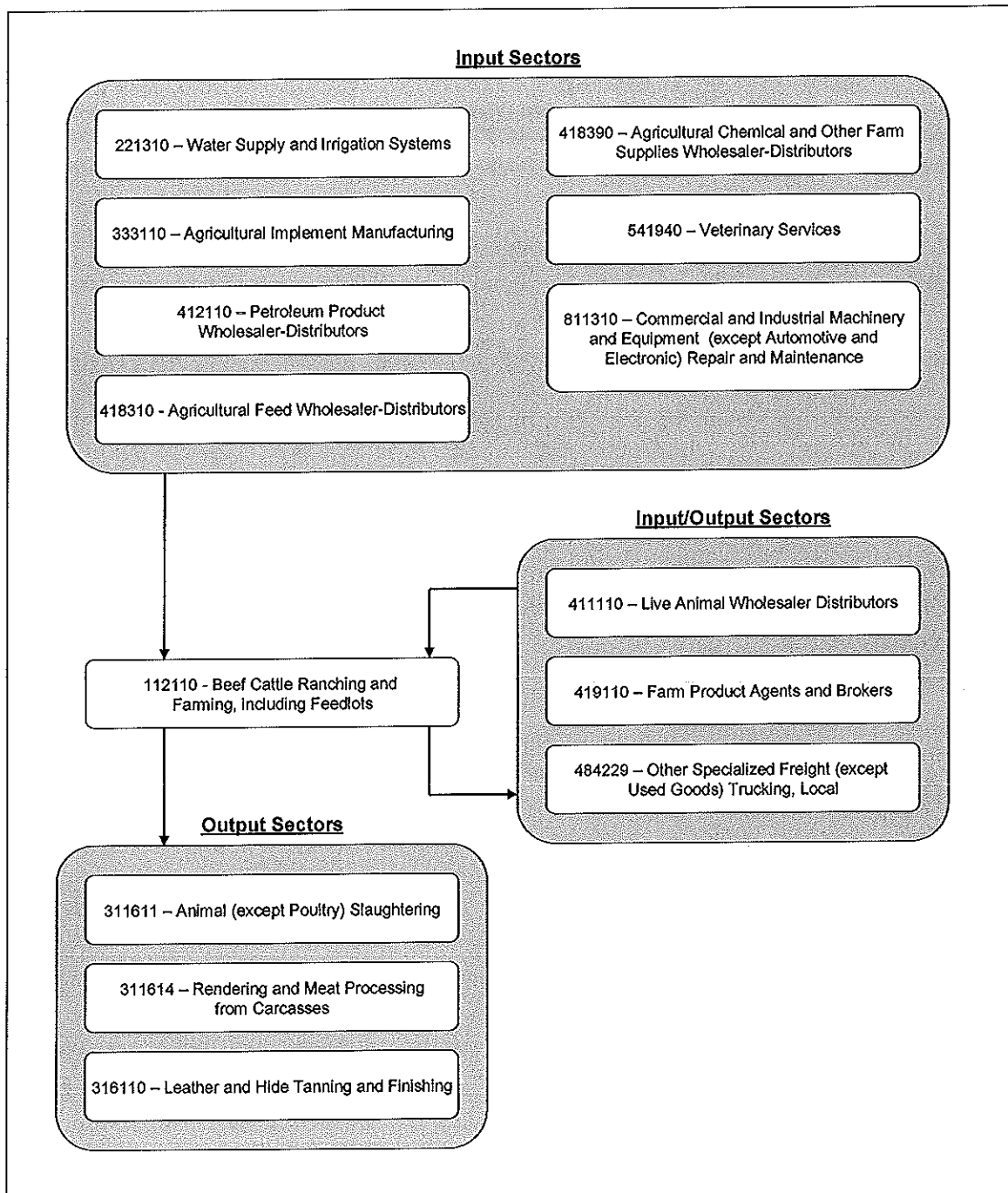
*Table 4.1: Key Input and Output Industries*

| NAICS Code | National Industry                                                                                           | Abbreviated Name       |
|------------|-------------------------------------------------------------------------------------------------------------|------------------------|
| 221310     | Water Supply and Irrigation Systems                                                                         | Irrigation             |
| 311611     | Animal (except Poultry) Slaughtering                                                                        | Slaughter              |
| 311614     | Rendering and Meat Processing from Carcasses                                                                | Rendering              |
| 316110     | Leather and Hide Tanning and Finishing                                                                      | Leather                |
| 333110     | Agricultural Implement Manufacturing                                                                        | Implements             |
| 411110     | Live Animal Wholesaler-Distributors                                                                         | Livestock Auction      |
| 412110     | Petroleum Product Wholesaler-Distributors                                                                   | Petroleum              |
| 418310     | Agricultural Feed Wholesaler-Distributors                                                                   | Feed                   |
| 418390     | Agricultural Chemical and Other Farm Supplies Wholesaler-Distributors                                       | Agricultural Chemicals |
| 419110     | Farm Product Agents and Brokers                                                                             | Farm Agents            |
| 484229     | Other Specialized Freight (except Used Goods) Trucking, Local                                               | Transport              |
| 541940     | Veterinary Services                                                                                         | Veterinary             |
| 811310     | Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance | Machinery Repair       |

In cattle production, feed is used to increase the weight of cattle. Sales of agricultural chemicals and farm supplies are a step higher in the production chain, and are used to maximize the output of feed producers. It thus stands to reason that feed and agricultural chemicals would be identified as significant inputs to cattle production. Slaughter comprises the other end of the beef production chain in which the cattle are converted into consumer products for profit. A simple economic model characterized by these primary inputs and outputs would have agricultural chemicals and farm supplies supporting feed crop production, feed (produced or purchased) given to the cattle, and the conversion of cattle into beef for consumers at a slaughter facility.

The remaining sectors can be identified as secondary inputs and outputs to cattle production. They fill in the gaps left by the rather skeletal economic model of primary inputs and outputs to create a more complete economic model (Figure 4.1). Industries selected as secondary inputs and outputs were either noted by more than one interview participant, or considered to be of uncompromising significance by a single participant. Water supply and irrigation systems (221310), agricultural implement manufacturing (333110), petroleum product wholesaler-distributors (412110), farm product agents and brokers (419110), veterinary services (541940), and commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance (811310) constituted these secondary inputs. The inputs can be summarized generally as support for crop production, infrastructure establishment and maintenance, and animal health services. Secondary outputs identified included rendering and meat processing from carcasses (311614) and leather and hide tanning and finishing (316110). The live animal wholesaler-distributor (411110) and other specialized freight (except used goods) trucking, local (484229) industries, which deal with the purchase and sale, and the transport of livestock, were also noted. These two industries exist as both inputs and outputs to cattle production. All of the key input and output industries will henceforward be referred to according to the abbreviated names identified in Table 4.1.

In addition to the primary and secondary sectors, a number of tertiary inputs and outputs were identified in the interview process that for varying reasons will not be included in the final model. Breeding service industries, which are encompassed in the NAICS category “support activities for animal production” (115110), were identified as an input, but are largely concentrated in the dairy industry. The contributions of this



*Figure 4.1: Conceptual Diagram of Key Input and Output Sectors*

industry to beef cattle production is subordinate to the secondary sectors previously identified. The construction and accounting industries have been omitted as well, due to the limitations of NAICS classifications. For both of these industries, the 6 digit NAICS

industries are too specific for the purposes of this study. Other tertiary inputs, such as retail services and utilities, were also omitted from the final list. Labour and manure were both noted as important inputs and outputs to cattle production, but neither can be identified as an independent industry under NAICS specifications, and therefore were not included. The primary and secondary industries identified comprise the entire list of key inputs and outputs used in this study. This list will be used to describe the economic linkages between cattle production and businesses in small towns and rural communities. Although industries have been identified as primary or secondary in nature, it is beyond the scope of this study to maintain that differentiation moving forward, and all of the identified key industries will be considered equal.

Since NAICS was developed for larger economies, some of the industry categories it uses are not ideal for use within a smaller scale study. None of the output sectors, which include slaughter, rendering, leather, and livestock auctions, are specific to the beef industry. NAICS does not identify the particular type of animal for which these facilities have been developed, and they may cater to any of a number of different types of agricultural livestock. This makes it impossible to differentiate between economic changes impacting beef slaughter plants from those impacting plants designed for the production of other meats. The petroleum and machinery repair industries quite obviously serve a wide range of clients beyond cattle producers, which must be considered when they are being examined. Livestock transport is a unique case as well, because the transport of livestock is merely a component of a NAICS category which encompasses any type of specialized local freight.

These issues demonstrate the extent to which cattle production and its constituent inputs and outputs are tied into the broader economy. Activities within the broader Albertan economy may isolate these key industries from oscillations in the economics of cattle production, and may prove to be important limiting factors when examining the economic ripple effects of BSE.

#### **4.3 Experiences with and Responses to BSE**

The interview process also sought to elicit information from participants regarding experiences with BSE. Perceived impacts of BSE are classified as either community level impacts or industry level impacts.

Community level impacts are rooted in the level of economic interaction between cattle producers and their local communities. Part of this comes from a desire to support local businesses, but it is also because the economic composition of local service centres caters to the specific needs of cattle producers. Participants alluded to a local economic downturn following the discovery of BSE, in which entire communities stagnated for a period of time. One community member believed that the economic “recession” in his town lasted for about six months before beginning to fade. A local business owner said “It took 2-3 years for [my business] to regain pre-BSE levels.” This economic downturn was precipitated by the conserving of money by cattle producers in the face of the economic uncertainty ushered in by BSE. A business owner claimed “people hoarded money.” Those most closely tied to the cattle industry spent money on essential commodities and necessities only, evading more indulgent expenses. An employee for a local newspaper surmised that BSE caused a 25% drop in income for businesses of all

types across the community. In some instances, businesses leaning heavily upon cattle producers were forced to layoff employees shortly after the border closed.

In spite of the economic downturn recognized by the interview participants, no participant could identify a specific business or farm that had gone bankrupt as a direct result of BSE. Although not all of the participants believed that their local community had completely recovered from the consequences of BSE, many echoed the sentiment that the impact of BSE was short-lived. Local service centres were perceived to be 80-90% recovered. Not one interview participant believed their particular community would not completely recover from the consequences of BSE.

Industry-level impacts largely mirrored those perceived to have been sustained by communities, simply on a different scale. Since cattle production constitutes the focal point of the consequences of BSE, some more subtle reactions to this stimulus are observed at the industry level. A common response to BSE by cattle producers has been the elimination of unnecessary new capital expenditures. Construction projects were halted, and upgrades were rendered nonessential and discontinued. A number of instances exist where cattle farms planning to implement expansion plans in the near future postponed those plans until the uncertainty surrounding the BSE situation became clearer.

Cattle producers felt pressure to cut costs, as the value of livestock plummeted immediately following the closure of the American border to Canadian beef. A feed mill operator expressed that farmers could reduce feed costs by "scrimping on nutrition." Many employed a strategy of repairing old and ailing infrastructure and equipment rather than replacing it. Regarding the construction industry, one cattle farmer said "eventually,

#### **4.4 Conclusion**

This chapter summarized the results of the interview process. Thirteen NAICS industries closely tied to cattle production were identified. These industries will serve as economic indicators in the research component of this thesis. Information regarding the perceptions of the BSE situation from individuals with ties to the cattle industry in Alberta provides additional context for the research objectives of this study. The interviews are a valuable source of data coming from local experts familiar with the specific characteristics of the cattle industry and the impacts of BSE in Alberta.

## **Chapter 5**

### **Impacts of BSE on the Cattle Industry**

#### **5.1 Introduction**

The expected impacts of BSE upon the cattle industry in Alberta have been outlined in chapter three. Previous research has focused on the economic losses that have resulted from BSE (Le Roy and Klein 2003; Mitura and Dipietro 2004; Auditor General of Alberta 2004). Other reports detail some of the changes taking place within Canada's beef production system (Forge and Fréchette 2005; Grier 2005). The goal of this chapter is to examine the impacts of BSE on the cattle industry in the context of numbers and types of cattle in Alberta from a geographical perspective. Chapter five begins with a discussion of background information relevant to the impacts of BSE on the cattle industry. The next section examines changes in cattle numbers for the entire province between 2001 and 2006. The remainder of this chapter describes changes in cattle numbers for three different components of the cattle industry. The respective geographies of the cow-calf, feeding, and dairy sectors and the changes manifest in them are addressed in turn.

#### **5.2 Background**

Regional variations in cattle production evolve as the industry changes over time. Producers manage herd size and structure in an effort to maximize efficiency and productivity in the face of changes to cattle prices, input costs, and input availability. The size and composition of cattle herds evolves over time as producers manage herds

via reproduction and slaughter, and the purchase and sale of live animals. Cattle of varying ages and types are retained or sold according to what is most beneficial for an operation. Cattle herds are thus continually changing in size, as well as in the age and type of cattle of which they are composed.

These changes are often spatially clustered, as herd management strategies are typically based on regional comparative advantages or disadvantages. When a number of similar changes occur in one area, regional trends develop. Localized occurrences such as drought and other disasters, crop yields that are uncharacteristically abundant or poor, or changing prices, result in spatial trends of convergence or divergence. Conditions favouring the increase of cattle numbers in one region may lead to declines in another. These changes, founded upon the response of cattle producers to external stimuli, vary over space as weather trends, input types and their costs, and existing differences in herd structure apply varying pressures on cattle producers throughout the province.

Existing regional variations provide the impetus for geographic changes that may have resulted from BSE. The economic impact of BSE differentiates between cattle types and ages, and given their uneven distribution in Alberta, BSE has likely had spatial consequences for regional cattle herds. Producers attempted to absorb the BSE shock through the processes of reproduction, slaughter, purchases, and sales. The manifestations of these activities, combined with their underlying regional biases, resulted in spatially detectable trends of herd growth, decline, and livestock transfer.

The unique dynamics of the BSE shock separate it from many of the struggles previously faced by cattle producers in Alberta. The consequences of events such as droughts or conventional cattle disease outbreaks are usually regionally confined, and can

be balanced by exchanges of cattle within the system of cattle production in Alberta. BSE, however, represents a ubiquitous shock with consequences impacting producers throughout the province. Since BSE was exogenous to the entire province, intra-provincial exchanges could not be used to mitigate its consequences.

Producers in regions better suited for cattle production are better equipped to sustain the shock than those in places without such a comparative advantage. There is a partiality inherent in the consequences of BSE that impairs some of the structural components of the industry more than others (animals over thirty months of age, for example, have become selected against) (LeRoy and Klein 2005). Industrial changes implemented in the wake of BSE to increase the traceability of livestock and meat, such as Country of Origin Labeling (COOL) and age verification, also have implications for cattle production (MacLachlan and Townshend 2008). BSE has a detectable spatial dimension, and the consequences of the crisis have been felt with more severity in some places than in others (Serecon Consulting 2004). The spatial manifestations of the impacts of BSE should provide information regarding varying responses to the disease.

Determining the response of the cattle industry to BSE in a geographical context requires an analysis of cattle numbers across the province both before and after the disease was discovered. Cattle numbers provide a good representation of the industrial changes taking place, as regional increases or decreases represent the combination of reproduction, slaughter, and interregional purchases and sales of cattle. Cattle numbers for both 2001 and 2006 have been obtained from the Census of Agriculture.

The initial analysis of cattle numbers is supplemented by an examination of the regional number of farms reporting cattle. The number of farms reporting cattle is a

coarser measure, and offers a different perspective on the geography of the cattle industry. The fact that no account is taken of the size of the farms enumerated can be problematic. Ten farms with 10,000 head of cattle will be perceived to be equal to ten farms with 50 head of cattle. Farm numbers therefore have a tendency to diminish the significance of the industry in regions characterized by larger farms, and to amplify the significance of the industry in regions with smaller farms. The number of farms is, however, a more stable unit of measurement than cattle numbers which can be highly spatially fluid. Changes in farm numbers represent either the exit or entry of cattle producing enterprises within the system. Such changes require more momentum than changes in cattle numbers, which do typically undergo regional ebbs and flows over time. An additional advantage to examining the number of farms reporting cattle is that there are fewer gaps in the dataset resulting from data disclosure control. Many of the northern regions for which actual cattle numbers were unavailable are able to report on farm numbers.

In examining the number of farms reporting various types of cattle, the three simplified categories of feeding, cow-calf, and dairy operations must be dissolved. Most farms contain more than one type of cattle, and using aggregated categories will result in double counting of these farms. Analyses of the number of farms are thus conducted using the un-aggregated component categories obtained directly from the census.

### **5.3 Cattle Numbers in Alberta**

Before examining the cattle industry at a sub-provincial level, it is useful to develop an understanding of the changes that have occurred in the industry at a provincial level

between 2001 and 2006. The total number of cattle in the province has remained virtually unchanged, having declined by only 3.72% over the five year time period (Table 5.1). This seems counterintuitive given the growing cattle herd that resulted from the BSE export bottleneck in 2003. Continued relaxation of trade barriers, unwavering domestic consumption of beef, and the reigning in of reproductive herd growth have all aided in limiting increases in cattle numbers. Canada's national cattle herd, whose size narrowly exceeds 15 million head, grew by a mere 200,000 head over the five year time period, an increase of less than 2%. This national trend of limited growth rules out inter-provincial livestock transfers as the cause of the lack of growth in Alberta. The explanation for this apparent consistency between 2001 and 2006 lies in the changes occurring within the province. Although total cattle numbers changed little from 2001 to 2006, significant structural changes within the industry took place.

*Table 5.1: Cattle Numbers in Alberta by Type*

|                     | 2001      | 2006      | Change   | Percentage |
|---------------------|-----------|-----------|----------|------------|
| Beef Cows           | 2,099,288 | 2,035,801 | -63,487  | -3.02%     |
| Replacement Heifers | 359,291   | 275,683   | -83,608  | -23.27%    |
| Cow-calf stage      | 2,458,579 | 2,311,484 | -147,095 | -5.98%     |
| Steers              | 991,554   | 974,559   | -16,995  | -1.71%     |
| Slaughter Heifers   | 761,553   | 805,829   | 44,276   | 5.81%      |
| Feeding stage       | 1,753,107 | 1,780,388 | 27,281   | 1.56%      |
| Milk Cows           | 84,044    | 78,875    | -5,169   | -6.15%     |
| Milk Heifers        | 38,485    | 37,803    | -682     | -1.77%     |
| Dairy industry      | 122,529   | 116,678   | -5,851   | -4.78%     |
| Bulls               | 111,379   | 109,753   | -1,626   | -1.46%     |
| Calves              | 2,169,607 | 2,050,773 | -118,834 | -5.48%     |
| Total Cattle        | 6,615,201 | 6,369,116 | -246,085 | -3.72%     |

Slaughter heifers are the only cattle type among the eight subdivisions examined to exhibit positive growth. The other categories all exhibit a decline in animal numbers. This trend helps to explain the lack of growth across the industry. As the trade status of

Canadian cattle and beef evolved following the initial BSE incident, one development was the accommodation of UTM animals by the United States (LeRoy and Klein 2003). The greater price certainty associated with younger animals favoured their production over that of older cattle. Young female calves were grown as slaughter heifers for sale rather than being bred to become replacement heifers. This choice also helps cow-calf producers to reduce their herd size. The number of producers choosing to slaughter young heifers rather than breed them accounts for the substantial decline in the number of replacement heifers (an over 25% decline), and the increase in slaughter heifers.

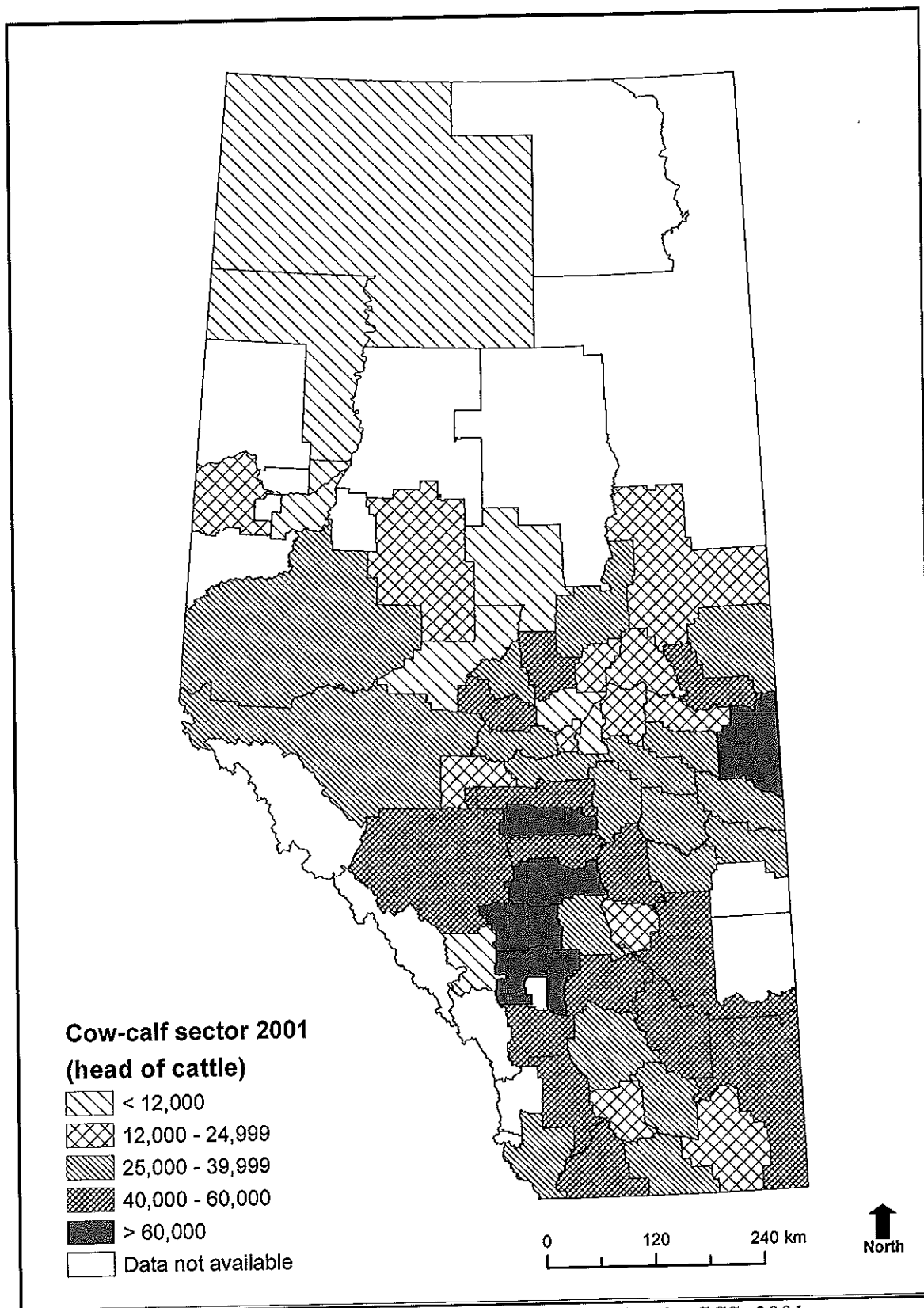
The decline in beef cows by 63,487 head can be tied to this same trend. Beef cows have a limited period of reproductive productivity before they are culled from herds and slaughtered. As producers choose to develop their young female heifers for slaughter rather than for reproduction, these older cows are being removed from herds without being replaced by young beef replacement heifers, resulting in decreasing numbers of beef cows. The cow-calf, backgrounding, and feeding stages of cattle production are interdependent with one another, and adjustments to the parameters of one can often be accounted for by the reactions of another. Dairy production, on the other hand, is a unique and largely independent industry. Limited declines in the number of milk cows and milk heifers can likely be accounted for by countervailing productivity increases within the dairy industry rather than BSE initiated structural changes.

Understanding the provincial-level changes that have occurred, these changes can be examined at a finer resolution. The sub-provincial changes, along with their patterns, are examined according to their respective industry type.

#### **5.4 Cow-calf Sector**

The reproductive and initial stage of cattle production, the cow-calf sector, is an appropriate starting point for analysis of the industrial changes taking place from 2001 to 2006. Recall that the cattle numbers used to define this stage of the industry are derived from the combination of the beef cow and replacement heifer categories. Beginning in 2001, the spatial organization of beef cows and replacement heifers is characterized primarily by a region of concentration in the Red Deer area (Figure 5.1). A corridor stretching from Leduc County in the north to Mountain View County in the south encompasses the regions with the most beef cows and replacement heifers. A branch off of this zone of concentration extends southward through Foothills and Willow Creek counties skirting the Rocky Mountains. A second extension follows Alberta's Eastern border with Saskatchewan, as two veins highlighted by Vermilion River County and Cypress County reach from the central zone of concentration near Red Deer towards the Eastern edge of Alberta. Lethbridge, Taber, and Vulcan Counties, renowned for their role in Alberta's cattle production industry, are curiously absent from this zone of concentration and the principal veins extending from it.

The pattern displayed corresponds to the pattern of cow-calf production one would expect to see in Alberta given the historical geography of the practice. Favourable climatic conditions as well as an affinity for the production of forage and grazing crops have long lent a competitive advantage to the central region of the province with regards to siring and rearing calves (Ross et al. 1990; MacLachlan 2001). The young animals are usually born in the spring, and cow-calf pairs can feed on the abundant pasture land in



*Figure 5.1: Beef Cows and Beef Replacement Heifers by CCS; 2001*

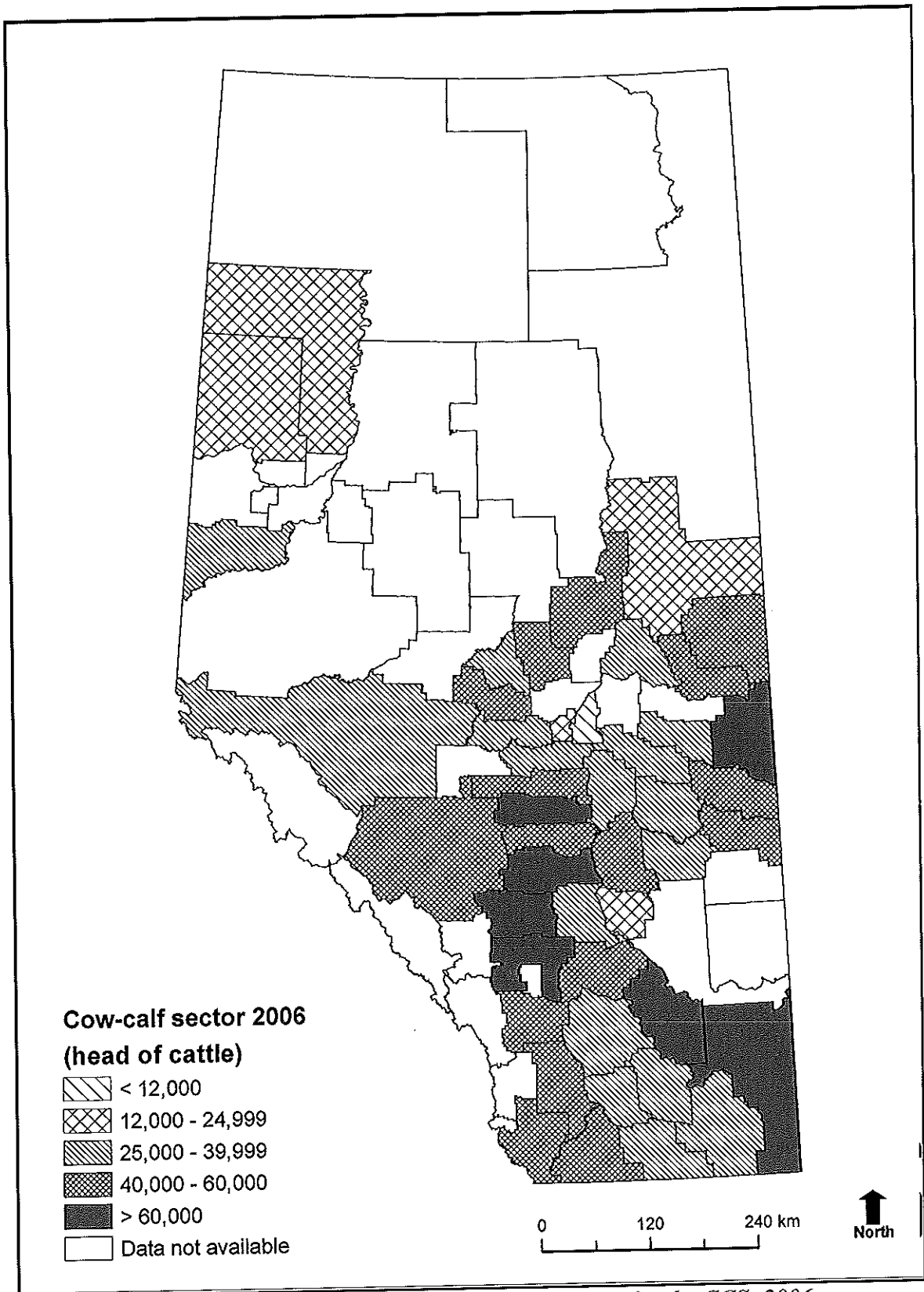
central Alberta into the fall if weather permits it. Once grazing land and available feed have been depleted, calves are sold to feeding and backgrounding operations. Cow-calf operators must then provide stored feed only for the cows over the winter months.

Although advances in irrigation as well as a large beef market in the nearby United States have spurred the development of cattle production in Southern Alberta, this growth has largely been focused on the feeding stage. Warmer temperatures and the availability of irrigation promotes strong crop yields in the south, better equipping farmers to provide the high protein rations required by feeding operations. This abundance in feed has further established the region as a destination for older calves sold by cow-calf producers. The propensity of southern regions to engage in feeding cattle accounts for the lack of beef cows and replacement heifers located there. The central region of the province, notably the Red Deer area, has developed a niche within the cattle industry whereby producers utilize abundant summer forage and pastureland production to rear calves for sale to feeding operations in the fall. The branches extending from the central zone of concentration represent additional regions in which the lack of irrigation precludes the large-scale production of higher valued cash crops or sufficient high protein grains to supply large populations of fed cattle.

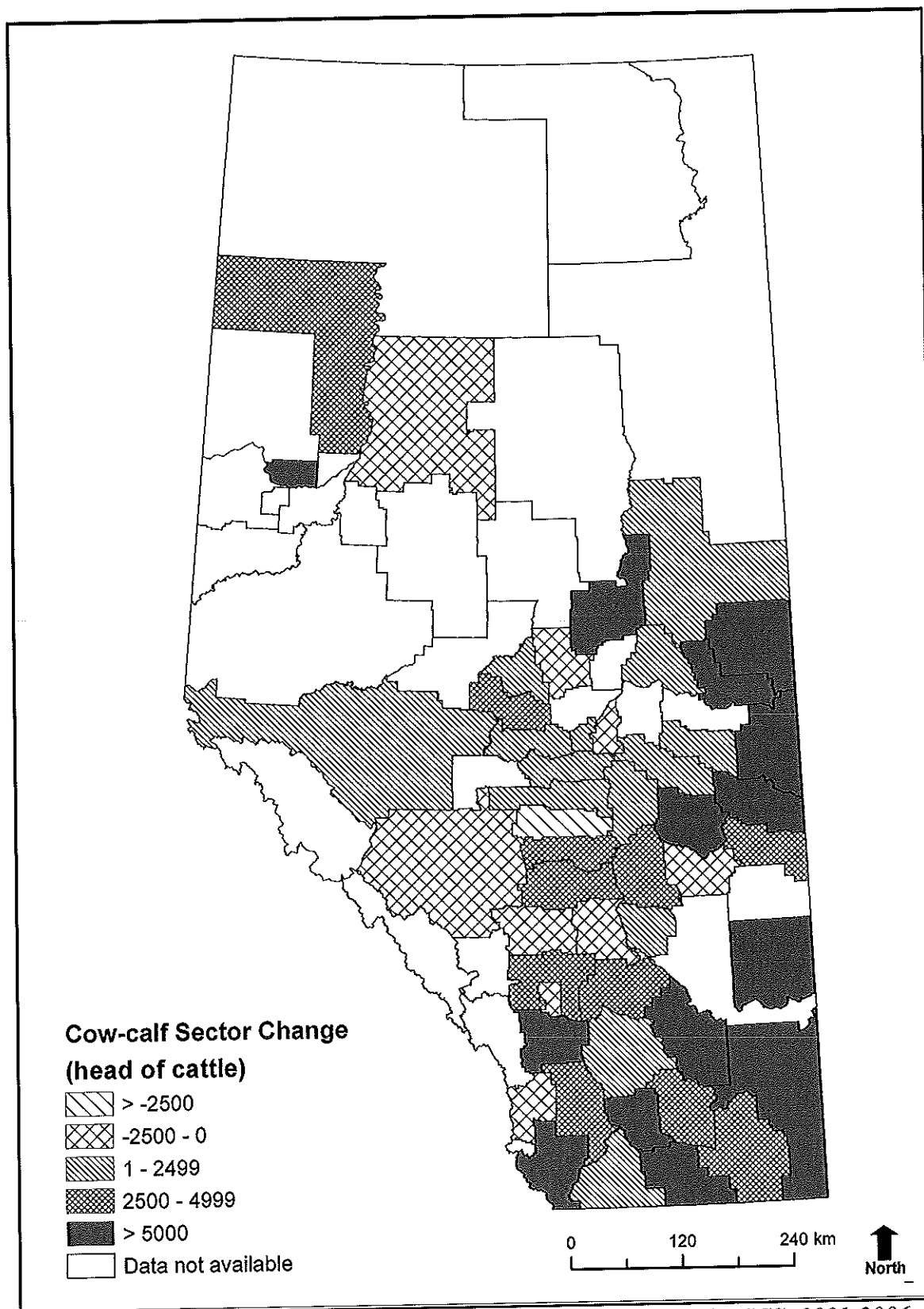
Economic considerations also contribute to the geography of the cattle industry. These considerations include spatial price discrepancies, transport costs, and input costs. Economic factors are more temporally fluid than physical geography factors, and are more likely to initiate spatial change within the industry. The economic implications of BSE enhance its impact upon the spatial organization of cattle in the province.

There are no radical changes to the overall spatial pattern of beef cows and replacement heifers over the five year period spanning the discovery of BSE in 2003. A subtle trend of divergence does emerge, however, and is indicated by strong growth in Vermilion and Bonnyville Counties along the eastern border, as well as in Newell, Warner, Cypress, and Lethbridge Counties in the southeast corner of the province (Figure 5.2). These six counties demonstrate the greatest absolute growth in number of beef cows and replacement heifers, with increases ranging from just over 8,000 head in Lethbridge County to a surge of over 13,000 head in Newell County. The regions of the province previously identified as extensions of the zone of concentration near Red Deer are the same areas in which some of the strongest growth in the cow-calf sector has occurred. Within the Red Deer area, moderate growth rates ranging from 4 to 10% are observed (Figure 5.3). Ponoka County represents a unique exception, where despite being located within the zone of concentration, the county has curiously declined by over 27,000 beef cows and replacement heifers, a reduction of 29.6%. Lethbridge and Warner Counties to the south, with moderate amounts of beef cows and replacement heifers in both 2001 and 2006, have the highest growth rates in the province, at 42.7% and 42.9% respectively. Both counties are located between the two primary southern extensions emanating from the core region in 2001.

The spatial pattern of relative growth, as calculated by dividing regional changes into cattle numbers in 2001, closely parallels that demonstrated by absolute growth. The rates of growth in the southeast corner of the province and along the eastern border with Saskatchewan are greater than those in the rest of the province.



*Figure 5.2: Beef Cows and Beef Replacement Heifers by CCS; 2006*



*Figure 5.3: Change in Beef Cows and Beef Replacement Heifers by CCS; 2001-2006*

Strong growth in the southern and eastern regions of the province and moderate growth in the core region of production provides evidence for the existence of a trend of spatial divergence in the cow-calf sector. This pattern does not occur by way of a conventional concentric ring formation radiating from a core, but rather appears to be nodal in its manifestation. Two principal nodes are located along the eastern border, and in the southeast corner of the province. The node situated in the southeast corner of the province is the dominant of the two. This node contains Newell, Warner, and Cypress Counties, the only three communities to increase by more than 10,000 head. The counties of Vermilion and Bonnyville, exhibiting the fourth and fifth highest levels of growth, highlight the secondary node located along the eastern border of the province.

The rapid growth experienced by these two nodes, combined with a slower pace of growth in the core region, has led to the emergence of a crescent-shaped region of cow-calf production. This crescent spans from Vermilion County along the eastern border, through the Red Deer area, down into Lethbridge, Vulcan, and Taber Counties, and terminates in Cypress County in the southeast corner of the province. This cow-calf crescent is characterized by communities notable for either substantial numbers of beef cows and replacement heifers, or high rates of growth in the industry.

The discussion to this point has focused on the number of *animals* in the cow-calf stage of production. However, an analysis of the number of *farms* reporting beef cows and replacement heifers provides another perspective of the changing structure of the cattle industry in Alberta. The number of farms reporting these animals lends further support to the trend of divergence within the cow-calf industry (See appendix A for details).

To avoid errors associated with double counting of farms, the cow-calf sector has been divided back into the beef cow and replacement heifer categories. Both categories exhibit understandably similar patterns, given that the cow-calf industry is accounted for by the synergy of the two. Primary concentrations in the Red Deer area are again evident in both categories, but the degree of concentration appears to be reduced.

Larger farms are enumerated in the same way as smaller farms, leading to an ascendancy of some of the more peripheral regions containing smaller farms. The crescent of cow-calf production is again evident, as the southeast corner of the province as well the area along the eastern border near Vermilion County, both contain high concentrations of farms reporting both beef cows and replacement heifers.

The two main results that can be gleaned from the geography of farms reporting beef cows and replacement heifers are concerned with the type of changes that have occurred, and the spatial pattern of those changes. The type of changes that have occurred echo the provincial level changes in cattle numbers. Almost every single CCS region has seen a decline in the number of farms reporting beef cows and replacement heifers. Only six of the CCS regions analyzed saw modest increases in the number of farms reporting beef cows, while the rest experienced decline. The six regions of growth were all located in the southeast and northwest corners of the province. Furthermore, only four agricultural communities showed an increase in the number of farms reporting replacement heifers, and all were located in the southeast corner of the province. No single CCS region reported an increase in farms reporting both beef cows and replacement heifers.

This system-wide decline can be explained by the same factors accounting for the structural changes occurring at a provincial level. Producer choices in the wake of BSE

have limited the numbers of the beef cows and replacement heifers used for cow-calf production in lieu of growth and sale of cattle in the feeding industry. Many farms previously engaged in producing calves are no longer reporting beef cows and replacement heifers. The decline in farms containing beef replacement heifers is likely a reflection of system-wide choices to feed young female calves for slaughter rather than retaining them for reproduction. These choices result in a transformation within the industry whereby young female cattle that might have been raised as beef replacement heifers for reproduction before BSE, are being raised as slaughter heifers for slaughter. Farms previously reporting replacement heifers may now be reporting slaughter heifers. The actual number of cattle on farms in such instances may not have changed, but rather the classification of the animals has changed, providing the impetus for larger scale industrial changes across the province. In contrast to replacement heifers, there is no mechanism by which beef cows can be reclassified. The decline in farms reporting beef cows is ultimately a reflection of the removal of these animals from farms.

The decline in farms reporting beef cows or replacement heifers could be indicative of the exit of farms from the agricultural economy. This decline could be the result of bankruptcy or a response to exogenous pressures threatening the long-term viability and desirability of cattle production. Alternately, this decline could simply be the consequence of structural changes on individual farms, whereby the cow-calf phase may have been forgone in favour of another stage of cattle production. The Canadian agricultural economy increasingly favours larger farms, creating a trend in which greater numbers of cattle are concentrated on fewer farms (MacLachlan 2001). Declining farm

numbers may therefore not be indicative of a response to BSE, but simply part of a trend that has been developing for decades.

The spatial pattern in which these changes are manifest is as significant as the changes themselves. This pattern provides further evidence for the existence of a province-wide trend of spatial divergence. The maps delineating change in the number of farms from 2001 to 2006 for both beef cows and replacement heifers are characterized by a cohesive area in the center of the province in which the communities experiencing the most substantial decline are clustered. This area coincides with the Red Deer area, where the greatest number of farms was concentrated in 2001. A very clear pattern of decreasing levels of decline radiates outward from this central point to the edges of the province. The areas experiencing the least decline, in the southeast and northwest corners of the province, are those regions most distant from the Red Deer area.

Of the 68 CCS regions for which these data were available, all but two experienced a decline in the number of farms with beef cows or replacement heifers on them. Even more notable was the level of decline exhibited, as 66 communities experienced losses ranging from 1 to 268 farms, the mean decline being 99 farms. The combined growth in Cypress and Mackenzie Counties of 20 farms, 18 of which were in Cypress County, comes nowhere close to balancing the province-wide losses. The most substantial of these declines have occurred in the Red Deer, Ponoka, Parkland, and Mountain View counties, all of which are keystone components of the Red Deer area noted for its propensity for cattle reproduction.

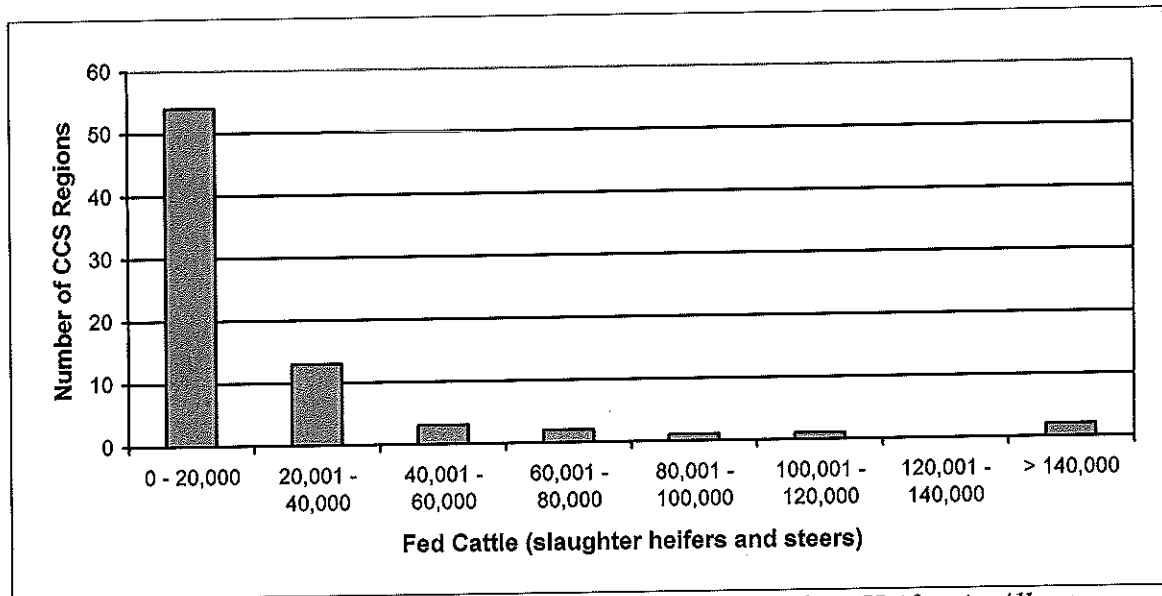
## **5.5 Backgrounding Sector**

Backgrounding constitutes the intermediate stage of cattle production. This stage is difficult to statistically differentiate from the cow-calf and feeding stages of production. Serving to connect the other two stages by bringing calves up to the requisite weight for feedlot admission, backgrounding is more of a bridge between stages than it is an actual stage itself. Delineating the geography of calves, the major component of this stage, does not correspond to a determination of the geography of backgrounding. This stage is often attached to either cow-calf or feeding operations, and is difficult to examine as a unique stage. In some cases, calves may skip the backgrounding stage, going directly from a cow-calf operation to a feeding operation. The strong degree of variability inherent in this stage of production exists because the desirability of the practice ebbs and flows according to constantly fluctuating economic conditions. Economic and geographical determinants, most often tied to the production, availability, and price of feed, lead to a level of desirability for the practice that varies from year to year. The geography of the practice can similarly change rapidly as local climatic conditions dictate the regional availability and price of forages and pastureland.

## **5.6 Feeding Sector**

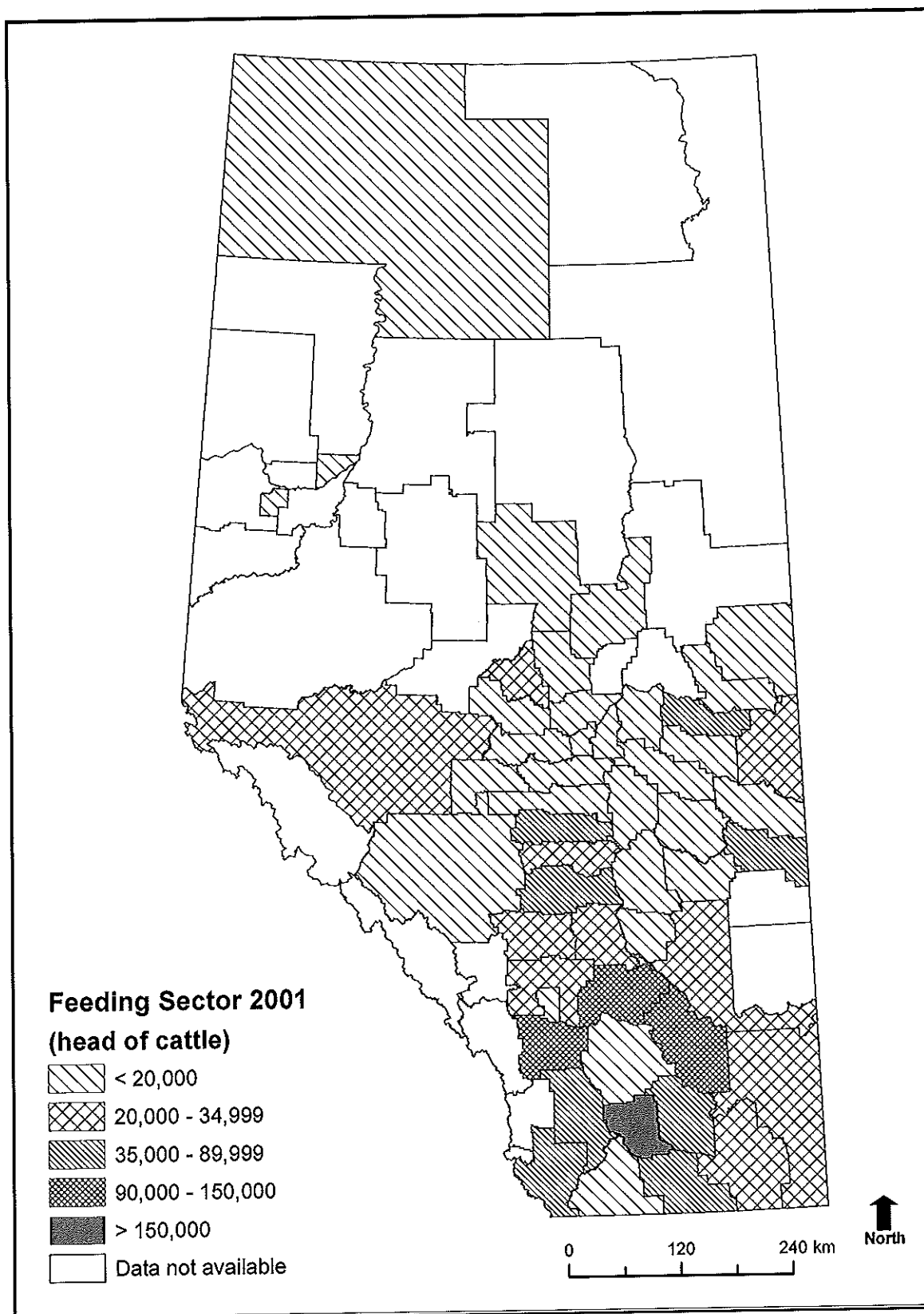
Slaughter heifers, young female cattle fattened to produce beef in lieu of use for reproductive purposes, and steers, emasculated males similarly fattened for slaughter, are the statistical categories of cattle combined to constitute the cattle feeding industry. A high degree of spatial concentration is evident in the feeding sector in 2001. The frequency distribution illustrated in Figure 5.4 demonstrates how most of the fed cattle in

Alberta are concentrated in just a few agricultural communities. Lethbridge County alone houses over 450,000 fed cattle, over one quarter of the 1.7 million head of fed cattle in Alberta in 2001.



*Figure 5.4: Frequency Distribution of Steers and Slaughter Heifers in Alberta*

The highly concentrated cattle feeding industry is located in the southern portion of the province (Figure 5.5). Lethbridge County, easily the most prominent of Alberta's cattle feeding agricultural communities, is the zenith of this zone of concentration. Newell, Foothills, Wheatland and Taber Counties, containing quantities of fed cattle ranging from roughly 80,000 to 150,000 head, round out the top five CCS regions regarding fed cattle numbers in 2001. These regions are connected to one another forming an incomplete ring encircling the County of Vulcan which is located immediately north of the County of Lethbridge. In addition to this primary zone of concentration, there are moderate fed cattle numbers across the central and southern portions of the province, as most regions here contain at least 20,000 head of slaughter heifers and steers combined. The propensity for feeding cattle declines in the northern

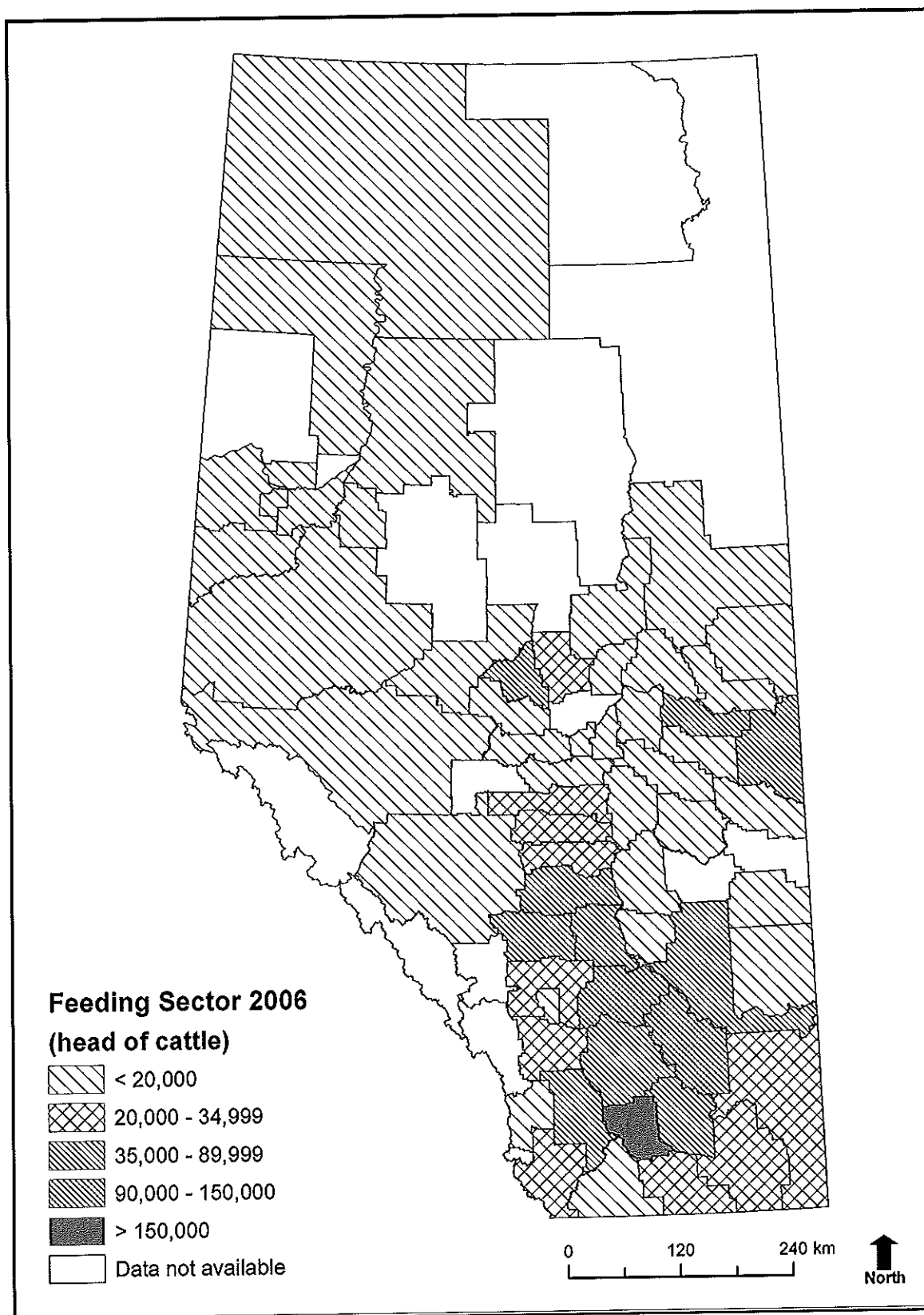


*Figure 5.5: Steers and Slaughter Heifers by CCS; 2001*

regions of province. Only two of the agricultural communities located north of Ponoka County have more than 25,000 head of fed cattle. The majority of CCS regions north of Ponoka actually have less than 10,000 head in 2001. At the core of the region of the province deficient in fed cattle is Edmonton. No CCS sharing a border with the CCS of Edmonton has more than 8,000 head of slaughter heifers and steers. This paucity in the central region of the province, combined with the extreme concentration in very few communities in the south, represents a distinct pattern contrasting the concentration of cow-calf production in the Red Deer area.

The concentration of the cattle feeding industry in the southern portion of the province and the scarcity of the practice in the north can be attributed to the geographical parameters disclosed earlier in accounting for the geography of cow-calf production. A longer growing season and an effective irrigation system in much of the south have fostered the development of higher crop yields. This advantage better equips the south with an ample supply of crops necessary for feeding the high protein rations required for fattening cattle for slaughter. Surpluses allow for the storage of feeds in quantities sufficient to sustain cattle populations throughout the winter. Furthermore, the nearby American market for fed cattle and finished beef products endows the southern portion of the province with a regional advantage (MacLachlan 2001).

No radical change is evident in the general spatial pattern of cattle feeding from 2001 to 2006. The primary zone of concentration underscored in 2001 remains the hearth of fed cattle production in Alberta in 2006, and the County of Lethbridge remains the pinnacle of this zone of concentration (Figure 5.6). The agricultural communities surrounding Vulcan County continue to be among the most abundant producers of fed

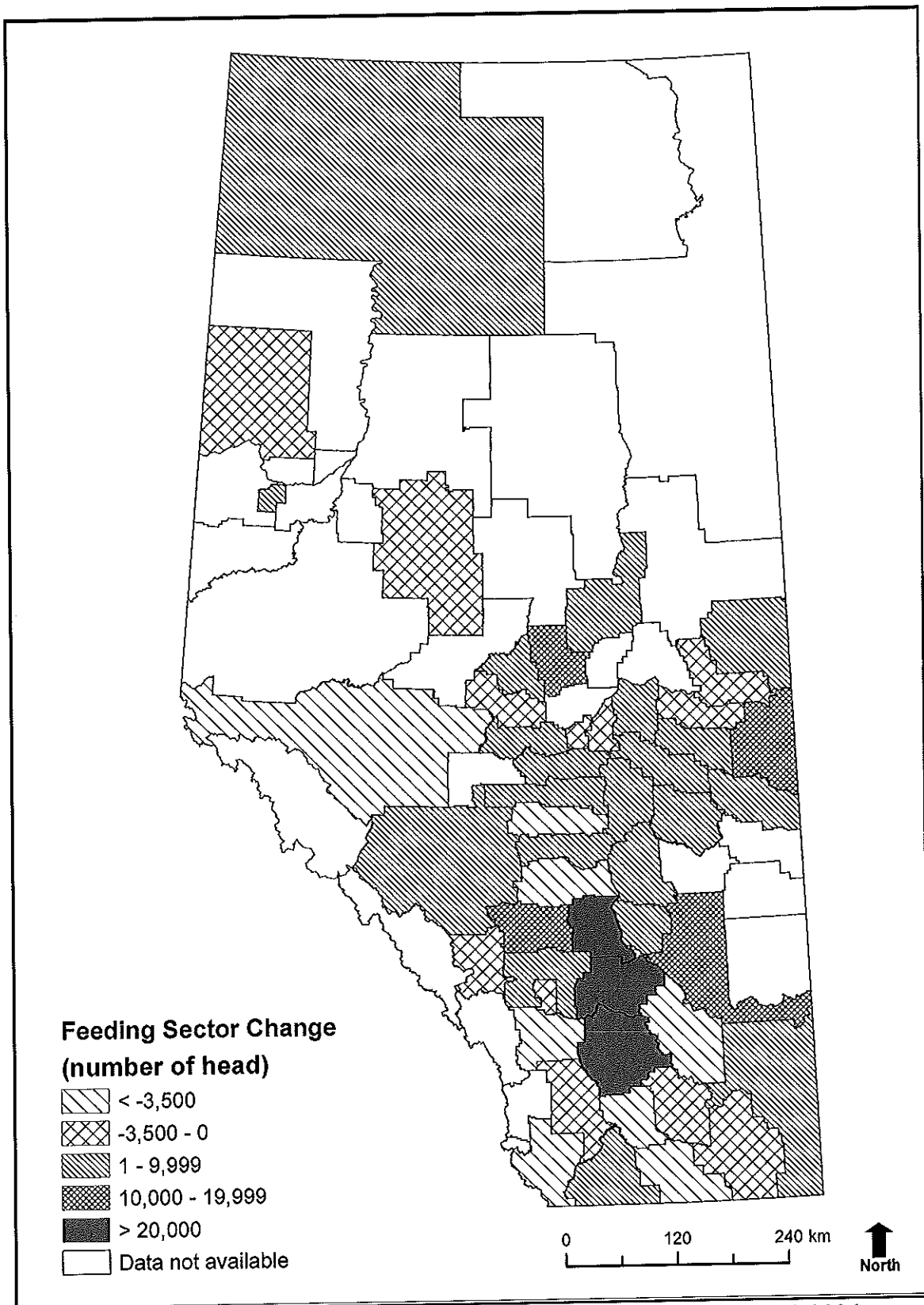


*Figure 5.6: Steers and Slaughter Heifers by CCS; 2006*

cattle in the province. Despite the constancy of this general pattern at a provincial level, important regional level changes do occur over the five year period.

Even though it shares its border with the five largest fed cattle producing regions in the province, Vulcan County contains only 16,210 slaughter heifers and steers of its own in 2001, well below the mean value for the province. By 2006, however, fed cattle numbers in Vulcan have grown more than in any other single CCS in the province, making Vulcan the fifth largest producer of fed cattle. Second to Vulcan's unprecedented growth of 57,000 head, is an increase of 46,000 head in Kneehill County. Both counties more than triple in fed cattle capacity. This trend of growth in Vulcan and Kneehill counties has been observed by MacLachlan and Townshend (2007) as well. These unprecedented rates of growth appear even more prodigious when compared to the rather modest rates of growth occurring elsewhere in the province. The number of slaughter heifers for all of Alberta increased by only 6.73%, while the number of steers actually declined by 1.66%.

The five regions with the greatest production of fed cattle 2001 all experienced a reduction in slaughter heifers and steers by 2006 (Figure 5.7). Lethbridge County and Foothills County decreased by close to 80,000 head, while Newell, Wheatland, and Taber Counties declined by 20,000, 22,000, and 1,000 head respectively. These changes are not substantial enough to alter the provincial spatial pattern of cattle feeding. Given the prominence of these particular communities within the pattern of fed cattle production in the province, however, these changes are dramatic enough to significantly alter the composition of the existing zone of concentration. In 2006 Vulcan County still has less fed cattle than four of the top five CCS regions from 2001, but it has become a key



*Figure 5.7: Change in Steers and Slaughter Heifers by CCS; 2001-2006*

element of the cattle feeding industry's zone of concentration in Southern Alberta.

Kneehill County, which by 2006 ranks directly behind Vulcan County, shares its southern border with Wheatland County, comprising a northern protrusion extending from the primary zone of concentration.

A map of the relative changes occurring from 2001 to 2006 reveals that while many of the core regions have undergone a period of decline, a number of peripheral regions to the north have grown substantially in fed cattle since 2001. Vulcan and Kneehill Counties are the champions of this growth, having increased by 350% and 220% respectively. Enhancing the impact of these high rates of growth is the fact that these two counties began with far more fed cattle in 2001 than any of the other regions with similarly high growth rates.

The discussion to this point has dealt with the regional variability in the number of *animals* in the feeding stage of production. An analysis of the number of *farms* reporting steers and slaughter heifers provides another perspective from which to view the spatial patterns and geographical changes in the feeding sector (see Appendix B for details).

The spatial pattern demonstrated by the number of farms reporting slaughter heifers and steers is actually characterized more by a concentration in the Red Deer area than by the concentration of cattle in the south of the province demonstrated by the numbers of fed cattle. Curiously, when accounting for the cattle feeding industry using the number of farms involved in the practice, the previously discussed agricultural crescent again becomes evident. The central region of concentration is in the Red Deer area, with protrusions curving northeastward and southeastward to Cypress County and Vermilion County. The apparent discrepancy between the spatial patterns exhibited by the number

of fed cattle and the number of farms reporting fed cattle illustrates the difference in farm sizes across the province. The CCS regions near Vulcan and Lethbridge which have the highest numbers of fed cattle still have more cattle farms than most other CCS regions, but they no longer stand alone far above the rest of the province. This is the result of how much larger the farms in these communities are. Large feeding operations cause the pattern of concentration in the feeding industry as defined by farm numbers to be subordinate to that illustrated by numbers of fed cattle. The mean number of steers per farm in 2006 was 85 and the mean number of slaughter heifers per farm was 126. In the same year, Lethbridge County had 806 steers per farm, which doubled the mean farm size for all but one CCS region. Lethbridge County also had 1260 slaughter heifers per farm, again doubling the mean farm size for all but one CCS region. The agricultural communities with the most fed animals per farm are almost all located in the southern region of the province, in or around the zone of concentration for the feeding sector.

The changes occurring in the number of farms reporting fed cattle is opposite to that demonstrated by the number of farms engaged in cow-calf production. Almost every CCS region in the province has seen an increase in the number of farms reporting either slaughter heifers or steers, while these same communities almost universally report fewer farms containing either beef cows or replacement heifers. The changes initiated within the industry as a result of BSE favoured the sale of younger cattle, and impaired the economic viability of older cattle. Additionally, producers appear to have chosen to reduce herd size by slaughtering heifers. The common choice by producers to feed young female calves for slaughter rather than retaining them for reproduction has resulted in a reduction in the number of replacement heifers and an increase in slaughter heifer

numbers across the province. This change has subsequently initiated an increase in the number of farms reporting slaughter heifers and a corresponding decrease in farms reporting beef replacement heifers.

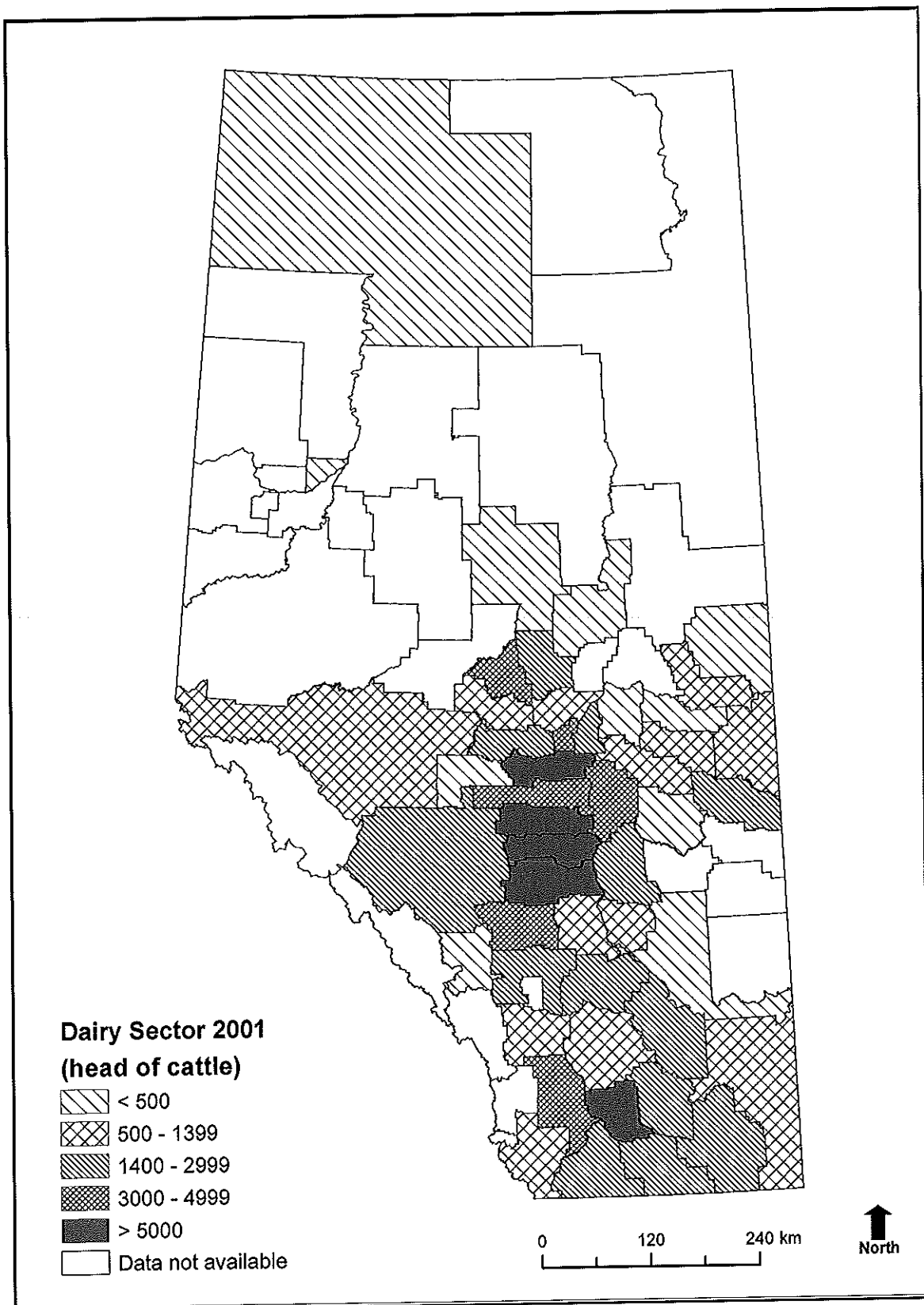
The number of farms reporting steers has an interesting spatial manifestation. Even though on a provincial level, the number of steers has declined very slightly by 1.66%, the number of farms reporting steers has grown in all but two of the agricultural communities in the province. Vermilion River County leads the way, with 114 more farms reporting steers in 2006 than in 2001. Stagnant steer numbers combined with ubiquitous growth in the number of farms reporting the animals indicate that there is a dispersion of steers in the province. It is possible that cow-calf producers have chosen to retain steers and young heifers to feed rather than selling them, as fed cattle represent a safer form of income than calf production.

## **5.7 Dairy Sector**

The dairy sector, as opposed to the cow-calf and feeding sectors, has a rather tenuous connection to the BSE shock. The primary economic impact sustained by dairy operations revolves around the depreciating value of older cows. As the level of milk production of a dairy cow wanes with age, declining productivity eventually renders older cows economic liabilities. These older cows are thus culled from the herd, and are sold as lower quality beef. Trade restrictions imposed in the wake of BSE have reduced the prices obtained by these older animals, reducing the profits garnered by dairy farmers. The sale of culled cows constitutes only a small portion the income generated by dairy operations, as more than 90% of profit is typically accounted for by the sale of fluid milk

(Lehenbauer and Oltjen 1998). Since milk is not known to be susceptible to BSE or any other known TSE, the product has withstood the BSE crisis unscathed, continuing to be a very strong profit driver for the dairy industry.

In 2001 the spatial organization of milk cows and milk heifers in Alberta was characterized by a significant urban bias (Figure 5.8). The region of highest concentration of dairy cattle was located in the Red Deer region between Calgary and Edmonton. In contrast to the geography of cow-calf production, secondary areas of concentration were located close to other centers of population. Agricultural communities near Lethbridge in the south, Lloydminster in the east, and north of Edmonton all have large numbers of milk cows and milk heifers. The County of Lethbridge has the greatest number of milk producing cattle in it with over 13,000 head. Leduc, Ponoka, and Lacombe counties, located between Calgary and Edmonton, all have dairy cattle populations exceeding 10,000 head. The fifth ranked county is Red Deer itself with 6,800 head, over 2,000 head more than the highest ranked county. Not only do these counties have more milk cows and milk heifers than any other community in the province, excluding Red Deer County they all have at least double the amount of milk producing cattle than any other county. The fact that these five communities comprise the core of milk production in Alberta illustrates the importance of proximity to urban areas in the dairy industry. The cities with the largest population in 2001 were Calgary, Edmonton, Red Deer, and the Lethbridge. All of these major population centres have a concentrated zone of dairy production nearby. Dairy products are highly perishable and expensive to transport, so locating close to markets is essential to the efficient maintenance of product quality and effective product distribution.

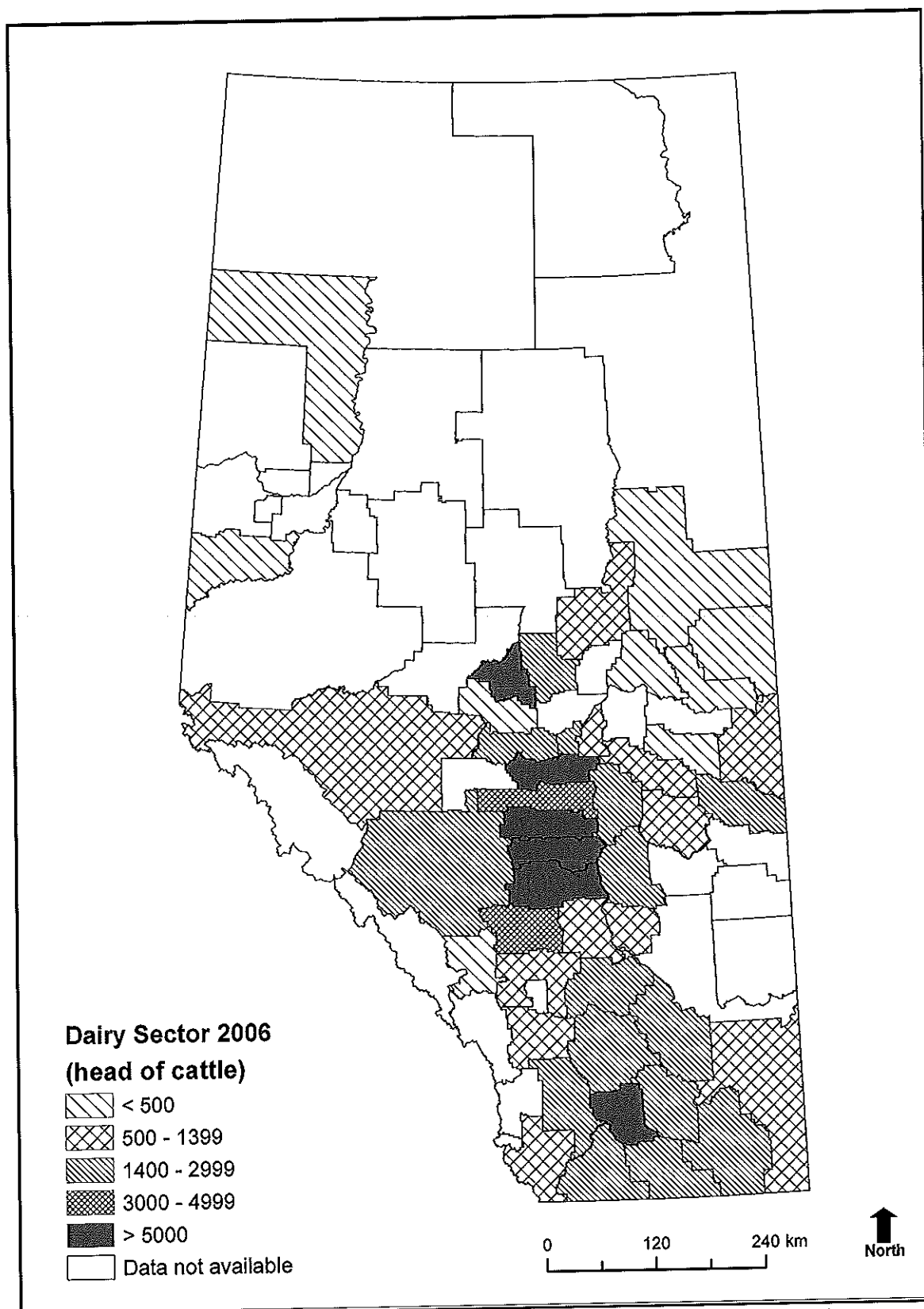


*Figure 5.8: Milk Cows and Milk Heifers in Alberta by CCS; 2001*

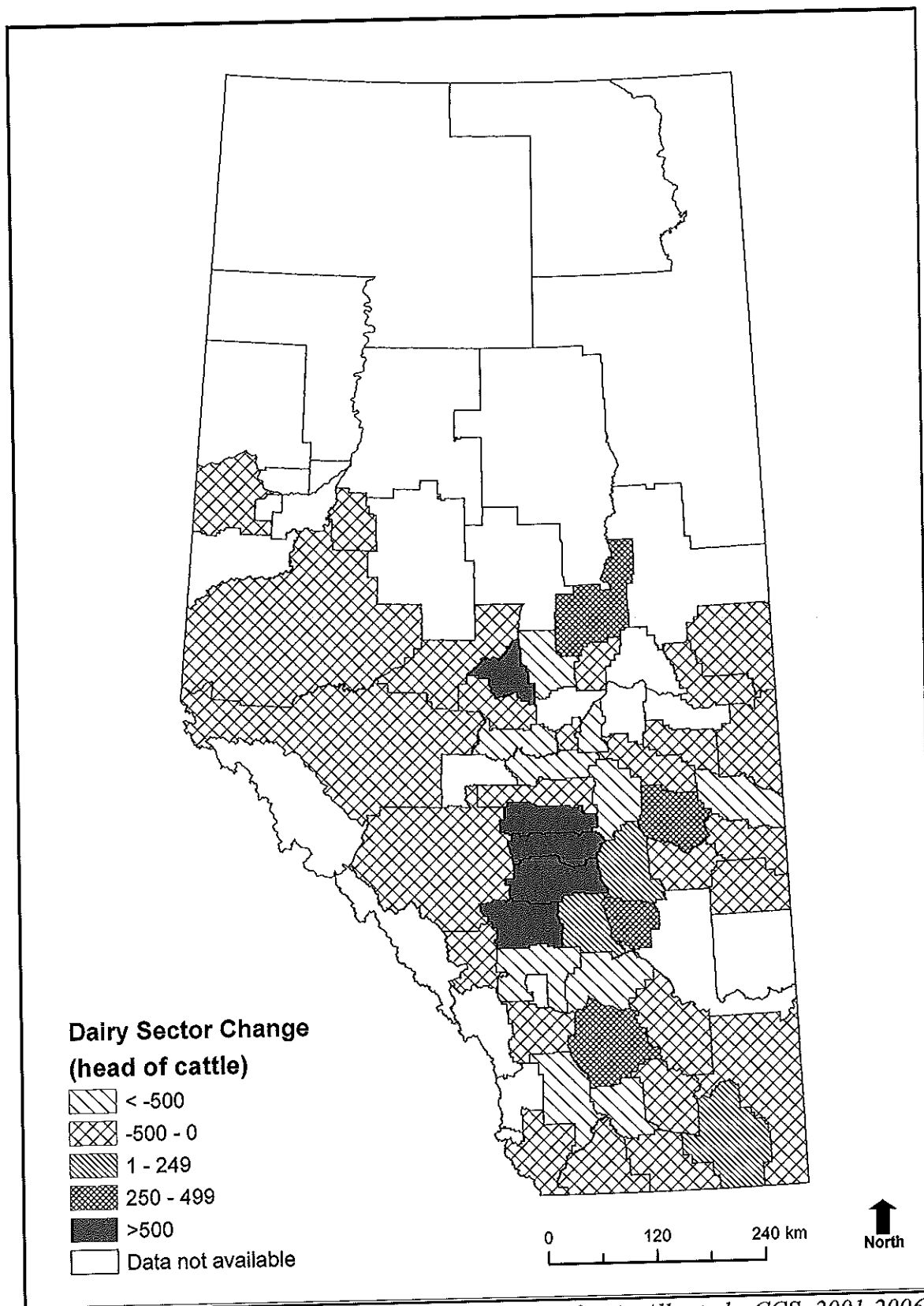
The isolation of the dairy industry from the consequences of the BSE shock of 2003 is evidenced by the unchanging geography of dairy cattle from 2001 to 2006. Clusters of milk cows and milk heifers observed in 2001 are again present in 2006 (Figure 5.9). The Red Deer area continues to comprise the core region of dairy production in 2006, and Lethbridge County remains among the counties containing the most milk cows and milk heifers. No change has been made in the top five communities with regards to numbers of milk producing cattle, and these communities all still contain far more dairy cattle than any other CCS region in the province.

There is no evidence to support any geographical restructuring having taken place between 2001 and 2006. This is evident from both the numbers of *animals* in dairy production, as well as the numbers of *farms* reporting milk cows and milk heifers (see Appendix C for details on the number of farms reporting milk cows and milk heifers).

Although the spatial pattern of change demonstrates some disparity in growth levels across the province, this differential growth does not threaten to alter the existing spatial pattern of milk production in the province (Figure 5.10). The regions of growth largely coincide with the centres of population in Alberta. The primary hub of growth in the dairy industry is located in the Red Deer area, which has already been established as the leader in milk production in Alberta. The region supplies dairy products to the most densely populated areas of the province, and as the populations of Calgary, Edmonton, and Red Deer grow, so do the numbers of dairy cattle close to them. As urban populations continue to grow, the dairy production proximal to these populations will also grow in order to meet an increasing demand for their products. The profit earned by milk, combined with the limited role played by the sale of culled cattle in profit



*Figure 5.9: Milk Cows and Milk Heifers in Alberta by CCS; 2006*



*Figure 5.10: Change in Milk Cows and Milk Heifers in Alberta by CCS; 2001-2006*

generation, has largely isolated the dairy industry from the consequences of BSE. At the farm level, one would not expect to encounter substantial ramifications stemming from BSE. This holds true when examining dairy production at the industry level. Any consequences incurred by the disease are not detectable in the evolving geography of milk cows and milk heifers in the province. In spite of any small regional deviations that may exist, the spatial organization of the dairy industry is characterized primarily by its focus on centres of population. BSE appears to have had no impact on the spatial organization of dairy production in Alberta.

## **5.8 Conclusion**

Upon analysis of the changes in cattle numbers in Alberta from 2001 to 2006, it appears that the consequences of BSE have impacted the geography of the cattle industry in Alberta. Two major intertwining trends exhibited by the cow-calf and feeding stages of production highlight these changes. The first of these is the general trend of growth evident in the number of slaughter heifers in the province, the only statistical category to experience growth. Accounting for this growth are producer choices to raise young female cattle for slaughter and consumption rather than for reproductive purposes at the outset of the changing economic reality brought on by BSE. The spatial manifestation of this growth can be observed in the rapid growth of fed animals in CCS regions near the very polarized core of fed animal production in Alberta. The counties of Vulcan and Kneehill, located just north of Alberta's unchallenged principal producer of fed cattle, are the champions of this growth. In contrast, the biggest owners of fed cattle experienced the most severe declines in the numbers of these animals between 2001 and 2006. These

changes represent a subtle shift in the composition of the core of fed cattle production in Alberta. The number of farms reporting slaughter heifers increased in almost every CCS in the province, including those that had experienced the most substantial declines in the number of animals.

The second major trend is the decline in the number of beef replacement heifers. This trend directly opposes the trend of growth in the number of slaughter heifers, as it reflects the choice to slaughter females that might otherwise have been used for reproduction. These changes were manifest in a spatial trend of divergence within the cow-calf industry, as growth was evident in some of the more peripheral regions of the province. Lower levels of growth, and even decline were observed in the Red Deer area in which the core of cow-calf production had been situated in 2001. It is evident that the composition of the cow-calf industry (roughly 90% beef cows and 10% beef replacement heifers), has isolated the sector from the severity of the decline in replacement heifer numbers. Older beef cows have likely been used for reproduction longer in lieu of replacement by heifers. The number of farms reporting beef cows and replacement heifers has declined in almost all CCS regions in the province, which is opposite to the trend exhibited by farms reporting steers and slaughter heifers.

New economic factors introduced in the wake of BSE, particularly the UTM export restrictions imposed by the United States, have altered the markets for Canadian cattle and beef. Much of the response has revolved around choices farmers have made regarding female calves. The trends indicate that cattle producers have chosen to feed these female calves with the intent to slaughter them rather than maintaining them for reproduction. The result has been a changing geography in both the cow-calf and feeding

stages of production. The feeding stage has grown substantially in a few selected regions, but the nearly ubiquitous growth in farm numbers across the province demonstrates the breadth of this growth. The cow-calf sector exhibits a spatial trend of divergence, and declining numbers of farms indicate producers have chosen to limit cow-calf production.

It is evident that the cow-calf sector is faced with declining desirability for farmers, while the feeding sector has become an increasingly desirable practice. The economic changes following BSE are still in flux, and the permanence of these spatial and structural changes remains to be seen. BSE created a new economic atmosphere, but this atmosphere is still evolving. As the economics of cattle production slowly work towards a stable equilibrium, the changes that have occurred in the cattle industry may either deteriorate or continue to evolve, depending upon the permanency of the economic changes BSE initiated, and upon the permanency of the changes in the cattle herd of Alberta.

## **Chapter 6**

### **Impacts of BSE on Community Economic Structure**

#### **6.1 Introduction**

The second consideration of this study is the geography of the impacts of BSE at a community level. The losses sustained by cattle producers in the wake of BSE have been well documented. The objective of chapter six is to examine the geography of the impact of this ripple effect on community economic structure. The chapter begins with a discussion of some of the conceptual background for this examination. Following that are the results, which are divided into three sections. The first section examines the response to BSE of the key inputs and outputs to cattle production at a provincial level. The second component summarizes the geographical dimensions of the changes in the key input and output industries. Finally, the third component compares the influence of the geography of cattle production upon the geography of the key industries to the influence the geography of Alberta's human population has on them.

#### **6.2 Background**

Central Place Theory is the conceptual background used to assess the impact of BSE upon community economic structure. Communities in the lower echelons of the urban hierarchy that are most closely connected to their rural hinterlands are of particular interest. There is a strong connection between communities in Alberta and their agricultural hinterlands (Stabler and Olfert 2002). This connection has made rural settlements vulnerable to the economic consequences of BSE (Mitura and Dipietro 2004).

The economic consequences of BSE may reverberate through the economies of small towns and rural communities that depend on cattle producers to use the goods and services they offer. This ripple effect will be experienced in varying levels of severity, depending on the nature and strength of the connection held by a particular business with the cattle industry. The geography of cattle production is another important consideration.

The spatial distribution of cattle in Alberta is not uniform, but is subject to regional variations. The influence of physical, and economic factors, play a part in determining the location of cattle production (Ross et al. 1990; MacLachlan 2001). Since cattle are not equally shared across the province, it stands to reason that the consequences of BSE will be spatially variable as well. The impacts of BSE in a region should be commensurate with the prominence of cattle production in that region. This has been found to be true in the regionally variable impact of BSE in Northern Ireland (Caskie et al. 1999). An analysis of the impacts of BSE in Western Canada suggests that the impact of BSE in Canada is spatially variable as well (Serecon Consulting 2004). In places where cattle production is important, an increased susceptibility to the economic fallout of BSE exists. Conversely, areas with lower levels of cattle production navigated the BSE shock more easily.

In addition to the influence of geography, economic characteristics may be a determinant of the regionally variable impacts of BSE on community economic structure. The economy of Alberta has roots in many different economic activities. The breadth of these activities limits the interactions between dissimilar industrial practices. The ebb and flow of the cattle industry may not be perceived by industries that are economically

distant. Additionally, economic changes stemming from the BSE situation represent only one facet of the many changes occurring in the complex and continuous evolution of the provincial economy. As a result, not every industry will feel the effects of BSE with enough severity to elicit a detectable spatial response. An examination of the entire economy as defined by 6 digit NAICS categories would thus prove to be both inefficient and largely ineffective, as a majority of the categories would demonstrate no detectable response. Examining the economy using more general 2 or 3 digit NAICS categories would solve this by drowning out the signatures of specific industries isolated from the BSE situation. The cost of this would be the absorption of subtle changes reflected by specific industries that are closely tied to beef production.

The 6 digit NAICS industries identified in the interview process as key inputs and outputs to cattle production are used to assess the impact of BSE on community economic structure. Industries closely tied to cattle production are included, while industries distant from cattle production have been omitted. The economic impacts of BSE on specific industries can be assessed while avoiding the use of cumbersome aggregated industrial categories. The input and output sectors identified represent direct forward and backward linkages to cattle production in Alberta. These industries are the most susceptible to an economic ripple effect that begins in the cattle industry (Midmore 1993). The number of business establishments in each of these key industries is examined.

### **6.3 Provincial Level Response of Key Inputs and Outputs to BSE**

This section discusses a broad provincial level examination of the response of the key input and output sectors to the economic consequences of BSE. Provincial level data were compiled for all of the NAICS defined industries in June and December of every year from 2001 to 2006. The changes exhibited by the number of businesses in each of the key economic sectors were scrutinized in an effort to discover any aberrant trends tied to the BSE situation which began in May of 2003. Four general trends emerged characterized by growth, zero growth, decline, and erratic change.

#### **6.3.1 Growth**

Sustained growth was a commonly occurring pattern, and was demonstrated by the local freight, veterinary services, and machinery and equipment repair and maintenance industries (Table 6.1). In addition to their economic interaction with beef producers, all three of these industries have strong ties to urban clients, catering to a broader market than just agricultural consumers. Ties to urban regions, where population growth precipitates increasing demand for goods and services of all types, account for much of the sustained growth in these sectors. The broad NAICS descriptions characterizing these industries allow them to encompass both the rural and urban based components of their operations. Livestock transport, for example, is just one component of a 6 digit NAICS category that encompasses many types of short range transport. Such a broad category isolates the industry category from BSE, as changes in the number of livestock transport businesses are diluted by the lack of change in other types of freight within the category. Veterinary services and machinery repair industries are subject to similar urban

*Table 6.1: Business Establishments in Alberta by Industry*

|                                                                                                                      | June<br>2001 | June<br>2002 | Dec<br>2002 | June<br>2003 | Dec<br>2003 | June<br>2004 | Dec<br>2004 | June<br>2005 | Dec<br>2005 | June<br>2006 |
|----------------------------------------------------------------------------------------------------------------------|--------------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|
| 221310 - Water Supply and Irrigation Systems                                                                         | 145          | 146          | 149         | 149          | 157         | 158          | 159         | 160          | 150         | 152          |
| 311611 - Animal (except Poultry) Slaughtering                                                                        | 64           | 69           | 66          | 62           | 64          | 66           | 67          | 64           | 63          | 62           |
| 311614 - Rendering and Meat Processing from Carcasses                                                                | 98           | 95           | 99          | 94           | 95          | 91           | 92          | 94           | 96          | 99           |
| 316110 - Leather and Hide Tanning and Finishing                                                                      | 17           | 15           | 17          | 15           | 16          | 14           | 13          | 13           | 13          | 11           |
| 333110 - Agricultural Implement Manufacturing                                                                        | 86           | 85           | 86          | 85           | 87          | 83           | 85          | 84           | 80          | 82           |
| 411110 - Live Animal Wholesaler-Distributors                                                                         | 196          | 214          | 221         | 224          | 232         | 242          | 238         | 223          | 213         | 212          |
| 412110 - Petroleum Product Wholesaler-Distributors                                                                   | 468          | 460          | 463         | 448          | 428         | 436          | 413         | 388          | 382         | 389          |
| 418310 - Agricultural Feed Wholesaler-Distributors                                                                   | 94           | 95           | 98          | 101          | 99          | 98           | 99          | 97           | 96          | 99           |
| 418390 - Agricultural Chemical and Other Farm Supplies Wholesaler-Distributors                                       | 204          | 208          | 205         | 215          | 216         | 217          | 267         | 265          | 268         | 264          |
| 419110 - Farm Product Agents and Brokers                                                                             | 119          | 109          | 109         | 104          | 104         | 106          | 103         | 107          | 102         | 108          |
| 484229 - Other Specialized Freight (except Used Goods) Trucking, Local                                               | 595          | 637          | 634         | 633          | 682         | 696          | 705         | 733          | 729         | 807          |
| 541940 - Veterinary Services                                                                                         | 493          | 528          | 538         | 540          | 565         | 578          | 590         | 603          | 588         | 605          |
| 811310 - Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance | 3862         | 4461         | 4592        | 4646         | 4840        | 5040         | 5085        | 5280         | 5276        | 5681         |

biases. The ubiquitous nature of veterinary services catering to pet owners overwhelms the smaller number of veterinary practices with an agricultural focus. The machinery repair industry serves any type of business with large industrial machinery, drowning out the subtle responses of those particular businesses catering to clients involved in agriculture. Although urban biases characterize the growth trends of these industries at a provincial level, the specific needs of cattle producing regions may ensure a stronger role for them within certain regional economies.

### 6.3.2 Zero Growth

The irrigation, farm agent, agriculture implement, and rendering industries all exhibited trends of zero growth. No substantial growth or decline is observable for any of these sectors over the five year period. Subtle fluctuations are evident, but are largely balanced by countervailing changes at other points in the timeline. None of these fluctuations exceeds a change of 6.25% and only 4 exceed 5% over any six month span. None of the substantial fluctuations occur subsequent to one another in the data timeline, indicating an absence of sustained change. The only change in any of these three industries with a potential temporal correlation with BSE in May of 2003 is a 5% increase in the number of irrigation businesses in the province from June to December of 2003. The number of businesses in this industry immediately plateaus following this jump, and begins to decline in December of 2005. It is a small deviation that is not sustained, and there is no indication that it is anything but a normal fluctuation. The constancy of the number of businesses in these industries over time indicates the absence of a unified response to BSE at a provincial scale as measured through business establishment numbers.

The agricultural feed industry exhibits a pattern of zero growth as well. Distinguishing this particular industry from the others with zero growth trends are small fluctuations in business numbers which are temporally correlated with the discovery of BSE. Immediately following June of 2003, business numbers briefly decline. This decline is subtle, never decreasing by more than 2% semi-annually, and by June 2006 the number of businesses has essentially regained pre-BSE levels. Serving producers of many types of livestock, the agricultural feed industry is more likely to have withstood a period of restructuring and diversification than to have sustained bankruptcies as a result

of the impact of BSE on cattle producers. The short period of decline may represent this period of uncertainty. As the industry evolved in response to BSE and the effects of the disease abated, the number of agricultural feed sales businesses recovered. Along with the other industries exhibiting trends of zero growth, the agricultural feed industry appears to be indifferent to the BSE shock, especially in the long term.

### **6.3.3 Decline**

The petroleum industry was the only key industrial sector to exhibit a steady decline in business numbers. Business numbers consistently decline between 2001 and 2006, averaging -2% for every 6 month period. There are subtle fluctuations in this trend of decline, but given the broad economic base of the market for petroleum sales, and the lack of temporal correlation with the incidence of BSE, there is little to suggest that these provincial level changes are a result of the disease.

### **6.3.4 Erratic Trends**

The remaining industry sectors are characterized by trends of change in which specific patterns are difficult to identify. The leather, slaughter, and livestock auction industries all exhibit these erratic trends of change between 2001 and 2006, and each are addressed in this section.

Immediately following June of 2003, the number of businesses in the slaughter industry increases until December of 2004, at which point it resumes a trend of decline. Alberta's limited capacity to slaughter cattle following the closure of the American border in May of 2003 resulted in a bottleneck whereby a limited production release

valve accentuated the issue of a burgeoning supply of cattle (Senate Committee 2005). The observed increase in slaughter facilities in Alberta could be indicative of a push to relieve the pressure of the growing cattle supply through an increase in domestic slaughter capacity. Industrial changes in the wake of BSE did lead to a marginal increase in domestic slaughter rates for Canadian cattle (Senate Committee 2005). The CBP business numbers indicate that in Alberta, the number of slaughter facilities has in fact decreased in recent years. These numbers do not take into account the increased capacities in existing slaughter plants in the province.

The number of businesses in the livestock auction industry increases consistently until June of 2004 before embarking on a period of decline which begins to level off by June of 2006. This trend could be tied to BSE, and could reinforce the idea that auction services were impacted by the changes to the beef industry precipitated by BSE. The decline in business numbers may be a reflection of bankruptcy and exit occurrences initiated by reduced profits in the immediate post-BSE cattle production economy.

The number of businesses in the leather industry exhibits a particularly erratic pattern of change. The limited presence of the industry within the province, with only 17 businesses fitting into this category in 2001, may be culpable for this trend. Although the industry often fluctuates by over 10% semi-annually until December 2003, it never actually grows or shrinks by more than two businesses over the entire five year period. A period of decline commences in December of 2003. One possible explanation is that the businesses in this industry may not be connected to cattle production, but to processing the hides of different animals.

Agricultural chemical industries rose tremendously in the number of businesses between June and December of 2004. The number of business establishments in this industry remains otherwise devoid of significant fluctuations either before or after this increase. This curious increase is indicative of a change in the enumeration of this industry. Although the NAICS category describing this industry has remained static through a few iterations of the NAICS system, this does not preclude the likely possibility of the influence of a statistical factor rather than a real-world economic influence.

#### **6.4 Summary of Provincial Level Response of Key Inputs and Outputs to BSE**

The changes in business numbers in the key industries do not indicate a connection to BSE at a provincial level. The absence of a system wide pattern detectable in these key economic sectors indicates the absence of a unified response to the consequences of BSE. Trends of consistent growth, zero growth, and decline are absent of major fluctuations, and those sectors with erratic trends of change were absent of uncharacteristic changes correlating with May of 2003. Economic consequences of BSE that have been sustained by these industries are not detectable on the basis of the number of businesses at a provincial level. This is not altogether unexpected, as the reverberation of the BSE shock upwards through the economy will be more pervasive for those regions more deeply reliant upon cattle production. A large proportion of the businesses in Alberta reside in Calgary and Edmonton, the two cities on top of the province's urban hierarchy. The broad economic base of these centres helps to isolate them from the economic fluctuations of individual industries. In addition, the economic diversity inherent to such

centres creates a great deal of intervening options for suppliers to the agriculture industry. Given the substantial contribution of Calgary and Edmonton to the industry totals in Alberta, a provincial-level response to BSE is unlikely to be detected.

The difficulty in detecting a response to BSE at the provincial-level does not indicate the absence of an economic ripple effect. An examination of the sub-provincial geography of the key upstream and downstream linkages to cattle production may help to isolate an economic impact, as extreme regional responses to the disease are more likely to be detected at a finer spatial scale.

### **6.5 Geography of Key Inputs and Outputs**

The examination of changes occurring to the key input and output industries province-wide is merely an initial and low resolution search for economic ripple effects emanating from the BSE shock. Examining the spatial pattern demonstrated by these changes is the next level of analysis. The varying composition of regional economies paves the way for the existence of spatial variability in the consequences of the disease across the province.

The spatial organization of each of the key economic sectors across the province was examined. CBP business establishment data for June of 2001 and 2006 were aggregated to a CCS level of geography. The six month temporal resolution used to study provincial level changes was discarded for the geographical analysis. The high spatial resolution of a CCS level geography limits the number of businesses present in each region. Subtle changes are more easily detectable, but the severity of these changes can be exaggerated due to lower numbers. For many of the agricultural regions containing only a handful of businesses within certain industries, annual fluctuations as high as 100% are not

uncharacteristic. Examining the evolution of this geography using two points in time straddling the discovery of BSE removes semiannual fluctuations, and dissolves some of the noise in the dataset.

In this component of the analysis the NAICS classification system becomes problematic. Designed to enumerate the economies of larger regions, national economies in many cases, the specific categories described by NAICS are less conducive to the examination of the specialized economies of smaller regions. NAICS industries are not distinct enough to pertain only to the specific agricultural economy under scrutiny. Many categories, even at the 5 or 6 digit level, describe more than one specific industry type. The freight industry can be used to illustrate this problem. The 6 digit NAICS category defining local freight includes most forms of short range transport, and cannot be further subdivided to enumerate businesses engaging specifically in the transport of cattle. This introduces the potential for the classification system itself to influence the economic changes detected in some of the key input and output industries.

Additionally, changes in a specific industry initiated by BSE are balanced by that industry's relationship with other parts of the economy. The real effect of BSE upon cattle transport businesses is tempered by external forces allowing the transport industry to use non-agricultural customers to support operations.

The geography of the key input and output industries is characterized by two main patterns. The former is characterized by spatial clustering around the urban settlements in the province, while the latter is a crescent pattern demonstrating the influence of agriculture on some of the industries. The following sections describe these two patterns.

### **6.5.1 Strong Urban Bias**

The influence of the large urban places in Alberta upon the location of industry is evident in the spatial pattern of each of the key upstream and downstream economic sectors. Major nodes of industrial concentration occur in and around both Calgary and Edmonton, and minor nodes are evident near Lethbridge and Red Deer. Even though the industries under examination are tied to agricultural functions, the economic complexity, diversity, and breadth of larger urban centres facilitates the congregation of these industries around them. These metropolitan concentrations must be taken into account when analyzing the spatial organization of the specific industries tied to cattle production. Although all of the key sectors are marked by the influence the urban places in Alberta, the geographies of the transport, machinery repair, petroleum, slaughter, and rendering industries are especially characterized by the geography of urban places. High concentrations of these industries are evident within and around Calgary, Edmonton, Red Deer, and Lethbridge. The regions of the province distant from these urban centres have fewer businesses engaged in these industries. This pattern demonstrates the influence of the urban system upon industries tied to rural economic functions.

In addition to the aforementioned industries, the business establishments comprising the veterinary industry also conform to an urban-influenced spatial pattern. Although the same four cities remain the nodal focal points of this geography, a subsidiary pattern is present as well. In the peripheral regions of the province, there are some communities containing more veterinary businesses than would be expected given the urban trend evident. These communities tend to be those located within the crescent of cattle production identified in chapter five. Vermilion County and Cypress County, the

terminal points of this crescent, along with a number of CCS regions in and around the Red Deer area, have more veterinary businesses than many of the other rural communities in the province.

### **6.5.2 Crescent Pattern**

The second spatial pattern observed in the key economic sectors is a crescent pattern, an obscured version of which was identified in the spatial organization of veterinary services. The agricultural implements, livestock auction, agricultural chemicals, and farm agents industries all conform to this pattern. In contrast to the weak manifestation of this pattern demonstrated by veterinary services, these four industries illustrate the crescent shape in a bolder fashion. A very clear urban bias still exists in which the largest cities in the province contain more businesses than do any of the other regions. This is to be expected, as the precepts of Central Place Theory dictate that the primacy of urban places will be correlated with their size and level of economic diversity. In the case of these four industries, however, the remaining businesses are distributed primarily within this agricultural crescent. This spatial pattern shows the spatial correlation between agricultural production and some of the key input and output industries. Vermilion and Cypress Counties again stand out as regions with many businesses in the key input and output industries, as do a number of CCS regions in the Red Deer area.

### **6.5.3 Change**

None of these key industries has undergone a substantial change in its spatial organization between 2001 and 2006. The strong urban influence that was so influential

in the initial spatial patterns a strong driver of the spatial variation in changes that have occurred. For most of the industries, the greatest growth has occurred in regions close to major urban centres. For many of these industries those urban regions were already at the core of their existing spatial concentrations. The impetus for the spatial change in these industries following the discovery of BSE seems to be derived from major urban centres in the province. Any spatial response to the BSE situation at this level is too subtle to be detected in the shadow of the economic influence of the large cities in the province.

There are some aberrations from the metropolitan influenced patterns of economic change, the most notable of which is demonstrated by the chemicals industry. Having exhibited the most unique of the aggregate provincial growth trends, this industrial sector again deviates from the patterns of the key industries. This sector had conformed to the agricultural crescent pattern with more lucidity than most, and this crescent shape emerges in the spatial organization of change in the industry. Rather than growing in regions close to urban centres, the agricultural chemical industry grows the most in the Red Deer area, as well as in other CCS regions located within the agricultural crescent. This growth thus appears to be more extensive in the regions that had previously been heartlands for the agricultural chemicals industry.

## **6.6 Key Inputs and Outputs and Population**

Besides being a core region of cattle production within Alberta, the corridor between Calgary and Edmonton is one of the fastest growing regions in Canada, chalking up some of the strongest gains in terms of both GDP and population in comparison to other urban areas across North America (TD Economics 2003). The increasing economic primacy of

the region allows it to exert a great deal of influence upon the entire provincial economy. Agricultural communities in nearby regions are particularly susceptible to its economic leverage. Economic changes occurring in the Calgary-Edmonton Corridor tend to be linked to those occurring in the entire province. Given the industrial strength of the region, it is possible that this economic hearth is driving changes occurring in distant economic sectors, including the key upstream and downstream linkages to cattle production. The influence of urban places upon the business conducted by industries with a primarily agricultural clientele may be accentuated in regions close to major economic centres. In addition to the Calgary-Edmonton Corridor, the economies of Lethbridge, Medicine Hat, Lloydminster, and Fort McMurray represent secondary urban economies whose influence, though less extensive, may have similar effects on nearby rural areas. This introduces the question of whether the impetus for the changes occurring in the inputs and outputs to cattle production lies in the cattle industry itself which has been painted by the BSE shock, or if this change is more closely tied to the momentum of the metropolitan influences in the province.

Besides BSE, the economic growth of the Calgary-Edmonton Corridor is likely the phenomenon with the greatest potential impact on the changes manifest in the key inputs and outputs to cattle production between 2001 and 2006. As one of the fastest growing regions in the country, this economic centre has impacted growth trends in many industries, particularly those closely tied to the oil and gas industry in Alberta (TD Economics 2003). This influence likely includes industries such as the key inputs and outputs to cattle production. If the urban system of the province proves to be a stronger

driver of change than BSE, then limits can be placed upon the economic influence of BSE upon community economic structure.

To determine which of the two factors is a more consequential driver of the changes occurring to the key economic sectors, the influence of each upon the spatial organization of these sectors must be analyzed. The geography of cattle production and of urban places will be compared to the geography of each of the inputs and outputs to cattle production to determine which factor has a stronger spatial correlation with each industry. The factor whose geography demonstrates the strongest association with the industries under examination likely plays a larger role in determining the spatial organization of those industries.

The geography of cattle production represents spatial variation in the consequences of BSE, and is accounted for by the number of cattle located in each CCS region. Population numbers in each CCS represent the geography of the urban centres of the province. Both of these influencing factors, along with the key economic sectors will be enumerated at a CCS level of geography.

The industries serving as upstream and downstream linkages to cattle production, are lower order goods and services, and according to the Central Place Theory, are unlikely to serve a consumer base located much beyond their local regions (Stabler and Olfert 2002). This is true whether the industries cater to the population of a large urban centre or serve a more sparsely populated rural hinterland, as the demand threshold attached to a particular business is not affected by the primacy of the trade centre in which it is situated. The changes occurring in each of these industries and their association with either population or cattle numbers will thus be examined using discrete community

units. Correlation measures facilitate this analysis by allowing for a system-wide measure of the relationships between the factors identified while ensuring that each CCS (or community unit) is considered to be unique and discrete. Although more complex spatial statistics have certain advantages, developing basic correlation matrices aids in capitalizing on some of the basic assumptions of central place theory.

Each CCS is included in a database along with the corresponding values for its contingent categories of cattle numbers, population, and key input and output industries. Matrices detailing the correlation between each pair of data categories reveal a system of relationships. Parallel matrices are developed for 2001, 2006, and for the change occurring between those two points in time. Absolute numbers of cattle, population, and business enterprises delineate relationships in both 2001 and 2006, while relative values  $((t_2-t_1)/t_1)$  are used to describe the changes over the five year time period.

#### **6.6.1 Cattle Numbers and Key Inputs and Outputs**

In 2001, all but two of the thirteen key economic sectors demonstrated significant ( $p < 0.05$  Spearman rank) correlations with the location of cattle at the 0.05 level in a two tailed Spearman's test (Table 6.2). The correlation values represent the extent to which the amount of cattle in communities corresponds to the number of businesses in the key economic sectors in those same communities. The two industry sectors not displaying a significant spatial correlation with cattle numbers were the leather hide tanning and finishing and the irrigation supplies industries. The leather industry has only twenty business establishments in the province, so finding a correlation between the location of businesses in this industry and any factor across the 76 CCS regions in Alberta is

unlikely. The weak association embodied by the irrigation industry can be accounted for by the strong southern bias in the geography of the industry.

*Table 6.2: CCS Level Correlation Values (Spearman's r)*

| Industry 2001 (number of business establishments) | Cattle 2001 | Population 2001 | Industry 2006 (number of business establishments) | Cattle 2006 | Population 2006 |
|---------------------------------------------------|-------------|-----------------|---------------------------------------------------|-------------|-----------------|
| Irrigation                                        | 0.097       | 0.458*          | Irrigation                                        | 0.166       | 0.495*          |
| Slaughter                                         | 0.377*      | 0.495*          | Slaughter                                         | 0.282*      | 0.527*          |
| Rendering                                         | 0.312*      | 0.657*          | Rendering                                         | 0.236       | 0.681*          |
| Leather                                           | 0.083       | 0.479*          | Leather                                           | 0.064       | 0.355*          |
| Implements                                        | 0.283*      | 0.507*          | Implements                                        | 0.310*      | 0.540*          |
| Livestock Auction                                 | 0.576*      | 0.684*          | Livestock Auction                                 | 0.569*      | 0.688*          |
| Petroleum                                         | 0.280*      | 0.674*          | Petroleum                                         | 0.276*      | 0.675*          |
| Feed                                              | 0.532*      | 0.639*          | Feed                                              | 0.381*      | 0.571*          |
| Chemicals                                         | 0.416*      | 0.554*          | Chemicals                                         | 0.342*      | 0.486*          |
| Farm Agents                                       | 0.424*      | 0.519*          | Farm Agents                                       | 0.408*      | 0.564*          |
| Transport                                         | 0.308*      | 0.736*          | Transport                                         | 0.259*      | 0.783*          |
| Veterinary Services                               | 0.490*      | 0.812*          | Veterinary Services                               | 0.430*      | 0.838*          |
| Machinery Repair                                  | 0.302*      | 0.859*          | Machinery Repair                                  | 0.299*      | 0.861*          |

Note: \* indicates  $p < 0.05$

Although the relationships for most of the sectors are deemed significant, the Spearman values measuring their association with regional cattle numbers are relatively weak. Only feed sales companies and auctions have correlation coefficients greater than .500. The relationship between the geography of cattle and that of the key economic sectors at a CCS scale is relatively weak. This relationship is significant enough, however, to indicate the presence of a relationship between the two geographies. The fact that eleven of the key economic sectors have maintained significant spatial correlations with cattle numbers validates the status of these sectors as key linkages to cattle production, since they do exhibit a tendency to be located in the CCS regions with greater cattle numbers.

The industry sectors with which the location of cattle had significant ties in 2001 are generally the same industries with significant relationships in 2006. Weak to moderate

correlations are again evident for most of the key input and output sectors, as the values obtained for each sector in 2006 changes very little from the values obtained in 2001. A notable exception is that the correlation between the rendering industry and cattle declined substantially, and was no longer significant by 2006. Livestock Auctions are the only key industry to register a correlation coefficient above .500 in 2006.

Most of the economic sectors do experience declining levels of association with cattle numbers over the five year period that are small to negligible in size. None of the sectors with a significant association with cattle numbers in 2001 sees that association increase. The two industries whose relationships with cattle numbers weakened the most were the agricultural feed industry and the slaughter industry. Declining correlation coefficients indicate that the geographies of the industries and the geography of cattle are diverging.

In both 2001 and 2006, the communities containing more cattle tend to house more of the industries serving as key upstream and downstream linkages to the cattle production industry. This underscores the fact that despite the ability of many of these industries to diversify and serve clientele beyond rural consumers, they are still apt to locate in regions where cattle production is more prominent. Most of the correlation values observed are quite weak, however, which places limitations upon the level of dependence these key sectors have upon the cattle production industry.

The geography of Alberta's cattle herd underwent significant change between 2001 and 2006. The key input and output industries may have undergone a spatial reorganization within the province as well, given their connection to the cattle industry. Businesses no longer able to depend upon cattle producers as a market for their goods or services may have suffered following BSE. Responses such as bankruptcy and relocation

may be detectable in the geographic pattern of the key economic sectors. The correlation values connecting changes in key economic sectors with changes in regional cattle numbers provide an indication of the connection between the regional exit and entry of industries and the spatial changes manifest in the cattle industry between 2001 and 2006.

The nonparametric correlation test comparing the relative change experienced by cattle numbers with the relative change experienced by the key industrial sectors indicates that changes in the regional geography of cattle in Alberta were not echoed by the geography of the key economic sectors. The only changes in regional numbers of business establishments to demonstrate a significant, albeit weak, correlation with regional changes in cattle numbers were experienced by the agricultural chemicals industry and the transport industry. Changes in business numbers in the remaining industries were characterized by very weak associations with changes in cattle numbers. This may be partially attributable to the rapid changes in cattle numbers across the province, to which industry numbers have been slow to respond. It is more likely that the presence of other opportunities for these businesses and an ability to be flexible, combined with the gradual recovery of the cattle industry from BSE, have limited the spatial responses of the key economic sectors. The key economic sectors, the components of regional economies most susceptible to the rise and decline of cattle production, did not change in synch with the spatial changes in cattle numbers following BSE in 2003.

### **6.6.2 Population Levels and Key Inputs and Outputs**

This section examines correlations between regional population levels and business numbers in the key input and output sectors. The objective of this section is to discern whether the urban system offers a better explanation for the geography of the key inputs and outputs to cattle production than cattle numbers.

The geography of population has a significant correlation with each one of the key input and output sectors in 2001 (Table 6.2). The three sectors demonstrating the strongest correlation with the location of population are the veterinary services, machinery repair, and transport industries, all with correlation coefficients exceeding 0.700. All three of these industries cater to a clientele that is predominantly urban, while agricultural and rural clients comprise a limited share of the business they conduct. The strength of the relationships between regional populations and key economic sectors indicates that population levels are associated with the presence of these agriculturally important industries.

The correlation matrix for 2006 is similar to 2001. Again the relationships are significant for all of the key sectors and their spatial correlation with CCS populations in Alberta. Despite generally modest changes, the relationships between industries and population as gauged by correlation coefficients remain very similar. Industries with a tendency to congregate in communities with greater regional populations in 2001 retain that spatial association in 2006. Most of the industry sectors do, however, undergo modest increases in their spatial correspondence with centres of population. None of these increases were significant enough to suggest population as the exclusive factor in determining the regional growth in any particular industry, but the fact that strengthening

relationships were evident for nearly all the industries lends significance to the limited size of these increases. There are three industries for which the strength of the spatial relationship with regional populations declined between 2001 and 2006. Agricultural feed sales and agricultural chemicals declined by close to 0.70, while the leather industry dropped by slightly more than .120. On the whole, the key input and output sectors demonstrate a greater propensity to locate in regions with larger populations in 2006 than in 2001.

### **6.6.3 Cattle Numbers and Population Levels**

Many of the NAICS industries connected to cattle production in Alberta are characterized by an inherent diversity and flexibility. Broad categorizations allow the industries to cater to a wide range of different consumers, lending them adaptive freedoms in the face of the vicissitudes of the cattle industry. Many of the key input and output industries can be molded to serve agricultural and non-agricultural clients outside of cattle production. In many cases a limited association with cattle production, under which an input or output serves to satisfy only one specific need of cattle producers, limits dependence on cattle production. These factors limit the strength of the spatial associations that emerge between the key input and output industries and cattle in Alberta. As a discrete and independent analysis, the correlations detailing these relationships are of limited value. The urban system, along with its economic influence which pervades rural hinterland regions, acts as an alternative influence upon the geography of the key economic sectors. By comparing the geography of the key economic sectors to both cattle numbers and

human populations, the influence of the urban system upon the spatial organization of these key economic sectors can be compared to that exerted by the cattle industry.

Given the connection between the cattle industry and the key economic sectors, it seems intuitive that these businesses would preferentially locate in regions where cattle production is common. Such preferential location is confirmed by the number of significant relationships existing between the key economic sectors and the size of regional cattle herds. These relationships are rather weak, however, indicating that cattle numbers play only a fractional role in determining the location of the key inputs and outputs to cattle production.

Regional human populations have a stronger association with the geography of the economic sectors tied to the cattle industry than do the regional numbers of cattle. According to nonparametric Spearman correlation tests, the relationships between regional populations and the key inputs and outputs to cattle production were much stronger than the relationships between regional cattle numbers and these industries. The correlation coefficients relating population to the key industries are universally higher than those relating cattle to the key industries in both 2001 and 2006. In most cases levels of association with the economic sectors are substantially higher for population than for cattle numbers.

The key economic sectors demonstrate a greater propensity to locate in communities with greater numbers of people than in communities with greater numbers of cattle. In other words, the geography of the key economic sectors has a stronger spatial association with the dynamics of the human settlement system than with the cattle industry. The benchmark provided by population demonstrates the influence of the urban system upon

the geography of industries providing essential support for cattle production. Population levels are often used as an indicator of the structure of an urban system, greater urban populations corresponding to greater primacy within a hierarchy of urban places (Marshall 1989). Higher order urban places offer a range of goods and services that encompasses and surpasses that offered by subordinate trade centres within the system. These highest order cities offer the greatest variety of services, and do so in the greatest quantity. Even industries which are tied to rural production, and seem to be isolated from the urban system can be impacted by proximal urban places. The connection between the urban system and its surrounding hinterlands limits the likelihood that the ripple effects of an exogenous shock such as BSE will initiate significant geographical restructuring in the key input and output industries. This is especially true given the recent ascendancy of the major cities in Alberta within the urban system of the entire country. The strength of the association of the key economic sectors with regional populations rules out cattle production as the primary determinant of the geography of these industries, and precludes the status of cattle production as the sole driver of the spatial changes in these industries between 2001 and 2006.

#### **6.6.4 Disaggregated Cattle Categories**

Parallel examinations of spatial relationships were undertaken using the disaggregated cattle categories. The cow-calf, feeding, and dairy industries may illustrate unique patterns stemming from their respective niches within the broader cattle production industry of Alberta. The general results and values obtained are close to those obtained for aggregate cattle numbers, and are not disclosed in the interest of avoiding

cumbersome repetition. A few notable trends demonstrating the divergent characteristics of the three sectors are discussed in this section.

The first of these trends involves the fact that the dairy component of cattle production in Alberta is characterized by significant relationships with more of the key economic sectors than the other two categories. Given the penchant of the industry for organizing according to an urban-biased spatial pattern, this trend is not unexpected. The feeding industry demonstrates an opposite trend, as it has a significant association with only four of the key economic sectors: agricultural chemicals, veterinary services, farm product agents and brokers, and auctions. This trend can also be connected back to the spatial organization cattle in Alberta discussed in chapter five. Fed cattle are organized in a highly polarized spatial pattern, and thus diverge from the metropolitan-influenced pattern that the key input and output industries tend to adhere to. It is evident that even when examined in terms of its constituent components, the spatial association of the cattle industry with its key inputs and outputs is tempered by an urban bias impacting those key industries. The urban system seems to have a strong influence upon the geography of even those industries serving to support rural practices such as cattle production.

A second notable trend involves the decline of significant relationships evident in the cow-calf industry between 2001 and 2006. The composition and strength of the relationships embodied by the dairy and feeding sectors remain relatively static over the five year period with a few exceptions. The cow-calf industry has, by 2006, experienced the loss of half of the significant relationships with key industries that it had in 2001. Relationships with the agricultural implement, petroleum, agricultural feed, and

agricultural chemical industries are no longer significant by 2006. This may be associated with the spatial divergence that has taken place within the cow-calf industry itself, rather than a responsive change on the part of any of these linked sectors. This change was quite rapid, and the spatial organization of the key input and output industries may not have had sufficient time to reorganize in response, as cattle numbers are more spatially fluid than business establishments. The declining levels of association are thus less likely to be a result of changes in these economic sectors, than to be a result of changes in the cow-calf sector itself. The comparatively static nature of relationships demonstrated by the feeding and dairy sectors, both of which underwent less spatial reorganization in the wake of BSE than the cow-calf sector, indicates that the key economic sectors are unlikely to be the source of declining association with the cow-calf sector.

The competing influences of cattle numbers and regional populations upon the geography of the key economics sectors were examined in the context of the cattle subcategories as well. The key economic sectors were compared to cattle numbers according to category for 2001 and 2006, as well as the relative changes between the factors. The same was done after exchanging regional populations for cattle numbers. The resulting matrix reveals nothing new of consequence to the study with regards to the strength of the relationships themselves. One curious occurrence worth noting was that when considering every cattle category, population had a higher correlation with almost every key economic sector than did the respective numbers of cattle. The correlations between the animal feed industry and the dairy industry in both 2001 and 2006 were exceptions to this. Change in the number of fed animals had a stronger alignment with

change in the agricultural feed and agricultural chemicals than did the change in population, constituting the remainder of the exceptions. This lends further support to the theory that the key input and output sectors are more closely tied to the urban system of Alberta than they are to the cattle industry.

## **6.7 Conclusion**

The key inputs and outputs to beef production in Alberta do not demonstrate a noticeable coordinated response to the economic consequences of BSE. The key economic sectors are the industries cattle producers interact with to acquire the goods and services they need, or to sell their products. These industries are the components of small town and rural communities that are the most innately susceptible to BSE. This lack of a response to the disease places limits on the extent to which economic ripple effects stemming from BSE could have penetrated regional economies.

On a provincial level, disparate trends of change were observed for each of the key input and output sectors. Almost all of these trends, however, adhered to curves of growth, zero growth, and decline, patterns hardly attributable to the economic uncertainty surrounding the BSE situation. Those sectors undergoing more erratic patterns of change at a provincial level largely did so in temporal isolation from the BSE incident which began in May of 2003. It is unlikely that any of these aberrant patterns can be tied to the struggles of Alberta's cattle industry between 2001 and 2006.

The geography of businesses comprising the key input and output sectors was also unable to implicate BSE in the changes manifest in community economic structure. The key economic sectors conformed primarily to two visible patterns. Most of the sectors

conformed to some extent to an urban biased geography, exhibiting a tendency to cluster in and around the larger urban areas of the province. A crescent aligning with a region of agricultural production in the southern region of the province was found to be prone to contain some of the key economic sectors. Neither of these two primary patterns underwent any noticeable transformations in the wake of BSE.

The strong urban bias evident in the geographies of all of the key economic sectors indicated that the urban system of Alberta plays a strong role in determining their geography despite the rural connections they maintain. A comprehensive correlation analysis indicated that at a community level, the spatial organization of the businesses in these industries has a stronger association with regional population levels than numbers of cattle. This remains true even when cattle numbers are divided into their constituent components. Despite a few outlying anomalies, the geography of population in Alberta has a far stronger spatial relationship with the key inputs and outputs to cattle production than do cattle numbers.

Two conclusions have been reached in this chapter. The first conclusion is that the economic consequences of BSE were not severe enough to impact the economic structure of communities in Alberta. The key inputs and outputs industries identified by local experts to be most closely associated with cattle production do not appear to have been impacted by BSE. The number of businesses in these industries, and their spatial arrangement has not changed in any way that might indicate that the losses suffered by the cattle industry have reverberated into the economies of local communities.

Secondly, correlation analyses indicate that the spatial organization of these industries is influenced more by the urban system of Alberta than by the geography of cattle

production in the province. Urban and economic growth in the province between 2001 and 2006 has impacted the inputs and outputs associated with cattle production more than BSE has. The implication here is that the urban system outweighs BSE as an influence on the patterns and change manifest by the key inputs and outputs between 2001 and 2006.

Examining the impacts of BSE using a different indicator may yield different results. Using business numbers and their regional changes as an indicator limits the size of the economic ripple effect that can be detected. Economic impacts not substantial enough to cause a business to exit the economic structure of a community have not been detected.

## **Chapter 7**

### **Impacts of BSE on Regional Agricultural Economies**

#### **7.1 Introduction**

Chapter seven addresses the third objective of this thesis which concerns the geography of the impacts of BSE on regional agricultural economies. The first section of this chapter deals with relevant background information, including evidence in both the United Kingdom and Canada for agricultural restructuring as a result of BSE. The following section introduces two indices used to measure agricultural diversity, the IFTD and the Gini Index. The two indices and their geographical dimensions are addressed in the following two sections. The chapter concludes with a discussion of the importance of these indices in the context of this study

#### **7.2 Background**

Agricultural practices of different types are often interdependent and intertwined with one another, and as such, the success or failure of one facet of the agricultural economy can benefit or impair the other types of agricultural production. The consequences of BSE may have extended beyond the cattle industry and the communities dependent upon it, and into the broader realm of agricultural production. Chapter seven measures the spatial response of the entire agricultural system to the BSE.

Research in the United Kingdom provides evidence that BSE led to agricultural restructuring. Input-output models indicate that output levels of cattle declined alongside partially compensating increases in outputs of sheep, pigs and poultry (McDonald and Roberts 1998; Bennett et al. 1999). The impact of BSE on the demand for beef

contributed to this restructuring in the United Kingdom (Burton and Young 1996). The British BSE Crisis does not transfer directly to the Canadian experience, but research in Canada does support similar trends. An input-output analysis of the Canadian economy indicates that production in the cattle and feed grains industries has been significantly affected (Wigle et al. 2006). The same study mentions notable industrial output changes for other crops, hogs, and poultry.

The industrial composition of agricultural communities varies across the province. Regional economic profiles are typically marked by specialization in the agricultural practices for which they are best suited. The decline in cattle and feed grain production indicates that prices for these products have declined, or the amount of feed grain or cattle produced has declined. Decreasing production volumes would indicate that farmers have produced less feed grains, presumably in favour of another form of production. Decreasing prices would provide an incentive for farmers to explore other forms of agriculture. In either case, losses in cattle industry induced by BSE appear to have impacted the desirability of different types of agriculture.

Changes in farm numbers outlined in Chapter five indicate the exit from cattle production of some farmers, and entry into the practice by others. There have also been significant regional movements of cattle following BSE. BSE, and the uncertainty it brings, acts as a push factor encouraging farmers in some regions to engage in other forms of agriculture. This agricultural switching has implications upon the economic composition of regional agricultural communities.

### **7.3 Economic Diversity**

Regional levels of economic diversity provide an indication of the composition of agricultural economies. Examined over time, levels of economic diversity can be used to characterize changes occurring within agricultural communities. Furthermore, delving into the roots of the diversity scores obtained can shed light on the nature of the changes that have taken place.

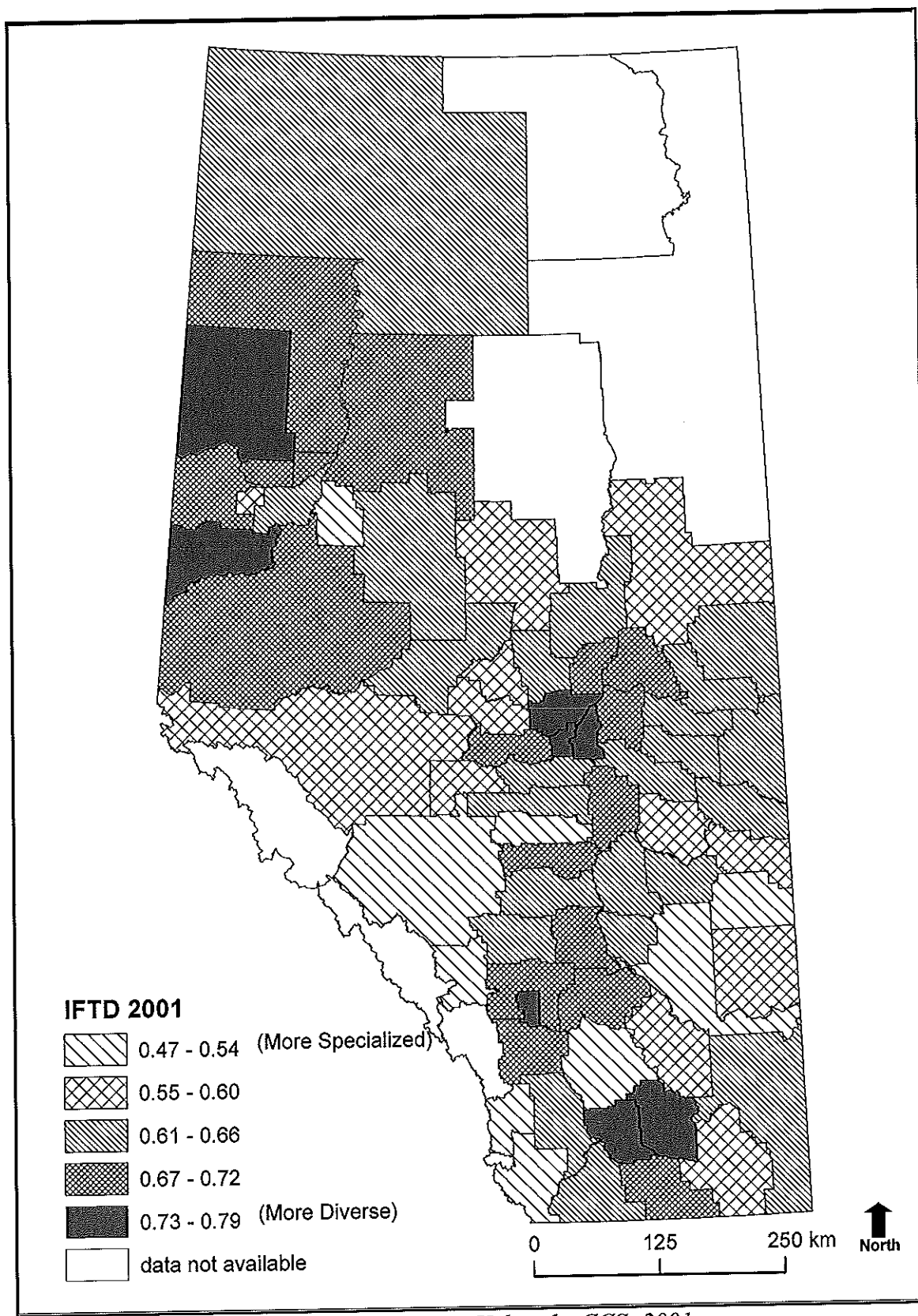
The IFTD and the Gini Index are used to assess the level of economic diversity of agricultural economies. Both indices measure economic diversity on the basis of the composition of the agricultural practices in a specific region. The indices are encompassing measures in that they measure the overall level of diversity inherent to each region. A single number is used to describe each regional economy. The reasons for the measured levels of diversity and the specific industries in which regions may be specialized cannot be deduced from examining the indices themselves, since they are summary measures. Delving into the values upon which the indices are built can provide valuable information regarding the genesis of the diversity levels obtained.

### **7.4 Index of Farm Type Diversity**

The IFTD measures the extent to which the economic shares occupied by agricultural farm types deviate from a theoretical standard of perfect diversity. Perfect economic diversity is defined by equal proportional representation of all of the industries within an agricultural community. The index is thus a measure of the equality of the shares occupied by the agricultural industries within a region. The closer to equality that the industrial shares are, the higher the diversity score obtained by a particular region will be.

Agricultural economies that are opposite to diverse economies are characterized by inequality in their respective industrial shares, and are considered to be specialized. A perfectly specialized region will have all of its production in one farm type. Mapping agricultural diversity as defined by the IFTD at a CCS level of resolution across the province reveals information regarding the spatial pattern of agricultural changes occurring in Alberta following the discovery of BSE. Delving into the proportional shares from which IFTD values are devised sheds light on the specific factors inducing the observed spatial patterns and the changes they have undergone.

The IFTD values derived from the 2001 NAICS farm types reveal that the spatial structure of agricultural diversity in Alberta conforms to an obvious pattern whereby diverse regions are clustered around large urban settlements in the province (Figure 7.1). More specialized regions whose economies may cater disproportionately to agricultural practices tend to be located further away from these larger settlements. The cities of Calgary, Edmonton, Lethbridge, Grande Prairie, and Medicine Hat are all surrounded by communities characterized by relatively diverse agricultural economies. Of the agricultural regions with IFTD values equal to or greater than 0.70, most are located within, or are in direct contact with a CCS containing one of the aforementioned cities. The remaining diverse communities are located in the northwest corner of the province, where they are close to, but not in direct contact with, the CCS containing the city of Grande Prairie. The strength of this metropolitan trend is demonstrated by the fact that almost all of the most diverse agricultural communities in Alberta are located near a large



*Figure 7.1: IFTD Values by CCS; 2001*

Note: for additional details see Appendix D

city. This metropolitan effect remains consistent for all of the major urban centres in the province except the city of Red Deer and its surrounding area. The obtained IFTD values for 2001 ranged from 0.47 for the most specialized community of Ranchland No.66 to 0.79 in the diverse agricultural community found in the CCS of Edmonton. This 0.32 range of IFTD values is spanned by nearly 70 different regions, and in many cases the difference from one CCS to another is hardly noticeable. The clear and incontrovertible emergence of a spatial pattern coloured by a metropolitan effect despite the limited variability offered by the IFTD values illustrates the significance of this trend.

Further support for the existence of a metropolitan effect impacting levels of agricultural diversity is the fact that almost every CCS region scoring 0.69 or lower was located some distance from the aforementioned urban areas. The most specialized agricultural communities in the province are located in some of the most sparsely populated regions of the province. Pockets of acutely specialized communities can be found along the Rocky Mountains in the west, as well as along the border of the province east of Red Deer. These communities are located in regions where the local trade centres are positioned near the bottom of the urban hierarchy. As such, these communities are devoid of major urban settlements, accounting for their relatively low regional populations. The clustering of diverse agricultural communities near large urban centres contrasts the location of specialized communities in peripheral regions lending credence to the influence of the urban system upon the spatial organization of agricultural diversity in the province. This metropolitan effect facilitates the dispersion of the economic characteristics of cities within the urban system of Alberta outwards into proximal agricultural communities.

Central place theory posits that trade centres positioned near the top of the urban hierarchy are likely to be more economically diverse than lower order urban places (Marshall 1989). This economic diversity stems from the larger service areas they encompass, and the subsequently inflated number and broader range of consumers to which they can market goods and services. Cities near the top of the urban hierarchy can offer a greater quantity and range of goods than lower order urban places (Stabler and Olfert 2002). The metropolitan effect which influences the economic composition of agricultural communities in Alberta is derivative of the economic diversity that is characteristic of these cities in the upper echelons of the urban hierarchy. According to the theory, cities act as distribution points for goods and services, drawing from their surrounding hinterlands the resources necessary to produce these goods and services (Marshall 1989). The hinterlands of higher order urban places, whose size and breadth are commensurate to that of the city they serve, are depended upon to provide the greater quantity and range of resources required by larger and more diverse trade centres. The primacy of an urban trade centre assists rural practitioners engaged in producing agricultural goods for which demand is limited. The influence of larger cities isolates agricultural communities from the pressures that would otherwise be placed upon them by the high demand thresholds associated with goods that may have limited markets. The large markets to which higher order urban places have access make viable those forms of agricultural production for which per capita demand may be limited, giving local farmers a number of options as to the agricultural practices they choose to engage in. Instead of producing only those agricultural products to which the region is best suited, these communities are able to engage in a variety of different agricultural practices. Diverse

agricultural economies develop as a result of the more varied agricultural production that often results.

In addition to the economic spinoff benefits, proximity to an important urban centre and the consumer markets present there serves to reduce inhibitive transport costs. Reduced transport costs further isolate agricultural communities from demand thresholds that might otherwise inhibit agricultural practices for which demand is limited by allowing products to be sold at lower prices in nearby trade centres. This serves to remove further limiting factors to agricultural diversification in regions surrounding significant nodes within the urban system. Demand thresholds are more difficult to overcome for farmers in peripheral regions, as inhibitive transport costs raise production costs, giving producers nearer to core regions a competitive advantage.

Farmers in the peripheral regions of the province do not have the luxury of choosing between as many viable agricultural practices. Sparse regional populations characteristic of peripheral regions limit local market capacities, and prohibitive transportation costs preclude the sale of many forms of peripherally grown produce in distant core markets. Peripheral agricultural communities thus typically engage in practices for which they are best suited, or for which a strong local demand exists. The resulting focus on fewer types of agricultural production leads to the development of specialized agricultural economies.

Agricultural specialization in peripheral regions is accentuated by the development of economies of scale. Collectively engaging in similar forms of agriculture can reduce capital expenditures as well as transport costs. The expanded profit margins that result can increase the regional capacity to overcome inhibitive demand thresholds. The metropolitan effect on the spatial organization of agricultural diversity is thereby

intensified by the economic characteristics of peripheral regions as well. While diverse regions tend to be clustered closer to cities near the top of the urban hierarchy, specialized regions are prone to exist in more peripheral areas. The competitive benefits offered by economies of scale serve as a further incentive for peripheral regions to specialize in certain agricultural practices.

This is the mechanism by which the economic prowess of the higher order urban places emanates from these settlements to permeate local agricultural communities. The urban system and the settlements comprising it have impacted the spatial organization of agricultural diversity in Alberta.

The area surrounding the CCS of Red Deer is the most notable exception to the metropolitan induced clustering of diverse agricultural communities. The CCS of Red Deer itself has a diversity score of 0.66, which is only slightly higher than the provincial mean of 0.638. The five agricultural communities bordering Red Deer combine for an even lower mean diversity score of 0.616. These data are curious given that for all of the other major urban areas, proximal agricultural communities consistently demonstrate IFTD values of 0.70 or greater resulting from the metropolitan influence upon agricultural diversity. The county, which contains the city of Red Deer, is the third most populous CCS region in the province for both 2001 and 2006. Furthermore, Red Deer County is an integral component of the strong economic community occupying the Calgary-Edmonton Corridor. The economic prominence of Red Deer intuitively suggests that nearby agricultural economies should be among the most diversified in the province.

The reason for the aberrant level of agricultural diversity surrounding Red Deer lies to some degree in the perspective from which it is viewed. In the context of Central

Place Theory, and the influence the urban system has upon how specialized or diversified regional agriculture is, the lower level of diversity observed in this area seems to be an aberration. In the context of the geography of the province, and comparative advantages favouring certain types of agriculture in this region, a more specialized agricultural economy is not altogether uncharacteristic. The Red Deer CCS illustrates that despite the demonstrated influence of the urban system upon agricultural economies in Alberta, physical geography remains an important factor.

In addition to the primary spatial pattern revealed by regional levels of agricultural diversity as calculated by the IFTD, a secondary pattern emerges which again highlights the recurring crescent of agricultural production. In addition to the concentration of diverse regions around urban centres, there is a clear group of diverse agricultural communities comprising this crescent which stretches from Vermilion County, through the Calgary-Edmonton Corridor and terminates in Cypress County. The metropolitan influence upon agricultural diversity admittedly plays a prominent role in the genesis of this pattern, as Calgary, Edmonton, Red Deer, and Lethbridge are all situated within this agricultural crescent. The inclusion of communities not within the primary region of influence of these major urban centres in the crescent, however, indicates that this pattern is distinct from that induced by the spatial organization of the urban places in the province.

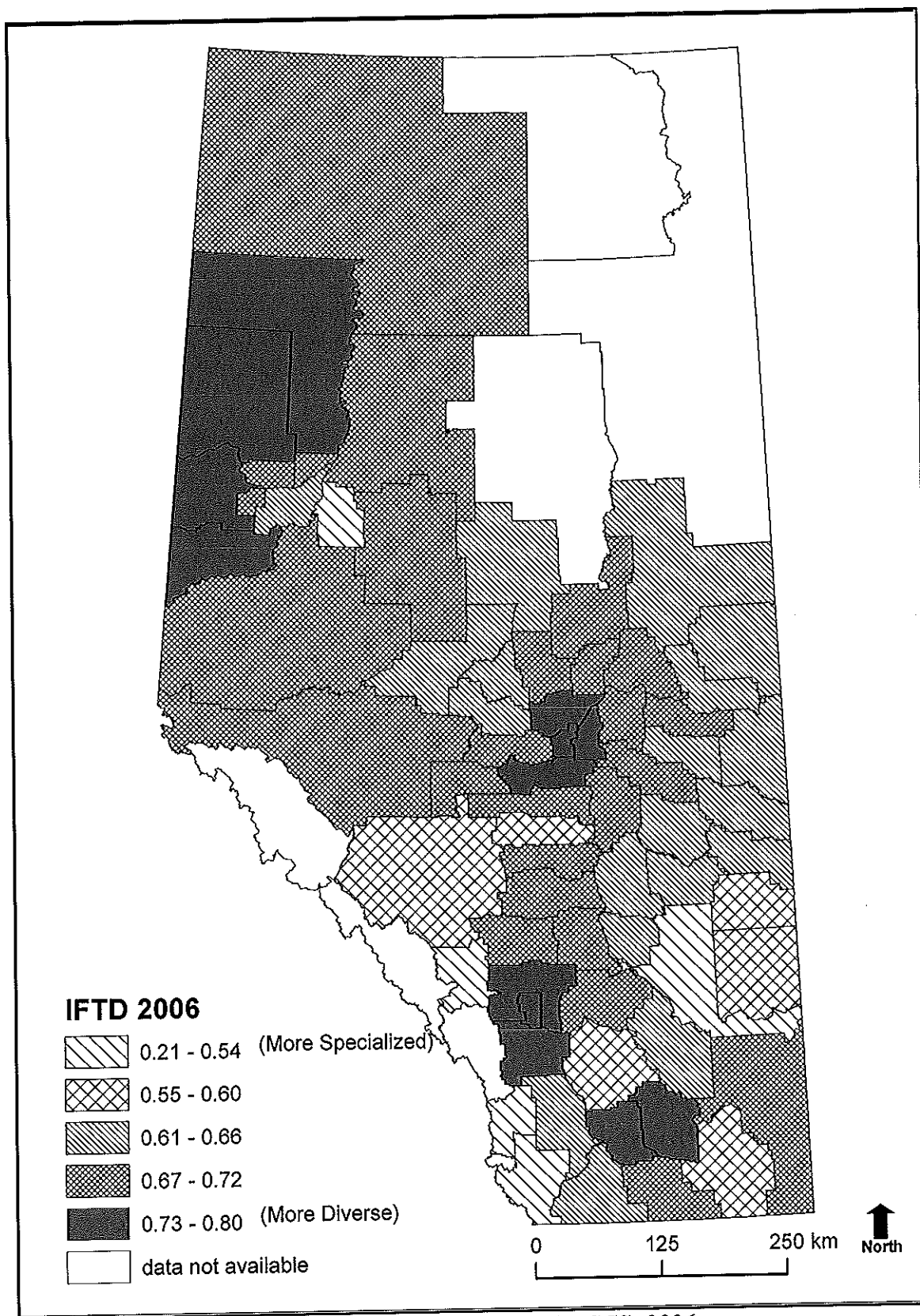
The regional characteristics underlying the IFTD values can be ascertained by examining the proportional economic shares of agricultural industries upon which these values are based. It is prudent to first examine how the diversity values calculated for the agricultural communities of Alberta look at a provincial level. Understanding the

construction of the typical agricultural community in the province makes it easier to identify communities of a unique composition and to determine the basis of this uniqueness. Of the ten NAICS farm types, two stand out as being prominent in Alberta. These sectors are cattle ranching and farming which comprise 44.7% of farms in Alberta, and oilseed and grain farming which comprise 27.9% of farms in Alberta. Together, cattle ranching and oilseed and grain farming account for over 70% of the farms in Alberta. The categories for other animal production and other crop production, accounting for forms of agricultural production not covered by the other eight categories, both weigh in at around 10%. These values can be misleading, however, as both categories consist of an amalgamation of a number of different less prominent agricultural practices. The remaining six sectors all comprise a mean proportion of regional economies of less than 2% at the CCS level of aggregation. This demonstrates the extent to which Alberta's agricultural economy is characterized by grain and oilseed farming and cattle production. The extreme dominance of two practices indicates that under an objective examination of the province as a discrete unit, the agricultural economy of Alberta would be considered to be quite specialized.

Given the typical composition of agricultural communities in the province, the communities considered by the IFTD to be the most diverse would likely contain more agricultural production in sectors uncommon in the province at the expense of grain and oilseed farming and cattle production. More specialized communities, on the other hand, are likely to be those with greater disparity between the typical types of production in Alberta and less common agricultural practices.

Upon examination of the economies of the most specialized communities in the province, the reasons for the low IFTD values they have become evident. In the case of the regions lining the mountain range along the western border of Alberta, and those parallel to Red Deer along the eastern border, specialized agriculture is the result of an high proportion of regional agriculture occupied by the production of cattle. This is not necessarily the result of relatively high levels of cattle production in the region, but the specialized economies have developed because local environmental constraints preclude successful and widespread production in other types of agriculture. These communities have 60 – 70% of their local agriculture engaged in cattle ranching and farming, far surpassing the provincial mean of 44.67%. The remaining highly specialized communities, such as Vulcan and Forty Mile Counties have high numbers of operations concerned with the growth of oilseeds and grains. The practice takes up over 60% of these regional economies, over double the proportional share expected based on the provincial average. The geneses of the diversity levels for the remaining agricultural communities are difficult to discern, as varying and smaller deviations from provincial means across the ten NAICS farm types serve to differentiate these remaining regions. From an industrial standpoint, cattle farming and ranching as well as grain and oilseed farming are the primary determinants of diversity as characterized by the IFTD. The impact of BSE upon regional levels of diversity should be detectable in the changes in diversity occurring between 2001 and 2006.

The pattern of agricultural diversity as determined by regional IFTD values in 2006 is very similar to that of 2001 (Figure 7.2). The urban settlements of Calgary, Edmonton, Lethbridge, and Grande Prairie are still surrounded by agricultural communities



*Figure 7.2: IFTD Values by CCS; 2006*

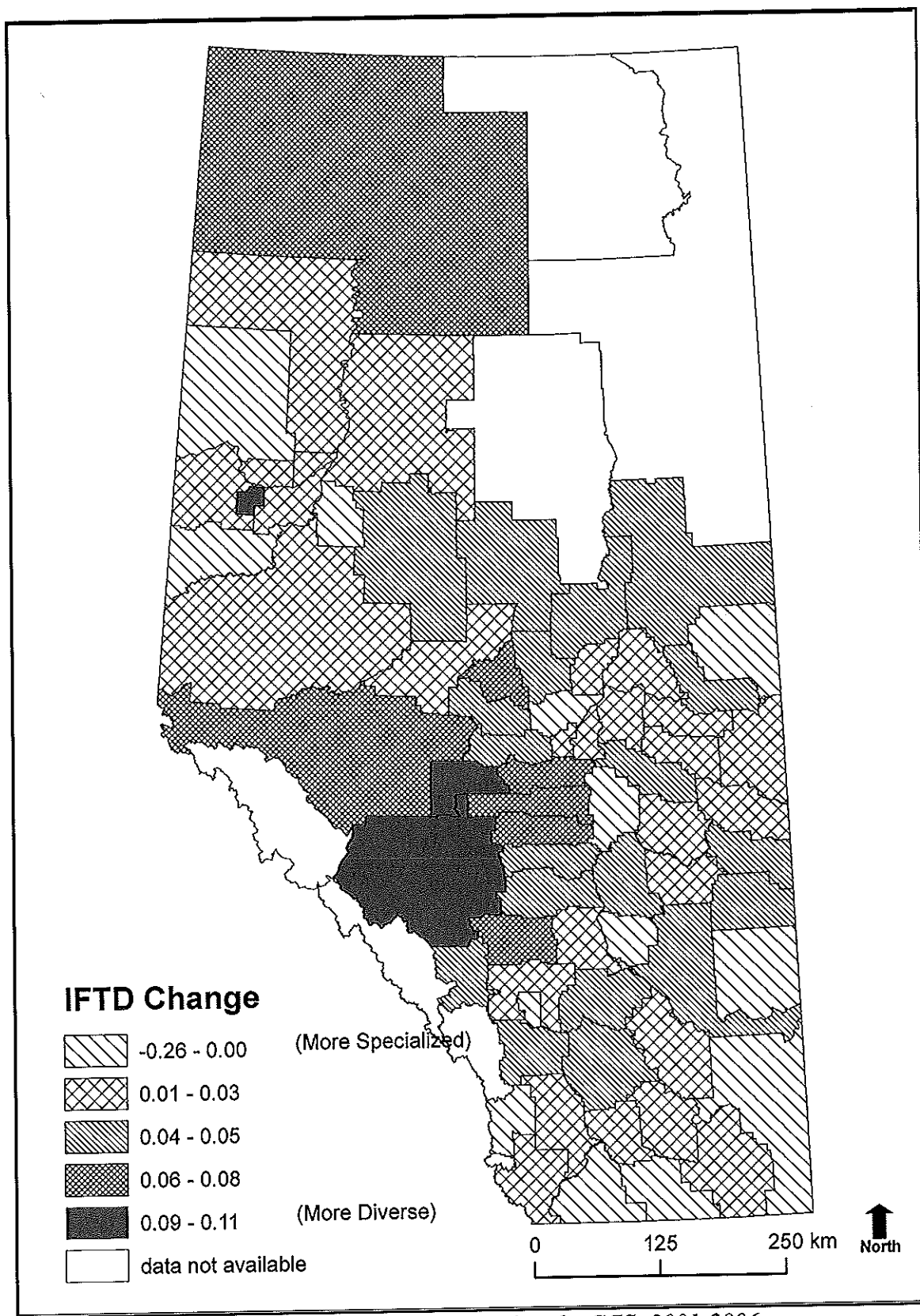
Note: for additional details see Appendix E.

characterized by high levels of agricultural diversity. The situation whereby the city of Red Deer does not submit to the influence of this metropolitan effect remains an aberration to the overall trend in 2006. The most specialized communities in 2006 are the same communities that were measured to be the most specialized in 2001.

At first glance it appears that any external stimulus impacting the development of agriculture in Alberta between 2001 and 2006 has had no impact on the spatial pattern of agricultural diversity in the province. A map of the actual changes in regional diversity, however, reveals that despite the stability of the metropolitan pattern, disparate levels of change are evident across the province (Figure 7.3).

Changing levels of diversity reveal a pattern contrasting the metropolitan influenced pattern observed in 2001 and 2006. The regions of the province that have become more diverse are not the regions located closest to the large urban settlements of the province. Increasing agricultural diversity in Alberta is championed by the west central region of the province which extends westward from the Red Deer area to the Rocky Mountains. Red Deer, a notable aberration from the previously examined metropolitan effect, again finds itself in a unique position, as it is the only CCS with a large urban centre in it to exhibit significant growth in its level of agricultural diversity.

The IFTD is an absolute measure, and is therefore unable to measure levels of diversity in the context of the specific agricultural economy of Alberta. This index reveals more about the composition of agricultural industries than it does about regional levels of diversity within the agricultural system of Alberta. The general nature of this absolute measure is perhaps why the data, once molded by the IFTD formula, tends to conform closely to the tenets of theoretical economic geography. The Gini Index, a



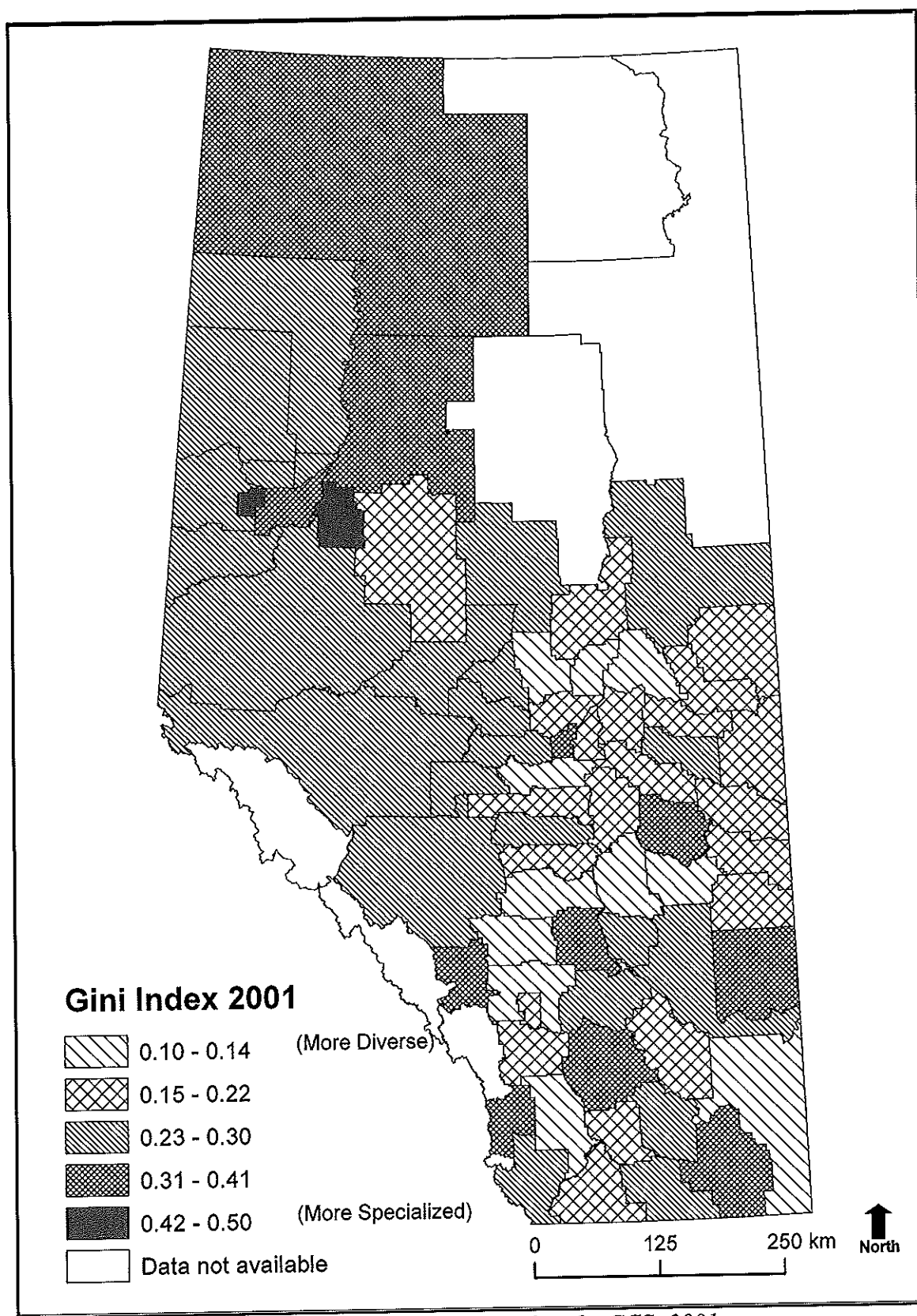
*Figure 7.3: Change in IFTD Values by CCS; 2001-2006*

relative measure, is perhaps better suited to assess the spatial patterns of regional agricultural diversity in Alberta.

### **7.5 Gini Index of Specialization**

Industrial specialization as calculated using the Gini Index assesses the deviation of each regional economic profile from a base profile determined by the economic composition of the entire province. As a result, the extreme level of significance lent by two industrial sectors to the IFTD values obtained should be reduced by the Gini Index. It is important to note that since the Gini Index measures specialization while the IFTD measures diversity, Gini Index values are the opposite of IFTD values. Higher Gini Index values indicate a higher level of specialization.

The resulting spatial pattern of agricultural diversity in 2001 is similar to that indicated by the diversity scores as determined by the IFTD (Figure 7.4). Although the pattern is not as strong, a metropolitan bias can be seen whereby diverse communities are located closer to the major urban centres of the province. This trend excludes Grande Prairie in the northwest corner of the province. Neither Edmonton nor Red Deer are among the most diverse agricultural communities, but the regions surrounding them are typically more agriculturally diverse than others in the province. It is significant that a relative measure of diversity reveals this trend in addition to the absolute IFTD measure. The support of both indices for the existence of a metropolitan influence impacting regional levels of agricultural diversity strengthens the argument that the urban system plays a meaningful role in determining the economic composition of rural agricultural communities.

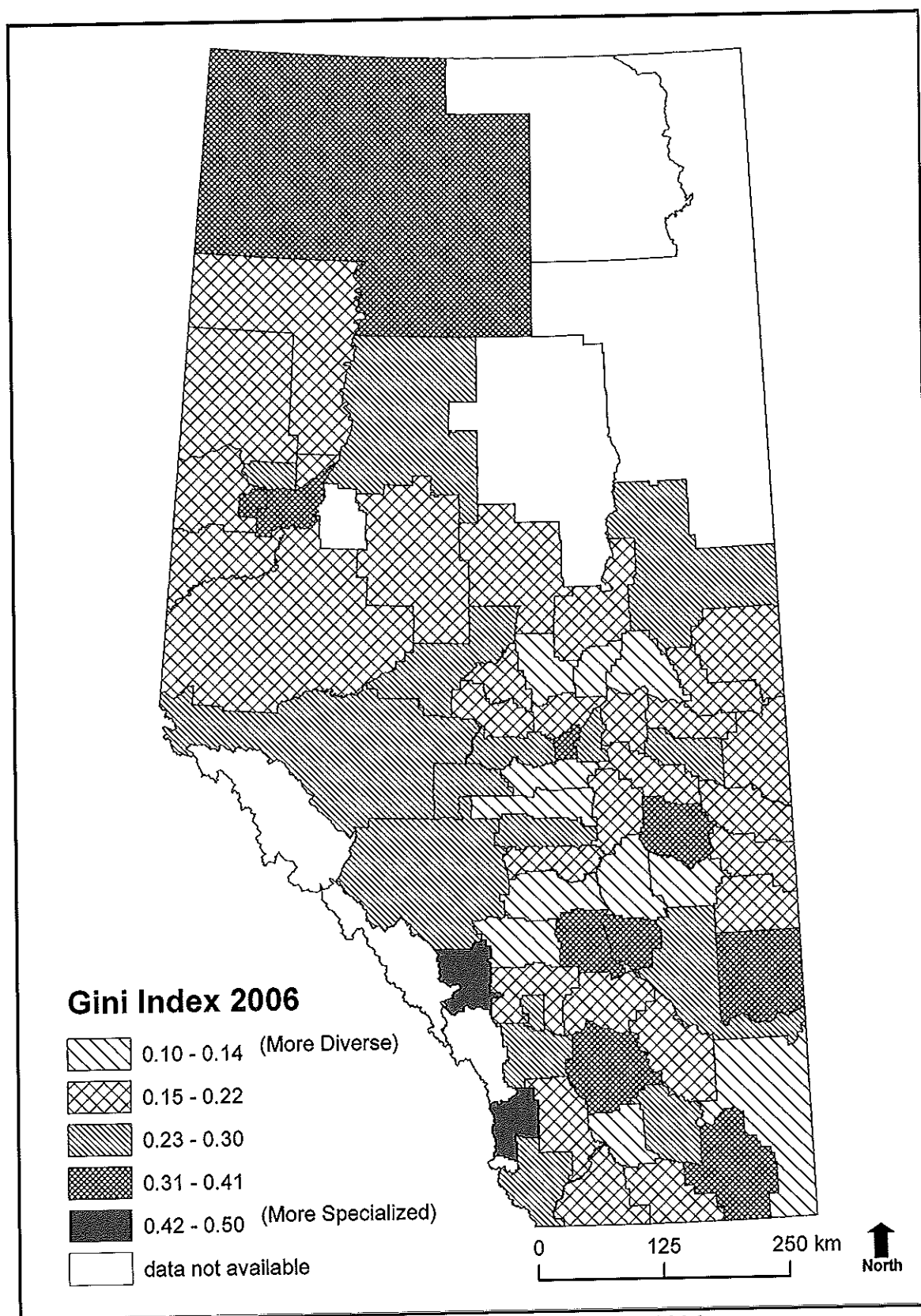


*Figure 7.4: Gini Index Values by CCS; 2001*

Note: for additional details see Appendix F

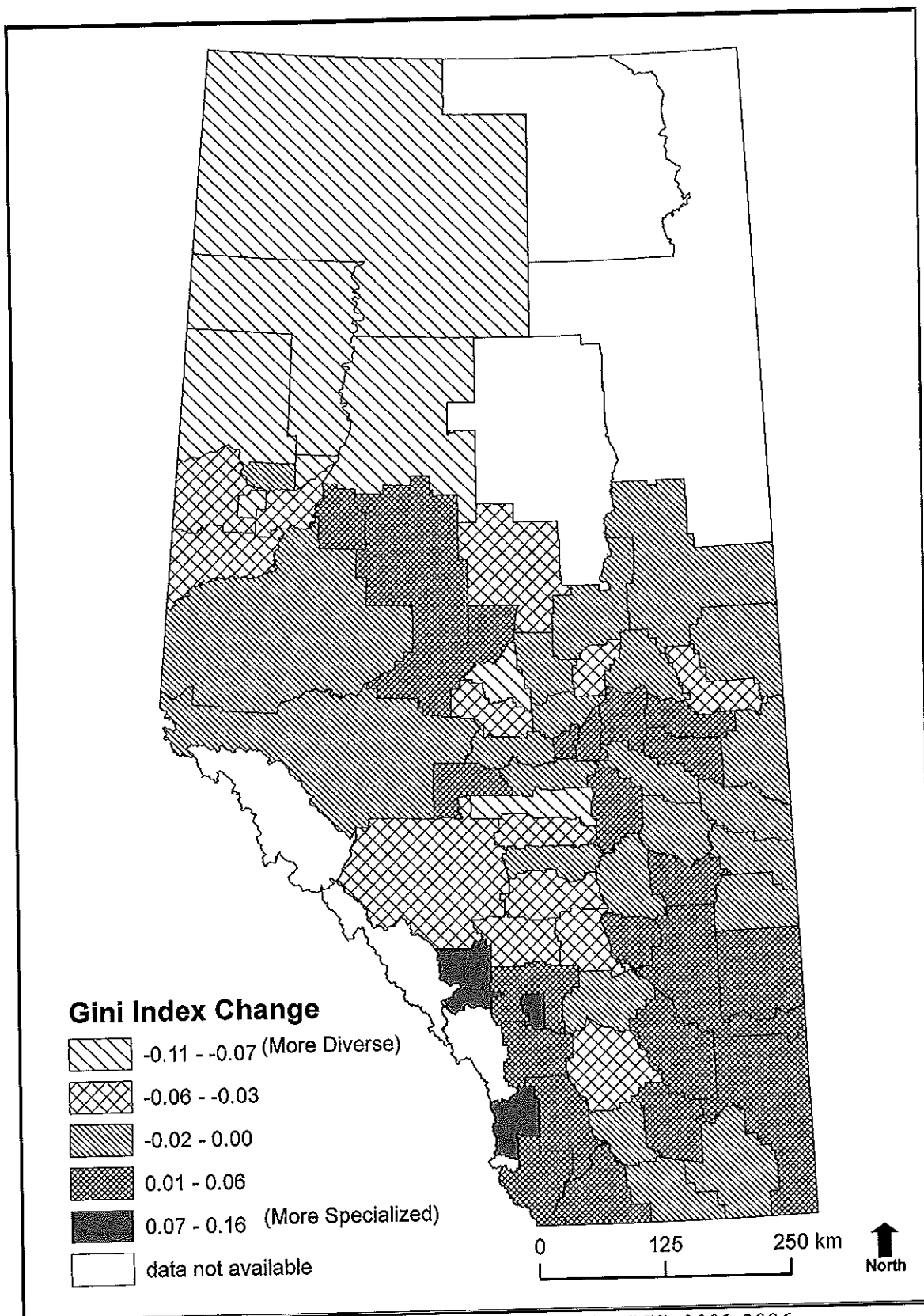
A number of agriculturally diverse regions are clustered together in the central and southern portions of the province overlaying the recurring agricultural crescent. The pattern is not as lucid as it had been with the cattle industry, with sporadically occurring specialized communities cropping up throughout the crescent, but many of the more diverse communities in the province reside within this crescent shaped polygon. Vulcan, Kneehill, and Forty Mile Counties comprise the primary aberrant specialized communities located within this otherwise generally diverse crescent-shaped region. The spatial pattern of agricultural diversity as measured by the Gini index in 2006 is very close to that demonstrated in 2001 (Figure 7.5). The primary difference between the map for 2001 and the map for 2006 is the increasing diversity in the northwest corner of the province. The two most specialized CCS regions in 2001 were in this area of the province.

Despite the differences in derivation between the IFTD and the Gini Index, the respective spatial patterns of agricultural diversity they suggest for Alberta are similar. The changes in diversity levels as determined by the IFTD were mirrored by Gini Index values as well. Most notable are the regions of increasing agricultural specialization. The southern portion of the province is generally becoming more agriculturally specialized (Figure 7.6). A group of the regions with the greatest percentage growth in Gini Index values is clustered along the Rocky Mountains, while a secondary cluster with more modest increases in specialization is located in the southeast corner of the province. As with the changes assessed by the IFTD, the large urban centres in the province tend to be surrounded by agricultural regions that are becoming more specialized. This is surprising given that these regions are typically more diverse. The cities of Calgary and



*Figure 7.5: Gini Index Values by CCS; 2006*

Note: for additional details see Appendix G



*Figure 7.6: Change in Gini Index Values by CCS; 2001-2006*

Edmonton have experienced tremendous growth between 2001 and 2006 in terms of their economies and populations. The Calgary-Edmonton Corridor is one of the fastest growing regions in the country. Such growth should correspond to ascendancy within the national and provincial urban systems. This rise in status, should in turn, initiate a greater degree of agricultural diversity in nearby regions. It appears that the influence of the urban system in Alberta, despite its influence on the geography of agricultural diversity in 2001, is not the primary driver of change between 2001 and 2006. To determine the root of these changes, an examination of the location quotients upon which the Gini Index is based is useful.

The geography of cattle farming and ranching operations as determined using location quotient values is somewhat different than might be expected. The regions with location quotient values below one, indicating that the local number of cattle farms and ranches is lower than what is expected for the province, are the same regions that have the highest numbers of cattle. The zone of concentration determined for the feeding industry is an area where location quotient values are lower than one. This region extends from Kneehill County, through Lethbridge County, and down to Forty Mile and Warner Counties on the southern border of the province. There are two explanations for this trend. First, the production taking place in the cattle feeding industry is characterized by fewer and larger farms, reducing the location quotient values which are based upon the number of cattle farming and ranching operations rather than the number of cattle. The second explanation involves the potential interaction occurring between cattle production and regional agricultural diversity. The presence of cattle ranches and farms may be linked to agricultural diversity. This would be reflected in location quotient

values as high numbers of cattle farms would be accompanied by higher numbers of other types of agriculture enterprises, thus reducing the regional significance of the cattle industry.

A second region of lower than expected numbers of cattle farms begins at the CCS of Edmonton and extends to the eastern border of the province. This is the same region which constitutes the northern extent of the recurring agricultural crescent.

Grain and oilseed production is the other dominating form of agricultural production in Alberta. The spatial pattern manifested by the location quotient values for this agricultural industry is opposite to that exhibited by cattle farming and ranching. South-central Alberta, including Kneehill, Vauxhall, and Lethbridge Counties which are characterized by lower location quotient values for cattle production, have relatively high numbers of farms engaged in the production of grains and oilseeds. The cluster of communities located in the east central region of the province east also exceeds the typical level of grain and oilseed farms. The contrast between the spatial patterns of these two forms of agricultural production indicates that generally every agricultural community is specialized to some degree in one or the other, and very few in both.

## **7.6 Conclusion**

The Index of Farm Type Diversity and the Gini Index generally support one another with regards to the spatial pattern of agricultural diversity in Alberta. For both of these indices, it is difficult to delve into the factors upon which measurements are based and assess the reasons for the development of particularly specialized or diverse regions.

Substantial movements of cattle were observed within the cow-calf and feeding stages of production in Chapter five provide. The changing levels of agricultural diversity may be connected to the spatial reorganization of the cattle herd structure of Alberta which is connected to the consequences of BSE.

Both indices indicate that the southeast corner of the province has become more specialized since 2001. Alternately, the west-central region of the province, extending west from the Red Deer area to the Rocky Mountains, has become more diverse in its agricultural composition. These are the primary temporal trends indicated by both indices. Given the substantial spatial changes to the cattle industry over that period of time, a connection between the cattle industry and the composition of regional agricultural economies likely exists.

The west-central region of the province, which has become more diverse, was characterized by very high animal numbers in the cow-calf sector, and moderate numbers of animals in the feeding sector in both 2001 and 2006. Additionally, this region has more farms reporting the constituent animals of both the cow-calf and feeding sectors in 2001 and 2006. Between both years, there were declines in the cow-calf sector in terms of both cattle populations and farm numbers. The feeding industry did not decline tremendously, but sustained limited to moderate growth at best between 2001 and 2006.

The southeast corner of the province, which has become more specialized, was characterized by moderate cattle populations and farm numbers in both the cow-calf and feeding sectors in 2001. By 2006 this region had experienced the most substantial growth in the province in terms of both cattle populations and farm numbers in the cow-calf industry, while the feeding industry remained largely unchanged.

The combination of the changes in these two areas, in terms of both cattle and farm numbers, and the broader agricultural economies, has significant implications for this study. On the one hand there is the west-central region, which has a specialized agricultural economy, and is an important region in terms of both stages of cattle production examined in this study. Cattle populations in this region decline substantially following structural changes in the cattle industry initiated by BSE, and the region becomes more diverse. On the other hand, there is the southwest corner of the province, which is generally an agriculturally diverse region, and is a moderate to somewhat strong participant in both the cow-calf and feeding industries. Cattle populations increase following BSE, and the region becomes more specialized.

There is a connection between BSE and the changes manifest in the spatial pattern of agricultural diversity in Alberta. These changes are associated with structural changes in the cattle industry, which are a direct result of producer responses to the consequences of BSE. This study, however, has sought to examine changes to regional agricultural economies in the context of an economic ripple effect stemming from BSE. The consequences of a ripple effect upon agricultural economies would include regionally variable entry and exit into cattle production production, which has been observed. Ripple effect consequences would also include similar entry and exit to other types of agriculture as changes in consumer preferences and agricultural regulations impact the desirability and viability of not only cattle production, but of other types of agriculture as well. Production of other meats to apportion a declining market share occupied by beef, as well as the production of inputs to cattle operations (crops such as grains or forages) should be particularly vulnerable to change, and contribute to the ebb and flow of

agricultural diversity. There is however, no evidence confirming that any of the major changes to the pattern of agricultural diversity in Alberta are derivative of anything but the structural changes endured by cattle industry between 2001 and 2006. BSE has had an impact on the economic characteristics of agricultural communities, but this impact appears to be a direct response to the first order impacts of the disease upon the cattle industry. None of the evidence examined provides any indication of an impact on regional agricultural economies that is associated with an economic ripple effect from BSE.

## **Chapter 8**

### **Conclusion**

There is little existing research on the geographical dimensions of BSE in Alberta. This thesis has sought to address this gap in research by examining the geographical dimensions of three areas of impact that have either been detected or suggest regarding the impact of BSE in Alberta.

The geography of the impact of BSE upon the cattle industry of Alberta is the geography most obviously changing as a result of BSE. The response of cattle producers to BSE created a shift in the industry whereby there was a province-wide decrease in the number of beef replacement heifers and a corresponding increase in the number of slaughter heifers. This is one of the most significant trends resulting from BSE either spatially or otherwise. The spatial pattern of change was characterized by subtle divergence outward from the core of cattle production in the Red Deer area. The highly polarized geography of the feeding sector, on the other hand, appears to be migrating northward from the County of Lethbridge into Vulcan and Newell Counties. The changes represent the spatial manifestation of BSE in terms of cattle numbers in the province. Continued research into this phenomenon is required to determine whether this impact is a short term aberration, or if it is an emerging pattern that will continue into the future.

The geography of the impact of BSE upon community economic structure was difficult to discern. The industries with the strongest connections to cattle production in Alberta were examined. At a provincial level, these industries appeared to have no response to BSE in terms of the numbers of businesses comprising them. None of the

changes that were observed could be conclusively connected to BSE and the losses sustained by the cattle industry. The limitations of the data used, and the difficulty in detecting an impact of BSE in business numbers in Alberta precluded the possibility of conclusively ruling out an impact. Since a response to BSE was not detected, an attempt to place limits on the potential impact of BSE was made. The geography of the key industries with the most likely susceptibility to BSE was compared to the geography of the cattle numbers and the geography of population. The stronger relationship evident between the geographies of most of these key economic sectors and the geography of population indicates that the spatial organization of the urban system in Alberta is a greater determinant of the geography of these industries than is cattle production. The geography of change in the key industries associates more strongly with the geography of change of the urban system than cattle production, placing limits on influence BSE could have had between 2001 and 2006. The spatial organization of population and urban centres in Alberta is a stronger driver of change for these industries than the cattle industry and the impacts it has sustained from BSE.

The final geography examined concerns the impact of BSE upon regional agricultural economies. Input-output analyses from both the United Kingdom and Canada have indicated the potential for BSE to impact the composition of agricultural production. Two indices capable of measuring economic diversity, the IFTD and the Gini Index, were used to assess the composition of regional economies. Both indices found the geography of agricultural production to be characterized by diverse regions located close to urban centres, and specialized regions located in the peripheral parts of the province. The change in regional levels of agricultural diversity between 2001 and 2006 was

characterized by an increase in specialization in the southeast corner of the province, and an increase in diversity in the west-central area of the province. Contrasting these changes with changes in the cattle industry reveals a possible link between the two. There is spatial trend in which increases in cattle numbers are associated with decreases in agricultural diversity, and decreases in cattle numbers are associated with increases in agricultural diversity. The geographical changes in the cattle industry initiated by BSE are therefore likely responsible for some of the changes in agricultural diversity in Alberta.

In chapter three, quantification of the potential ripple effect of BSE in terms of its severity and temporal dimension was expressed. Chapter five assessed the direct impact of BSE upon the cattle industry. Chapters six and seven examined spheres into which a ripple effect from BSE might enter.

The evidence examined did not indicate the existence of a ripple effect of BSE in community economic structure. In fact, an argument is made that the prodigious economic growth in Alberta over the last five years, particularly in the Calgary-Edmonton Corridor, has had a greater influence upon industries tied to cattle production than cattle production itself. Any ripple effect of BSE impacting community economic structure is too small to be detected with the data and methods used in this study, although it must be emphasized that this study did not perform a systematic analysis of all central place functions.

BSE has had an impact on regional agricultural economies, but this impact is largely derivative of the interregional movements of cattle precipitated by the disease. An

impact from BSE is spatially detectable, but not measurable in terms of regionally variable entry and exit of businesses to the economies of agricultural regions.

The difficulty in measuring the amplitude of the consequences of BSE precludes the possibility of measuring the length of time these consequences have been present. The ripple effect of BSE was not large enough to be detected at the level of analysis used in this study. The temporal dimension of such a ripple effect will need to be ascertained with finer resolution analysis.

Ultimately, this thesis places limits on the severity of the impact of BSE. BSE impacted the spatial organization and structure of the cattle herd of Alberta. No consequences for BSE were found in community economic structure. An argument was made, however, that the influence BSE may have had on community economic structure is secondary to the influence of the urban economic growth in the province between 2001 and 2006. Although a relationship exists between spatial changes in the cattle industry and regional levels of agricultural diversity, little evidence of an economic ripple effect stemming from BSE was found.

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## Appendices

### Appendix A. Number of Farms Reporting Beef Cows and Beef Replacement Heifers by CCS

|                             | Beef Cows |      |        |            | Beef Replacement Heifers |      |        |            |
|-----------------------------|-----------|------|--------|------------|--------------------------|------|--------|------------|
|                             | 2001      | 2006 | Change | Change (%) | 2001                     | 2006 | Change | Change (%) |
| Athabasca County No. 12     | 547       | 492  | -55    | -10.05     | 376                      | 252  | -124   | -32.98     |
| Barrhead County No. 11      | 559       | 497  | -62    | -11.09     | 388                      | 288  | -100   | -25.77     |
| Beaver County               | 533       | 465  | -68    | -12.76     | 319                      | 251  | -68    | -21.32     |
| Big Lakes                   | 269       | 232  | -37    | -13.75     | 188                      | 114  | -74    | -39.36     |
| Bighorn No. 8               | 32        | 26   | -6     | -18.75     | 16                       | 21   | 5      | 31.25      |
| Birch Hills County          | 98        | 87   | -11    | -11.22     | 69                       | 45   | -24    | -34.78     |
| Bonnyville No. 87           | 558       | 523  | -35    | -6.27      | 380                      | 302  | -78    | -20.53     |
| Brazeau County              | 354       | 294  | -60    | -16.95     | 227                      | 175  | -52    | -22.91     |
| Calgary                     | 52        | 41   | -11    | -21.15     | 38                       | 13   | -25    | -65.79     |
| Camrose County No. 22       | 630       | 575  | -55    | -8.73      | 410                      | 322  | -88    | -21.46     |
| Cardston County             | 406       | 347  | -59    | -14.53     | 226                      | 181  | -45    | -19.91     |
| Clear Hills No. 21          | 242       | 252  | 10     | 4.13       | 176                      | 130  | -46    | -26.14     |
| Clearwater County           | 838       | 730  | -108   | -12.89     | 537                      | 412  | -125   | -23.28     |
| Cypress County              | 515       | 515  | 0      | 0.00       | 324                      | 326  | 2      | 0.62       |
| Edmonton                    | 45        | 40   | -5     | -11.11     | 19                       | 18   | -1     | -5.26      |
| Fairview No. 136            | 133       | 109  | -24    | -18.05     | 106                      | 60   | -46    | -43.40     |
| Flagstaff County            | 449       | 426  | -23    | -5.12      | 302                      | 237  | -65    | -21.52     |
| Foothills No. 31            | 623       | 573  | -50    | -8.03      | 374                      | 305  | -69    | -18.45     |
| Forty Mile County No. 8     | 276       | 247  | -29    | -10.51     | 139                      | 146  | 7      | 5.04       |
| Grande Prairie County No. 1 | 568       | 543  | -25    | -4.40      | 373                      | 318  | -55    | -14.75     |
| Greenview No. 16            | 419       | 383  | -36    | -8.59      | 268                      | 220  | -48    | -17.91     |
| Kneeshill County            | 385       | 360  | -25    | -6.49      | 239                      | 180  | -59    | -24.69     |
| Lac Ste. Anne County        | 715       | 652  | -63    | -8.81      | 502                      | 392  | -110   | -21.91     |
| Lacombe County              | 701       | 627  | -74    | -10.56     | 449                      | 363  | -86    | -19.15     |
| Lakeland County             | 250       | 224  | -26    | -10.40     | 165                      | 126  | -39    | -23.64     |
| Lamont County               | 456       | 432  | -24    | -5.26      | 282                      | 226  | -56    | -19.86     |
| Leduc County                | 781       | 692  | -89    | -11.40     | 521                      | 379  | -142   | -27.26     |
| Lesser Slave River No.124   | 114       | 98   | -16    | -14.04     | 80                       | 61   | -19    | -23.75     |
| Lethbridge County           | 307       | 330  | 23     | 7.49       | 147                      | 121  | -26    | -17.69     |
| Mackenzie No. 23            | 237       | 261  | 24     | 10.13      | 159                      | 153  | -6     | -3.77      |
| Minburn County No. 27       | 417       | 360  | -57    | -13.67     | 244                      | 203  | -41    | -16.80     |
| Mountain View County        | 1082      | 980  | -102   | -9.43      | 658                      | 527  | -131   | -19.91     |
| Newell County No. 4         | 503       | 466  | -37    | -7.36      | 290                      | 253  | -37    | -12.76     |
| Northern Lights No. 22      | 209       | 207  | -2     | -0.96      | 151                      | 120  | -31    | -20.53     |
| Northern Sunrise County     | 66        | 60   | -6     | -9.09      | 43                       | 33   | -10    | -23.26     |
| Paintearth County No. 18    | 366       | 310  | -56    | -15.30     | 221                      | 186  | -35    | -15.84     |
| Parkland County             | 583       | 477  | -106   | -18.18     | 396                      | 266  | -130   | -32.83     |
| Pincher Creek No. 9         | 354       | 319  | -35    | -9.89      | 209                      | 204  | -5     | -2.39      |
| Ponoka County               | 842       | 722  | -120   | -14.25     | 514                      | 389  | -125   | -24.32     |
| Provost No. 52              | 345       | 309  | -36    | -10.43     | 205                      | 171  | -34    | -16.59     |
| Ranchland No. 66            | 36        | 24   | -12    | -33.33     | 21                       | 17   | -4     | -19.05     |
| Red Deer County             | 1038      | 928  | -110   | -10.60     | 659                      | 501  | -158   | -23.98     |
| Rocky View No. 44           | 791       | 720  | -71    | -8.98      | 525                      | 394  | -131   | -24.95     |
| Saddle Hills County         | 221       | 211  | -10    | -4.52      | 156                      | 116  | -40    | -25.64     |

**Appendix A. Number of Farms Reporting Beef Cows and  
Beef Replacement Heifers by CCS (continued)**

|                               | Beef Cows |        |        |            | Beef Replacement Heifers |        |        |            |
|-------------------------------|-----------|--------|--------|------------|--------------------------|--------|--------|------------|
|                               | 2001      | 2006   | Change | Change (%) | 2001                     | 2006   | Change | Change (%) |
| Smoky Lake County             | 354       | 307    | -47    | -13.28     | 224                      | 168    | -56    | -25.00     |
| Smoky River No. 130           | 55        | 57     | 2      | 3.64       | 44                       | 29     | -15    | -34.09     |
| Special Area No. 2            | 447       | 392    | -55    | -12.30     | 279                      | 248    | -31    | -11.11     |
| Special Area No. 3            | 337       | 310    | -27    | -8.01      | 204                      | 186    | -18    | -8.82      |
| Special Area No. 4            | 278       | 223    | -55    | -19.78     | 176                      | 151    | -25    | -14.20     |
| Spirit River No. 133          | 38        | 41     | 3      | 7.89       | 30                       | 25     | -5     | -16.67     |
| St. Paul County No. 19        | 553       | 496    | -57    | -10.31     | 378                      | 274    | -104   | -27.51     |
| Starland County               | 211       | 199    | -12    | -5.69      | 112                      | 92     | -20    | -17.86     |
| Stettler County No. 6         | 595       | 530    | -65    | -10.92     | 378                      | 298    | -80    | -21.16     |
| Strathcona County             | 334       | 264    | -70    | -20.96     | 227                      | 128    | -99    | -43.61     |
| Sturgeon County               | 362       | 343    | -19    | -5.25      | 244                      | 189    | -55    | -22.54     |
| Taber                         | 409       | 355    | -54    | -13.20     | 203                      | 174    | -29    | -14.29     |
| Thorhild County No. 7         | 315       | 263    | -52    | -16.51     | 202                      | 136    | -66    | -32.67     |
| Two Hills County No. 21       | 396       | 366    | -30    | -7.58      | 255                      | 200    | -55    | -21.57     |
| Vermilion River County No. 24 | 775       | 687    | -88    | -11.35     | 535                      | 399    | -136   | -25.42     |
| Vulcan County                 | 336       | 290    | -46    | -13.69     | 155                      | 138    | -17    | -10.97     |
| Wainwright No. 61             | 351       | 343    | -8     | -2.28      | 246                      | 199    | -47    | -19.11     |
| Warner County No. 5           | 272       | 263    | -9     | -3.31      | 137                      | 142    | 5      | 3.65       |
| Westlock County               | 613       | 515    | -98    | -15.99     | 415                      | 281    | -134   | -32.29     |
| Wetaskiwin County No. 10      | 712       | 611    | -101   | -14.19     | 448                      | 362    | -86    | -19.20     |
| Wheatland County              | 472       | 424    | -48    | -10.17     | 254                      | 205    | -49    | -19.29     |
| Willow Creek No. 26           | 544       | 500    | -44    | -8.09      | 274                      | 257    | -17    | -6.20      |
| Woodlands County              | 185       | 165    | -20    | -10.81     | 142                      | 98     | -44    | -30.99     |
| Yellowhead County             | 527       | 448    | -79    | -14.99     | 356                      | 234    | -122   | -34.27     |
| Mean                          | 417.88    | 375.85 | -42.03 | -10.06     | 264.84                   | 207.79 | -57.04 | -21.54     |
| Standard Deviation            | 239.74    | 213.46 | 33.67  | -10.96     | 155.54                   | 119.86 | 43.51  | -22.94     |

## Appendix B. Number of Farms Reporting Steers and Slaughter Heifers by CCS

|                             | Steers |      |        |            | Slaughter Heifers |      |        |            |
|-----------------------------|--------|------|--------|------------|-------------------|------|--------|------------|
|                             | 2001   | 2006 | Change | Change (%) | 2001              | 2006 | Change | Change (%) |
| Athabasca County No. 12     | 106    | 168  | 62     | 58.49      | 52                | 110  | 58     | 111.54     |
| Barrhead County No. 11      | 127    | 190  | 63     | 49.61      | 68                | 134  | 66     | 97.06      |
| Beaver County               | 118    | 154  | 36     | 30.51      | 76                | 110  | 34     | 44.74      |
| Big Lakes                   | 62     | 98   | 36     | 58.06      | 22                | 61   | 39     | 177.27     |
| Bighorn No. 8               | 8      | 11   | 3      | 37.50      | 4                 | 4    | 0      | 0.00       |
| Birch Hills County          | 20     | 35   | 15     | 75.00      | 7                 | 19   | 12     | 171.43     |
| Bonnyville No. 87           | 128    | 196  | 68     | 53.13      | 61                | 121  | 60     | 98.36      |
| Brazeau County              | 72     | 99   | 27     | 37.50      | 26                | 50   | 24     | 92.31      |
| Calgary                     | 16     | 19   | 3      | 18.75      | 7                 | 7    | 0      | 0.00       |
| Camrose County No. 22       | 149    | 195  | 46     | 30.87      | 74                | 126  | 52     | 70.27      |
| Cardston County             | 99     | 114  | 15     | 15.15      | 43                | 63   | 20     | 46.51      |
| Clear Hills No. 21          | 70     | 90   | 20     | 28.57      | 23                | 60   | 37     | 160.87     |
| Clearwater County           | 217    | 270  | 53     | 24.42      | 94                | 174  | 80     | 85.11      |
| Cypress County              | 164    | 218  | 54     | 32.93      | 99                | 147  | 48     | 48.48      |
| Edmonton                    | 11     | 16   | 5      | 45.45      | 6                 | 8    | 2      | 33.33      |
| Fairview No. 136            | 34     | 50   | 16     | 47.06      | 14                | 25   | 11     | 78.57      |
| Flagstaff County            | 139    | 162  | 23     | 16.55      | 83                | 118  | 35     | 42.17      |
| Foothills No. 31            | 195    | 232  | 37     | 18.97      | 82                | 146  | 64     | 78.05      |
| Forty Mile County No. 8     | 89     | 122  | 33     | 37.08      | 42                | 73   | 31     | 73.81      |
| Grande Prairie County No. 1 | 159    | 208  | 49     | 30.82      | 57                | 105  | 48     | 84.21      |
| Greenview No. 16            | 98     | 158  | 60     | 61.22      | 36                | 82   | 46     | 127.78     |
| Kneehill County             | 120    | 164  | 44     | 36.67      | 52                | 86   | 34     | 65.38      |
| Lac Ste. Anne County        | 176    | 228  | 52     | 29.55      | 87                | 137  | 50     | 57.47      |
| Lacombe County              | 198    | 232  | 34     | 17.17      | 102               | 133  | 31     | 30.39      |
| Lakeland County             | 45     | 86   | 41     | 91.11      | 21                | 55   | 34     | 161.90     |
| Lamont County               | 106    | 174  | 68     | 64.15      | 57                | 122  | 65     | 114.04     |
| Leduc County                | 201    | 258  | 57     | 28.36      | 90                | 132  | 42     | 46.67      |
| Lesser Slave River No.124   | 31     | 30   | -1     | -3.23      | 8                 | 19   | 11     | 137.50     |
| Lethbridge County           | 181    | 225  | 44     | 24.31      | 146               | 160  | 14     | 9.59       |
| Mackenzie No. 23            | 61     | 82   | 21     | 34.43      | 20                | 51   | 31     | 155.00     |
| Minburn County No. 27       | 75     | 138  | 63     | 84.00      | 49                | 66   | 17     | 34.69      |
| Mountain View County        | 278    | 359  | 81     | 29.14      | 121               | 195  | 74     | 61.16      |
| Newell County No. 4         | 150    | 183  | 33     | 22.00      | 71                | 114  | 43     | 60.56      |
| Northern Lights No. 22      | 66     | 85   | 19     | 28.79      | 30                | 49   | 19     | 63.33      |
| Northern Sunrise County     | 10     | 26   | 16     | 160.00     | 4                 | 12   | 8      | 200.00     |
| Paintearth County No. 18    | 91     | 120  | 29     | 31.87      | 60                | 74   | 14     | 23.33      |
| Parkland County             | 181    | 191  | 10     | 5.52       | 79                | 109  | 30     | 37.97      |
| Pincher Creek No. 9         | 134    | 140  | 6      | 4.48       | 90                | 108  | 18     | 20.00      |
| Ponoka County               | 234    | 262  | 28     | 11.97      | 130               | 164  | 34     | 26.15      |
| Provost No. 52              | 104    | 131  | 27     | 25.96      | 57                | 80   | 23     | 40.35      |
| Ranchland No. 66            | 14     | 14   | 0      | 0.00       | 9                 | 8    | -1     | -11.11     |
| Red Deer County             | 311    | 383  | 72     | 23.15      | 141               | 211  | 70     | 49.65      |
| Rocky View No. 44           | 235    | 286  | 51     | 21.70      | 98                | 153  | 55     | 56.12      |
| Saddle Hills County         | 55     | 83   | 28     | 50.91      | 26                | 43   | 17     | 65.38      |
| Smoky Lake County           | 62     | 77   | 15     | 24.19      | 37                | 65   | 28     | 75.68      |
| Smoky River No. 130         | 27     | 21   | -6     | -22.22     | 12                | 13   | 1      | 8.33       |
| Special Area No. 2          | 105    | 162  | 57     | 54.29      | 58                | 104  | 46     | 79.31      |

**Appendix B. Number of Farms Reporting Steers and Slaughter Heifers by CCS  
(continued)**

|                               | Steers |        |        |            | Slaughter Heifers |       |        |            |
|-------------------------------|--------|--------|--------|------------|-------------------|-------|--------|------------|
|                               | 2001   | 2006   | Change | Change (%) | 2001              | 2006  | Change | Change (%) |
| Special Area No. 3            | 83     | 103    | 20     | 24.10      | 31                | 63    | 32     | 103.23     |
| Special Area No. 4            | 65     | 86     | 21     | 32.31      | 38                | 54    | 16     | 42.11      |
| Spirit River No. 133          | 8      | 14     | 6      | 75.00      | 6                 | 9     | 3      | 50.00      |
| St. Paul County No. 19        | 146    | 197    | 51     | 34.93      | 76                | 126   | 50     | 65.79      |
| Starland County               | 56     | 76     | 20     | 35.71      | 26                | 45    | 19     | 73.08      |
| Stettler County No. 6         | 144    | 187    | 43     | 29.86      | 79                | 119   | 40     | 50.63      |
| Strathcona County             | 104    | 115    | 11     | 10.58      | 47                | 60    | 13     | 27.66      |
| Sturgeon County               | 108    | 156    | 48     | 44.44      | 47                | 82    | 35     | 74.47      |
| Taber                         | 103    | 131    | 28     | 27.18      | 62                | 65    | 3      | 4.84       |
| Thorhild County No. 7         | 71     | 83     | 12     | 16.90      | 39                | 52    | 13     | 33.33      |
| Two Hills County No. 21       | 90     | 122    | 32     | 35.56      | 53                | 78    | 25     | 47.17      |
| Vermilion River County No. 24 | 196    | 310    | 114    | 58.16      | 116               | 211   | 95     | 81.90      |
| Vulcan County                 | 80     | 113    | 33     | 41.25      | 36                | 66    | 30     | 83.33      |
| Wainwright No. 61             | 129    | 134    | 5      | 3.88       | 45                | 93    | 48     | 106.67     |
| Warner County No. 5           | 85     | 121    | 36     | 42.35      | 38                | 64    | 26     | 68.42      |
| Westlock County               | 160    | 181    | 21     | 13.13      | 76                | 135   | 59     | 77.63      |
| Wetaskiwin County No. 10      | 181    | 223    | 42     | 23.20      | 89                | 144   | 55     | 61.80      |
| Wheatland County              | 130    | 162    | 32     | 24.62      | 70                | 99    | 29     | 41.43      |
| Willow Creek No. 26           | 196    | 241    | 45     | 22.96      | 111               | 155   | 44     | 39.64      |
| Woodlands County              | 50     | 65     | 15     | 30.00      | 22                | 41    | 19     | 86.36      |
| Yellowhead County             | 153    | 163    | 10     | 6.54       | 62                | 92    | 30     | 48.39      |
| Mean                          | 112.79 | 146.00 | 33.21  | 34.10      | 55.88             | 89.10 | 33.22  | 68.51      |
| Standard Deviation            | 67.62  | 83.39  | 22.65  | 25.61      | 35.42             | 51.52 | 21.29  | 44.41      |

## Appendix C. Number of Farms Reporting Milk Cows and Milk Heifers by CCS

|                             | Milk Cows |      |        |            | Milk Heifers |      |        |            |
|-----------------------------|-----------|------|--------|------------|--------------|------|--------|------------|
|                             | 2001      | 2006 | Change | Change (%) | 2001         | 2006 | Change | Change (%) |
| Athabasca County No. 12     | 10        | 12   | 2      | 20.00      | 5            | 5    | 0      | 0.00       |
| Barrhead County No. 11      | 45        | 38   | -7     | -15.56     | 34           | 33   | -1     | -2.94      |
| Beaver County               | 15        | 11   | -4     | -26.67     | 9            | 7    | -2     | -22.22     |
| Big Lakes                   | 8         | 1    | -7     | -87.50     | 2            | 2    | 0      | 0.00       |
| Bighorn No. 8               | 0         | 0    | 0      | n/a        | 0            | 0    | 0      | n/a        |
| Birch Hills County          | 3         | 3    | 0      | 0.00       | 1            | 1    | 0      | 0.00       |
| Bonnyville No. 87           | 8         | 10   | 2      | 25.00      | 3            | 9    | 6      | 200.00     |
| Brazeau County              | 11        | 5    | -6     | -54.55     | 7            | 5    | -2     | -28.57     |
| Calgary                     | 1         | 1    | 0      | 0.00       | 1            | 0    | -1     | -100.00    |
| Camrose County No. 22       | 40        | 24   | -16    | -40.00     | 33           | 18   | -15    | -45.45     |
| Cardston County             | 32        | 23   | -9     | -28.13     | 19           | 19   | 0      | 0.00       |
| Clear Hills No. 21          | 10        | 5    | -5     | -50.00     | 1            | 2    | 1      | 100.00     |
| Clearwater County           | 41        | 29   | -12    | -29.27     | 25           | 21   | -4     | -16.00     |
| Cypress County              | 15        | 9    | -6     | -40.00     | 7            | 5    | -2     | -28.57     |
| Edmonton                    | 4         | 1    | -3     | -75.00     | 3            | 1    | -2     | -66.67     |
| Fairview No. 136            | 2         | 3    | 1      | 50.00      | 2            | 1    | -1     | -50.00     |
| Flagstaff County            | 14        | 15   | 1      | 7.14       | 10           | 11   | 1      | 10.00      |
| Foothills No. 31            | 16        | 13   | -3     | -18.75     | 10           | 11   | 1      | 10.00      |
| Forty Mile County No. 8     | 22        | 17   | -5     | -22.73     | 16           | 12   | -4     | -25.00     |
| Grande Prairie County No. 1 | 14        | 7    | -7     | -50.00     | 6            | 5    | -1     | -16.67     |
| Greenview No. 16            | 17        | 7    | -10    | -58.82     | 4            | 2    | -2     | -50.00     |
| Kneehill County             | 19        | 11   | -8     | -42.11     | 14           | 9    | -5     | -35.71     |
| Lac Ste. Anne County        | 23        | 13   | -10    | -43.48     | 18           | 9    | -9     | -50.00     |
| Lacombe County              | 79        | 75   | -4     | -5.06      | 67           | 69   | 2      | 2.99       |
| Lakeland County             | 8         | 4    | -4     | -50.00     | 4            | 3    | -1     | -25.00     |
| Lamont County               | 13        | 7    | -6     | -46.15     | 9            | 2    | -7     | -77.78     |
| Leduc County                | 122       | 79   | -43    | -35.25     | 122          | 79   | -43    | -35.25     |
| Lesser Slave River No.124   | 3         | 1    | -2     | -66.67     | 0            | 1    | 1      | n/a        |
| Lethbridge County           | 89        | 75   | -14    | -15.73     | 80           | 65   | -15    | -18.75     |
| Mackenzie No. 23            | 32        | 27   | -5     | -15.63     | 9            | 13   | 4      | 44.44      |
| Minburn County No. 27       | 13        | 6    | -7     | -53.85     | 9            | 7    | -2     | -22.22     |
| Mountain View County        | 53        | 50   | -3     | -5.66      | 41           | 39   | -2     | -4.88      |
| Newell County No. 4         | 22        | 17   | -5     | -22.73     | 16           | 16   | 0      | 0.00       |
| Northern Lights No. 22      | 7         | 4    | -3     | -42.86     | 3            | 4    | 1      | 33.33      |
| Northern Sunrise County     | 2         | 2    | 0      | 0.00       | 3            | 5    | 2      | 66.67      |
| Paintearth County No. 18    | 10        | 7    | -3     | -30.00     | 6            | 7    | 1      | 16.67      |
| Parkland County             | 30        | 18   | -12    | -40.00     | 22           | 14   | -8     | -36.36     |
| Pincher Creek No. 9         | 15        | 9    | -6     | -40.00     | 10           | 7    | -3     | -30.00     |
| Ponoka County               | 94        | 92   | -2     | -2.13      | 82           | 74   | -8     | -9.76      |
| Provost No. 52              | 11        | 7    | -4     | -36.36     | 3            | 1    | -2     | -66.67     |
| Ranchland No. 66            | 2         | 1    | -1     | -50.00     | 1            | 0    | -1     | -100.00    |
| Red Deer County             | 57        | 52   | -5     | -8.77      | 56           | 44   | -12    | -21.43     |
| Rocky View No. 44           | 19        | 18   | -1     | -5.26      | 18           | 15   | -3     | -16.67     |
| Saddle Hills County         | 12        | 9    | -3     | -25.00     | 2            | 4    | 2      | 100.00     |
| Smoky Lake County           | 7         | 5    | -2     | -28.57     | 3            | 4    | 1      | 33.33      |
| Smoky River No. 130         | 2         | 1    | -1     | -50.00     | 2            | 3    | 1      | 50.00      |
| Special Area No. 2          | 7         | 6    | -1     | -14.29     | 3            | 5    | 2      | 66.67      |

**Appendix C. Number of Farms Reporting Milk Cows and Milk Heifers by CCS  
(continued)**

|                               | Milk Cows |       |        |            | Milk Heifers |       |        |            |
|-------------------------------|-----------|-------|--------|------------|--------------|-------|--------|------------|
|                               | 2001      | 2006  | Change | Change (%) | 2001         | 2006  | Change | Change (%) |
| Special Area No. 3            | 5         | 8     | 3      | 60.00      | 2            | 5     | 3      | 150.00     |
| Special Area No. 4            | 4         | 3     | -1     | -25.00     | 2            | 2     | 0      | 0.00       |
| Spirit River No. 133          | 1         | 1     | 0      | 0.00       | 0            | 2     | 2      | n/a        |
| St. Paul County No. 19        | 16        | 9     | -7     | -43.75     | 11           | 6     | -5     | -45.45     |
| Starland County               | 7         | 10    | 3      | 42.86      | 6            | 8     | 2      | 33.33      |
| Stettler County No. 6         | 20        | 23    | 3      | 15.00      | 20           | 13    | -7     | -35.00     |
| Strathcona County             | 19        | 11    | -8     | -42.11     | 16           | 13    | -3     | -18.75     |
| Sturgeon County               | 30        | 20    | -10    | -33.33     | 24           | 22    | -2     | -8.33      |
| Taber                         | 17        | 14    | -3     | -17.65     | 13           | 11    | -2     | -15.38     |
| Thorhild County No. 7         | 4         | 2     | -2     | -50.00     | 3            | 0     | -3     | -100.00    |
| Two Hills County No. 21       | 8         | 8     | 0      | 0.00       | 5            | 5     | 0      | 0.00       |
| Vermilion River County No. 24 | 15        | 8     | -7     | -46.67     | 6            | 7     | 1      | 16.67      |
| Vulcan County                 | 12        | 13    | 1      | 8.33       | 10           | 15    | 5      | 50.00      |
| Wainwright No. 61             | 11        | 11    | 0      | 0.00       | 10           | 6     | -4     | -40.00     |
| Warner County No. 5           | 22        | 20    | -2     | -9.09      | 16           | 17    | 1      | 6.25       |
| Westlock County               | 22        | 17    | -5     | -22.73     | 17           | 14    | -3     | -17.65     |
| Wetaskiwin County No. 10      | 57        | 40    | -17    | -29.82     | 48           | 38    | -10    | -20.83     |
| Wheatland County              | 21        | 14    | -7     | -33.33     | 18           | 13    | -5     | -27.78     |
| Willow Creek No. 26           | 30        | 20    | -10    | -33.33     | 24           | 15    | -9     | -37.50     |
| Woodlands County              | 4         | 5     | 1      | 25.00      | 1            | 3     | 2      | 200.00     |
| Yellowhead County             | 18        | 18    | 0      | 0.00       | 10           | 9     | -1     | -10.00     |
| Mean                          | 20.91     | 16.25 | -4.66  | -22.48     | 15.63        | 13.13 | -2.50  | -2.91      |
| Standard Deviation            | 23.33     | 19.49 | 6.51   | 28.48      | 21.99        | 17.44 | 6.52   | 58.01      |

### Appendix D. IFTD Values by CCS; 2001

| CCS                         | NAICS Farm Types (%) |      |      |      |       |       |      |      |      |       | IFTD |
|-----------------------------|----------------------|------|------|------|-------|-------|------|------|------|-------|------|
|                             | 1                    | 2    | 3    | 4    | 5     | 6     | 7    | 8    | 9    | 10    |      |
| Athabasca County No. 12     | 51.20                | 0.46 | 0.80 | 1.14 | 9.01  | 16.31 | 0.11 | 0.11 | 0.68 | 20.18 | 0.66 |
| Barrhead County No. 11      | 61.23                | 8.38 | 1.16 | 1.05 | 7.22  | 10.13 | 0.23 | 0.12 | 0.70 | 9.78  | 0.59 |
| Beaver County               | 42.77                | 1.67 | 1.31 | 1.31 | 8.84  | 38.35 | 0.36 | 0.12 | 0.48 | 4.78  | 0.66 |
| Big Lakes                   | 53.32                | 0.69 | 0.23 | 0.46 | 10.30 | 16.02 | 0.00 | 0.00 | 0.23 | 18.76 | 0.64 |
| Bighorn No. 8               | 69.57                | 0.00 | 0.00 | 6.52 | 13.04 | 2.17  | 0.00 | 0.00 | 2.17 | 6.52  | 0.49 |
| Birch Hills County          | 22.76                | 0.00 | 0.32 | 0.00 | 5.77  | 54.49 | 0.00 | 0.32 | 0.32 | 16.03 | 0.62 |
| Bonnyville No. 87           | 54.81                | 0.23 | 0.34 | 1.03 | 14.42 | 10.30 | 0.11 | 0.11 | 0.69 | 17.96 | 0.64 |
| Brazeau County              | 62.82                | 0.59 | 0.20 | 1.37 | 15.46 | 1.96  | 0.00 | 0.20 | 1.57 | 15.85 | 0.56 |
| Calgary                     | 38.60                | 0.00 | 3.51 | 0.00 | 15.79 | 23.68 | 0.00 | 2.63 | 5.26 | 10.53 | 0.75 |
| Camrose County No. 22       | 38.90                | 2.09 | 3.26 | 1.67 | 7.76  | 38.65 | 0.42 | 0.42 | 0.58 | 6.26  | 0.69 |
| Cardston County             | 56.21                | 1.14 | 0.33 | 1.63 | 14.05 | 18.63 | 0.49 | 0.16 | 0.65 | 6.70  | 0.62 |
| Clear Hills No. 21          | 29.96                | 0.56 | 0.19 | 0.56 | 10.30 | 30.34 | 0.19 | 0.00 | 0.00 | 27.90 | 0.73 |
| Clearwater County           | 68.68                | 0.85 | 0.34 | 0.93 | 13.33 | 2.38  | 0.09 | 0.09 | 1.02 | 12.31 | 0.49 |
| Cypress County              | 50.49                | 1.19 | 0.22 | 0.43 | 6.27  | 25.19 | 0.54 | 0.11 | 4.97 | 10.60 | 0.66 |
| Edmonton                    | 22.93                | 1.27 | 1.91 | 2.55 | 15.92 | 33.12 | 2.55 | 1.27 | 9.55 | 8.92  | 0.79 |
| Fairview No. 136            | 29.84                | 0.98 | 0.00 | 0.66 | 4.92  | 46.56 | 0.33 | 0.33 | 1.31 | 15.08 | 0.67 |
| Flagstaff County            | 31.76                | 1.57 | 0.12 | 0.73 | 5.56  | 55.92 | 0.12 | 0.24 | 0.73 | 3.26  | 0.58 |
| Foothills No. 31            | 45.29                | 0.42 | 1.01 | 1.51 | 21.51 | 15.38 | 0.34 | 0.08 | 3.03 | 11.43 | 0.71 |
| Forty Mile County No. 8     | 23.28                | 1.90 | 0.73 | 0.44 | 3.66  | 61.93 | 1.76 | 0.00 | 0.44 | 5.86  | 0.56 |
| Grande Prairie County No. 1 | 28.79                | 0.60 | 0.98 | 1.50 | 14.62 | 29.69 | 0.08 | 0.23 | 1.50 | 22.04 | 0.76 |
| Greenview No. 16            | 46.15                | 0.80 | 0.53 | 1.33 | 14.46 | 13.66 | 0.00 | 0.13 | 0.40 | 22.55 | 0.70 |
| Kneehill County             | 30.73                | 5.70 | 5.82 | 0.87 | 6.07  | 47.34 | 0.00 | 0.00 | 0.87 | 2.60  | 0.67 |
| Lac Ste. Anne County        | 61.35                | 0.95 | 0.48 | 1.99 | 11.59 | 5.03  | 0.29 | 0.19 | 1.14 | 17.00 | 0.58 |
| Lacombe County              | 53.44                | 4.72 | 1.28 | 2.08 | 10.16 | 17.12 | 1.28 | 0.08 | 2.40 | 7.44  | 0.67 |
| Lakeland County             | 62.40                | 0.00 | 0.00 | 0.84 | 10.86 | 5.85  | 1.11 | 0.00 | 1.39 | 17.55 | 0.56 |
| Lamont County               | 32.63                | 1.87 | 0.82 | 0.94 | 8.89  | 43.74 | 0.23 | 0.00 | 0.94 | 9.94  | 0.68 |
| Leduc County                | 53.19                | 1.54 | 1.39 | 1.54 | 12.99 | 15.55 | 0.44 | 0.07 | 2.13 | 11.15 | 0.66 |
| Lesser Slave River No. 124  | 60.37                | 1.22 | 0.00 | 2.44 | 8.54  | 9.76  | 0.00 | 0.00 | 1.22 | 16.46 | 0.59 |
| Lethbridge County           | 36.37                | 5.98 | 2.28 | 2.18 | 7.88  | 29.63 | 0.95 | 0.19 | 2.18 | 12.35 | 0.75 |
| Mackenzie No. 23            | 18.17                | 0.48 | 0.32 | 0.97 | 7.07  | 56.75 | 0.64 | 0.16 | 0.48 | 14.95 | 0.62 |
| Minburn County No. 27       | 36.48                | 0.28 | 0.28 | 0.83 | 7.49  | 49.52 | 0.00 | 0.00 | 0.28 | 4.85  | 0.61 |
| Mountain View County        | 56.09                | 1.09 | 0.86 | 1.43 | 11.09 | 14.24 | 0.40 | 0.11 | 1.72 | 12.98 | 0.64 |
| Newell County No. 4         | 59.10                | 1.46 | 0.24 | 0.73 | 6.07  | 16.75 | 1.21 | 0.00 | 0.73 | 13.71 | 0.60 |
| Northern Lights No. 22      | 24.75                | 0.51 | 0.67 | 1.52 | 9.43  | 39.39 | 0.17 | 0.00 | 0.67 | 22.90 | 0.72 |
| Northern Sunrise County     | 20.69                | 0.86 | 0.00 | 0.86 | 9.91  | 41.81 | 0.00 | 0.00 | 0.00 | 25.86 | 0.71 |
| Paintearth County No. 18    | 53.42                | 0.83 | 0.21 | 0.62 | 6.42  | 29.19 | 0.00 | 0.00 | 0.83 | 8.49  | 0.62 |
| Parkland County             | 51.47                | 0.78 | 0.88 | 2.75 | 17.84 | 10.20 | 0.88 | 0.59 | 3.73 | 10.88 | 0.68 |
| Peace No. 135               | 27.45                | 0.49 | 0.00 | 0.49 | 9.31  | 43.14 | 0.49 | 0.98 | 0.49 | 17.16 | 0.70 |

### Appendix D. IFTD Values by CCS; 2001 (continued)

| CCS                           | NAICS Farm Types (%) |      |      |      |       |       |      |      |      |       | IFTD |
|-------------------------------|----------------------|------|------|------|-------|-------|------|------|------|-------|------|
|                               | 1                    | 2    | 3    | 4    | 5     | 6     | 7    | 8    | 9    | 10    |      |
| Pincher Creek                 | 69.82                | 0.82 | 1.03 | 0.62 | 11.29 | 8.83  | 0.21 | 0.62 | 0.21 | 6.57  | 0.49 |
| Ponoka County                 | 65.71                | 3.03 | 0.85 | 1.63 | 11.17 | 7.76  | 0.08 | 0.08 | 0.85 | 8.84  | 0.54 |
| Provost No. 52                | 55.26                | 0.83 | 0.00 | 0.21 | 5.77  | 33.61 | 0.21 | 0.00 | 0.21 | 3.92  | 0.58 |
| Ranchland No. 66              | 70.83                | 0.00 | 1.39 | 1.39 | 15.28 | 4.17  | 0.00 | 0.00 | 1.39 | 5.56  | 0.47 |
| Red Deer County               | 52.88                | 3.39 | 0.51 | 1.86 | 12.15 | 17.12 | 0.23 | 0.17 | 1.81 | 9.89  | 0.66 |
| Rocky View No. 44             | 44.08                | 1.29 | 1.02 | 1.96 | 17.47 | 21.19 | 0.20 | 0.14 | 3.11 | 9.55  | 0.72 |
| Saddle Hills County           | 31.11                | 0.56 | 0.19 | 1.48 | 8.52  | 34.82 | 0.00 | 0.00 | 0.37 | 22.96 | 0.72 |
| Smoky Lake County             | 50.65                | 1.30 | 0.37 | 0.93 | 8.53  | 18.92 | 0.00 | 0.00 | 1.11 | 18.18 | 0.67 |
| Smoky River No. 130           | 9.81                 | 0.42 | 0.21 | 0.84 | 6.68  | 64.93 | 0.21 | 0.21 | 0.42 | 16.28 | 0.54 |
| Special Area No. 2            | 66.55                | 0.00 | 0.00 | 0.36 | 5.04  | 18.17 | 0.18 | 0.00 | 0.18 | 9.53  | 0.51 |
| Special Area No. 3            | 31.63                | 1.41 | 0.00 | 0.35 | 3.16  | 56.06 | 0.00 | 0.00 | 0.18 | 7.21  | 0.58 |
| Special Area No. 4            | 63.61                | 0.59 | 0.30 | 0.00 | 5.03  | 23.96 | 0.00 | 0.00 | 0.00 | 6.51  | 0.53 |
| Spirit River No. 133          | 13.04                | 1.24 | 0.00 | 0.62 | 7.45  | 62.73 | 0.62 | 0.00 | 0.00 | 14.29 | 0.56 |
| St. Paul County No. 19        | 56.87                | 2.13 | 0.36 | 0.59 | 9.83  | 12.44 | 0.24 | 0.12 | 0.71 | 16.71 | 0.62 |
| Starland County               | 29.16                | 1.79 | 0.26 | 0.77 | 6.65  | 53.71 | 0.26 | 0.00 | 0.77 | 6.65  | 0.62 |
| Stettler County No. 6         | 57.48                | 1.99 | 1.17 | 0.58 | 8.53  | 21.61 | 0.12 | 0.12 | 0.35 | 8.06  | 0.61 |
| Strathcona County             | 37.29                | 0.39 | 1.83 | 1.57 | 22.95 | 19.30 | 0.52 | 0.39 | 5.74 | 10.04 | 0.76 |
| Sturgeon County               | 30.32                | 3.74 | 3.32 | 1.35 | 14.33 | 31.98 | 0.62 | 0.42 | 3.53 | 10.38 | 0.77 |
| Taber                         | 36.66                | 2.76 | 0.48 | 0.60 | 4.81  | 27.76 | 9.26 | 0.12 | 0.48 | 17.07 | 0.75 |
| Thorhild County No. 7         | 44.85                | 0.74 | 0.92 | 0.74 | 8.46  | 28.13 | 0.18 | 0.00 | 0.37 | 15.63 | 0.69 |
| Two Hills County No. 21       | 40.86                | 1.59 | 0.64 | 1.27 | 5.72  | 39.59 | 0.00 | 0.00 | 0.00 | 10.33 | 0.66 |
| Vermilion River County No. 24 | 43.74                | 1.79 | 0.49 | 0.49 | 9.27  | 38.94 | 0.00 | 0.16 | 0.49 | 4.63  | 0.65 |
| Vulcan County                 | 24.50                | 0.29 | 0.43 | 0.58 | 5.19  | 64.70 | 0.14 | 0.00 | 0.29 | 3.89  | 0.52 |
| Wainwright No. 61             | 47.62                | 1.36 | 0.00 | 1.53 | 5.78  | 37.25 | 0.17 | 0.17 | 0.68 | 5.44  | 0.63 |
| Warner County No. 5           | 30.40                | 1.28 | 1.28 | 1.47 | 8.79  | 45.24 | 0.37 | 0.18 | 0.55 | 10.44 | 0.68 |
| Westlock County               | 53.44                | 2.26 | 0.62 | 1.13 | 6.67  | 23.08 | 0.10 | 0.10 | 0.92 | 11.69 | 0.64 |
| Wetaskiwin County No. 10      | 54.19                | 1.97 | 1.15 | 1.72 | 18.39 | 11.17 | 0.41 | 0.16 | 1.23 | 9.61  | 0.65 |
| Wheatland County              | 34.73                | 2.16 | 0.80 | 1.25 | 9.76  | 43.59 | 0.23 | 0.34 | 2.27 | 4.88  | 0.68 |
| Willow Creek No. 26           | 55.29                | 1.65 | 0.82 | 0.94 | 10.00 | 22.82 | 0.12 | 0.12 | 1.53 | 6.71  | 0.63 |
| Woodlands County              | 54.51                | 1.39 | 0.00 | 4.17 | 17.71 | 8.33  | 0.00 | 0.00 | 1.39 | 12.50 | 0.65 |
| Yellowhead County             | 58.09                | 0.37 | 0.50 | 1.24 | 18.53 | 4.10  | 0.62 | 0.00 | 1.62 | 14.93 | 0.60 |

### Appendix E. IFTD Values by CCS; 2006

| CCS                         | NAICS Farm Types (%) |      |      |      |       |       |      |      |       |       | IFTD |
|-----------------------------|----------------------|------|------|------|-------|-------|------|------|-------|-------|------|
|                             | 1                    | 2    | 3    | 4    | 5     | 6     | 7    | 8    | 9     | 10    |      |
| Athabasca County No. 12     | 47.90                | 0.33 | 0.66 | 0.77 | 15.45 | 15.34 | 0.22 | 0.22 | 0.55  | 18.54 | 0.69 |
| Barrhead County No. 11      | 53.62                | 5.31 | 1.45 | 0.85 | 11.35 | 16.91 | 0.60 | 0.24 | 0.60  | 9.06  | 0.66 |
| Beaver County               | 38.24                | 1.13 | 0.75 | 1.38 | 13.21 | 37.23 | 0.50 | 0.63 | 0.38  | 6.54  | 0.69 |
| Big Lakes                   | 48.17                | 0.69 | 0.69 | 0.92 | 13.53 | 15.14 | 0.23 | 0.00 | 0.69  | 19.95 | 0.69 |
| Bighorn No. 8               | 54.90                | 0.00 | 0.00 | 3.92 | 39.22 | 0.00  | 0.00 | 0.00 | 1.96  | 0.00  | 0.54 |
| Birch Hills County          | 28.36                | 0.37 | 0.00 | 0.00 | 6.34  | 51.12 | 0.37 | 0.00 | 0.37  | 13.06 | 0.64 |
| Bonnyville No. 87           | 56.39                | 0.23 | 0.23 | 0.94 | 17.00 | 9.26  | 0.23 | 0.47 | 0.94  | 14.30 | 0.62 |
| Brazeau County              | 48.77                | 0.57 | 0.19 | 0.76 | 24.48 | 4.55  | 0.00 | 0.76 | 1.71  | 18.22 | 0.67 |
| Calgary                     | 25.00                | 0.00 | 1.79 | 0.00 | 11.61 | 38.39 | 1.79 | 1.79 | 3.57  | 16.07 | 0.75 |
| Camrose County No. 22       | 36.47                | 1.31 | 3.05 | 1.48 | 10.36 | 40.47 | 0.35 | 0.35 | 1.22  | 4.96  | 0.69 |
| Cardston County             | 57.22                | 1.10 | 0.55 | 0.91 | 13.89 | 18.65 | 0.00 | 0.18 | 0.55  | 6.95  | 0.61 |
| Clear Hills No. 21          | 36.36                | 0.81 | 0.20 | 0.40 | 13.94 | 24.44 | 0.20 | 0.20 | 0.00  | 23.43 | 0.73 |
| Clearwater County           | 59.14                | 0.74 | 0.08 | 0.66 | 21.51 | 3.23  | 0.17 | 0.25 | 1.90  | 12.32 | 0.59 |
| Cypress County              | 49.57                | 0.86 | 0.11 | 0.21 | 9.21  | 26.02 | 0.32 | 0.64 | 4.60  | 8.46  | 0.67 |
| Edmonton                    | 15.29                | 0.00 | 1.18 | 1.18 | 15.88 | 32.35 | 2.94 | 2.94 | 14.12 | 14.12 | 0.80 |
| Fairview No. 136            | 31.92                | 1.92 | 0.00 | 1.15 | 5.77  | 45.00 | 0.77 | 0.38 | 0.38  | 12.69 | 0.68 |
| Flagstaff County            | 28.23                | 1.39 | 0.38 | 0.89 | 8.73  | 55.32 | 0.00 | 0.51 | 1.27  | 3.29  | 0.61 |
| Foothills No. 31            | 36.44                | 0.36 | 0.50 | 1.42 | 30.46 | 14.45 | 0.14 | 0.64 | 4.91  | 10.68 | 0.74 |
| Forty Mile County No. 8     | 26.91                | 1.66 | 0.33 | 0.83 | 1.99  | 58.31 | 1.33 | 0.50 | 0.50  | 7.64  | 0.58 |
| Grande Prairie County No. 1 | 29.98                | 0.73 | 0.36 | 0.80 | 20.79 | 26.55 | 0.22 | 0.29 | 1.68  | 18.60 | 0.76 |
| Greenview No. 16            | 45.21                | 0.14 | 0.28 | 1.80 | 20.25 | 12.07 | 0.00 | 0.42 | 1.25  | 18.59 | 0.70 |
| Kneehill County             | 26.45                | 3.08 | 4.43 | 1.11 | 10.58 | 48.34 | 0.00 | 0.49 | 1.48  | 4.06  | 0.68 |
| Lac Ste. Anne County        | 55.42                | 0.65 | 0.37 | 1.31 | 19.07 | 6.82  | 0.28 | 0.37 | 1.59  | 14.11 | 0.63 |
| Lacombe County              | 48.24                | 4.27 | 1.64 | 1.89 | 12.39 | 19.85 | 1.39 | 0.49 | 2.95  | 6.89  | 0.70 |
| Lakeland County             | 57.31                | 0.29 | 0.29 | 0.57 | 17.19 | 6.02  | 0.86 | 0.57 | 0.57  | 16.33 | 0.61 |
| Lamont County               | 31.26                | 0.59 | 0.47 | 1.29 | 15.04 | 42.42 | 0.24 | 0.12 | 1.41  | 7.17  | 0.69 |
| Leduc County                | 42.91                | 0.83 | 1.53 | 1.46 | 19.61 | 17.39 | 0.42 | 0.70 | 3.62  | 11.54 | 0.73 |
| Lesser Slave River No.124   | 54.80                | 1.13 | 1.69 | 1.69 | 18.64 | 9.60  | 0.56 | 0.00 | 1.69  | 10.17 | 0.64 |
| Lethbridge County           | 36.48                | 4.35 | 2.55 | 2.08 | 10.49 | 28.45 | 1.13 | 0.95 | 2.17  | 11.34 | 0.76 |
| Mackenzie No. 23            | 22.57                | 0.62 | 1.24 | 0.93 | 8.50  | 47.76 | 0.15 | 0.93 | 0.46  | 16.85 | 0.68 |
| Minburn County No. 27       | 31.97                | 0.29 | 0.44 | 1.31 | 9.34  | 51.24 | 0.15 | 0.44 | 0.44  | 4.38  | 0.62 |
| Mountain View County        | 48.29                | 0.65 | 0.93 | 1.47 | 17.09 | 17.53 | 0.22 | 0.49 | 2.45  | 10.89 | 0.69 |
| Newell County No. 4         | 58.19                | 1.12 | 0.12 | 1.12 | 8.68  | 17.25 | 1.61 | 0.62 | 0.99  | 10.30 | 0.61 |
| Northern Lights No. 22      | 29.39                | 0.37 | 0.18 | 0.92 | 14.23 | 32.35 | 0.18 | 0.18 | 1.48  | 20.70 | 0.75 |
| Northern Sunrise County     | 25.35                | 0.00 | 0.00 | 1.38 | 16.13 | 41.94 | 0.00 | 0.00 | 0.46  | 14.75 | 0.71 |
| Paintearth County No. 18    | 51.15                | 1.61 | 0.00 | 0.46 | 10.37 | 28.57 | 0.00 | 0.00 | 0.69  | 7.14  | 0.64 |
| Parkland County             | 44.74                | 0.41 | 1.23 | 1.74 | 24.11 | 10.42 | 1.43 | 1.43 | 3.88  | 10.62 | 0.72 |
| Peace No. 135               | 34.33                | 1.00 | 0.50 | 1.49 | 11.94 | 37.81 | 1.00 | 1.49 | 2.49  | 7.96  | 0.72 |

### Appendix E. IFTD Values by CCS; 2006 (continued)

| CCS                           | NAICS Farm Types (%) |      |      |      |       |       |      |      |      |       | IFTD |
|-------------------------------|----------------------|------|------|------|-------|-------|------|------|------|-------|------|
|                               | 1                    | 2    | 3    | 4    | 5     | 6     | 7    | 8    | 9    | 10    |      |
| Pincher Creek                 | 67.76                | 0.88 | 1.32 | 0.44 | 12.94 | 6.36  | 0.44 | 0.22 | 0.44 | 9.21  | 0.51 |
| Ponoka County                 | 59.53                | 1.87 | 1.14 | 1.46 | 15.65 | 10.22 | 0.24 | 0.32 | 1.30 | 8.27  | 0.60 |
| Provost No. 52                | 51.22                | 0.22 | 0.22 | 0.44 | 7.10  | 32.15 | 0.00 | 0.22 | 0.44 | 7.98  | 0.62 |
| Ranchland No. 66              | 88.46                | 0.00 | 0.00 | 0.00 | 1.92  | 5.77  | 0.00 | 1.92 | 0.00 | 1.92  | 0.21 |
| Red Deer County               | 47.74                | 2.06 | 0.51 | 1.48 | 15.88 | 18.33 | 0.34 | 0.57 | 2.46 | 10.62 | 0.70 |
| Rocky View No. 44             | 38.68                | 0.64 | 0.71 | 1.81 | 24.89 | 17.86 | 0.58 | 0.45 | 4.64 | 9.74  | 0.74 |
| Saddle Hills County           | 33.53                | 0.60 | 0.00 | 0.80 | 11.65 | 31.12 | 0.00 | 0.00 | 0.80 | 21.49 | 0.73 |
| Smoky Lake County             | 48.89                | 0.40 | 0.40 | 1.82 | 10.71 | 22.42 | 0.61 | 0.00 | 0.61 | 14.14 | 0.68 |
| Smoky River No. 130           | 10.23                | 0.51 | 0.51 | 0.26 | 7.67  | 68.29 | 0.26 | 0.77 | 0.26 | 11.25 | 0.50 |
| Special Area No. 2            | 64.01                | 0.19 | 0.00 | 0.00 | 7.98  | 17.70 | 0.00 | 0.00 | 0.19 | 9.92  | 0.54 |
| Special Area No. 3            | 31.18                | 1.18 | 0.00 | 0.00 | 2.94  | 55.88 | 0.00 | 0.00 | 0.39 | 8.43  | 0.58 |
| Special Area No. 4            | 57.55                | 0.36 | 0.36 | 0.36 | 6.47  | 27.70 | 0.00 | 0.00 | 0.36 | 6.83  | 0.58 |
| Spirit River No. 133          | 17.72                | 0.00 | 0.00 | 0.00 | 15.19 | 50.00 | 0.63 | 0.00 | 0.00 | 16.46 | 0.67 |
| St. Paul County No. 19        | 52.58                | 0.48 | 0.60 | 0.72 | 14.17 | 15.13 | 0.72 | 0.24 | 0.60 | 14.77 | 0.66 |
| Starland County               | 30.22                | 0.82 | 0.27 | 0.82 | 7.97  | 53.30 | 0.55 | 0.00 | 0.82 | 5.22  | 0.62 |
| Stettler County No. 6         | 54.35                | 1.39 | 0.63 | 0.76 | 12.48 | 20.55 | 0.00 | 0.50 | 0.88 | 8.45  | 0.64 |
| Strathcona County             | 30.18                | 0.39 | 2.33 | 1.55 | 29.79 | 17.62 | 0.91 | 0.91 | 5.44 | 10.88 | 0.77 |
| Sturgeon County               | 28.44                | 1.34 | 2.59 | 1.03 | 18.10 | 31.54 | 0.72 | 1.24 | 5.17 | 9.82  | 0.77 |
| Taber                         | 33.33                | 3.13 | 0.39 | 0.91 | 6.77  | 29.17 | 9.51 | 0.26 | 0.52 | 16.02 | 0.76 |
| Thorhild County No. 7         | 43.67                | 0.41 | 0.82 | 1.22 | 12.65 | 26.73 | 1.02 | 0.00 | 0.61 | 12.86 | 0.70 |
| Two Hills County No. 21       | 42.00                | 0.33 | 0.67 | 1.83 | 6.00  | 36.33 | 0.67 | 0.33 | 0.67 | 11.17 | 0.68 |
| Vermilion River County No. 24 | 43.98                | 1.23 | 0.35 | 0.35 | 11.26 | 35.71 | 0.00 | 0.35 | 0.79 | 5.98  | 0.66 |
| Vulcan County                 | 23.12                | 0.92 | 0.00 | 1.07 | 7.96  | 61.41 | 0.15 | 0.15 | 0.46 | 4.75  | 0.56 |
| Wainwright No. 61             | 47.01                | 1.27 | 0.00 | 1.27 | 9.44  | 34.12 | 0.00 | 0.36 | 0.73 | 5.81  | 0.65 |
| Warner County No. 5           | 32.71                | 2.07 | 0.38 | 0.94 | 9.96  | 43.61 | 0.56 | 0.19 | 1.88 | 7.71  | 0.69 |
| Westlock County               | 47.53                | 1.23 | 0.78 | 1.12 | 10.54 | 27.02 | 0.34 | 0.22 | 1.23 | 9.98  | 0.68 |
| Wetaskiwin County No. 10      | 45.57                | 0.99 | 0.91 | 1.49 | 20.96 | 15.66 | 0.91 | 0.33 | 2.40 | 10.77 | 0.71 |
| Wheatland County              | 30.01                | 1.95 | 1.15 | 1.26 | 12.83 | 42.27 | 0.46 | 0.69 | 2.52 | 6.87  | 0.71 |
| Willow Creek No. 26           | 53.59                | 2.97 | 1.11 | 0.74 | 14.36 | 19.43 | 0.25 | 0.25 | 0.62 | 6.68  | 0.65 |
| Woodlands County              | 52.07                | 0.34 | 0.00 | 1.38 | 20.69 | 5.17  | 0.69 | 0.69 | 1.38 | 17.59 | 0.65 |
| Yellowhead County             | 47.90                | 0.38 | 0.76 | 1.27 | 25.73 | 5.86  | 0.51 | 0.76 | 1.91 | 14.90 | 0.68 |

## Appendix F. Gini Index Values by CCS; 2001

| CCS                         | NAICS Farm Types (location quotient values) |      |      |      |      |      |      |       |      |      | Gini |
|-----------------------------|---------------------------------------------|------|------|------|------|------|------|-------|------|------|------|
|                             | 1                                           | 2    | 3    | 4    | 5    | 6    | 7    | 8     | 9    | 10   |      |
| Athabasca County No. 12     | 1.11                                        | 0.27 | 0.90 | 0.92 | 0.85 | 0.63 | 0.24 | 0.77  | 0.50 | 1.76 | 0.19 |
| Barrhead County No. 11      | 1.33                                        | 4.88 | 1.31 | 0.85 | 0.68 | 0.39 | 0.49 | 0.79  | 0.51 | 0.85 | 0.28 |
| Beaver County               | 0.93                                        | 0.98 | 1.48 | 1.06 | 0.83 | 1.48 | 0.75 | 0.81  | 0.35 | 0.42 | 0.17 |
| Big Lakes                   | 1.16                                        | 0.40 | 0.26 | 0.37 | 0.97 | 0.62 | 0.00 | 0.00  | 0.17 | 1.63 | 0.19 |
| Bighorn No. 8               | 1.51                                        | 0.00 | 0.00 | 5.27 | 1.23 | 0.08 | 0.00 | 0.00  | 1.60 | 0.57 | 0.38 |
| Birch Hills County          | 0.49                                        | 0.00 | 0.36 | 0.00 | 0.54 | 2.10 | 0.00 | 2.16  | 0.24 | 1.40 | 0.37 |
| Bonnyville No. 87           | 1.19                                        | 0.13 | 0.39 | 0.83 | 1.35 | 0.40 | 0.24 | 0.77  | 0.51 | 1.56 | 0.22 |
| Brazeau County              | 1.36                                        | 0.34 | 0.22 | 1.11 | 1.45 | 0.08 | 0.00 | 1.32  | 1.15 | 1.38 | 0.28 |
| Calgary                     | 0.84                                        | 0.00 | 3.94 | 0.00 | 1.48 | 0.91 | 0.00 | 17.75 | 3.87 | 0.92 | 0.19 |
| Camrose County No. 22       | 0.84                                        | 1.22 | 3.66 | 1.35 | 0.73 | 1.49 | 0.88 | 2.82  | 0.43 | 0.55 | 0.20 |
| Cardston County             | 1.22                                        | 0.67 | 0.37 | 1.32 | 1.32 | 0.72 | 1.03 | 1.10  | 0.48 | 0.58 | 0.15 |
| Clear Hills No. 21          | 0.65                                        | 0.33 | 0.21 | 0.45 | 0.97 | 1.17 | 0.39 | 0.00  | 0.00 | 2.43 | 0.28 |
| Clearwater County           | 1.49                                        | 0.50 | 0.38 | 0.75 | 1.25 | 0.09 | 0.18 | 0.57  | 0.75 | 1.07 | 0.30 |
| Cypress County              | 1.10                                        | 0.69 | 0.24 | 0.35 | 0.59 | 0.97 | 1.13 | 0.73  | 3.66 | 0.92 | 0.12 |
| Edmonton                    | 0.50                                        | 0.74 | 2.15 | 2.06 | 1.50 | 1.28 | 5.35 | 8.59  | 7.02 | 0.78 | 0.33 |
| Fairview No. 136            | 0.65                                        | 0.57 | 0.00 | 0.53 | 0.46 | 1.79 | 0.69 | 2.21  | 0.96 | 1.31 | 0.28 |
| Flagstaff County            | 0.69                                        | 0.92 | 0.14 | 0.59 | 0.52 | 2.15 | 0.25 | 1.63  | 0.53 | 0.28 | 0.34 |
| Foothills No. 31            | 0.98                                        | 0.25 | 1.13 | 1.22 | 2.02 | 0.59 | 0.71 | 0.57  | 2.22 | 1.00 | 0.20 |
| Forty Mile County No. 8     | 0.51                                        | 1.11 | 0.82 | 0.36 | 0.34 | 2.39 | 3.69 | 0.00  | 0.32 | 0.51 | 0.40 |
| Grande Prairie County No. 1 | 0.63                                        | 0.35 | 1.10 | 1.21 | 1.37 | 1.14 | 0.16 | 1.52  | 1.10 | 1.92 | 0.23 |
| Greenview No. 16            | 1.00                                        | 0.46 | 0.60 | 1.07 | 1.36 | 0.53 | 0.00 | 0.89  | 0.29 | 1.96 | 0.23 |
| Kneehill County             | 0.67                                        | 3.32 | 6.55 | 0.70 | 0.57 | 1.82 | 0.00 | 0.00  | 0.64 | 0.23 | 0.36 |
| Lac Ste. Anne County        | 1.33                                        | 0.55 | 0.53 | 1.61 | 1.09 | 0.19 | 0.60 | 1.28  | 0.84 | 1.48 | 0.26 |
| Lacombe County              | 1.16                                        | 2.75 | 1.44 | 1.68 | 0.95 | 0.66 | 2.69 | 0.54  | 1.76 | 0.65 | 0.17 |
| Lakeland County             | 1.35                                        | 0.00 | 0.00 | 0.68 | 1.02 | 0.23 | 2.34 | 0.00  | 1.02 | 1.53 | 0.27 |
| Lamont County               | 0.71                                        | 1.09 | 0.92 | 0.76 | 0.84 | 1.69 | 0.49 | 0.00  | 0.69 | 0.87 | 0.20 |
| Leduc County                | 1.16                                        | 0.90 | 1.57 | 1.25 | 1.22 | 0.60 | 0.92 | 0.50  | 1.56 | 0.97 | 0.13 |
| Lesser Slave River No. 124  | 1.31                                        | 0.71 | 0.00 | 1.97 | 0.80 | 0.38 | 0.00 | 0.00  | 0.90 | 1.43 | 0.23 |
| Lethbridge County           | 0.79                                        | 3.49 | 2.56 | 1.77 | 0.74 | 1.14 | 1.99 | 1.28  | 1.61 | 1.08 | 0.16 |
| Mackenzie No. 23            | 0.39                                        | 0.28 | 0.36 | 0.78 | 0.66 | 2.19 | 1.35 | 1.08  | 0.36 | 1.30 | 0.39 |
| Minburn County No. 27       | 0.79                                        | 0.16 | 0.31 | 0.67 | 0.70 | 1.91 | 0.00 | 0.00  | 0.20 | 0.42 | 0.28 |
| Mountain View County        | 1.22                                        | 0.63 | 0.96 | 1.16 | 1.04 | 0.55 | 0.84 | 0.77  | 1.26 | 1.13 | 0.14 |
| Newell County No. 4         | 1.28                                        | 0.85 | 0.27 | 0.59 | 0.57 | 0.65 | 2.55 | 0.00  | 0.54 | 1.19 | 0.17 |
| Northern Lights No. 22      | 0.54                                        | 0.29 | 0.76 | 1.22 | 0.89 | 1.52 | 0.35 | 0.00  | 0.50 | 1.99 | 0.29 |
| Northern Sunrise County     | 0.45                                        | 0.50 | 0.00 | 0.70 | 0.93 | 1.61 | 0.00 | 0.00  | 0.00 | 2.25 | 0.36 |
| Paintearth County No. 18    | 1.16                                        | 0.48 | 0.23 | 0.50 | 0.60 | 1.12 | 0.00 | 0.00  | 0.61 | 0.74 | 0.12 |
| Parkland County             | 1.12                                        | 0.46 | 0.99 | 2.22 | 1.68 | 0.39 | 1.85 | 3.97  | 2.74 | 0.95 | 0.24 |
| Peace No. 135               | 0.60                                        | 0.29 | 0.00 | 0.40 | 0.87 | 1.66 | 1.03 | 6.61  | 0.36 | 1.49 | 0.27 |

### Appendix F. Gini Index Values by CCS; 2001 (continued)

| CCS                           | NAICS Farm Types (location quotient values) |      |      |      |      |      |       |      |      |      | Gini |
|-------------------------------|---------------------------------------------|------|------|------|------|------|-------|------|------|------|------|
|                               | 1                                           | 2    | 3    | 4    | 5    | 6    | 7     | 8    | 9    | 10   |      |
| Pincher Creek                 | 1.52                                        | 0.48 | 1.15 | 0.50 | 1.06 | 0.34 | 0.43  | 4.15 | 0.15 | 0.57 | 0.29 |
| Ponoka County                 | 1.43                                        | 1.76 | 0.96 | 1.32 | 1.05 | 0.30 | 0.16  | 0.52 | 0.63 | 0.77 | 0.26 |
| Provost No. 52                | 1.20                                        | 0.48 | 0.00 | 0.17 | 0.54 | 1.29 | 0.43  | 0.00 | 0.15 | 0.34 | 0.19 |
| Ranchland No. 66              | 1.54                                        | 0.00 | 1.56 | 1.12 | 1.43 | 0.16 | 0.00  | 0.00 | 1.02 | 0.48 | 0.32 |
| Red Deer County               | 1.15                                        | 1.98 | 0.57 | 1.51 | 1.14 | 0.66 | 0.47  | 1.14 | 1.33 | 0.86 | 0.13 |
| Rocky View No. 44             | 0.96                                        | 0.75 | 1.14 | 1.59 | 1.64 | 0.82 | 0.43  | 0.91 | 2.29 | 0.83 | 0.12 |
| Saddle Hills County           | 0.68                                        | 0.32 | 0.21 | 1.20 | 0.80 | 1.34 | 0.00  | 0.00 | 0.27 | 2.00 | 0.25 |
| Smoky Lake County             | 1.10                                        | 0.76 | 0.42 | 0.75 | 0.80 | 0.73 | 0.00  | 0.00 | 0.82 | 1.58 | 0.14 |
| Smoky River No. 130           | 0.21                                        | 0.24 | 0.24 | 0.68 | 0.63 | 2.50 | 0.44  | 1.41 | 0.31 | 1.42 | 0.50 |
| Special Area No. 2            | 1.45                                        | 0.00 | 0.00 | 0.29 | 0.47 | 0.70 | 0.38  | 0.00 | 0.13 | 0.83 | 0.24 |
| Special Area No. 3            | 0.69                                        | 0.82 | 0.00 | 0.28 | 0.30 | 2.16 | 0.00  | 0.00 | 0.13 | 0.63 | 0.34 |
| Special Area No. 4            | 1.38                                        | 0.35 | 0.33 | 0.00 | 0.47 | 0.92 | 0.00  | 0.00 | 0.00 | 0.57 | 0.22 |
| Spirit River No. 133          | 0.28                                        | 0.72 | 0.00 | 0.50 | 0.70 | 2.42 | 1.30  | 0.00 | 0.00 | 1.24 | 0.46 |
| St. Paul County No. 19        | 1.24                                        | 1.24 | 0.40 | 0.48 | 0.92 | 0.48 | 0.50  | 0.80 | 0.52 | 1.45 | 0.19 |
| Starland County               | 0.63                                        | 1.04 | 0.29 | 0.62 | 0.62 | 2.07 | 0.54  | 0.00 | 0.56 | 0.58 | 0.29 |
| Stettler County No. 6         | 1.25                                        | 1.16 | 1.31 | 0.47 | 0.80 | 0.83 | 0.25  | 0.79 | 0.26 | 0.70 | 0.13 |
| Strathcona County             | 0.81                                        | 0.23 | 2.05 | 1.26 | 2.16 | 0.74 | 1.10  | 2.64 | 4.22 | 0.87 | 0.21 |
| Sturgeon County               | 0.66                                        | 2.18 | 3.74 | 1.09 | 1.35 | 1.23 | 1.31  | 2.80 | 2.60 | 0.90 | 0.21 |
| Taber                         | 0.80                                        | 1.61 | 0.54 | 0.49 | 0.45 | 1.07 | 19.42 | 0.81 | 0.35 | 1.49 | 0.24 |
| Thorhild County No. 7         | 0.97                                        | 0.43 | 1.03 | 0.59 | 0.79 | 1.08 | 0.39  | 0.00 | 0.27 | 1.36 | 0.10 |
| Two Hills County No. 21       | 0.89                                        | 0.93 | 0.72 | 1.03 | 0.54 | 1.53 | 0.00  | 0.00 | 0.00 | 0.90 | 0.17 |
| Vermilion River County No. 24 | 0.95                                        | 1.04 | 0.55 | 0.39 | 0.87 | 1.50 | 0.00  | 1.10 | 0.36 | 0.40 | 0.18 |
| Vulcan County                 | 0.53                                        | 0.17 | 0.49 | 0.47 | 0.49 | 2.49 | 0.30  | 0.00 | 0.21 | 0.34 | 0.41 |
| Wainwright No. 61             | 1.03                                        | 0.79 | 0.00 | 1.24 | 0.54 | 1.43 | 0.36  | 1.15 | 0.50 | 0.47 | 0.18 |
| Warner County No. 5           | 0.66                                        | 0.75 | 1.44 | 1.18 | 0.83 | 1.74 | 0.77  | 1.24 | 0.40 | 0.91 | 0.23 |
| Westlock County               | 1.16                                        | 1.32 | 0.69 | 0.91 | 0.63 | 0.89 | 0.22  | 0.69 | 0.68 | 1.02 | 0.10 |
| Wetaskiwin County No. 10      | 1.18                                        | 1.15 | 1.29 | 1.39 | 1.73 | 0.43 | 0.86  | 1.11 | 0.91 | 0.84 | 0.21 |
| Wheatland County              | 0.75                                        | 1.26 | 0.89 | 1.01 | 0.92 | 1.68 | 0.48  | 2.30 | 1.67 | 0.43 | 0.23 |
| Willow Creek No. 26           | 1.20                                        | 0.96 | 0.93 | 0.76 | 0.94 | 0.88 | 0.25  | 0.79 | 1.12 | 0.58 | 0.11 |
| Woodlands County              | 1.18                                        | 0.81 | 0.00 | 3.37 | 1.66 | 0.32 | 0.00  | 0.00 | 1.02 | 1.09 | 0.25 |
| Yellowhead County             | 1.26                                        | 0.22 | 0.56 | 1.01 | 1.74 | 0.16 | 1.31  | 0.00 | 1.19 | 1.30 | 0.27 |

### Appendix G. Gini Index Values by CCS; 2006

| CCS              | NAICS Farm Types (location quotient values) |      |      |      |      |      |      |      |      |      | Gini |
|------------------|---------------------------------------------|------|------|------|------|------|------|------|------|------|------|
|                  | 1                                           | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   |      |
| Athabasca        |                                             |      |      |      |      |      |      |      |      |      |      |
| County No. 12    | 0.18                                        | 1.12 | 0.27 | 0.79 | 0.68 | 1.03 | 0.60 | 0.38 | 0.48 | 0.30 | 1.71 |
| Barrhead County  |                                             |      |      |      |      |      |      |      |      |      |      |
| No. 11           | 0.19                                        | 1.26 | 4.39 | 1.72 | 0.75 | 0.76 | 0.67 | 1.04 | 0.53 | 0.33 | 0.84 |
| Beaver County    | 0.15                                        | 0.90 | 0.94 | 0.90 | 1.23 | 0.88 | 1.47 | 0.87 | 1.37 | 0.20 | 0.60 |
| Big Lakes        | 0.20                                        | 1.13 | 0.57 | 0.82 | 0.81 | 0.90 | 0.60 | 0.40 | 0.00 | 0.37 | 1.84 |
| Bighorn No. 8    | 0.50                                        | 1.29 | 0.00 | 0.00 | 3.47 | 2.61 | 0.00 | 0.00 | 0.00 | 1.07 | 0.00 |
| Birch Hills      |                                             |      |      |      |      |      |      |      |      |      |      |
| County           | 0.33                                        | 0.66 | 0.31 | 0.00 | 0.00 | 0.42 | 2.01 | 0.64 | 0.00 | 0.20 | 1.20 |
| Bonnyville No.   |                                             |      |      |      |      |      |      |      |      |      |      |
| 87               | 0.21                                        | 1.32 | 0.19 | 0.28 | 0.83 | 1.13 | 0.36 | 0.41 | 1.02 | 0.51 | 1.32 |
| Brazeau County   | 0.30                                        | 1.14 | 0.47 | 0.23 | 0.67 | 1.63 | 0.18 | 0.00 | 1.65 | 0.93 | 1.68 |
| Calgary          | 0.27                                        | 0.59 | 0.00 | 2.12 | 0.00 | 0.77 | 1.51 | 3.09 | 3.89 | 1.94 | 1.48 |
| Camrose County   |                                             |      |      |      |      |      |      |      |      |      |      |
| No. 22           | 0.22                                        | 0.85 | 1.08 | 3.62 | 1.31 | 0.69 | 1.59 | 0.60 | 0.76 | 0.66 | 0.46 |
| Cardston County  | 0.17                                        | 1.34 | 0.91 | 0.65 | 0.81 | 0.93 | 0.73 | 0.00 | 0.40 | 0.30 | 0.64 |
| Clear Hills No.  |                                             |      |      |      |      |      |      |      |      |      |      |
| 21               | 0.17                                        | 0.85 | 0.67 | 0.24 | 0.36 | 0.93 | 0.96 | 0.35 | 0.44 | 0.00 | 2.16 |
| Clearwater       |                                             |      |      |      |      |      |      |      |      |      |      |
| County           | 0.27                                        | 1.39 | 0.62 | 0.10 | 0.59 | 1.43 | 0.13 | 0.29 | 0.54 | 1.03 | 1.14 |
| Cypress County   | 0.14                                        | 1.16 | 0.71 | 0.13 | 0.19 | 0.61 | 1.02 | 0.56 | 1.40 | 2.50 | 0.78 |
| Edmonton         | 0.39                                        | 0.36 | 0.00 | 1.40 | 1.04 | 1.06 | 1.27 | 5.08 | 6.40 | 7.67 | 1.30 |
| Fairview No. 136 | 0.28                                        | 0.75 | 1.59 | 0.00 | 1.02 | 0.38 | 1.77 | 1.33 | 0.84 | 0.21 | 1.17 |
| Flagstaff County | 0.34                                        | 0.66 | 1.15 | 0.45 | 0.78 | 0.58 | 2.18 | 0.00 | 1.10 | 0.69 | 0.30 |
| Foothills No. 31 | 0.25                                        | 0.85 | 0.29 | 0.59 | 1.26 | 2.03 | 0.57 | 0.25 | 1.39 | 2.67 | 0.98 |
| Forty Mile       |                                             |      |      |      |      |      |      |      |      |      |      |
| County No. 8     | 0.40                                        | 0.63 | 1.37 | 0.39 | 0.74 | 0.13 | 2.29 | 2.30 | 1.09 | 0.27 | 0.70 |
| Grande Prairie   |                                             |      |      |      |      |      |      |      |      |      |      |
| County No. 1     | 0.19                                        | 0.70 | 0.60 | 0.43 | 0.71 | 1.39 | 1.04 | 0.38 | 0.64 | 0.91 | 1.71 |
| Greenview No.    |                                             |      |      |      |      |      |      |      |      |      |      |
| 16               | 0.22                                        | 1.06 | 0.11 | 0.33 | 1.60 | 1.35 | 0.47 | 0.00 | 0.91 | 0.68 | 1.71 |
| Kneehill County  | 0.33                                        | 0.62 | 2.54 | 5.26 | 0.98 | 0.71 | 1.90 | 0.00 | 1.07 | 0.80 | 0.37 |
| Lac Ste. Anne    |                                             |      |      |      |      |      |      |      |      |      |      |
| County           | 0.21                                        | 1.30 | 0.54 | 0.44 | 1.16 | 1.27 | 0.27 | 0.48 | 0.81 | 0.86 | 1.30 |
| Lacombe County   | 0.16                                        | 1.13 | 3.53 | 1.95 | 1.67 | 0.83 | 0.78 | 2.41 | 1.07 | 1.60 | 0.64 |
| Lakeland County  | 0.26                                        | 1.34 | 0.24 | 0.34 | 0.51 | 1.15 | 0.24 | 1.49 | 1.25 | 0.31 | 1.51 |
| Lamont County    | 0.21                                        | 0.73 | 0.49 | 0.56 | 1.15 | 1.00 | 1.67 | 0.41 | 0.26 | 0.77 | 0.66 |
| Leduc County     | 0.13                                        | 1.01 | 0.69 | 1.82 | 1.29 | 1.31 | 0.68 | 0.72 | 1.51 | 1.96 | 1.06 |
| Lesser Slave     |                                             |      |      |      |      |      |      |      |      |      |      |
| River No.124     | 0.20                                        | 1.28 | 0.93 | 2.01 | 1.50 | 1.24 | 0.38 | 0.98 | 0.00 | 0.92 | 0.94 |
| Lethbridge       |                                             |      |      |      |      |      |      |      |      |      |      |
| County           | 0.14                                        | 0.85 | 3.59 | 3.03 | 1.84 | 0.70 | 1.12 | 1.96 | 2.06 | 1.18 | 1.05 |
| Mackenzie No.    |                                             |      |      |      |      |      |      |      |      |      |      |
| 23               | 0.31                                        | 0.53 | 0.51 | 1.47 | 0.82 | 0.57 | 1.88 | 0.27 | 2.02 | 0.25 | 1.55 |
| Minburn County   |                                             |      |      |      |      |      |      |      |      |      |      |
| No. 27           | 0.30                                        | 0.75 | 0.24 | 0.52 | 1.16 | 0.62 | 2.02 | 0.25 | 0.95 | 0.24 | 0.40 |
| Mountain View    |                                             |      |      |      |      |      |      |      |      |      |      |
| County           | 0.10                                        | 1.13 | 0.54 | 1.10 | 1.30 | 1.14 | 0.69 | 0.38 | 1.07 | 1.33 | 1.00 |
| Newell County    |                                             |      |      |      |      |      |      |      |      |      |      |
| No. 4            | 0.20                                        | 1.36 | 0.92 | 0.15 | 0.99 | 0.58 | 0.68 | 2.79 | 1.35 | 0.54 | 0.95 |
| Northern Lights  |                                             |      |      |      |      |      |      |      |      |      |      |
| No. 22           | 0.21                                        | 0.69 | 0.31 | 0.22 | 0.82 | 0.95 | 1.27 | 0.32 | 0.40 | 0.80 | 1.91 |
| Northern Sunrise |                                             |      |      |      |      |      |      |      |      |      |      |
| County           | 0.26                                        | 0.59 | 0.00 | 0.00 | 1.22 | 1.08 | 1.65 | 0.00 | 0.00 | 0.25 | 1.36 |
| Paintearth       |                                             |      |      |      |      |      |      |      |      |      |      |
| County No. 18    | 0.14                                        | 1.20 | 1.33 | 0.00 | 0.41 | 0.69 | 1.12 | 0.00 | 0.00 | 0.38 | 0.66 |
| Parkland County  | 0.24                                        | 1.05 | 0.34 | 1.46 | 1.54 | 1.61 | 0.41 | 2.47 | 3.11 | 2.11 | 0.98 |
| Peace No. 135    | 0.16                                        | 0.80 | 0.82 | 0.59 | 1.32 | 0.80 | 1.49 | 1.72 | 3.25 | 1.35 | 0.73 |

### Appendix G. Gini Index Values by CCS; 2006 (continued)

| CCS                           | NAICS Farm Types (location quotient values) |      |      |      |      |      |      |       |      |      | Gini |
|-------------------------------|---------------------------------------------|------|------|------|------|------|------|-------|------|------|------|
|                               | 1                                           | 2    | 3    | 4    | 5    | 6    | 7    | 8     | 9    | 10   |      |
| Pincher Creek                 | 0.30                                        | 1.59 | 0.73 | 1.56 | 0.39 | 0.86 | 0.25 | 0.76  | 0.48 | 0.24 | 0.85 |
| Ponoka County                 | 0.23                                        | 1.39 | 1.54 | 1.35 | 1.29 | 1.04 | 0.40 | 0.42  | 0.71 | 0.70 | 0.76 |
| Provost No. 52                | 0.17                                        | 1.20 | 0.18 | 0.26 | 0.39 | 0.47 | 1.27 | 0.00  | 0.48 | 0.24 | 0.74 |
| Ranchland No. 66              | 0.49                                        | 2.07 | 0.00 | 0.00 | 0.00 | 0.13 | 0.23 | 0.00  | 4.19 | 0.00 | 0.18 |
| Red Deer County               | 0.10                                        | 1.12 | 1.70 | 0.61 | 1.32 | 1.06 | 0.72 | 0.59  | 1.24 | 1.33 | 0.98 |
| Rocky View No. 44             | 0.17                                        | 0.91 | 0.53 | 0.84 | 1.60 | 1.66 | 0.70 | 1.00  | 0.98 | 2.52 | 0.90 |
| Saddle Hills County           | 0.20                                        | 0.79 | 0.50 | 0.00 | 0.71 | 0.78 | 1.22 | 0.00  | 0.00 | 0.44 | 1.98 |
| Smoky Lake County             | 0.13                                        | 1.15 | 0.33 | 0.48 | 1.61 | 0.71 | 0.88 | 1.05  | 0.00 | 0.33 | 1.30 |
| Smoky River No. 130           | 0.51                                        | 0.24 | 0.42 | 0.61 | 0.23 | 0.51 | 2.69 | 0.44  | 1.67 | 0.14 | 1.04 |
| Special Area No. 2            | 0.25                                        | 1.50 | 0.16 | 0.00 | 0.00 | 0.53 | 0.70 | 0.00  | 0.00 | 0.11 | 0.91 |
| Special Area No. 3            | 0.37                                        | 0.73 | 0.97 | 0.00 | 0.00 | 0.20 | 2.20 | 0.00  | 0.00 | 0.21 | 0.78 |
| Special Area No. 4            | 0.21                                        | 1.35 | 0.30 | 0.43 | 0.32 | 0.43 | 1.09 | 0.00  | 0.00 | 0.20 | 0.63 |
| Spirit River No. 133          | 0.37                                        | 0.42 | 0.00 | 0.00 | 0.00 | 1.01 | 1.97 | 1.09  | 0.00 | 0.00 | 1.52 |
| St. Paul County No. 19        | 0.17                                        | 1.23 | 0.40 | 0.71 | 0.64 | 0.94 | 0.60 | 1.24  | 0.52 | 0.33 | 1.36 |
| Starland County               | 0.31                                        | 0.71 | 0.68 | 0.33 | 0.73 | 0.53 | 2.10 | 0.95  | 0.00 | 0.45 | 0.48 |
| Stettler County No. 6         | 0.13                                        | 1.27 | 1.15 | 0.75 | 0.67 | 0.83 | 0.81 | 0.00  | 1.10 | 0.48 | 0.78 |
| Strathcona County             | 0.24                                        | 0.71 | 0.32 | 2.77 | 1.38 | 1.99 | 0.69 | 1.57  | 1.97 | 2.96 | 1.00 |
| Sturgeon County               | 0.19                                        | 0.67 | 1.11 | 3.07 | 0.92 | 1.21 | 1.24 | 1.25  | 2.70 | 2.81 | 0.91 |
| Taber                         | 0.27                                        | 0.78 | 2.58 | 0.46 | 0.81 | 0.45 | 1.15 | 16.43 | 0.57 | 0.28 | 1.48 |
| Thorhild County No. 7         | 0.07                                        | 1.02 | 0.34 | 0.97 | 1.08 | 0.84 | 1.05 | 1.76  | 0.00 | 0.33 | 1.19 |
| Two Hills County No. 21       | 0.18                                        | 0.98 | 0.28 | 0.79 | 1.62 | 0.40 | 1.43 | 1.15  | 0.73 | 0.36 | 1.03 |
| Vermilion River County No. 24 | 0.17                                        | 1.03 | 1.02 | 0.42 | 0.31 | 0.75 | 1.41 | 0.00  | 0.77 | 0.43 | 0.55 |
| Vulcan County                 | 0.38                                        | 0.54 | 0.76 | 0.00 | 0.95 | 0.53 | 2.42 | 0.26  | 0.33 | 0.25 | 0.44 |
| Wainwright No. 61             | 0.17                                        | 1.10 | 1.05 | 0.00 | 1.13 | 0.63 | 1.34 | 0.00  | 0.79 | 0.39 | 0.54 |
| Warner County No. 5           | 0.21                                        | 0.77 | 1.71 | 0.45 | 0.83 | 0.66 | 1.72 | 0.97  | 0.41 | 1.02 | 0.71 |
| Westlock County               | 0.08                                        | 1.11 | 1.02 | 0.93 | 0.99 | 0.70 | 1.06 | 0.58  | 0.49 | 0.67 | 0.92 |
| Wetaskiwin County No. 10      | 0.14                                        | 1.07 | 0.82 | 1.08 | 1.32 | 1.40 | 0.62 | 1.58  | 0.72 | 1.31 | 0.99 |
| Wheatland County              | 0.21                                        | 0.70 | 1.61 | 1.36 | 1.12 | 0.86 | 1.66 | 0.79  | 1.50 | 1.37 | 0.63 |
| Willow Creek No. 26           | 0.16                                        | 1.26 | 2.46 | 1.32 | 0.66 | 0.96 | 0.76 | 0.43  | 0.54 | 0.34 | 0.62 |
| Woodlands County              | 0.26                                        | 1.22 | 0.29 | 0.00 | 1.22 | 1.38 | 0.20 | 1.19  | 1.50 | 0.75 | 1.62 |
| Yellowhead County             | 0.27                                        | 1.12 | 0.32 | 0.91 | 1.13 | 1.72 | 0.23 | 0.88  | 1.66 | 1.04 | 1.37 |