YOU WANT ME TO GROW TREES?
THE SOCIAL IMPLICATIONS OF BIOMASS CROPS ON THE RESILIENCE OF QUESNEL, BRITISH COLUMBIA

by

Eric Kopetski

B.Sc (Geography), University of Victoria, 2010

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Abstract

Forest-dependent communities in the central-interior of British Columbia are facing an increasingly uncertain future due to ongoing change in the forest industry and more recently because of the mountain pine beetle. The use of forest resources to produce biochemicals and bioproducts is seen by many communities and the provincial and federal governments as having potential to help communities adapt to this change. This thesis will focus on the implications of establishing short-rotation forestry crops on marginal ranchland in Quesnel, BC to provide a source of fibre for a biochemical/bioproducts industry.

Ranchers in the Quesnel area were interviewed to determine how short rotation forestry crops would affect their current operations, the opportunities and barriers they see to its implementation, and their level of interest in growing these crops on their own land. The majority of ranchers were willing to grow crops provided it was profitable, though they were concerned about losing agricultural land to tree production. If agroforestry methods that integrate traditional crop production with short rotation forestry crops are used, there is potential for ranchers to have another source of income. However, there is also a chance that agricultural land will be removed from food production or excessively regulated. Both of these outcomes would negatively affect ranchers.

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Acknowledgements

This thesis would not have been possible without the cooperation of everyone that agreed to be a part of my research. I was very impressed with the depth of knowledge people had, and have tried to convey that throughout the thesis. It was clear that the majority of the people I interviewed were very passionate and deeply attached to their community, and I am grateful for their efforts to build a sustainable future for Quesnel.

The process of researching and writing this thesis proved to be difficult but ultimately very rewarding, and I am indebted to the work of my committee for their encouragement and guidance. Dr. Tracy Summerville helped me to understand more about how the political system works and how decisions are made. Her suggestion to incorporate the work of Kingdon in particular proved to be invaluable. My understanding of the community development process would be a lot poorer without her help.

Dr. Duncan Taylor introduced me to panarchy while I was a student at UVic and inspired me to continue on to grad school. His knowledge of panarchy and the process of change in general has helped me to understand better how change happens, a lesson I've applied in all aspects of my life.

In one of our first meetings my supervisor, Dr. Greg Halseth told me that grad school is more about becoming a better person than about the actual thesis. In large part because of him I feel that I've become a much better writer, speaker, and researcher. His knowledge and commitment to communities in the North serves as a constant inspiration. His patience, guidance, and editing skills helped me to create a finished product that I believe will contribute to discussions on a more resilient future for Quesnel.

I am fortunate to have had great friends that have made my time at UNBC a truly memorable experience. Jordie Fraser, Sam Albers, Jack Lonsdale, Becky Cadsand, Ty Smith, Ian Picketts, Krista Sittler, Libby Williamson-Ehlers, Nick Ehlers, John Hall, Jessica Shapiro, Alyson Watt, and Kasia Caputa helped to stimulate my thoughts through engaging conversation and relieve any stress through coffee breaks, ski trips, and of course the odd pint here and there.

Finally, I am grateful for the love and support my family has always provided me throughout the whole process. Their continued interest in my work and belief in its importance was always an inspiration.

Chapter 1 Introduction

Forest dependent communities in the central interior of BC are facing a crisis. The mountain pine beetle (MPB) epidemic has resulted in millions of hectares of dead trees, trees which formed the bulk of the fibre supply for communities dependent on jobs from the forest sector. These communities are now facing a future with a significantly smaller fibre supply and a greatly reduced forest industry. This represents an unprecedented challenge for many communities, and their ability to adapt to change will determine their future viability and shape the economic and social systems of BC.

Though the magnitude of change communities are facing is unprecedented, the fact that they are going through a period of uncertainty is not. Persistent uncertainty has come to be a defining trait of resource dependent communities. Randall and Ironside (1996:17) describe them as "communities on the edge", a reference to their often unstable economic status and their location away from the major metropolitan areas of the country. Forest dependent communities have become accustomed to price fluctuations, layoffs due to mechanization, labour unrest, international trade disputes, and industrial consolidation. Unresolved First Nations land claims and disputes over contentious resource management plans have thwarted efforts to develop valid long-term strategies for the land base that provides certainty for stakeholders. For the first time, however, these communities are faced with a long-term shortage of timber.

Just as change is not new to forest dependent communities, disturbances such as the mountain pine beetle are frequent in forest ecosystems in the central interior of BC. Wood and

Unger (1996) documented MPB outbreaks in BC as far back as 1910. These outbreaks were relatively small and had negligible impacts on the forest industry as they were held in check by forest fires and cold winters (Wood and Unger, 1996; Pedersen, 2004).

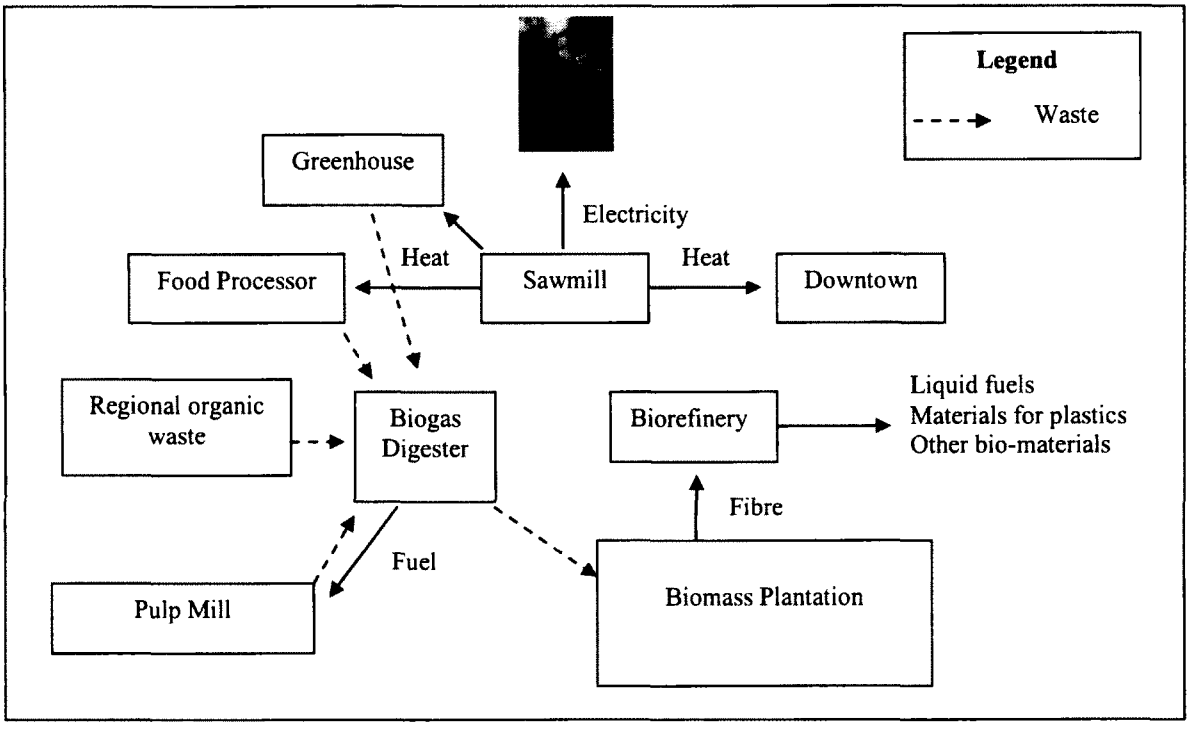
The current MPB epidemic has shown how closely linked forest-based communities are to ecological systems, and the effect of those communities on forest ecosystems. The policies and practices used to manage the forests along with the larger scale effects of climate change helped turn a normal infestation into an epidemic. The most resilient communities that depend on forests will go through an extensive period of restructuring while those most vulnerable face the prospect of collapse. The challenges faced by these communities points to the fact that the current economic structure that is heavily reliant on resources has undermined the resilience of both communities and the ecological systems on which they depend.

Many communities are trying to become more resilient in the face of the coming challenges. Resilience, sustainable development, and diversification are all key ideas in the community economic development literature and feature prominently in many development plans. This thesis will use panarchy, a theory describing the process of change in complex systems, to better understand the concept of resilience and how it can be achieved. A strategy that was devised, named the bioenergy/bioproducts initiative, will be used to assess the prospect of building resilience through developing economic systems that enhance the resilience of both social and economic systems.

The bioenergy/bioproducts initiative was developed from Quesnel 2020, a community visioning process that occurred in Quesnel from 2004-2005 under the guidance of the Quesnel

Community and Economic Development Initiative (QCEDC). The goal of the initiative was for Quesnel to become "a Canadian centre for the 'bio-based' energy and materials revolution, which aims at replacing the use of fossil fuels for energy and materials" (QCEDC, 2008:4). A key part of the initiative was developing an economy mimicking nutrient flows in natural systems, where the waste from one industry is the input for another, as shown by Figure 1.1.

Figure 1.1: Model of the Quesnel Bioenergy/Bioproducts Initiative
Source: Savage, 2008



This thesis will focus on one portion of the initiative, the development of biomass plantations. The biomass plantations are intended to be a reliable, easily accessible source of fibre for a biorefinery that would use deciduous tree species to make a wide range of different products, including cellulosic ethanol, lignin-based chemicals, and xylose (a food sweetener) (Paster *et al.*, 2003). A biorefinery would add a new element to the local economy and use a

fibre source (deciduous trees) that the existing industry does not. Many of the chemicals and products the biorefinery would produce are currently made with petroleum, so switching to a renewable source will make these products more environmentally friendly. The plantations themselves will be located primarily on private ranchland for two reasons. First, the tree species selected as most suitable are all either non-native or hybrid species, meaning that they cannot be grown on crown land. Second, growing trees may provide ranchers with another income source.

My thesis will assess the social impacts on ranchers and the community of growing trees on agricultural land. More specifically, what do they think about growing trees? Are they willing to devote portions of their land to the growth of these crops? What are the perceived ecological risks? These questions are important in that social factors can play a large role in the acceptance of new ideas or innovations, and must be considered along with economic factors (Granovetter, 1985; Tigges *et al.*, 1998; McCann, 2002; Ommer, 2007). This represents an important practical component to the research that hopefully will provide the QCEDC with information concerning the social impacts of the project on ranchers as well as policy barriers to the implementation of the plan.

This topic was chosen after discussions with members of the QCEDC aimed at determining where research could be most effectively directed. The social impacts of biomass plantations on ranching was something that had not been addressed, and provided the opportunity to assess how biomass plantations would affect the resilience of both the community and the ranchers in the face of significant change.

Through investigating the perceptions of ranchers to biomass cropping and bioenergy/bioproducts and linking those perceptions to the literature on social-ecological resilience, I have two main research objectives: (1) contribute in a practical way to economic development initiatives in Quesnel BC and (2) contribute to more general discussions related to community resiliency and the efforts of forest-dependent communities to respond to the MPB epidemic.

1.1 Research Topic:

To assess whether an industry based on growing fibre for use by a biochemical/bioproducts industry can help forest dependent communities become better able to adapt to change by helping to diversify the economy and contribute to the ecological health of the area.

1.2 Research Questions:

1. Do ranchers perceive short rotation biomass crop plantations as a viable way to diversify their incomes?
2. How do ranchers feel about possibly converting some of their land to biomass crop plantations?
3. Are there policy constraints to growing biomass crops on agricultural land?

This thesis will consist of five sections: a literature review, a description of research methods, results, discussion, and conclusion. The literature review will provide background and context to the research through a survey of topics discussed in the thesis. These topics include a description of Quesnel, BC, rural community development, resilience, biomass cropping, and agroforestry. They will be discussed to better understand how growing biomass crops on

ranchland can contribute to strategies to help resource dependent communities adapt to change and become more resilient.

The methods section will include a rationale discussing why the research methods were chosen, what those methods are, and how they were carried out. The successes and difficulties encountered during the field research will also be discussed, along with how participants were chosen and recruited. The analysis of the interviews will be described, with an emphasis on how the themes that comprise the results were selected.

The results section is composed of six themes; belief in vision, practicality, stewardship ethic, leadership, independence, and survival. These themes emerged from interviews conducted with community members and ranchers, and are used as the basis for the findings in the thesis. This section is meant to show as plainly as possible what interviewees thought of the Bioenergy/Bioproducts Initiative and growing biomass crops in particular in relation to the research questions.

The discussion chapter links the findings from the results section to the literature by comparing the thoughts and opinions expressed by interviewees with findings from related studies. This section contains a more thorough and critical examination of the opportunities and problems associated with biomass cropping, both as identified by interviewees and as noted in the literature. Disagreements between interviewees as well as instances where interviewee's opinions differed from the results of other studies are discussed. The original research questions are thoroughly answered here.

The conclusion summarizes the thesis and 'ties together' loose ends. Finally, the thesis closes with a set of recommendations for the future of biomass cropping are made, as well as recommended next steps and further research questions.

Chapter 2 Case study – Quesnel, BC

2.1 Location and Economic Base

Quesnel is located at the confluence of the Fraser and Quesnel Rivers on Highway 97 between Williams Lake and Prince George (see Figure 2.1). It is the third most forest dependent community in the province, with 46% of people deriving their income directly from the forest industry (BC Stats, 2001).

Figure 2.1: Map of the Quesnel Timber Supply Area
Source: BC Ministry of Forests website. http://www.for.gov.bc.ca/mof/maps/regdis/ndqu.htm
Accessed Feb. 5, 2009.

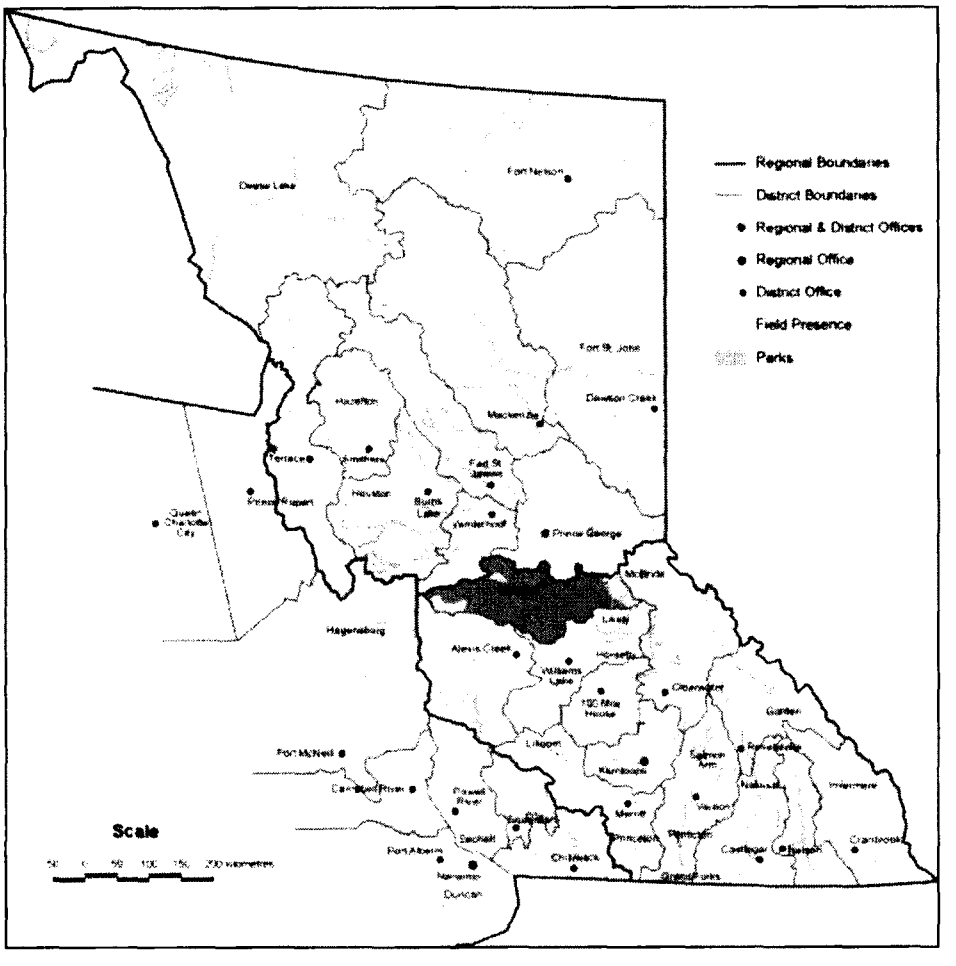
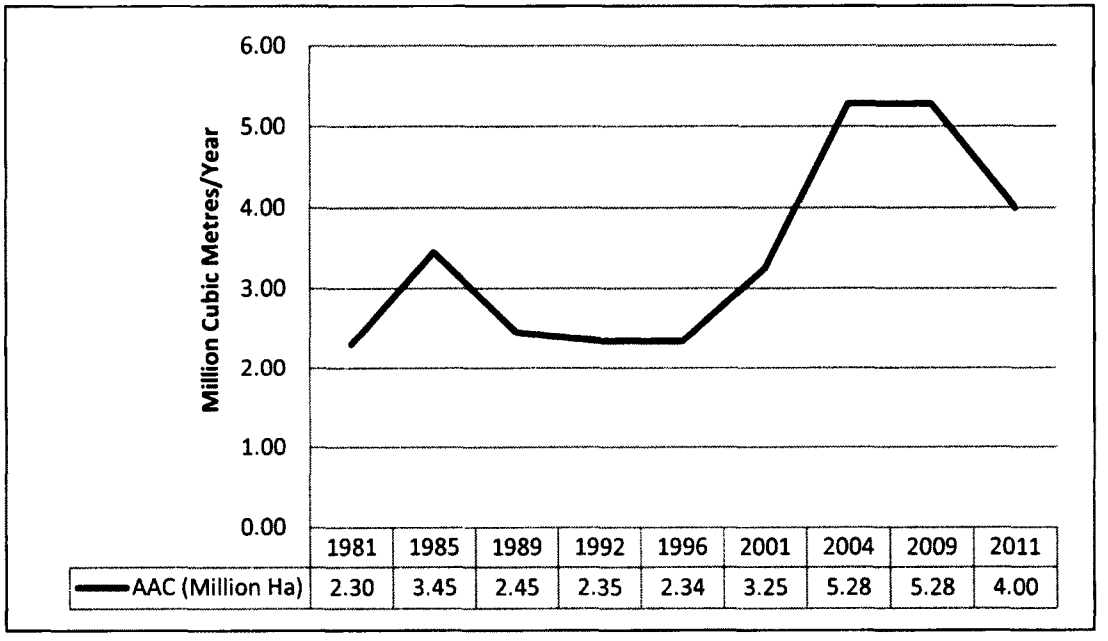


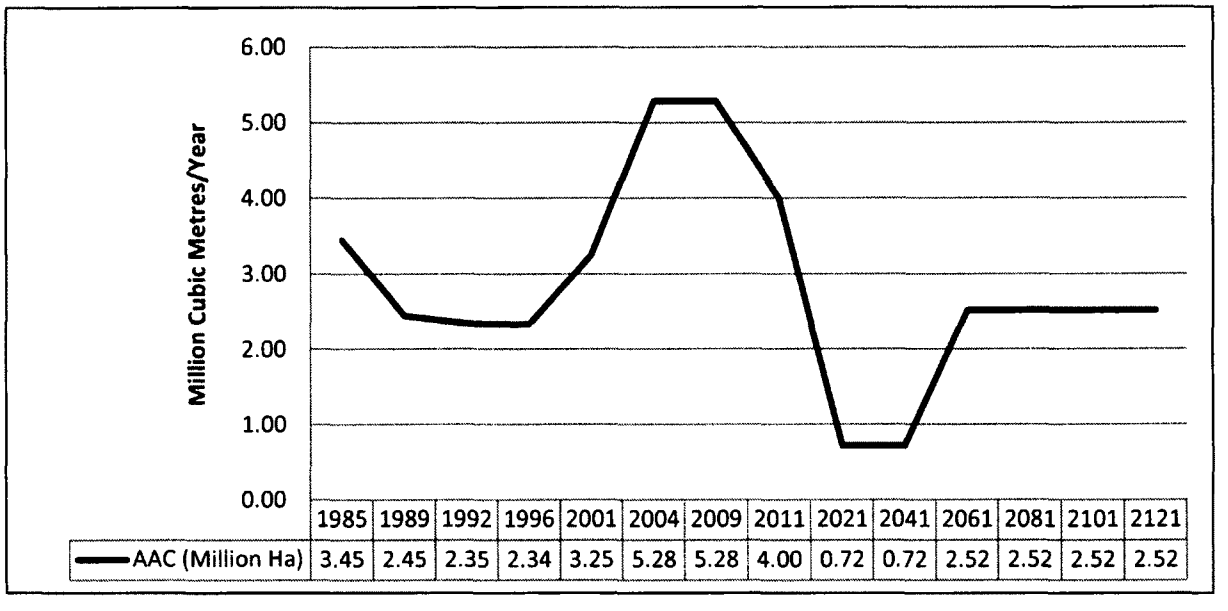
Figure 2.2: Past AAC for the Quesnel Timber Supply Area
Source: Snetsinger, 2011: 8



The Quesnel Timber Supply Area (TSA) shown in Figure 2.1 encompasses 1.6 million hectares. Lodgepole Pine is the dominant species within the TSA constituting 85% of available timber, of which 73 million cubic metres are estimated to be infested with MPB (Pedersen, 2004). In response, the Ministry of Forests has temporarily uplifted the annual allowable cut (AAC) in an attempt to salvage merchantable timber before it degrades (see Figure 2.2). This has created a short term 'boom' for the forest industry but will have implications for the future as the projected AAC will fall below that of the long-run sustained yield, exacerbating the 'fall-down' effect of the transition from primary (old) growth to secondary growth (see Figure 2.3) (Pedersen, 2004).

Figure 2.2 shows the past AAC in the Quesnel TSA. The increase in the harvest levels in the early 1980s was in response to a previous MPB infestation, one which did not reach the epidemic levels the region is currently experiencing. The increase in AAC to 5.28 million metres^3/year was an attempt to salvage the beetle-killed wood before it deteriorated. In 2011 the AAC was reduced to 4.0 million metres^3/year in order to bring the AAC closer in line to what was actually being harvested (Snetsinger, 2011). This cut level is still quite high, but as figure 2.3 shows, the AAC is projected to decline over the next ten years until it reaches 720,000 metres^3/year. After 50-60 years the AAC is expected to increase to 2.52 million metres^3/year once plantations become merchantable. At this point the timber supply will consist almost solely of managed forest stands (Snetsinger, 2011). As mentioned, the 'fall-down' effect would have decreased the AAC in the Quesnel TSA without the pine beetle, but the TSA now faces a serious timber shortage in the mid-term.

Figure 2.3: Projected AAC for the Quesnel Timber Supply Area
Source: Snetsinger, 2011: 8



	1985	1989	1992	1996	2001	2004	2009	2011	2021	2041	2061	2081	2101	2121
AAC (Million Ha)	3.45	2.45	2.35	2.34	3.25	5.28	5.28	4.00	0.72	0.72	2.52	2.52	2.52	2.52

2.1.2. Demographics

The municipality of Quesnel has a population of about 9,947 (BC Stats, 2011), and the school district (representing the population of the market area of Quesnel) has approximately 23,784 people (BC Stats, 2011). The population has fluctuated slightly but has shown a relatively constant growth. Figure 2.4 shows a plateau in the late 1980's and early 1990's, which may be due to the recession that was hampering the forest industry at the time (Hayter, 2000). There is a rapid increase in the 2001 census which was the result of an expansion of the city limits, not an influx of people to the city. The 2006 census shows a decrease of roughly 700 people, a loss which the 2011 census shows has been replaced.

Figure 2.4: The population of the municipality of Quesnel – 1931-2011
Source: BC Stats, 2011

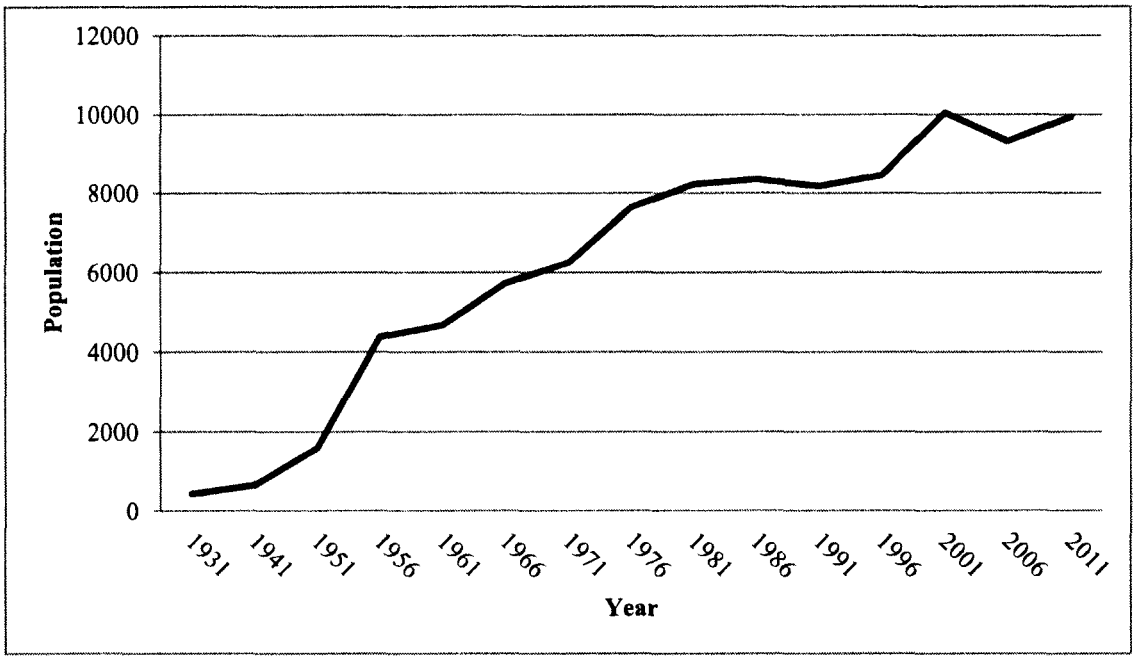
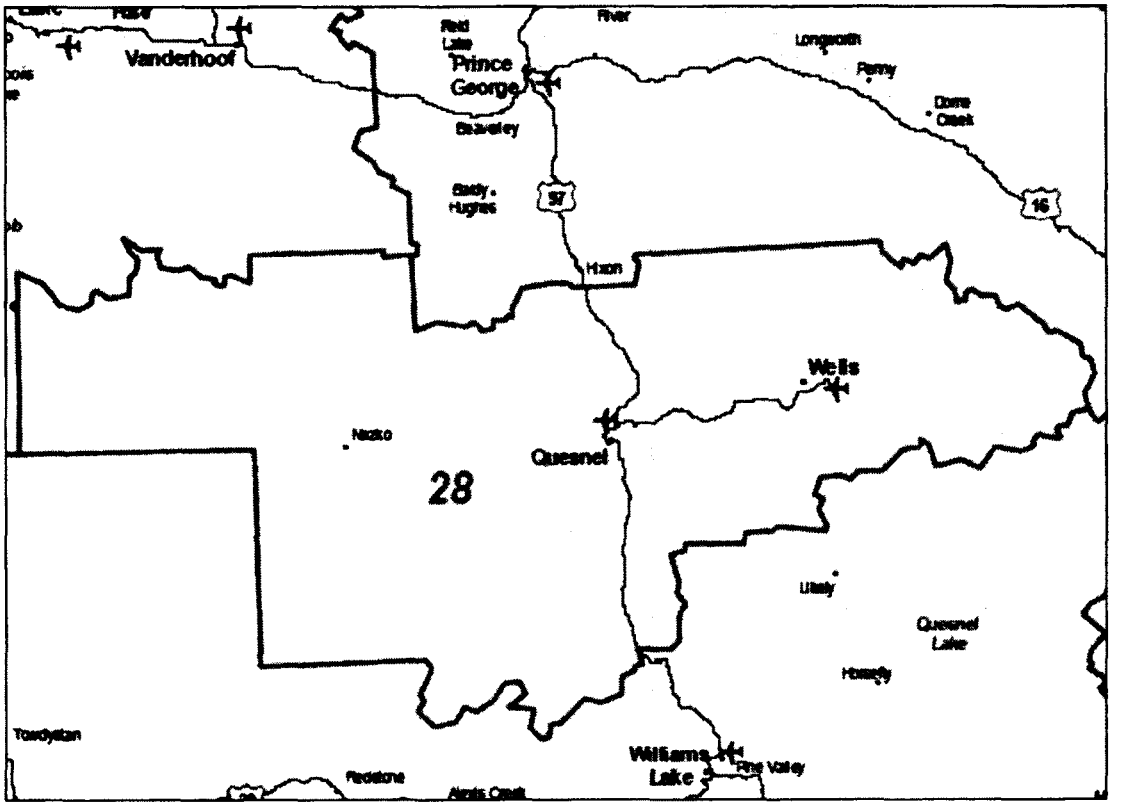


Figure 2.5 Quesnel School District (SD #28)
Source: BC Stats, 2008a.



The Quesnel School District encompasses most of the market area of Quesnel, or the area for which Quesnel serves as the primary service centre. It stretches north to Hixon, east to Wells, south to Alexandria and west to Nazko and the Kluskus reserve (see figure 2.5). Although only going back to 1986, the area has not changed as much as the City of Quesnel and represents the population that works, provides services, and purchases goods within the city, which is a comparatively small geographic area.

Figure 2.6 Population of the Quesnel School District 1986-2007
Source: BC Stats, 2011

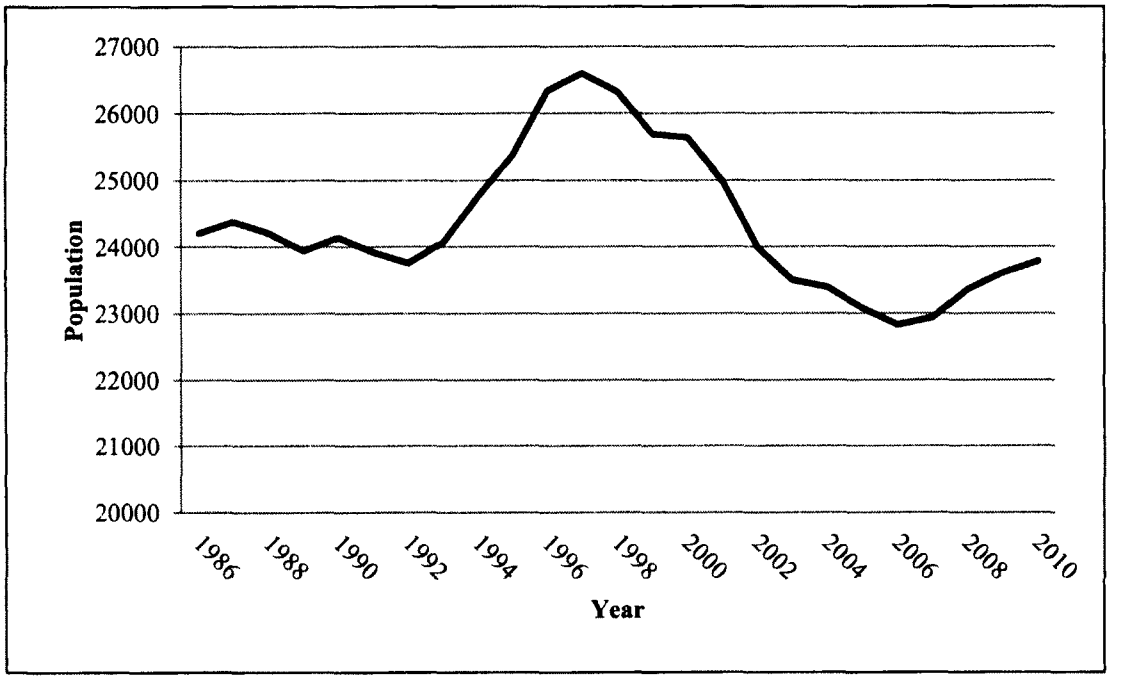
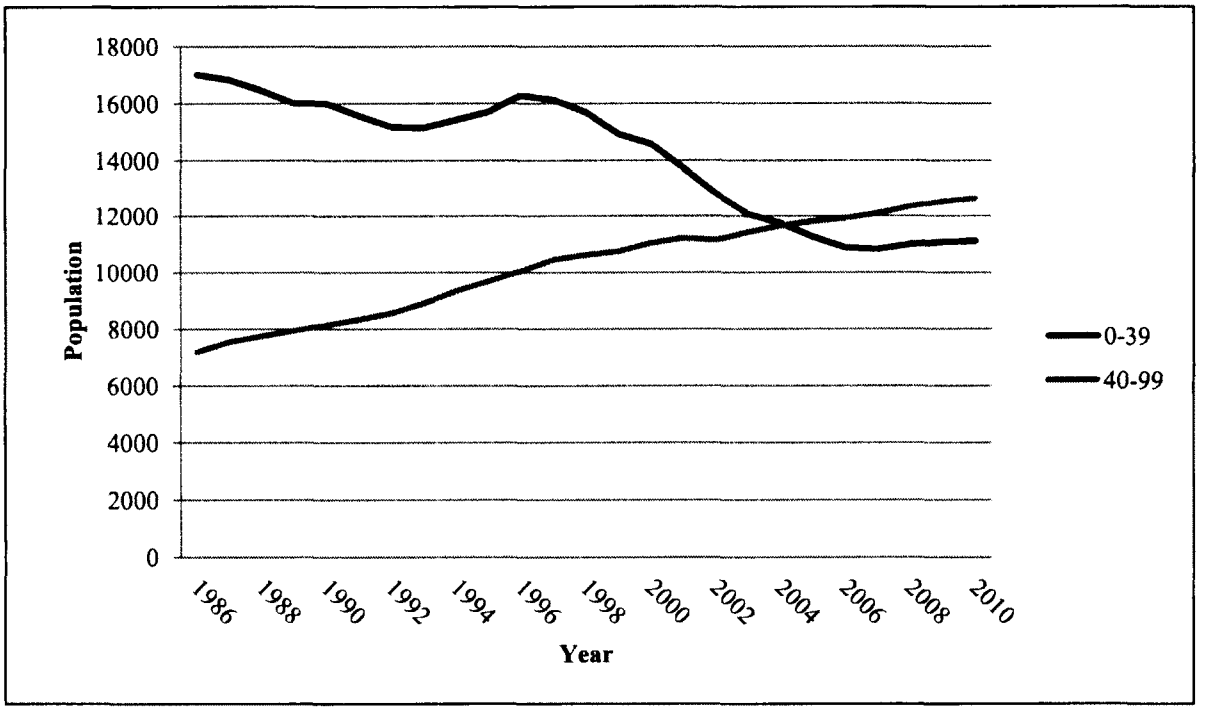


Figure 2.6 shows a significant increase in population in the School District from 1992-2003, after which it returns to the same level it was in the late 1980's. This decrease may be the result of a decline in the local economy as well as a decreasing birth rate. Figure 2.7 shows that the age structure of the population in the Quesnel School District has shifted to 52% of residents being 40 or older compared with 30% in 1986. This is consistent with "resource frontier aging" described by Hanlon and Halseth (2005: 7) featuring an increase in the median age of a population due to a lack of jobs for young people and the desire for people established in the community to "age in place". This lack of opportunity has resulted in high school graduates leaving the community and not returning, plus a failure to attract and retain young families (Beshiri *et al.*, 2004; Hanlon and Halseth, 2005). The ageing population represents a marked

change from earlier patterns of development in resource dependent communities that were characterized by an in-migration of young people who came to comprise the majority of the population. These people were drawn by economic opportunities in the burgeoning resource sector which was offering high paying jobs (Halseth, 1999a). Restructuring has led to a decrease in the availability of these jobs (Hayter and Barnes, 1997; Hayter, 2000; Markey *et al.*, 2005), which has led to a decrease in opportunity for young people.

Figure 2.7 Population of the Quesnel School District under 40 versus over 40 1986-2010. Source: Adapted from BC Stats 2011.



Figures 2.8 and 2.9 show the population age distribution for the Quesnel School District in 1986 and 2008, respectively. There is a noticeable change in the 25-40 year old demographic, indicating that this age group is not being successfully retained or recruited. The consequence of

this is that fewer people are starting families in Quesnel compared to 1986 when school age children constituted a large part of the population.

Figure 2.8: Population Age Distribution for the Quesnel School District – 1986.
Source: BC Stats, 2009.

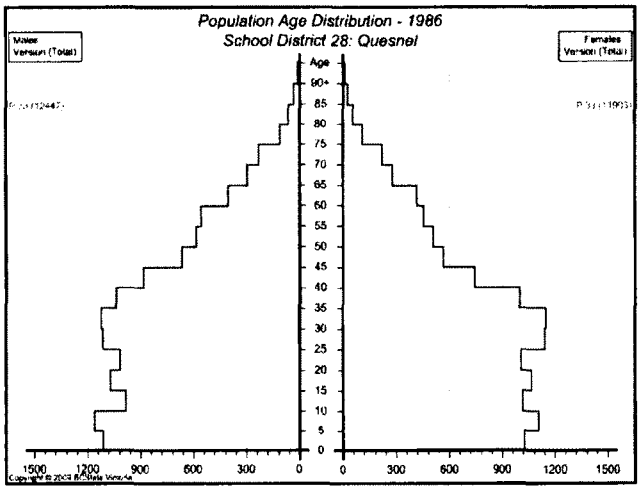
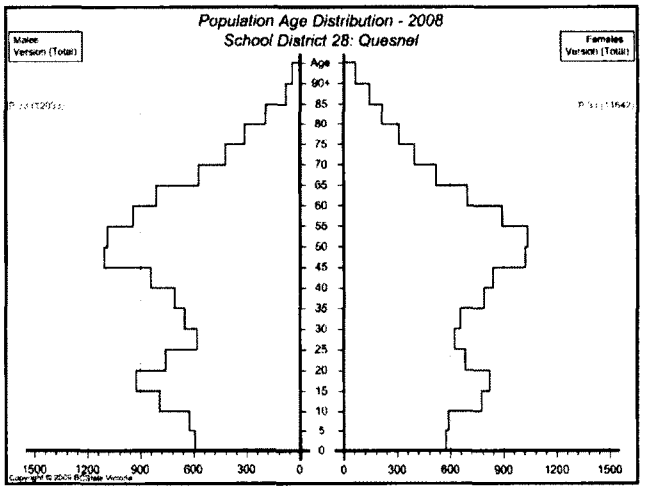


Figure 2.9: Population Age Distribution for the Quesnel School District – 2008.
Source: BC Stats, 2009.



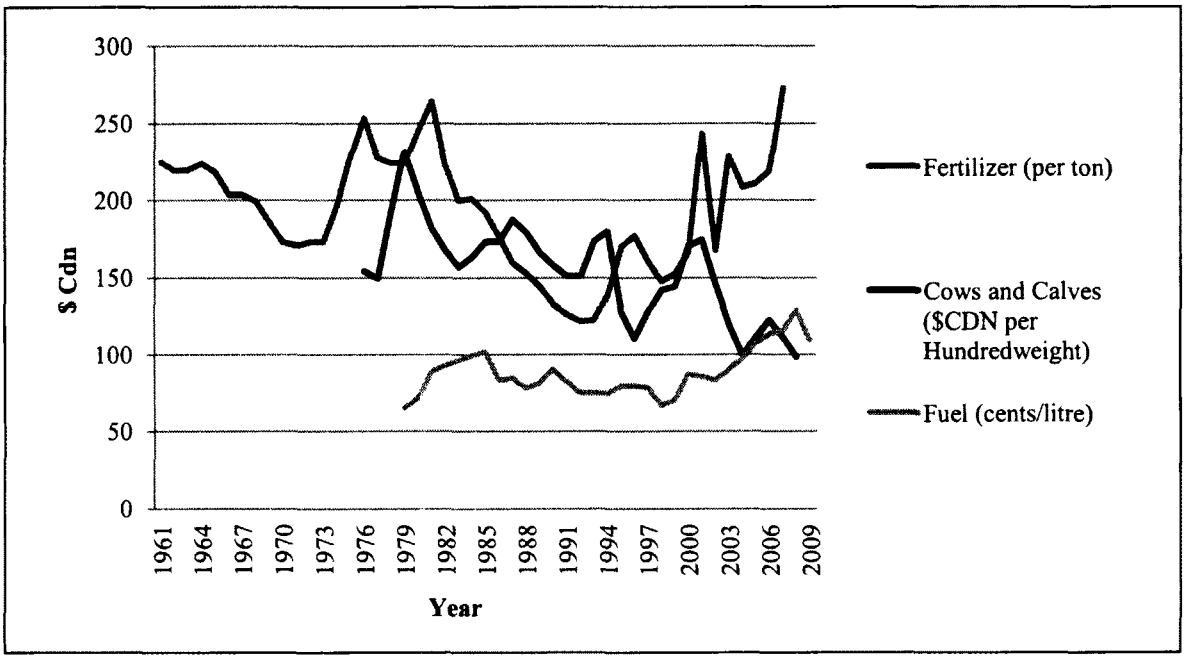
The transition from a youthful to an ageing population has numerous consequences for resource dependent communities. Service provision in rural areas is already hampered by distance and low population densities, so a decreasing population is likely to cause a loss of education and health care services. Without these services communities are caught in a positive feedback loop where loss of services causes further population loss which then makes it increasingly difficult to retain and attract residents, decreasing the potential for new industries to locate in these communities (Hanlon and Halseth, 2005). This is a challenge for communities such as Quesnel that are trying to develop new ideas and attract investment to diversify and adapt their economies to deal with a declining forestry sector.

As mentioned, the economy of Quesnel is dominated by forestry, a sector accounting for 46% of the experienced labour force in the Quesnel School District (BC Stats, 2010). Agriculture ranks behind tourism in employment, constituting 2% of jobs compared with 5% for tourism (BC Stats, 2007). 50% of the agricultural activity in the Cariboo is derived from cattle ranching, which accounts for 20% of the provincial cattle herd, with roughly 15% of those cattle located within the boundaries of the Quesnel Forest District. Cattle sold at the Williams Lake Stockyard are worth approximately $23.5 million annually, with cattle from the Cariboo making up a significant portion of the sales. Beyond the economic impact, the agricultural industry in and around Quesnel is vital part of the history and culture of the community. A highly successful farmers market is held every Saturday throughout the summer and the agricultural complex is home to several rodeos and the annual Fall Fair held in late August that showcases local agricultural products. In addition, ranchers are an important source of ecological knowledge and have valuable insights in building and managing resilient social-ecological systems. So while the agricultural industry may not contribute much employment, it is a vitally important industry to the resilience of Quesnel - a topic discussed in greater detail in the results and discussion chapters.

Part of the reason agriculture supports such a small percentage of the regions employment is that ranching has been going through a long period of decline hastened by the following factors. The legacy of the Mad Cow disease has resulted in closed borders and low cattle prices. High fuel and fertilizer costs have eroded the already thin margins, putting many ranchers on the brink of bankruptcy. The demographic shift Quesnel and other rural communities are

experiencing is visible on local ranches, as few young people are taking over family farms and fewer still have the capital and expertise to start their own farm. Figure 2.10 shows how, after adjusting for inflation, the price of cattle has decreased significantly while fertilizer and fuel have risen substantially. Several ranchers that were interviewed stated that low cattle prices and the high cost of inputs (fuel and fertilizer) were the main factors for the struggles of the ranching community. The cost of fertilizer shown on the graph may be low, as during an interview one rancher produced a bill showing he was paying $700/ton in 2009.

Figure 2.10: Cost of Fertilizer and Fuel vs. Price of Cattle - Adjusted for Inflation for 2010
Source: Stats Canada, 2011.



Quesnel is a community facing significant change due to the projected decrease in timber supply. After years of relative stability and modest population growth, the demographics now resembles a mature resource-based community with an older workforce and lack of opportunity

for young people that leads to out-migration of youth (Bradbury and St. Martin, 1983). Forestry remains the dominant industry, with tourism and ranching comprising a small but significant part of the community's economy. Cattle ranching comprises the bulk of the agricultural sector, but is facing hard times due to low cattle prices and the high cost of fuel and fertilizer. It too is dealing with an aging workforce that is not being replaced with younger workers. Given these problems and spectre of a drastically diminished timber supply, the need to build a more resilient social-ecological system is clear.

Chapter 3 Literature Review

The literature review will provide context to the research topic: whether an industry based on growing fibre can help Quesnel become more resilient - the overarching goal of the bioenergy/bioproducts initiative. The initiative is inspired by natural systems and strives to emulate processes such as nutrient cycling and forest succession. Biomass cropping is intended to increase both biological and economic diversity through the establishment of deciduous plantations on ranchland. If successful, it could be an example of a well integrated social-ecological system that will increase the resiliency of ranchers and Quesnel.

The majority of this chapter is dedicated to resilience, the central concept of this thesis. The first section will differentiate between engineering and ecological resilience. Engineering resilience refers to the speed in which a system returns to its previous state, while ecological resilience is defined as the magnitude of disturbance a system can withstand before losing its characteristic structures and functions (Holling, 1973; Ludwig *et al.*, 1997; Folke, 2006.) It is the definition used throughout the thesis.

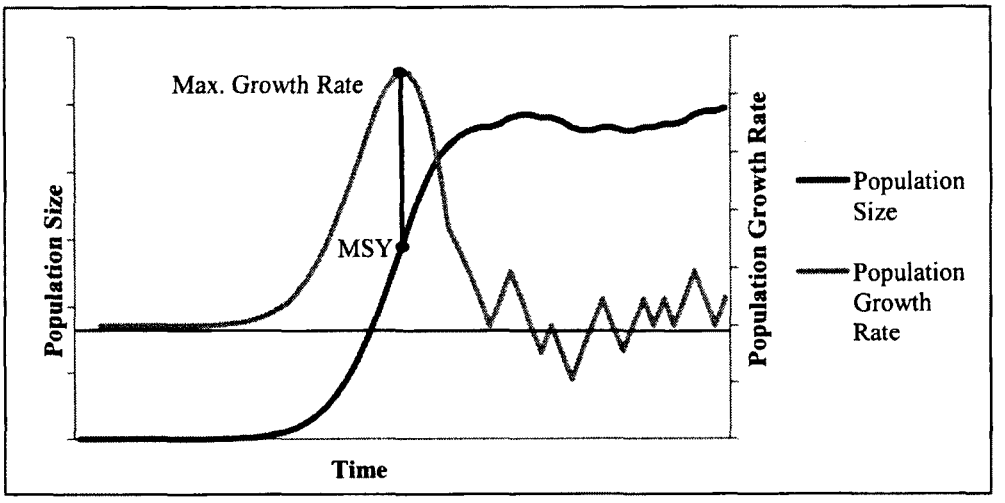
The second section explains how resilience (the ecological definition) can be gained or lost through a discussion of panarchy, a theory that explains cycles of change in complex systems. The important lessons of panarchy are that change is not only inevitable, but an integral part of all complex systems, and that diversity and potential are the fundamental 'building blocks' of resilience. These ideas will lead into a comparison of resilience in social-ecological systems with community economic development. The chapter will conclude with brief descriptions of bioenergy and agroforestry.

3.1 Engineering Resilience

Engineering resilience has formed the basis for our current resource management programs and heavily influenced the development of rural communities in British Columbia. It refers to the speed with which a system can return to a previous state (Pimm, 1984; Anderies *et al.*, 2004) or more specifically it "focuses on efficiency, control, constancy, and predictability – all attributes at the core of desires for *fail-safe* design and optimal performance" (Holling and Gunderson, 2002: 27 – emphasis mine). This definition can work well in simple systems with high degrees of certainty, but has (and is still) all too often been applied to complex systems full of variability and surprise. This leads to attempts to make systems less complex and easier to control, as well as more *resistant* to change (Holling, 1996; Smith, 1996; Holling and Gunderson, 2002; Fraser, 2003; Olsson *et al.*, 2004). Two examples will demonstrate the hazard of this type of strategy: maximum sustained yield management and the 'staples trap'.

Maximum sustained yield (MSY) is the foundation for many of our resource management systems, including forestry, hunting, and fishing (Holling *et al.*, 1998; Carpenter *et al.*, 2002). It is based on a mathematical model for population growth shown in figure 3.1. At low population levels resources are plentiful and competition minimal, which allows for rapid population growth. As the population reaches its carrying capacity, the death rate begins to approach the birth rate until population growth is zero (Carpenter *et al.*, 2002).

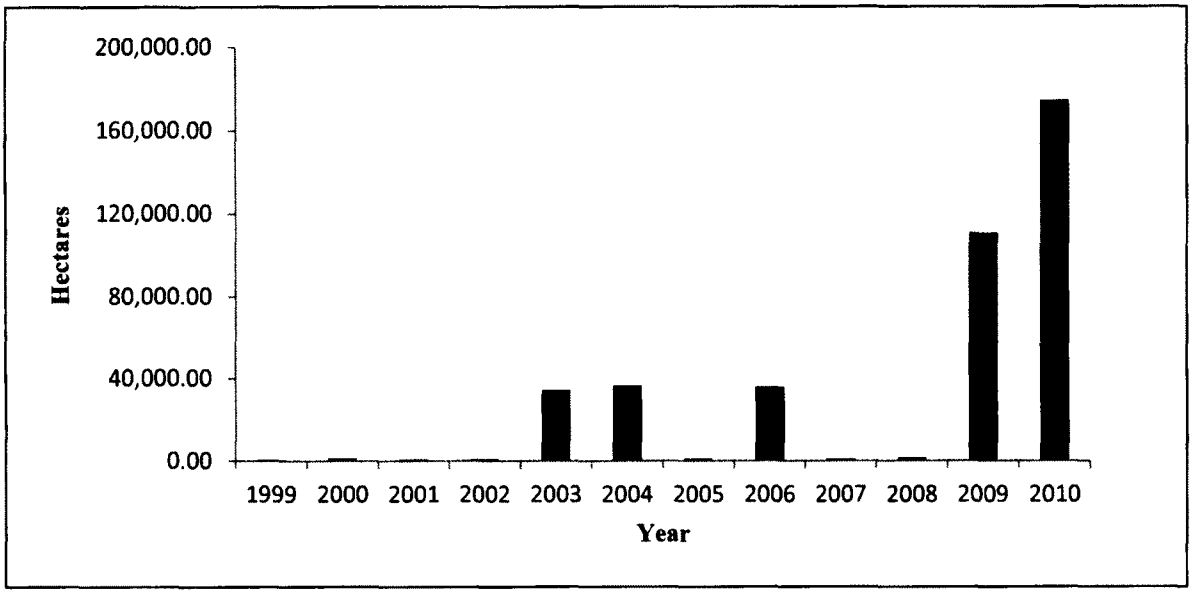
Figure 3.1: Maximum Sustained Yield – Population Size vs. Population Growth Rate for a Theoretical Population
Source: Carpenter *et al.*, 2002.



Populations often fluctuate around this maximum depending on yearly variations of resource availability and mortality, as shown by figure 3.1. The principle of MSY is that competition for resources amongst a given species is inefficient as it slows the growth rate. By removing a portion of the population, the growth rate can be kept at a maximum level, ensuring a constant supply (Holling, 1973). Figure 3.1 shows the point (MSY) on the population size curve where growth is at its peak. This, as the figure shows, is the maximum sustained yield – the ideal population size. When a population grows past this point, it is considered 'surplus' and available for harvest. Thus MSY legitimizes the replacement of natural mortality with human-caused mortality as a population control, and is a big part of why effort is put into fire suppression, pesticide application, and predator culls. Fewer resources lost to fires, pests, or predators means more for human consumption. The application of MSY requires a high degree of control and simplification of natural systems; and emphasizes the quick return of population

size after a harvest – the essence of engineering resilience (Westley *et al.*, 2002). Forest management in BC developed around this philosophy and led to a strategy that is still based on the conversion of old growth stands to fast growing young plantations (Taylor and Wilson, 1993). Old growth stands, often considered over-mature or 'decadent' were seen as wasteful due to higher mortality, while young plantations, with low mortality, were thought to be crucial to an efficient, sustainable forest economy (Marchak, 1983). The current mountain pine beetle epidemic illustrates nicely an unintended side effect of using MSY to achieve engineering resilience on complex forest ecosystems. In the Quesnel Forest District, as old-growth forests were cut, they were replanted primarily with Lodgepole pine - the fastest growing merchantable tree species. This created vast stands of contiguous, even-aged pine stands which were poised to be ready for harvest within 60-80 years. However, these stands also turned out to be perfect for the spread of the mountain pine beetle, which by 2009 had consumed 16.3 million hectares, consisting of 675 million cubic metres of wood (BC Ministry of Forests, Mines, and Lands, 2010). The vast expanses of dead wood served to facilitate the ignition and spread of large, intense forest fires (Hawkes, 2008; Baker, 2009). Figure 3.2 shows the number of hectares burnt in the Cariboo Fire Centre from 1999-2010. The fire seasons of 2009 and 2010 clearly show that the increased fuel load due to the mountain pine beetle combined with hot, dry summers can lead to extensive wildfires that overwhelm the suppression capacity of the BC Wildfire Management Branch.

Figure 3.2: Hectares Burnt in the Cariboo Fire Centre 1999-2010
Source: Cariboo Fire Centre, 2011



As mentioned earlier, engineering resilience and MSY assume that natural mortality can be replaced with human-caused mortality. Engineering resilience focuses on making systems *resistant* to change, an approach that is ill-suited to complex systems where disturbance is not only inevitable, but necessary for the long-term health of the system (Levin *et al.*, 1998; Johnson *et al.*, 2001; Holling and Gunderson, 2002).

The principles of engineering resilience – resisting change, simplification, and the emphasis on a quick return of function can be seen in rural communities as well. Most of the communities in rural BC have been composed of simple economic systems from their inception, relying almost exclusively on resource extraction. Some communities were established as company towns to house workers for mining, fishery, or forestry operations (Halseth, 2005; Ommer, 2007). Others developed more informally around these activities into small – medium

sized towns (Mouat, 1995; Halseth, 1999b). The pattern of development is classic staples theory – raw resources are gathered from the 'hinterland' and exported to metropolitan areas; an asymmetrical relationship that sees rural places become resource producing regions that supply the more fully developed core (Hutton, 1997; McCann and Simmons, 2000). This has resulted in rural communities being caught in a 'staples trap', where the resources are shipped away to the core regions, processed, then sold back to peripheral regions as finished goods (Barnes *et al.*, 2001). Major investments by the provincial government in rural BC, and particularly the North, during the 1950's and 60's created a 'boom' period that transformed BC into a 'have' province. These investments also allowed for the growth of communities across rural BC, solidifying the geography of the province's resource-based economies (Hayter, 2000; Young and Matthews; 2007; Markey *et al.*, 2008). The success of this strategy has been part of the reason successive governments continue to see the resources of rural BC as a "bank" (Markey *et al.*, 2008: 409) to supply the provincial treasury or to lift the economy out of recession (Baxter and Ramlo, 2002; Halseth, 2005). Thus the reaction to mill closures and mine shut-downs has historically been to open up new centres of extraction. Currently, this can be seen in the growth of the oil and gas industry in north-east BC and the investments the provincial government has made to stimulate the mining sector (Halseth, 2005; Markey *et al*, 2008).

The dependence on large-scale resource extraction has prevented investment and policy being directed towards developing diversified, sustainable communities across BC. Rather, effort has been spent trying "to repair a system which has been identified as needing fundamental change" (Halseth, 2005: 339), a strategy displaying the traits of engineering resilience –

simplification, resistance to change, and a quick return of function. The staples economy is a relatively simple economic model – access to resources is traded for resource rents (i.e. stumpage and royalties) and employment. Rather than addressing problems such as resource depletion and community instability, effort is made to continue the ability of industry to access resources. As the traditional vision of rural BC has been as a source of wealth, declines in revenues from a fading sector have been quickly replaced by switching to another resource. The effect on communities is the familiar cycle of boom and bust, described by Harold Innis as a cyclone "blowing across the economic landscape, global-cyclonic winds touch down at a few sites – single-industry towns – to create in a burst of frenetic energy the infrastructure and wherewithal of resource production" (Barnes *et al.*, 2001: 2130). Of course after the storm has passed the community has all too often failed to develop alternatives and is left suffering the effects of restructuring.

The image of rural places as resource extraction sites is ingrained just as deeply in many communities as it has become with the provincial government. This has made other options for development difficult, and served to strengthen resistance amongst stakeholders against perceived threats to their livelihood (Halseth, 2005). For example, Reed (2003) describes a tendency amongst people directly dependant on the forest industry to attribute employment loss to decreased timber supply resulting from government policy and the environmental movement. This is despite evidence stating that resource depletion (Marchak, 1983), downsizing, and technological upgrades have been a significant source of job loss in the forest industry (Halseth, 1999b).

This reluctance to acknowledge the role of industry in restructuring has led communities and governments to remain focused on preventing job loss and layoffs from occurring, rather than focusing on decreasing their dependence on forestry. Community members have often supported industry opposition to land use plans that would decrease the AAC in an attempt to allow for other (non-logging) uses of the land; the Commission on Resources and the Environment in the 1990's being a prime example (Halseth, 1999b; Reed, 2003). Halseth (2005) describes how the imaginations of community members can be constrained by the fact that most rural communities have only known an economy based on resource extraction, something which can impede attempts to diversify. He cites the example of Tumbler Ridge, a mining community that went through the shut-down of both of their mines in 2000. While there was considerable interest and commitment to developing non-resource based industries, many members of the community supported town council's preference to pursue re-opening the mine, constraining other opportunities in the process. The quick return of plentiful, high-paying jobs and a rich tax base is often too tempting to pass up when compared with long term, less lucrative, but ultimately more stable diversification strategies. Councils are often reticent to go against the wishes of major industry, as seen in the case of Tumbler Ridge, and some interviewees from Quesnel stated that the city council was unwilling to support efforts to acquire a community forest because of concerns it would compete with the local forest industry for timber.

To sum up, engineering resilience is measured by the speed a system is able to return to equilibrium after a disturbance. It is a definition that can be applied meaningfully to simple, highly controlled systems, but is all too often applied to complex, uncontrolled systems such as

ecosystems and communities. As change is not considered a necessary part of systems managed for engineering resilience, they are designed to resist change, to be 'fail-safe'. A great deal of effort is expended in maintaining the system and protecting it from perturbations. The results are often attempts to simplify and impose control on these systems, which then leads to instability and unforeseen consequences. Maximum sustained yield (MSY) is an example of engineering resilience applied to ecological systems. The ideal forest under MSY is a fast-growing monoculture with zero natural mortality – leading to high yields for forest companies. The loss of diversity this management regime caused made the forests more susceptible to the mountain pine beetle and forest fires, increasing the mortality from that which could be expected in a more diverse system. In other words, the application of MSY ended up increasing the 'problem' – natural mortality - that it was attempting to stop.

Engineering resilience causes a decrease in diversity in natural systems and tends to 'lock up potential in social systems – communities in the context of this paper. The provincial economy is based on harvesting and exporting raw materials; with rural areas serving as the periphery and metropolitan areas being the 'core' to which resources are sent and processed. Provincial governments have dealt with declines in one resource sector by opening up others, helping to fuel the 'boom and bust' cycle of resource-based communities. These communities find it difficult to break from this cycle as the resource extraction economy has a firm hold on labour, capital, and the imaginations of provincial and local politicians – examples of potential. As a result, communities find it difficult to develop the capacity and gain the support needed to develop more diverse, locally controlled economies.

The concept of engineering resilience needs to be substituted for one that emphasizes adaptation rather than resistance to change, and builds diversity while preserving potential. This will help to move away from managing natural resources for maximum yield, and help communities to broaden their economic bases to gain more stability. Holling (1973) termed this 'ecological resilience', a much more suitable definition for complex social-ecological systems, as will be demonstrated in the next section.

3.2 Ecological Resilience

Ecological resilience refers to a system that goes through a disturbance and emerges looking different but retaining the fundamental characteristics that allow the system to function (Holling and Gunderson, 2002). Rather than focusing on maintaining the efficiency of function, ecological resilience focuses on "maintaining existence of function" (Holling and Gunderson, 2002: 28). While engineering resilience aims to prevent failure (*fail-safe*), ecological resilience desires *safe-fail* systems that allow for disturbance but attempt to prevent collapse (Holling and Gunderson, 2002). An ecologically resilient system does not suffer from change; rather it requires it to persist. These systems are typically complex and non-linear such as ecosystems or societies. Those systems that are able last do so because they are able to respond and adapt to change. They do this by retaining a diverse collection of 'parts' that, when confronted with disturbance, can be re-assembled to better suit the new environment the system is now situated in. For example, consider a large area of land. This area is made up of different ecosystems – grasslands, forests, wetlands, and alpine. If the climate were to change and become warmer, grasslands may expand, wetlands could decrease, and alpine areas could shrink. Yet if all of

those components remain in some form on the landscape, the area would remain resilient and able to adapt to further disturbance. If the climate suddenly became cooler, the species that comprise the alpine areas could expand. If this same area lost alpine vegetation, a cooling climate would mean the alpine would revert to rock and ice. If the area did not have grasslands, a warming climate could mean forests would turn to desert. In both of these examples a lack of diversity would lead to a diminished ability within the system to respond to change, and increase the chances that the system would collapse. This will be explained more through a discussion of panarchy. The key part is that ecological resilience is increased through diversity, which makes it more likely the system will be able to adapt to unpredictable events.

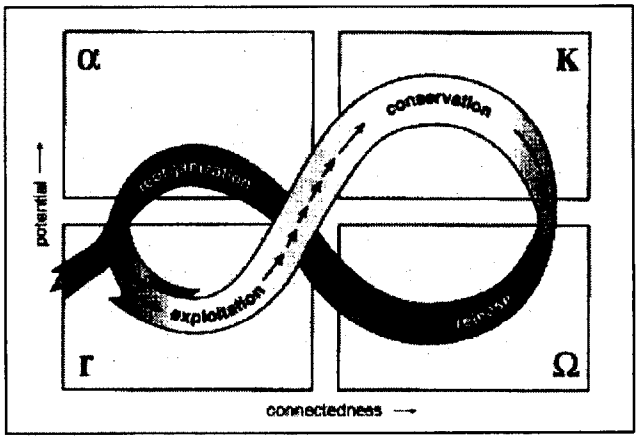
Ecological resilience has had a significant impact on ecology and resource management, is beginning to change the way social scientists perceive resilience, and is helping to better link social and ecological systems (Folke, 2006; Binkley, 1997; Egan, 2007). It has been used as a theoretical bridge between the two systems to analyze the reasons for collapse in societies (Finlayson and McCay, 1998; Fraser, 2003; Homer-Dixon, 2006), the social and ecological health of communities (Ommer, 2007), and ways to improve resource management (Acheson *et al.*, 1998, Pinkerton, 1998; Kendrick, 2003; Trosper, 2003; Wheatley, 2006). In simple terms, ecological resilience is based on adapting to change, building diversity, and preserving potential. The intricacies are best explained through panarchy – a theory describing processes of change in complex systems.

Panarchy can be understood through four features:

1. The adaptive renewal cycle.

2. Systems exist in nested hierarchies of different sizes that operate on different time scales.
3. Change is crucial to the development of resilient systems.
4. Resilient systems maintain diversity and potential.

Figure 3.3: The Adaptive Renewal Cycle
Source: Holling and Gunderson, 2002: 34

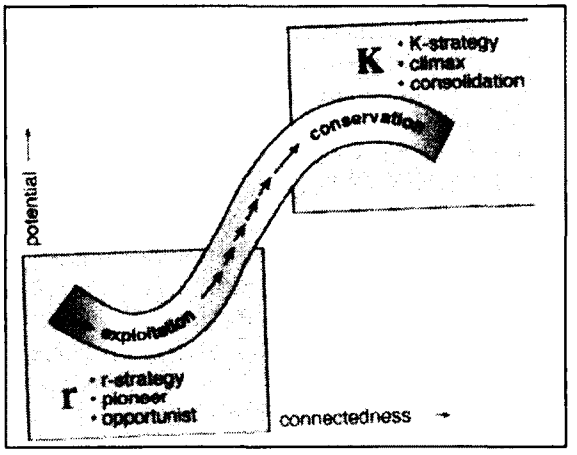


3.2.1 Adaptive Renewal Cycle

The adaptive renewal cycle is the fundamental unit of panarchy. It was created to integrate change, diversity and resilience into existing conceptual models to help explain how complex systems behave (Holling and Gunderson, 2002). The cycle consists of four phases, *r* (exploitation), *K* (conservation), Ω (release), and α (reorganization) as shown by figure 3.3. These phases can be grouped into two main parts – the front loop and the back loop. The front loop (figure 3.4) consists of the *r* and *K* phases and is basically the linear model of development that engineering resilience is based on (note the similarity to the population growth curve in figure 3.2). It represents the part of the cycle that is best known. The growth of systems is quite well understood, we can predict the different stages a forest will go through as it grows back after a fire or clearcut, and how an industry develops to exploit new resources or innovations. What is less well understood is the role of disturbances such as a pest infestation in forests or an economic recession.

The backloop places these events as an integral part of a cycle and therefore equally important to the health of a system as the front loop. Change is often considered detrimental but avoidable; a belief that leads to a great deal of effort spent preserving the system in a growth or maintenance phase. Through the addition of the backloop, the adaptive renewal cycle shows that this is not true, that in fact change is both inevitable and necessary for resilient systems. Thus, the impetus for management shifts from *preserving* the frontloop to *preparing* for the backloop – or from creating *resistant* systems to *resilient* systems.

Figure 3.4: Frontloop of the Adaptive Renewal Cycle
Source: Berkes and Folke, 2002: 125



So while the backloop helps to show the importance of change, the four phases of the adaptive renewal cycle help to gain a more detailed understanding of how systems change as they move through the cycle. During the α phase the system is recovering from the disturbance or 'release' that occurred during the Ω phase. All of the resources that were controlled during the *K* phase are now available, creating opportunity for a 'fresh start' and novel arrangements. For example, resources such as light, water, and nutrients in a forest are made available after a disturbance such as a forest fire. This allows pioneer species to become established which in turn creates habitat for species dependant on early seral vegetation. It also allows species and ecological communities that are better adapted to new conditions to develop, such as drought resistant species becoming dominant over those that thrive during wetter periods (Tilman and Downing, 1994). At this point, the system is

highly resilient as the components are loosely connected and able to quickly adapt to change. It also has a high potential for change because the system is relatively unstable – small perturbations will have a big impact on the development of the system in the *r* phase.

As the system moves into the *r* (exploitation) phase, the components are more tightly organized and the development path of the system is set. In forests, early seral, pioneer species have become firmly established. In social-economic systems, the early competition for resources and opportunity has given way to exploitation of resources, leading to the slow build up of the system to the highly connected and complex *K* phase. The system is still highly resilient at this phase due to its simplicity and the weaker connections between components, and is therefore able to adapt to perturbations relatively easily.

The progression from the *r* to the *K* phase is typically a long, slow process where the system increases in complexity and becomes highly interconnected. The system is said to be at its climax in the *K* phase, exemplified by old growth forests and established, mature communities. A system in the *K* phase is 'brittle' and highly vulnerable to perturbations. The numerous connections within the system mean that stresses that affect one component will be felt by others. This has the effect of making the system resistant to stress, but when it eventually becomes overwhelmed it is more likely to collapse rather than adapt to the change. This problem is exacerbated when diversity is lost in the progression from the *r* to *K* phase, something forest dependent communities are witnessing first hand. As the forest industry developed, mills consolidated to the point where many communities are depending on just a few mills for their livelihood (Marchak, 1983, Hayter, 2000). Industrial consolidation has allowed companies to

invest in new technologies and develop economies of scale that have kept them globally competitive (Forgacs, 1997, Williston and Keller, 1997; Hayter, 2000), but when they do fail it can be extremely difficult for the communities that have come to depend on the mills for employment and taxation – sometimes leading to a system collapse. The probability of collapse is increased when the transition to the Ω phase is resisted, a common occurrence for systems in the *K* phase.

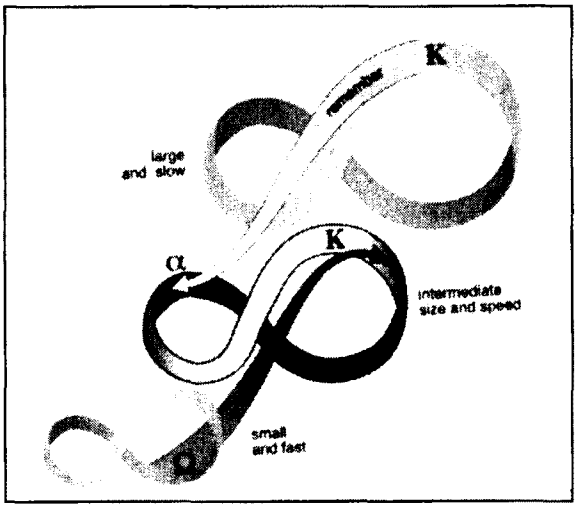
One of the key lessons of the adaptive renewal cycle is that change is inevitable and no system can persist in the *K* phase indefinitely. At some point, stresses build up and force the system into a period of release, leading to the Ω phase. The Ω phase is turbulent and uncertain as the resources that were tightly controlled in the *K* phase are released, and the system loses structure. The transition from the *K* to Ω phase is quick, exemplified by events such as insect outbreaks, forest fires, stock market crashes and mill closures. This phase is needed for the system to adapt to change, but if the magnitude of the release is too severe, the system can collapse and be irreversibly altered. Change that happens too frequently can also lead to collapse, as some resources are lost each time the system goes through the backloop. Overgrazing is a prime example, as reduced vegetation cover leads to increased erosion which in turn can lead to the conversion of grassland to shrubs and woody plants, with little chance of reversal (Holling and Gunderson, 2002; Baker, 2009).

Through the adaptive renewal cycle the importance of ecological resilience (safe-fail) becomes clear. Resisting change by prolonging the *K* phase increases the magnitude of the release phase (*K* - Ω). As this phase is the most dangerous part of the cycle, it is the part that is

most important to plan for. The most effective way to achieve ecological resilience is to cultivate and maintain high levels of diversity, which then allow for a greater number of possible combinations during the α phase. With more options, the likelihood of one being suited to the conditions that caused the system to enter a reorganization phase is greater. A simple example of this is found in arid grassland ecosystems. Tilman and Downing (1994) found that grasslands in Minnesota were composed primarily of two kinds of grasses, those that thrived on abundant water and those that were able to grow well in drought. The plots with the greatest number of species produced more biomass during a drought than those with the least. While the drought altered the composition of species, diversity allowed the grassland to persist through the drought rather than succumbing to desertification or a different form of collapse. Another example is communities that have multiple industries to support the economy. As conditions change it is likely that not all will suffer and economic downturns will not be as severe as it would be in a community with only one major industry. Similar results were found for agricultural systems (Thrupp, 2000; Bullock *et al.*, 2007), forests (Burton, 2010), entire ecosystems (Naeem *et al.*, 1994), and for community economic development (Wagner and Deller, 1998). Diversity is the main component of resilience, and increasing and preserving diversity should be the main goal for systems striving to become more resilient.

3.2.2 Hierarchies

Figure 3.5: Panarchy
Source: Holling *et al.*, 2002: 75



As mentioned, the adaptive renewal cycle is the building block of panarchy. Figure 3.5 shows the panarchy model which consists of linked adaptive renewal cycles of different sizes. It shows how systems are affected by others of different time and spatial scales. For example, a forest consists of individual trees, stands of trees, and the broader forest landscape; each representing a system of different scale. Individual trees operate on the smallest, fastest scale, with each larger scale increasing in size and decreasing in the speed in which it responds to stresses. During a pest infestation, a single tree is attacked and quickly succumbs to the pest, causing the system to move from the *K* phase to the Ω phase. Having gained a foothold, the pests expand to the forest stand, initiating the 'revolt' shown in figure 3.5. If strong enough, the 'revolt' acts as a perturbation that can cause the larger system (in this case the stand) to move from *K* to Ω, meaning the infestation will now spread to the entire forest (Holling *et al.*, 2002).

The process of 'revolt' demonstrates how change is initiated by small, fast moving systems. As systems get larger, the pace of change slows and stronger perturbations are required for change to occur. This adds stability to the systems in that it slows the pace of change and helps to 'weed out' maladaptive adaptations. Larger systems help smaller ones recover from

disturbance, shown in figure 3.5 by the arrow labelled 'remember'. For example, a forest fire can burn hot enough to kill all vegetation and sterilize the soil. Yet these patches are able to recover through inputs of seeds and other resources from the surrounding unburned forest, preventing a collapse (Baker, 2009). The likelihood of recovery is related to how close the burnt patches are to the unburned forest, or how strong the connections are between large and small systems.

Another example is the plight of forest-dependent communities facing the MPB epidemic. The ecological, economic, and social systems in these communities are sliding from the *K* phase to the back loop, characterized by uncertainty and the possibility of collapse. These communities are important sources of revenue and employment for the provincial economy, so the spectre of their collapse is a significant perturbation to larger scale systems such as the provincial government. If the stress from a smaller scale system (community) is strong enough, or if many communities are going through the same thing, the province could begin to slide into the backloop as well. Should this happen, the stress would spread to the next level up, in this case the federal government which depends on British Columbia, a 'have' province to contribute to a strong national economy.

'Remember' can be seen in MPB affected communities through inputs of capital and capacity building, as has been demonstrated by the provincial and federal governments programs to aid communities affected by the MPB (Rural BC Secretariat, http://www.ruralbc.gov.bc.ca/secretariat.htm. Accessed Dec. 5, 2008; Western Economic Diversification Canada, http://www.deo-wd.gc.ca/eng/77_2069.asp. Accessed Dec. 5, 2008).

These programs are meant to help forest dependent communities avoid collapse, which will in turn reduce the perturbations experienced by the larger systems, and decrease the likelihood they too will collapse (Holling, 2004).

Through adaptive renewal cycles and hierarchical interactions, panarchy is both creative and conserving. It provides opportunities for innovations and creativity through small, fast cycles and *revolt*, yet buffers systems from harmful or extreme change through larger, slower cycles and *remember*. By emphasizing the need to plan for the backloop, panarchy demonstrates how systems can lessen the impact of change through decreasing the magnitude of the release from the *K* phase to the Ω phase. The key to this is building and preserving diversity within the system to increase the options the system has during the α phase. Ecological resilience and panarchy have been often used to better understand linked social-ecological systems (Levin *et al.*, 1998; Gallopin, 2006; Gooch and Warburton, 2009) and will be used in this thesis to both understand the restructuring process facing forest-dependent communities such as Quesnel, and to assess the implication of biomass crops on the resiliency of Quesnel. However, panarchy was designed originally for ecological systems and though it has been used to describe social systems (Gunderson *et al.* 2002; Fraser, 2003; Holling, 2004), there are important differences between ecological and social systems that must be considered when using panarchy to understand linked social-ecological systems.

3.3 Differences between Social and Ecological Systems

A concept linking social with ecological resilience is helpful in understanding systems such as resource dependent communities where the social systems are directly dependent on the

resilience of the ecological system that produces the resource (Adger, 2000). As social-ecological systems are more complex than simply adding the two together, concepts such as ecological resilience cannot be directly transferred from ecological systems to social systems (Westley *et al.*, 2002; Anderies *et al.*, 2004). The main difference between ecological systems and social systems is that ecological systems are purely self-organizing and respond to, but do not predict change, while social systems are consciously produced and are able to predict and therefore prepare for change. These differences are elaborated upon in the following sections.

Ecological Systems

Westley *et al.*, (2002: 105) define ecological systems as "places on earth that consist of biotic components (life) and abiotic or physical components." Time and space are the two most important dimensions in ecological systems, as they define the structures and processes that shape the system as well as determining how the system responds to disturbances. For example, disturbances that are large-scale and happen infrequently are difficult for the system to deal with, whereas disturbances that happen frequently and are small in scale can be incorporated into the regular successional processes of the ecosystem (Agee, 1993; Egan, 2007). This reflects the fact that ecological systems are self-organizing and must react to change as it happens. While social systems rely on forecasting and can consciously alter the structure and functions of their systems, ecological systems deal with change by retaining diversity which decreases the likelihood of a system collapse (Adger, 2000).

Social Systems

Social systems are defined as:

> any group of people who interact long enough to create a shared set of understandings, norms, or routines to integrate action, and established patterns of dominance and resource allocation. Like any system it is dynamic, meaning that it is difficult to change anyone part of it without considerable effects on other parts. Depending on how boundaries are drawn, social systems can be as small as a family or as large as nation. Like natural systems, social systems must fulfill key functions. The must be oriented towards certain goals or objectives, they must create mechanisms for integration and adaptation, and the must create mechanisms for self-reproduction (Westley *et al*, 2002: 107).

Social systems are somewhat more variable than ecological systems in that they can either be self-organizing or designed, whereas ecological systems are purely self-organizing (Anderies *et al.*, 2004). A defining characteristic of social systems is that they are "structured by the human ability to construct and manipulate symbols, the most obvious of these being words" (Westley *et al*, 2002: 107). In addition to the structure provided by symbols, termed "structures of signification" (Westley *et al.*, 2002:107), social systems are composed of "structures of domination" (the flow of power and resources and patterns of authority in a particular system) and "structures of legitimation" (norms, rules, routines, and procedures) (Westley *et al.*, 2002:107). Because of the importance of symbols and the human need to create order through the invention of paradigms and worldviews, social systems are abstractions, separated somewhat from the ecological systems on which they depend (Murdoch, 1998; Allen, 2004). While they do have emergent properties and are self-organizing, they are also, to a degree, consciously designed and created to maintain the structures of signification, domination, and legitimation. This can create resilience as social systems are able to predict and adapt to damage to ecological

systems without losing function. Only when the meaning provided by structures of signification and the order provided by structures of domination and legitimation are lost does the system lose resilience; something seen in resource-dependent communities experiencing severe economic shock (Frankl, 1985; Bradbury and St. Martin, 1983; Halseth, 2005; Besser *et al.*, 2008; Fowler and Etchegary, 2008).

Another distinguishing feature of social systems is reflexivity. The institutions, rules, and norms of a society have all been constructed and over time are internalized by individuals until they seem 'natural' or forget they are social creations (Markey *et al.*, 2008). This gives social systems rigidity and the impression that they cannot be changed. However, Westley *et al.*, (2002: 110) argue that,

> this does not mean that social systems cannot be changed. For if social structures are to be maintained, they must in fact be continually reproduced, in social action, by the members of that society. Social laws are constructed and mutable, unlike some laws that govern biophysical systems, such as the laws of gravity, thermodynamics, biogeochemistry, or evolution. For example, a society could change its laws to better represent environmental externalities in its marketplaces. A society cannot change the rules that govern gravitational acceleration, the creation of entropy, the cycling of carbon, or the extinction of maladapted species.

In summary, social systems are consciously created and reproduced. The creation and internalization of symbols provide meaning while structures of domination and legitimation provide order, helping people to make sense of their world. Social systems are able to forecast and be proactive to perceived changes in the future, rather than reacting as they come. Laws that govern social systems can be changed, making them more flexible and adaptive. While social systems have emergent properties and are self-organizing, some are carefully designed and

therefore, different from the ecological systems of which the concept of resilience is based. Anderies *et al.*, (2004:17) argue that this decreases the uncertainty in social systems as more of the variables and component parts are known, as well as how they interact. Therefore, the term 'robustness' is more appropriate as it "emphasizes the cost-benefit tradeoffs associated with systems designed to cope with uncertainty" (Anderies *et al.*, 2004) whereas resilience does not describe how to build adaptive capacity or discuss the costs associated with building adaptive capacity. This argument highlights again the key difference between social and ecological systems – social systems have consciously designed components whereas ecological systems do not.

3.4 Similarities between Social and Ecological Systems

One of the ideas that makes resilience and the adaptive renewal cycle both powerful and transferable is that change is integral to innovation within the system. This is not a new idea, as Schumpeter (1950) came up with the term creative destruction to describe capitalist economic systems. He believed that capitalism was in a constant state of destruction and renewal as,

> the opening up of new markets, foreign or domestic, and the organizational development from the craft shop and factory to such concerns as U.S. Steel illustrate the same process of industrial mutation – if I may use that biological term – that incessantly revolutionizes the economic structure *from within*, incessantly creating a new one. This process of Creative Destruction is the essential fact about capitalism. It is what capitalism consists in and what every capitalist concern has got to live in (Schumpeter, 1950: 83).

Harold Innis describes the development of Canada as a process somewhat similar to creative destruction (Innis, 1995; Evenden, 1999; Barnes *et al.*, 2001). Innis argues that the industrial development of Canada is based on staples, first with the fur trade and fishing and then

mining, logging, and agriculture (Innis, 1995). The fur trade provided the impetus for exploration and colonization of Canada, establishing a network of infrastructure, transportation, and institutions to facilitate the harvesting and export of furs to the United States and Europe. This network was utilized when the fur trade declined and timber and minerals became the chief export, allowing for a relatively easy transition. When viewed from this spatial and time scale, the development of Canada appears to follow closely the linear model of ecological succession, wherein each seral stage provides the conditions for another stage, which is then able to out-compete the preceding stage. However, Innis believed that staples were inherently unstable and prone to wide fluctuations which could not be controlled for long time periods. Barnes *et al.*, (2001: 2128) describe Innis' perception of staples-based economic development as ultimately destructive, where:

> particular space-time relations produced within staples production can be temporarily controlled by noneconomic institutions, permitting stability and prosperity. But it never lasts. Sooner rather than later, space and time burst asunder, creating economic disruption of whirlwind ferocity and contributing to the staple region's dependency.

These periods of disturbance serve to decrease the ability of staple regions to adapt to change, decreasing their resilience, as would be expected from a system with low diversity going through a severe period of disturbance, according to the adaptive renewal cycle.

The examples of Schumpeter and Innis show how the adaptive renewal cycle could be readily integrated into the disciplines of economics and geography. While social and ecological systems have their differences, they are interlinked in that social systems are ultimately dependant on ecological systems, and ecological systems are profoundly affected by social

systems which determine how humans interact with and utilize ecological systems. Both go through similar cycles of change as described by the adaptive renewal cycle and both are part of hierarchies. Because of these interconnections, creating communities and industries that increase the resilience of both social and ecological systems is crucial. The discussion chapter will be devoted primarily to determining if biomass cropping has the potential to contribute to making Quesnel a more resilient social-ecological system.

3.5 Is Quesnel a social-ecological system?

A social-ecological system is defined as a system composed of linked social and ecological systems (Janssen *et al.*, 2006). The degree of reliance Quesnel has on the forest industry and the implications of the MPB show clearly the effect of ecological systems on Quesnel. The forests in the Quesnel timber supply area (TSA) have been heavily impacted by fire suppression, logging, and silviculture. Fire suppression has altered the disturbance regime of the ecosystem, changing the structure and composition of the forests (BC Ministry of Forests, 1995; Pedersen, 2004). Logging has affected water quality (Macdonald *et al.*, 2003; Jordan, 2006), altered habitat selection (Courtois *et al.*, 2008; Ouellet *et al.*, 2008), and resulted in different vegetation communities (Coxson and Marsh, 2001).

The social and ecological systems of the Quesnel area are clearly linked with and influential on each other. Changes in either system are felt by the other, exemplified by the changes to ecological systems brought about by forest management and the effect of the MPB on the social systems of Quesnel. These linkages strongly suggest that Quesnel is a social-ecological system and can be understood as such.

3.6 Community Economic Development

Quesnel is one of many communities having to deal with the accelerated rate of change rural communities are facing (Halseth, 2005). Decreased jobs in the resource sector and the transition to a knowledge-based economy have left many communities that had depended on high-paying labour jobs searching for ways to develop new economies. Many are finding that pursuing new resource extraction industries as replacements is neither effective nor a long-term solution. These communities are attempting to find locally-based solutions that take into account the needs of economic, social, and ecological systems (Markey, 2005). Whereas growth for many communities occurred due to plentiful, high-paying jobs (Halseth, 1999a), communities are now looking at the importance of amenities and ecological integrity as ways to attract residents (Green, 2001; Wong, 2001). This new approach, termed community economic development (CED), is described by Markey *et al.* (2005: 102) as, "community based, participatory, sustainable, asset-based, and self-reliant." It is a holistic approach that emphasizes the health of all the systems that comprise the communities, and is in this way concerned with more than solely increasing economic activity.

As one of the objectives of this thesis is to explore how panarchy can be used to assess economic development initiatives, it is useful to see how it fits with CED. One similarity is that CED requires developing better linkages between social and ecological systems, as described by Nozik (1999: 5),

> What is needed is an *integrated* approach that addresses economic, ecological, political, and `cultural development as part of a strategy to reclaim and restore community as a focal point in people's lives and an essential life-support system. We need to build communities that (1) can sustain and regenerate themselves

> through economic self-reliance, increased community control, and environmentally sound development, and (2) are worth preserving because they are grounded both in the life experience of people who live in them and in the natural histories of specific regions. This calls for the revival of local culture and the meeting of people's needs.

Linking social-ecological systems has been one of the prime uses of panarchy, which like CED, advocates for local knowledge and culture, the recognition of our dependence on ecological systems, and greater community control over resources (Berkes *et al.*, 2003). In addition to linking social-ecological systems, CED acknowledges the inevitability of change (Broadway, 1999) and the importance of diversity (Smith and Gibson, 1988; Wagner and Deller, 1998; Dissart, 2003; Markey *et al.*, 2005). CED calls for communities to devise and implement their own strategies for economic diversification and community growth (Markey *et al.*, 2005), making them analogous to the smallest system in figure 3.5 which, through 'revolt', stimulates change in larger systems. However, just as in panarchy, CED strategies are strongly affected by the linkages smaller community systems have with larger systems, such as the provincial and federal governments (Bruce, 1991). In BC communities are severely restrained in what they can do by senior levels of government (Markey, 2005; Markey *et al.*, 2007; Young and Mathews, 2007). In the previous section discussing the role of hierarchies in the panarchy model, inputs from larger systems to smaller systems ('remember' in figure 3.5) was said to stabilize smaller systems, slow the pace of change, and provide resources for the reorganization (α) phase. These are all beneficial functions of larger systems, but in the case of communities they can also prevent necessary change from occurring, as well as force rapid change on communities that increases the risk of collapse. For example, Markey *et al.* (2008) argue that a lack of investment from the provincial government has greatly contributed to the decline of rural communities in

BC. Failure to implement policies that will prevent resource exhaustion has led to the collapse of some resource dependent communities (Ommer and Sinclair, 1999). The relationship communities have with senior levels of government is clearly important for any development initiative. Markey *et al.* (2007) argue that those calling for greater local control as part of CED plans need to put more work into understanding the linkages between communities and the provincial and federal governments, particularly in relation to how resources and decision making can realistically be placed in the hands of communities.

So while there are limits to what can be accomplished at the local level, the success of CED is based on involving stakeholders to devise plans based on an intimate knowledge of the community's specific circumstances (Markey *et al.*, 2005; Joseph and Krishnaswamy, 2010). Panarchy can contribute to the development of CED plans through emphasizing the need to consider what will happen during the backloop. If the implementation of a development plan causes a loss of diversity or reduces the ability of a system to adapt to change, the community may find itself worse off than it was before. For example, small towns in Alberta were successful at attracting beef packing plants only to find their infrastructure and social systems overwhelmed by the influx of workers (Broadway, 2001). What was considered part of the solution ended up creating new problems as the idea moved from the *r* to the *K* phase, or from an idea to reality.

3.7 Biomass Cropping

Biomass cropping refers to purpose-grown, intensively stocked plantations of non-food crops grown for use as a fibre source for bioenergy, bioproducts, or pulp. Several European

countries and particularly Sweden have a long history in biomass cropping, with studies on willow (*Salix sp.*) beginning there in the 1970's (Helby *et al.*, 2006; Vande Walle *et al.*, 2007; van Oosten, 2008a). The United States has experimented with and used grass crops such as switchgrass (*Panicum virgatum*) and miscanthus (*Miscanthus x giganteus*), as well as woody crops such as willow, poplar (*Populus* sp.), American sycamore (*Platanus occidentalis*) and silver maple (*Acer saccharum*) (Abrahamson *et al.*, 1998; Walsh *et al.*, 2003; Volk *et al.*, 2006).

The main species used in Canada are hybrid poplar and willow, though there are trials attempting to use other species. Non-woody crops being considered include hemp (*cannabis sativa*), reed canarygrass (*Phalaris arundinacea*), switchgrass (*Panicum virgatum*) and miscanthus (*Miscanthus sinensis*), prairie cordgrass (*Spartina pectinata*), prairie sandreed (*Calamovilfa longifolia*), and big bluestem (*Andropogon gerardii*) (Samson *et al.*, 2000). Of these crops, switchgrass is the only commercially viable species. Hemp has been grown extensively across Canada, but has yet to be used for large-scale industrial applications (Hansen-Trip and Schiefele, 2009), though the District of 100 Mile House in BC is currently testing the viability of growing hemp as a fibre source (Western Economic Diversification Canada, 2008b). Of the grass species, only switchgrass has been used extensively, and mostly as a bioenergy source through pellets and as a source for cellulosic ethanol (Samson *et al.*, 2000). Miscanthus has been used extensively in Europe and the southern United States but is not cold tolerant and therefore unsuitable for Canadian climates. The other species are considered to have potential but have not been developed enough to be used commercially.

Tree species have greater potential than grasses for most of the country. Willows have been grown in short-rotation intensive cropping systems in Quebec, Ontario, Manitoba, Alberta, and Saskatchewan (Labrecque and Teodorescu, 2005; Marchand and Masse, 2007; Seinen, 2007; Konecsni, 2010; Manitoba Rural Adaptation Council, 2010). Hybrid poplar is more widespread in Canada and has a longer history of research and commercial use. Trial plantations have been established in Quebec, Ontario, Alberta, and BC, with some in BC and Alberta being used for pulp (van Oosten, 2008b).

Biomass crops have typically been grown in high density plantations utilizing monocultures. The reliance on monocultures makes the plantations more susceptible to disease, limits land use options, and requires more irrigation and pesticides, but allows for the greatest yield of the specific crop (Paine *et al.*, 1996; Coyle *et al.*, 2005). This is the industrial model adopted by companies such as Alberta-Pacific (Al-Pac) in northern Alberta for their hybrid poplar plantation. These plantations require a great deal of care for the first three years, as grass and other shrubs can slow the growth of trees until they reach a height where they can shade out competition (van Oosten, 2008a; Brauer *et al.*, 2009). An alternative to an intensive monoculture system proposed by Powell (2009) is to use agroforestry methods which promote a more diversified use of land.

For this thesis, the term short-rotation forestry will be used somewhat interchangeably with biomass cropping as the two terms are quite close. Biomass cropping includes non-woody species such as grasses, while short-rotation forestry refers to all woody species that are

harvested in a relatively short period of time. As the system proposed for Quesnel is using short-rotation forestry to produce biomass crops, the two terms will be synonymous.

3.8 Agroforestry

Agroforestry is defined as an "intensive land management system that optimizes the benefits from the biological interactions created when trees and/or shrubs are deliberately combined with crops and/or livestock" (Association for Temperate Agroforestry, 2010). Agroforestry is a very broad topic and practiced differently in tropical climates compared to temperate ones. Temperate agroforestry will be the focus throughout this paper. The most prominent agroforestry practices include (from Garret *et al.*, 1994):

1. Riparian vegetative buffer strips;
2. Tree-agronomic systems such as alley cropping or inter-cropping;
3. Silvo-pastoral or forest livestock grazing;
4. Shelterbelts and;
5. Forest farming.

A key feature of agroforestry is increasing the biodiversity within a farm system in a way that mimics natural systems. In this way, agroforesty systems are intended to improve the ecological health of agricultural land as well as to create more marketable production per unit of land. Practices that increase biodiversity have been shown to decrease soil erosion, increase water quality, reduce the need for irrigation, and improve soil productivity (Young, 1989; Stinner *et al.*, 1997; Smukler *et al.*, 2010).

Garret *et al.*, (1994) describe a wide variety of benefits agroforestry can provide. Shelter provided by trees either through shelterbelts or in some cases alley cropping can reduce wind speed, leading to less erosion, lower crop mortality, capture more snow, decrease evaporation, and moderate temperatures. These benefits vary based on specific site conditions, but have been found generally to positively influence crop yields. The feed required by livestock can also be reduced significantly by having shelter, particularly from wind on cold winter days (Webster, 1970).

Several studies have shown that trees can enrich soil. Alder (*Alnus* spp.) are able to fix nitrogen in the soil, willow (*Salix* spp) has been used in phytoremediation to restore polluted or degraded soils (Witters *et al.*, 2009), and aspen (Populus spp.) enhances the organic soil layers through decay of leaf litter (St. Marie *et al.*, 2007). Mixtures of trees and other crops also permits access to nutrients, minerals, and water that are present at different depths in the soil, though Quinkenstein *et al.*, (2009) state that trees can compete with grasses and other crops for water in certain situations.

Agroforestry diversifies habitat structure, attracting a greater variety of fauna, particularly bird species. These birds feed on insects, helping to control agricultural pests. Strategies such as intercropping break up monocultures, reducing the ease with which insect pests are able to access their favoured plants. Tree plantations can also serve as corridors for beneficial insects and bird species, helping them to spread throughout the agricultural landscape.

Riparian buffers intercept runoff laden with animal waste, fertilizer, and other potentially harmful substances. They also provide shade helping to moderate stream temperature and slow

the transmission of rainwater and nutrients. Root structure stabilizes streambanks and can provide cover for fish.

Agroforestry systems are able to sequester more carbon than grass agriculture fields, though not as much as a natural forest (Marland and Schlamadinger, 1997). Using deciduous trees greatly increases the carbon sequestration of an agricultural field as they hold carbon above ground as well as contribute to below ground carbon levels, whereas grassland systems store carbon almost exclusively below ground. If used for bioenergy, agroforestry crops are generally considered to be carbon neutral, and lower greenhouse gas emissions if they replace fossil fuels as an energy source (Heller *et al.*, 2003; Fantozzi and Buratti, 2010).

One of the primary economic benefits of agroforestry is the provision of ecosystem services such erosion control, soil building, and water filtration. Diversifying crop production can also help farmers and ranchers increase their economic prospects (Barbieri and Mahoney, 2009). Agroforestry techniques are designed to increase the intensity land is used, meaning that more than one crop can be grown on the same plot of land. The difference between biomass cropping and agroforestry relating to the production of woody biomass is that in an agroforestry system land can have other uses while the woody biomass crops are maturing. Garret *et al.*, (1994) state that it can be profitable to produce hay while, in the case cited, pine trees were maturing. Grazing was permitted in the plantation three years after it was established. However Brauer *et al.* (2009) caution that optimal growth for the same species of pine is found in systems with no competing vegetation and no grazing for the first three years. So while an agroforestry system may be profitable, it may not result in maximum productivity. There are clearly many

ecological benefits to agroforestry and diversifying farm production is a powerful economic argument. It remains to be seen, however, if these benefits will outweigh the greater yield brought about by intensive biomass cropping systems.

Chapter 4 Methods

This chapter will describe the research methods used and explain why they were selected. The first section consists of a description of details such as the number of interviews, a breakdown of the people interviewed by sector, and a discussion on the average length of interview. This is followed by the rationale for the research method chosen and how it was most suited to answering the research question. Discussions on how difficult issues such as objectivity, power relations, rigour, validity, and reliability, were addressed throughout the research project are included next. The chapter concludes with an explanation of how the interviews were analysed and interpreted.

4.1 Research Overview

To understand the social impacts of growing biomass crops on ranchers in the Quesnel area, a qualitative research design was chosen consisting of 34 semi-structured interviews with ranchers and community representatives. In total 40 people were interviewed as some interviews consisted of two or three people. The interview matrix below (Table 4.1) shows a breakdown of interviewee's affiliations. A further breakdown of the age and gender of interviewees is found in the results chapter.

Table 4.1: Interview Matrix

Local Government	Provincial Government	Economic Development	Industry	Ranchers
6	5	5	4	20

Interviews ranged in length from 15 minutes to 2 hours. The questionnaire developed to guide the interview was designed to be 15 minutes in length if the questions were answered

concisely, but the length of the interview depended on the interest of the interviewee and if responses generated follow-up questions from the interviewer. This format allowed for a great deal of flexibility, for if an interviewee did not have a lot of time the information could be gathered quickly. If interviewees had a lot to say the interview could be extended. The questionnaires were different for community representatives and ranchers as community representatives were asked how growing biomass crops fit in with the community while ranchers were asked how growing biomass crops would affect them and their business. Interviews took place from October, 2009 to February, 2010. They were timed to coincide with the period when ranchers were not busy with haying or calving, increasing the likelihood they would be able to provide an interview.

Community representatives were selected based on their positions in their respective organizations and were contacted via publicly available information. They were chosen to provide information on how growing biomass crops could fit in with economic development plans at the municipal, provincial, and federal level. While ranchers provided the practical insight on actually growing the crops, community representatives provided background on the financial and regulatory hurdles to establishing an industry that could use the crops. When possible, their knowledge of things such as agricultural regulations and biomass cropping was cross-referenced with that of ranchers to gain a more complete understanding of the issues.

Ranchers were originally intended to be selected out of focus groups, but that idea was soon found to be ineffective. The first interviews were with 'gatekeepers' who then recommended other ranchers. The 'snowball sampling' technique proved to be effective. Other

ranchers were found through their association with various agriculture-related community or advocacy groups. Ranchers were asked to voice practical concerns about actually growing biomass crops, as well as the potential implications growing trees may have on agriculture in the Quesnel area. Their input forms the bulk of the results for this thesis.

4.2 Rationale

The initial reaction from ranchers and community representatives regarding biomass crops was often that it was all about economics – if it was profitable it would happen, and the fact that biomass crops are not common was likely because the crops are not very lucrative. However, authors such as Laumann *et al.*, (1978), Granovetter (1985), Tigges *et al.*, (1998), and Prudham (2008) argue that social factors are often more important than economic factors in community economic development. Studies focused on growing biomass crops found this to be true as well. Paulrud and Laitila (2010) found farmers were less likely to grow economically viable crops because of factors such as crops obscuring views. Neumann *et al.* (2007) found that a general resistance to growing trees on farmland was the biggest determinant in whether or not farmers would plant trees on their land in northern Alberta. Cope *et al.* (2011) found farmers perceptions of land suitability to be the biggest factor in their decision to grow energy crops in Illinois. Matthews *et al.*, (1993) found some farmers were willing to establish agroforestry systems for the ecological benefits, despite the higher costs. Thus, the proposal by the QCEDC to have ranchers grow biomass crops requires research into the social impacts on ranchers and their perceptions in regards to growing these crops.

As social impacts are often difficult to quantify, qualitative research techniques are more appropriate to gather the information that is required. Qualitative research allows one to "elucidate human environments and human experience within a variety of frameworks" (Winchester, 2005: 4). It permits the researcher to probe for the deeper meanings behind social phenomena, to understand the experiences of people within the context of their lived environment (Mountz *et al.*, 2003; Winchester, 2005). It allows for an in-depth examination of people's beliefs, thoughts, and experiences in a way that cannot be done through quantitative methods. This type of examination was crucial to evaluating the potential for growing biomass crops, as its success will largely depend on the perception that community leaders, government officials, and ranchers have of growing biomass crops. As one of the goals of the QCEDC's Bioenergy/Bioproducts Initiative is to help ranchers diversify their incomes through growing biomass crops, it is important to assess how these crops fit with rancher's perceptions of their business and their lifestyles. The research questions are designed for that assessment:

1. Do ranchers perceive short rotation biomass crop plantations as a viable way to diversify their incomes?
2. How do ranchers feel about possibly converting some of their land to biomass crop plantations?
3. Are there policy constraints to growing biomass crops on agricultural land?

These questions relate to Winchester's (2005: 5) fundamental questions concerning qualitative researchers:

> "What is the shape of societal structures and by what processes are they constructed, maintained, legitimized, and resisted?"
>
> "What are individuals' experiences of places and events?"

A variety of different methods have been used in other research into farmers and ranchers perceptions of alternative agricultural practices. Stinner *et al.*, (1997) interviewed ranchers to determine the effectiveness of holistic resource management. Paulrud and Laitila (2010) use a choice experiment method to determine farmer's willingness to grow energy crops. Matthews *et al.* (1993) sent out surveys by mail to determine knowledge and levels of adoption of agroforestry in southern Ontario. The advantages of qualitative methods, according to Stinner *et al.*, (1997:200) are that the information is "rich in contextual information, relatively inexpensive, quick, and highly confounded with complexities of the real world". Interviews that are loosely structured permit the interviewee to have more control over what information is important. They can provide context, anecdotes, and stress the issues or themes that they consider to be the most important. They can also add information that the interviewer did not ask, something that is difficult to do in highly-structured surveys.

Qualitative methods provide the opportunity to bring out the voice of the researched, showing the depth of knowledge they contain. Flora (1992: 94) calls for greater inclusion of local knowledge in attempts to develop sustainable agriculture, stating "in some circumstances, local knowledge also consists of knowing how to keep conditions of productivity over the long run, rather than maximizing productivity in years of optimal climatic conditions." In order for this potential to be realized, local knowledge must be given more respect as a legitimate and powerful source of information. Kloppenburg (1991: 523) argues for the formation of an "alternative science" for agriculture that utilizes local knowledge, for "should not that alternative science encompass – at a minimum – the knowledge production capabilities of farmers who by

their very survival outside conventional agriculture have already demonstrated their capacity for the generation of useful and workable alternatives?" Throughout the results and discussion sections, the voices of ranchers were used as much as possible in order to recognize the validity of their knowledge and provide information based on deep-rooted local knowledge of natural, social, and economic agricultural systems. In an attempt to preserve the context in which the words were spoken, paragraph-length quotes were used when possible instead of shorter sentences. Through the process of transcription and during the analysis, each interview was read many times, helping to get a thorough understanding of what each interviewee said.

The attitudes people have towards biomass crops and environmental sustainability in general will provide some understanding into the dominant paradigms and processes that have created the current economic and political situation in Quesnel. This understanding will contribute to efforts to build a more diverse, resilient community better suited to the changing economic and ecological conditions.

4.3 Objectivity/Subjectivity

Objective, unbiased research is impossible to achieve (Clifford, 1986; England, 1994; Behar, 1996; Dowling, 2005). This realization fundamentally changed the nature of inquiry in social sciences (Babbie, 2007). Rather than assuming objectivity and presenting research as the 'truth' biases and assumptions are presented and discussed in order to inform the reader of the 'lense' through which the researcher interpreted their experience (Clifford, 1986; Behar, 1996).

The problem of objectivity came up in two ways throughout the interviews. First, I knew several of the interviewees before the interviews, and some of them believed that I was advocating for growing biomass crops and were somewhat reluctant to express negative thoughts about the idea. I attempted to remedy this by saying from the beginning that the idea was not mine, that I was looking for a broad range of opinions, and that I would not be offended if they did not like the idea. In a few instances I expressed some of my own concerns about the viability of the project to reinforce that I am not trying to convince them that it is a great idea. Secondly, many interviewees were not knowledgeable about the Bioenergy/Bioproducts Initiative, agroforestry, or biomass cropping, so I had to explain what each of those terms meant. Though I tried to explain them in a consistent manner, each time was slightly different. Their responses were also based closely on my explanations, which introduces the potential for bias in their opinions. When I started the interviews I was very optimistic about the potential for biomass crops, and though I attempted to disguise my enthusiasm, I believe I portrayed the idea in a positive light which may have influence some of the responses. However as the interviews progressed and the people I interviewed pointed out more of the potential challenges and problems, my view of biomass cropping became much more neutral. The questions asked by interviewees also pointed out gaps in my knowledge that I attempted to remedy after the interview. Therefore, I would consider interviews done in the latter part of the research phase to be better, as the information I provided about biomass cropping was more neutral and thorough. My interviewing strategy also changed from a conversational approach to one where I tried to speak less in an attempt to minimize the influence of my own opinions on the interviewees.

4.4 Positionality

The relative position one has as a researcher in relation to the research subjects impacts the research process and results (England, 1994; Tuhiwari-Smith, 1999). One's status as an insider or an outsider influences not only how research is perceived but how it must be carried out (Nast, 1994). Outsiders are typically seen as more objective and less likely to have a personal stake in the research, which can result in the research having more credibility (Baxter and Eyles, 1997). Yet outsiders can struggle to make contacts or gain trust within a given community, and can misunderstand information because they often lack an understanding of the local context (England, 1994; Gilbert, 1994). Sensitive information can sometimes be gathered more easily by outsiders, as people feel there is a greater chance of remaining anonymous with someone without personal connections within a community. However, the lack of familiarity can work against the researcher as well if research subjects perceive a hidden agenda or have had negative experiences with researchers in the past (Reed, 2003). In these cases, the researcher may have to spend time building a relationship; something an insider may be able to avoid (Gilbert, 1994).

The position of insider also has its benefits and disadvantages. Insiders may be afforded more trust initially as prior contact or history with an interviewee may lessen the concern of the interviewee that the information will be used in a negative fashion. This trust may allow for more sensitive information to be gathered in a shorter time period as the relationship building that is sometimes required for the transmission of this type of information has already been completed (Gilbert, 1994). However, this history can also prove to be negative as past

interactions, work experience, or family relations may hinder one's ability to find interview subjects or have them relate sensitive information.

As Gilbert (1994) points out, the position of outsider or insider is dynamic, depending on the group of people one is with. My research placed me amongst several different groups within the community of Quesnel. When I spoke to ranchers I was an outsider for while I grew up in the same community I was not raised on a ranch. As an outsider, I had to spend more time establishing rapport, explaining my research, my background, the purpose of the interview, and what will be done with the information I gathered. However, the dynamic created as an outsider provided opportunities that would not have been available to me as an insider. For example, by taking the position of supplicant as described by England (1994) and acknowledging my lack of knowledge in regards to the ranching industry, I was able to avoid omissions of basic information, the 'everyday' things that are taken for granted.

When I spoke to local government and the QCEDC I was considered to be an insider, as I had worked briefly for the QCEDC. My familiarity made it easier to get interviews and to develop effective questions. However some interviewees assumed I had more knowledge than I did, or were afraid I would be insulted if they told me things I already knew. I had to be very clear about the extent of my knowledge which was sometimes difficult especially if I had to admit that I did not know something the interviewee thought I should know. So while I was an insider with the QCEDC and with government staff and an outsider with ranchers, the fact that I grew up in Quesnel made me more of an insider than an outsider overall. This proved to be very helpful in getting interviews and generally helped to create a comfortable environment for

discussion. Many of the interviewees were acquainted with my relatives in the community, something that led to a good reception especially amongst ranchers, some of whom expressed distrust towards academic research. My relations were a great help in securing the first interviews with ranchers, which then allowed me to use the snowball method to recruit ranchers as they were much more eager to participate if I was able to say someone they knew had recommended them. Participants were also able to recommend knowledgeable people after going through the interview, which led to high quality, relevant interviews.

4.5 Validity

Validity refers to whether or not the interpretations of the researcher are considered to be credible by the researched (Guba and Lincoln, 1989). As my research will hopefully form part of a feasibility analysis by the QCEDC, it is very important for my results to reflect accurately what the interviewees were attempting to convey, rather than relying solely on my interpretation of what I heard.

Howitt and Stevens (2005) describe colonial research as doing just that, excluding the insight and participation of the researched, resulting in research that reflects the preconceptions and worldview of the researcher rather than the experience of those being interviewed. In response to this, researchers have developed post-colonial methodologies, influenced largely by feminist theory and post-colonialism.

Feminist methodologies introduce another realm of inquiry into qualitative studies, one that is vastly different from traditional methodologies. This difference creates the opportunity for richer, more meaningful observations yet can create problems in the quest to standardize

evaluation. The descriptions of methods advocated by Mountz *et al.*, (2003) do not really fit with the criteria established by Baxter and Eyles (1997), yet create the potential for qualitative scientists to produce research that is more relevant and perhaps reflective of the perspectives of the researched and the researcher, which I believe can create the opportunity for a more honest evaluation of research, which is the heart of validity.

In order for my research to reflect the opinions and experiences of the participants as honestly as possible, I was critical of my research throughout the process in order to find and correct problems as they arose. This, according to Morse *et al.*, (2002), helps to prevent errors from being incorporated into data analysis and the final write up. They go on to add that it is crucial for researchers to be active during data gathering rather than depending on external reviewers to catch errors after the research is complete. I did this by retaining flexibility in my methods by adding questions as required, subtracting ineffective questions, and providing opportunities for participants to tell me what they feel is important regarding the topic. I evaluated as I went to determine if I have consulted all of the relevant sectors, and if the representatives of those sectors have provided enough information. I conducted interviews until all of the relevant sectors had been consulted and the information I was receiving was redundant (Braun and Clarke, 2006).

Participant member checks were used to ensure my interpretation reflected the message interviewees attempted to communicate. Interviews were returned to interviewees after they were transcribed to provide them with the opportunity to correct or remove portions they did not want to be used. This process was explained to interviewees, and several declined the

opportunity to look over the transcripts. Of those that did, nine returned the transcripts with corrections or deletions.

4.6 Reliability

Reliability refers to the data collection methods giving consistent results (Babbie, 2007). As it is not likely another person would come to the exact same conclusions based on interpretation of interviews, I performed the interviews and analysis myself, ensuring the biases and interpretation style were consistent throughout the study. A drawback is that other interpretations can add to the analysis, check for interpretations which may be out of context, and ensure information is not fabricated by the author, knowingly or unknowingly (Fereday and Muir-Cochrane, 2006). I attempted to make up for this through peer de-briefing and conversations with my supervisor to help ensure my interpretations are logical and defensible.

While I did not use method triangulation, I used information triangulation by selecting sectors within the community with an interest in biomass crops and bioenergy I gathered a variety of different and sometimes opposing views. This assisted me in finding inconsistencies and biases in my interview data, as well as shedding light on barriers to cooperation amongst the different sectors that may prevent the development of a bioenergy industry in Quesnel (Cowman, 1993). For example, rancher's interpretations of policy and legislation were compared with that of government officials, and the intent of the policies was compared with their actual effect on ranchers. The sectors chosen aided in this cross-referencing, as each one had a stake in the bioenergy/bioproduct initiative and had a slightly different perspective on the important issues related to the project.

4.7 Data gathering method

Semi-structured interviews were used to gather information. They "can provide detail, depth, and an insider's perspective, while at the same time allowing for hypothesis testing and the quantitative analysis of interview responses" (Leech, 2006: 665). Interviews were recorded with a digital recorder, with the exception of one where the interviewee declined to have the conversation recorded. Responses to the questions were recorded in a notebook and then read back to the interviewee at the end of the interview.

The interviews were transcribed using Dragon Naturally Speaking v. 10.0™. This software increased the speed of transcription but was inaccurate, so thorough proof-reading was required after each transcription. Despite this effort, some transcripts were returned to interviewees with several transcription errors, though all were minor. The software took only a few hours to 'train' and continued to become more accurate as I became more accustomed to using it. The transcription process allowed me to familiarize myself with the data and develop a thorough grasp of what the transcripts contained (Braun and Clarke, 2006; Ziebland and McPherson, 2006).

4.8 Communication

The results of the project will be provided to the community, by presenting copies of the thesis to the QCEDC, and a summary of the results and recommendations will be offered to all participants in the study. In addition, a presentation on the results and recommendations was given to the Quesnel Sustainability Task Force, which included several interviewees.

4.9 Analysis

Analysis of the data was done using thematic analysis, "a method for identifying, analysing and reporting patterns (themes) within data" (Braun and Clark, 2006: 79). Three rounds of coding were conducted. The first round identified the main themes based on reading the transcripts and my perceptions of the interviews in general. The second round was meant to test those perceptions by selecting quotes from the interviews that supported the themes indentified in the first round. The third round consisted of a critical analysis of the themes based on the amount and quality of quotes under each theme. Themes that were not well supported were discarded or combined with other themes. This process permitted one to first recognize preconceptions that arose from the interview process and then test them against what interviewees actually said. Themes such as the importance of economics and mistrust of government were more important than I had originally thought, while themes related to stewardship, while still important, were not mentioned as frequently as I assumed they were.

A software program NVivo 9™ was used for the analysis. It proved to be a very powerful and useful tool for coding. Themes could be organized in 'tree nodes', allowing for sub-themes under the main themes. It was easy to code to a finer level of detail as the software kept it neatly organized. The relative importance of each theme to interviewees could be easily quantified as well, for percent of text devoted to each theme in an interview was automatically calculated. This helped to determine how often themes were mentioned compared with my perceptions of how frequently they were discussed. Tutorials provided with the software were very helpful, so the time spent learning to use it was minimal.

Chapter 5 Results

The results chapter describes the main themes that emerged from interviews. While the discussion chapter links information from interviewees with relevant literature, the results chapter is intended to relay, as faithfully as possible, the knowledge, opinions, and perceptions of the interviewees regarding biomass cropping. The chapter begins with a description of the interviewees, breaking down both the ranchers and community representatives to show the different sectors and positions represented within the sample. The remainder of the chapter is organized into the six main themes:

- Belief in Vision;
- Practicality;
- Stewardship Ethic;
- Leadership;
- Independence and;
- Survival.

A total of 34 interviews were conducted, consisting of 20 ranchers and 20 community representatives. Of the interviews with ranchers, three consisted of a husband and wife, and one interview consisted of a husband, wife, and their adult daughter. Rancher's interviews were most useful to answering the research questions; if biomass crops can diversify rancher's incomes, how ranchers feel about biomass crops on their land, and if there are policy constraints to biomass crops on agricultural land. Interviews with community representatives provide background and context to the information provided by ranchers.

Though the 20 ranchers interviewed do not form a representative sample, efforts were made to include some of the diversity that exists within the agricultural sector in Quesnel. Of the 20, only 4 were under 50 years of age, which reflects the aging demographics of ranchers in the area as well as a limitation of snowball sampling. Ranchers over 50 years of age tended to recommend others of the same age for interviews. To find younger ranchers, I consulted the website of a local agricultural organization (FARMED[1]). Two of the younger ranchers were contacted through this website, and one of them recommended a peer after the interview. In addition to age, there was some variety as to what was produced on the ranch, as shown in Table 5.1.

Table 5.1: Product and Number of Producers in the Quesnel Area
Source: Thesis Interviews

Product	**# of Ranchers**
Beef Cattle	8
Beef Cattle, agri-tourism, dog food	1
Vegetables and Sheep	1
Vegetables	1
Agri-tourism, birch syrup, eggs, wreaths	1
Agri-tourism	1
Hay	1
Land not in production	1

Of the 6 farms without cattle, 3 sold their cattle herds due to low prices. While again not representative, the interviews do reflect that agriculture in the Quesnel area is dominated by cattle ranching, though there are numerous examples of alternatives. Of the 15 ranches, 9

[1] FARMED: Farm Agriculture Rural Marketing Eco Diversification http://www.farmed.ca/index.html

provided the income for those running them, while the others had at least one person working off the farm.

There was also some variation in the family history of the ranches. 6 had been in the family for at least 2 generations, with the two oldest ranches dating back to 1903 and 1922. The long history of agriculture in the area helps to explain its cultural importance, as food production in the area is as old as the community of Quesnel itself. The majority of the interviewees had spent over 30 years on the same ranch, as shown by Table 4.2. While there is some diversity, the interviewees were primarily cattle ranchers over 50 years of age that have lived on the ranch for a number of years.

Table 5.2: Length of Residence on Ranch
Source: Thesis Interviews

Years on Ranch	0-10	11-20	21-30	31-40	41-50	51+
# of Ranchers	2	2	4	5	3	4

Community representatives were chosen to give a broad range of opinions on both bioenergy/bioproducts and biomass crops. The interviews were successful in providing information for how biomass cropping would be linked to community development plans, as well as how it would be affected by provincial and federal government programs and policies. They also showed the level of knowledge community representatives in various capacities have towards biomass cropping and sustainable development in general. Table 5.3 shows the different sectors community representatives were selected from.

Table 5.3: Community Representatives
Source: Thesis Interviews

Local Government	Provincial Government	Economic Development	Industry
6	5	5	4

There was some confusion throughout the interview regarding the terms 'biomass cropping' 'short-rotation forestry' and 'agroforestry'. For many interviewees this was the first they had heard of all three topics which resulted in some people using the terms interchangeably. While efforts were made to educate participants on the terminology, lack of time and a concern for introducing bias prevented the confusion from being sorted out. This did not prove to be a significant problem throughout the interview, as participants were asked to give their opinion on growing deciduous trees that would be harvested within 5-25 years as a fibre source for a biochemical/bioproducts industry. This was sufficient information for most to give an opinion.

The level of knowledge ranchers had towards biomass cropping varied slightly, but overall those interviewed were unfamiliar with the topic. Some had read about crops being planted elsewhere, such as eastern Canada and the United States, but none had seen crops being grown or harvested. Few ranchers had ever considered growing the crops although some had considered logging and selling aspen trees. For many the information I gave them served as their introduction to the topic, and this lack of familiarity may have been a reason why economics was much more prevalent in conversations than ecological concerns.

5.1 Belief in Vision

Belief in Vision refers to what people thought of growing biomass crops on a broad, general level. The details of opportunities and challenges will be discussed in the other themes, but this theme will try to capture how interviewees feel biomass cropping will impact the future of Quesnel.

Community representatives all acknowledged the difficulties faced by ranchers and were supportive of efforts to make the sector more viable. Some interviewees saw biomass cropping as having the potential to drastically change the economy,

> This is how you reset the economy. You simply say that 'look, the world has some significant problems and we are going to start resolving those problems, we are going to become leaders in figuring out how to take our standing crops, deciduous and non-deciduous, grasses or whatever it is, and we are going to position ourselves to address the global issue of alternate, alternates to the fossil fuels that are there that we eventually have to wean ourselves off (Community Representative #11).

The prevailing belief was that if biomass cropping was viable, it would be a great way to create both an income source for ranchers and a new source of fibre. This may reflect the fact that most community representatives did not know very much about biomass cropping, so they were unable to offer a detailed assessment.

Ranchers opinions were typically much more reserved than that expressed in the previous quote, but all ranchers except for one were willing to grow trees provided it was profitable. As one rancher summed up, "It sounds like a great idea if you can make a living out of it" (Rancher #4). So while no one was philosophically opposed to the idea, they were sceptical that it would ever be profitable. Without profit, ranchers were understandably concerned that it would

become "... just another thing to do without making a profit" (Rancher #11)." They identified this as their biggest concern, and it was the thing that seemed to cause the most doubt regarding the establishment of biomass cropping in Quesnel.

Interestingly, the one rancher who was not interested in growing biomass crops was not primarily concerned with economics. The reasons he stated for not wanting to be involved was that he did not want non-native or hybrid species on his land, and he was concerned that land early ranchers had struggled to clear would revert back to trees. Other ranchers were concerned about these issues as well, but spoke of economics as being the main factor in their decisions.

The fact that so many ranchers were genuinely interested in biomass crops may reflect the fact that the agricultural community is currently in the backloop and open to ideas. Some have sold their cattle, others are hoping to sell their ranches and those that are hoping to stay ranching are looking for innovative ways to hold onto their businesses. There was far more scepticism towards biomass cropping and the entire bioenergy/bioproducts initiative from community representatives, an indication that the forest industry is still in the *K* phase and more resistant to change and novel ideas.

5.2 Practicality

The second theme that emerged was related to the strong desire amongst both ranchers and community representatives for practical ideas. This may reflect the backgrounds of the interviewees, as the majority of community representatives were involved to some extent with business and tended to stress the importance of building a business case rather than more abstract ideas such as community development or sustainability. Ranchers were very pragmatic,

stressing economics as well as the challenges related to finding suitable land and the equipment required to harvest and tend biomass crops. This underscores the need to find practical solutions that can fit with the expertise and infrastructure that exists in Quesnel.

As mentioned, economics was considered to be one of the main constraints regarding biomass cropping. Ranchers repeatedly stressed the importance of economics in their decision to grow trees. Many identified it as the number one factor in their decision, as shown by the following quotes,

> every farm here in town is a business, and people are probably going to be reluctant to get into something unless they see a future in it. Somehow somebody has got to come up with a model that demonstrates some kind of economic gain (Rancher #11).

> No real issues other than they would have to prove that there is an economic benefit there for us. I mean, I guess that is obvious. People are not going to do it unless they can see a financial return (Rancher #12).

Based on past experience with logging and hay production, one rancher offered a detailed explanation of how challenging he felt it would be make money off of biomass crops:

> To have any return at all you would have to have, let's say over $20 a cubic meter to the producer, and a cubic meter isn't much. Because it is $17 to log, and it is going to be at least three bucks to get it to town from here, that is kind of the minimum rate, and that is with big equipment. I don't think, like I am saying you have to move a lot of stuff fast, you would have to get $25 a meter or something, $22 would maybe give a guy two bucks. And you want to buy fertilizer at $700 a ton!? [Laughs]. And that is just in case it doesn't go up (Rancher #1).

> But I don't think you can, here is probably something that would pretty much probably be in the ballpark. You are going to have to generate as much income out of this stuff wherever you grow it as what the lumber industry works on or it probably won't work. And their breakeven is about $180 per thousand board feet of lumber, which takes about, what the hell is that? 4 1/2 to 5 m^3 and they make 1000 board feet of lumber. So... But whatever they're going to make out of it, it better be worth something. I mean you are doing it on a shorter rotation, but if you say 15 to 20 years, well that is for crops, and you still have to do all the harvesting though, so that

> costs you three times, not once. Whereas an 80 year crop where you could grow lumber, and you've got to get $200 per meter there to make it work. Plus you have got to harvest that three times. That is $20 a meter every time. Other than that, a guy should just grow regular trees. I mean, you would still have the by-product. That is what I think they should go after something that is a by-product, not a main crop I would think. There was some talk with this ethanol bullshit, is that what you're thinking of making is ethanol out of it? (Rancher #1)

While the numbers in these quotes are not necessarily reflective of the costs of biomass crops, it does show the level of scepticism ranchers have about the economic feasibility of growing trees for energy crops, and the difficulties in making a profit. Ranchers also stated that biomass crops would likely have to compete with forage crops which are worth between $200 to $500 per acre per year, depending on how many cuttings can be made per year (Ranchers #5&7). Ranchers felt that biomass crops would not be able to compete with that price.

When developing the plan for biomass crops, the QCEDC was concerned with losing prime agricultural land to tree plantations, so they based the strategy on using marginal land. Nearly all ranchers felt this would be much more feasible as it would allow them to use biomass cropping to supplement their incomes rather than replacing their current crops. However, ranchers cautioned that although they have marginal land, it is not unused as "the better land is always used for hay, and then the rough, rocky stuff is logged, or whatever, and that is where the cows graze" (Rancher #1). Ranchers felt that growing biomass crops would affect the number of cattle they would be able to raise, as a portion of their pasture land would be taken up in tree production, at least until trees were of sufficient size cattle would not bother them.

Ranchers were also quick to point out that marginal land is marginal for a reason, often it is steep, rocky, forested, or consisting of poor soil. One rancher pointed out the difficulty of growing trees on marginal land,

> ...our marginal soil, I mean it is marginal because it has lots of gravel and pores so it dries out quick. If you irrigated and fertilized it, it will grow a lot of grass, so it would trees too, but again you are putting in a lot of money into it. It is the good soil that really makes you the money that grows the crops. So you know, I don't know but I would imagine it wouldn't make a difference whether you are growing grass or growing trees, is going to be the same. Your marginal soil is going to grow a third as much as your good soil would. You might be ahead, if there is any money in it, to put your better soil into Willow's or whatever you are putting them into and leave the marginal soil for the cows [laughs] (Rancher #6).

Ranchers were concerned that they would have to irrigate to get production out of their marginal land, something they felt would be very costly and difficult to do, "well, we could irrigate it but it would cost an awful lot of money to pump water out of the river, or use some of the irrigation water that we use for crops" (Rancher #2). Of the 5 species considered most suitable for the region, 2 would likely require irrigation (Powell, 2009). Irrigation was not considered by everyone to be a major hurdle, and most ranchers thought that growing trees on marginal land could work, as they felt trees grew quite well in the region regardless of the quality of soil. One concern that ranchers had was that the equipment they had for irrigation would not be suitable for trees, so they may have to purchase new equipment, another cost they would have to recoup from the sale of trees. As many ranchers were over 50, they felt the prospect of being able to get their money back from investing in growing trees was not very good, as expressed by the following quote,

> I am 60 years old Eric. I don't know... 10 years, a 10 year crop I could see myself doing, but nothing else. I mean really, unless there was some high value... (Rancher #1).

This sentiment was quite common. Ranchers were concerned that they would not be around to see the benefits from tree crops. Despite this concern, the majority of ranchers

interviewed were still interested in biomass crops, partly because some of the shorter rotation species would still provide some benefits to them, and also because if growing biomass crops was feasible, it may provide incentive for someone to take over their farm.

Ranchers were concerned about the lack of flexibility inherent in growing trees, they worried that the market may change by the time the trees were ready to harvest. A common view amongst ranchers was, "forget about trees, if they could grow grass or forage. I mean that is what we are doing already and then if you can't sell it for this or that, we still have feed, we could buy some cattle or do something to stuff the feed through. So you have another option for it, but like a tree, a willow bush or something, well..." (Rancher #4)

Ranchers were reluctant to commit a portion of their land to growing trees, which would be costly to then convert back to grass. Due to the poor state of the cattle industry, most ranchers were not willing to take on much risk, meaning that either the government or industry would have to assume the risk of growing trees that may take 20 or more years to harvest.

In addition to ranchers being concerned they would not see the benefit from growing trees, some questioned whether ranchers would be too committed to the lifestyle inherent with raising cattle to even be interested in trees,

> But true cattleman, they do not even want to log. They consider guys like me just Johnny-come-lately's, that built the capital to build a ranch out of timber. Partially founded out of timber. Cattlemen are not interested in trees, they love cows. So that takes care of a large part of that group, they would not think about it (Rancher #7).

As mentioned earlier, many of the ranchers interviewed had lived on their ranch for most of their lives, and many were from multi-generational ranching families and would likely fit the description of 'true cattlemen'. While it was often acknowledged that growing trees would be a

significant change from raising cattle, there was little evidence to indicate that an attachment to cattle would stop ranchers from growing trees. The following quote perhaps best sums up how interviewees' felt biomass cropping would affect their lifestyle,

> That would affect guys like me. You know, like I just grew up in the livestock industry and spent my whole life there. There is nothing I would rather do; I mean that is why I am still here. But I don't think that would affect the younger generation. There are not many guys like me around [laughs]. You know, but that would be a real cultural thing for me. I can see, I can see, you know diversifying but I could not see going completely out of the livestock business and not having any [laughs]. But yeah, it would be nice to have something that would let you run cattle too and make you a little money so that you could afford to run cattle. But that cultural thing, the older guys it would affect but I don't think it would affect the younger people. They look at things a lot different (Rancher #6).

Extremely low cattle prices have made it difficult for ranchers to keep their cattle, which likely contributed to their willingness to integrate biomass crops. While most ranchers wanted to keep some cattle, others appeared to be willing to reduce their herds substantially or even get rid of their cattle altogether, "I am done with cows [laughs]. I have been done with cows for a long time. Yeah it is a great idea. Anything" (Rancher #4). One rancher noted that growing trees might be less work, which would be attractive to older ranchers.

The consensus amongst the ranchers interviewed was that there may be some ranchers who are not looking to change, but the majority are not making a living from raising cattle and would be happy to plant biomass crops if it was viable. This view was prevalent even amongst ranchers who have spent, or seen their parents and grandparents spend, tremendous amounts of time clearing land of trees to establish fields for forage crops. While they were nervous about having to clear the land again if the market for energy crops disappeared, the previous effort spent to clear land did not emerge as a major factor in decision making.

5.3 Leadership

Community representatives and ranchers all clearly stated that they did not believe biomass cropping could happen without strong, committed leadership from all levels of government. Ranchers mentioned repeatedly that there would not be a future for biomass crops without policy change, funding, research, and government will. As one interviewee pointed out, "Well for one, policies that lead to funding programs and laws are instrumental. If those were not in place, I do not think we would have much of a chance of getting this going" (Community Representative #2). The importance of the three levels of government is described in the following quote,

> So I think that a joint partnership between the federal, provincial, and municipal governments to actually, to ask the question "what is the public policy framework?" Realign the incentives and the subsidies and then ask the people who are getting into the game, including community energy corporations, what they need. Then together align the public policies so that they facilitate it happening (Community Representative #11).

To get an idea of the responsibilities of the federal, provincial, and municipal governments, interviewees were asked to describe the specific roles each level of government will have to play to make biomass cropping viable. As the provincial government controls agricultural policy in BC, they were seen to have the biggest say in determining the potential for biomass cropping. The following sections describe the role of government in more detail.

Federal

The role of the federal government regarding the development of biomass crops was generally considered to be providing funding, research, and environmental policy, especially in

regards to carbon. Few interviewees had much insight into how the federal government has been involved, but one comment from those who had was,

> The federal government needs to look at our province's set up and see if they can learn something from it. If they can have equally flexible programs or other activities they can do to make it work. Because they have more money. They've been saying over and over again that it is a priority. But we need to have more. Community Representative #1).

Two of the interviewees felt that there were a number of viable projects in Quesnel and in other communities that were not being financed due to lack of funds or because they did not meet the criteria of any programs. The interviewees questioned the commitment of the federal government and whether they were actually willing to help the region as much as they claimed.

Besides providing capital, research through organizations such as Natural Resources Canada was considered important to develop technology and provide access to scientists in order to apply new technology. Many interviewees thought that a market for carbon credits would be vital to making biomass cropping viable. While the Pacific Carbon Trust administered by the provincial government would likely be involved as well, some interviewees felt that it was important to be involved in a North American program where carbon credits could be traded internationally. This, they felt, was the responsibility of the federal government. Outside of research and the development of a carbon market, interviewees felt the federal government would have little impact on the development of biomass cropping, as what occurs on land is a provincial jurisdiction.

Provincial

The provincial government was seen to have a large role to play in the development of biomass cropping. The main areas where interviewees felt the government had the most work to do were in policy and education/research. Interviewees, both ranchers and community representatives, felt that government will have to make substantive changes for biomass cropping to be viable.

The main policy issues brought up by community representatives were regarding farm status legislation and carbon credits. Currently, not all of the biomass crops being considered for the Quesnel area are farm crops according to BC Assessment. Of the species selected, only *Populus* and *Salix* species are considered farm crops by (Province of BC, 1995). In addition crops must be harvested within 12 years and must be planted to be farm crops (Community Representative #11; Province of BC, 1995). Ranchers risk losing farm status on their land if it is producing crops that are not considered to be farm crops under the Assessment Act.

When asked about specific regulations that would prevent them from growing biomass crops, few ranchers were able to name any. When informed about the possible implications to the way their farms would be assessed, all acknowledged that losing their farm status would be detrimental, yet most felt that this would not occur if they were still able to raise cattle or produce other agricultural crops. They felt that they would only lose their farm status if they committed their whole farm to intensive plantations, meaning that all of their income would come from biomass crops. As explained by one rancher,

that may be applicable if you are 100% growing agroforestry products. But if you are

> still in the cattle game or the hay game or the vegetable game I am sure your status would be fine. I mean, I have got farm status on another farm with, with just hay and it is probably a third of the property. So the other two thirds is timber. And there are quite a few places in our community like that (Rancher #11).

While this will need clarification, ranchers felt that if biomass cropping develops as envisioned by the QCEDC – with cattle able to graze amongst the trees which are primarily on marginal land, the loss of farm status should not be an issue. It would, in the opinion of one rancher, be not much different from existing forested land on ranches,

> my cows use every square foot of this place. So it is all being utilized. Even though some of it is timber and it does not grow a spit of grass on it, they do wander through there, I mean they do go lay down, when it is hot they lay in the shade (Rancher #1).

Several ranchers felt that if the provincial government was behind the development of biomass cropping the policy would be quickly changed and the concern about farm status would not be an issue. Rather than anything specific, ranchers repeatedly stressed that the government has to have the will for biomass cropping to succeed. As one rancher said, if the government is behind biomass cropping, "I am just not worried about it. I think in the long run, I think rationality will prevail. I am not worried about it" (Rancher #2).

The potential for carbon credits was also cited as being important. It was seen as a possible way to make biomass cropping viable, as well as compensating ranchers for some of the ecological services they provide, as one rancher pointed out, "we do not get paid, like I said earlier, we do not get paid to raise the deer. We do not get paid to sequester carbon on all of our grasslands now" (Rancher #9). Determining the worth of potential carbon credits would go a long way to helping ranchers decide if growing trees would be economically viable.

Both ranchers and community representatives had many questions about biomass cropping, and identified the need for renewed government efforts to provide research and extension services for agriculture. Several community representatives asked about the effect of tree plantations on the environment, such as, "what will that do to our ground? What will that do to our soil? What does it do to the water? I would just like to know more about-can it all work and keep us green and it's not going to kill all the land like corn has done" (Community Representative #1).

Ranchers asked questions about yield, production costs, and the specific requirements of the different tree species. This points to the fact that, "local trials are needed to determine the growth potential of various biomass crops and regional production costs" (Community Representative #4). According to one rancher, "...the policies right now that are having the biggest effect on us is the lack of support. And I don't mean this in terms of monetary support" (Rancher #9). There is currently no Ministry of Agriculture office in Quesnel, and the lack of research and extension services is considered a major hindrance by ranchers. They find it is very difficult to get information on new techniques or crops, making it difficult for their industry to evolve. This was not always the case, as "we used to have experimental farms in every area. I think we have two left in BC now, maybe not even. And they would do all of this stuff. [...] They figured out how to plant trees, if new grasses came in, will they grow here and all that stuff" (Rancher #1). Several ranchers indicated that they would be willing to provide the land base for crop trials, so the provincial government could help by providing funding and expertise.

Municipal

During interviews with community representatives, it became very clear that there is a lot of confusion regarding the municipal government's role in community economic development. This is partly because the scale of the crisis Quesnel is facing is unprecedented in the recent history of the community, which along with a devolution of responsibilities from the provincial government, has created the need for a different way of thinking about local government. Many communities have gained a measure of control over their future; but with that comes the responsibility to be more self-dependent. Confusion in the community over the role of the municipal government, both among Councillors and community members, became very clear in the interviews. One interviewee felt that the current Council has not made this transition effectively (Community Representative #11). Another pointed to a decision not to pursue a community forest licence as evidence of a difficulty with the need for long term planning and self-sufficiency (Community Representative #1), an assertion that was supported by a current councillor (Community Representative #7). This same councillor also felt that the municipal government should not make decisions that interfere with industry, meaning that many of the projects related to the Bioenergy/Bioproducts Initiative should not feature municipal government involvement. Yet one interviewee stated that without leadership from the municipal government, Quesnel would not meet its goal of becoming a sustainable community (Community Representative #3). The following quotes illustrate the confusion:

> I am not convinced that the current council, or even the previous council really understood what the potential of this [District Heating System] is. And how it could be part of them controlling their own destiny and owning their own destiny rather than being, you know, dependent upon other entities to control that. And that is

partly because of the way that we see municipal governments and the kind of people that you attract in municipal government. Municipal governments have not really shifted in the kind of leadership that they get, and the kind of membership that they get on their councils to the responsibilities that have accrued over the years. So you still get a lot of people in there that think all they are doing is controlling property taxation levels and doing official community planning and so on. You don't really get, because they are on a three-year term, you don't get them taking a 30 year view or taking the 100 year view and saying "where do we need to go in this community?" And that is the kind of thinking that you really need to understand why you would want to get into that kind of game (Community Representative #11).

we've talked to them about a community forest, and I don't know if they've fully understood what that could be. Now if we went back to them and said we want to have an area designated that does quick-turn crops so that we can help facilitate another business operate or even precipitate our district energy system, that might, help them understand a little bit better. Right now we go to them they hear "community forest" they think we are going to go out and compete with industry and that was never the intent. It's more like 40 years from now we might have a valuable piece of property that would have some timber on it and we could sell that to somebody else. So let's plan out the next 40 or 50 or 100 years of our community. But that hasn't gone very well (Community Representative #1).

I know they were quite disappointed, economic development and the former mayor originally wanted to have a community forest, but to me, for us to get involved with the community forest, that is an awful lot of money and an awful lot of work. Sure, it would have been something great to have, but when we are so forest dependent, I do not think we should get into that business (Community Representative #7).

and local government, I do not know if we really understand what it is you're supposed to do. We are certainly; you know we are dictated to by other levels of government to do this. And I know that it has cost us money because we are tracking a lot of things. [...] And we try, and Council, it is like anything else, it is just a new way of thinking. And you young people are way more on it than what we are, but every time when we do something, we think 'hey, we could count that'. I mean, I have to take a big leap with its sustainability. You know, for me, thinking 50 or 100 years out, I have a real problem with that. You know I am a former business person, and I'd just like to think about whether we can afford it-then let's make it happen. But it cannot be like that, we have to think out, and we have to get people buying into it as well (Community Representative #7).

the city has to be the leader because it should be trying hard to provide an example of sustainable operations. To provide the example and get the community moving in this direction and to be making the community more sustainable and hopefully that should

> come with cost-efficiencies that can be passed on to the residents (Community Representative #3).

The municipal government does not have jurisdiction over agricultural policy or over much of the agricultural land in the area, as it is outside city limits. It can however, lobby the provincial government for regulatory changes, promote the city as a site for a bioproducts industry, and perhaps most importantly, strongly commit to being a partner in determining the feasibility of biomass crops. This may take the form of financial support, allocation of staff time, or inclusion of the pursuit of a bioproducts industry in community planning documents. The first priority should be to broaden the scope of the municipal government to include a more active role in community economic development. This may require pursuing opportunities like community forestry that may create conflict with existing industry, but increasing the community's resiliency through diversification should be a top priority.

5.4 Independence

The theme of independence arose from interviews with ranchers. Ranchers expressed a strong desire to be able to run their ranches as they see fit, free from government intervention, as expressed by one rancher who dreamed of the day he would not have to deal with government, "so I have said this before, for the last part of my life, I want to have nothing to do with any government at all [laughs]. I don't know when that is going to start but... [Laughs]" (Rancher #3).

However, as the previous theme showed, in order for biomass cropping to be successful, ranchers and community representatives both stated that government must become involved by providing subsidies and favourable regulations. The problem with this is that ranchers resent

being told what to do or how to do it, and directed a lot of frustration at the government for doing just that. While ranchers did identify some specific regulations, they were more concerned with the amount of regulation ranchers have to deal with. For some, their experiences have caused them to lose faith in government, while some believe the government is purposefully creating the conditions to drive family farms out of business.

Amount of Government Regulation

There were some differences in how ranchers felt about regulation. Younger ranchers did not see the government as a major impediment to their life. One opinion was that,

> I think there is more to it than just regulatory. I think it is more, well I guess it could come down to regulatory but I think it is market related. I mean, we are pretty sure as a community and as an industry that someone is making money, somewhere down the line (Rancher #11).

Another rancher that has another job off the farm felt that his familiarity with regulations was a big asset,

> through my professional life, I deal with the regulatory world. We signed on to the Environmental Farm Plan; we are one of the first people in this part of the world to sign on. And I think we are the first one to be approved for the Environmental Farm Plan. Again, we dealt with the mountain pine beetle opportunities when they came through, and got some money to work on our place because we fit into the criteria. Like I say, we have been able to work with it. And not in every case is it beneficial, but usually it has not been overly negative at this point" (Rancher #8).

By contrast, older ranchers, and particularly those on multi-generational ranches felt that the government was the biggest factor in their struggles. Their chief complaint was the sheer mass of regulations that prevented them from using common sense or time-honoured practices to run their ranch. According to one rancher, "the bureaucracy and red tape in any business now is

one of the biggest drawbacks because it is huge. I mean it is beyond huge. It is massive. It is just, mind-numbing really" (Rancher #9).

An example given by nearly every rancher was the government's response to the BSE, or Mad Cow Disease. Before BSE ranchers were able to have their cattle butchered locally, in many cases on the farm. After BSE, cattle could only be butchered in government approved abattoirs (slaughterhouses). Existing abattoirs were faced with the choice of spending a lot of money to meet the standards or going out of business. Here is how one rancher described the situation at an abattoir in Prince George,

> "that poor buggers just about got no hair left from ripping it out trying to meet the regulations. And he is just a family run, just him and his wife and one kid and they have one hired employee that works in there" (Rancher #1).

The result is that there are no abattoirs in Quesnel, and ranchers have to ship cattle to Prince George or Williams Lake, both about 130 km's away. These are both small facilities, so many ranchers are forced to ship their cattle to Alberta, and after generations of butchering their own cattle, many ranchers feel that these regulations are overkill. They felt that the regulations were designed specifically to favour large meat processors and put small operations out of business,

> they made the regulations for Cargill[2], and Cargill is saying "oh perfect, that will just cut out a whole bunch more of these little guys so we get it all. Because we can spend $20 million and that other poor bugger has got to spend $1 million and he don't have it (Rancher #1).

[2] Cargill is a large meat packing company.

Another example was the regulations put in place by the Worker's Compensation Board of BC Many ranchers had woodlots with their ranches or harvested trees periodically from their own land which helps them to diversify their operation and has supplied many ranchers with another source of income. This is becoming increasingly difficult to do for reasons explained in the following quote,

> now it is going to come so that if you are not a certified Faller, you can't go out and cut down a tree. If you are not, if you don't have your fire suppression, you don't have, I don't know, all the courses that you probably get involved in. Your WHIMIS and all that stuff. The government is making it so the mills won't buy their wood from me because I am not a certified person to be in the bush. Even though I am just myself, if I drop a tree on me, that's it. I am done. But I have to have compensation, but you can't have compensation for yourself. I have to have an employee, because you can't even be in the bush by yourself. You have to have all these god damn tickets because that is the regulations that they are shoving down to the mills (Rancher #1).

One consequence of these regulations is that ranchers cannot afford to hire people as the costs to be covered under workers compensation are too high. The strong reaction from many ranchers against regulations is partly philosophical and partly practical,

> that is another case where I think they have gone overboard with their... And I think probably workers compensation was a good thing originally. I guess probably the whole nature of ranching makes you sort of independent anyway. And then we start to go out and do something you have all these rules and things to do, and your back gets up right away [laughs]. Maybe that is half of it. If you are out in industry you are accepting all of these things. And all of these things are okay, if you have something to pass the cost on, but we do not have any place to push the cost (Rancher #3).

Some ranchers feel the situation is so bad they were reluctant to become involved with biomass cropping because they were worried it may create more regulations. Even if there were no regulations to begin with, one rancher feared that eventually they would be choked with red

tape,

> and being government, and being, when departments are given authority, they tend to build little empires around themselves. Because they can hire people and hire more people and pretty soon you have this guy who has just this huge... They brought in policies and such that basically hamstrung the industry (Rancher #9).

Mistrust of Government

Sentiments like this reflect a deep mistrust of government amongst some ranchers. The level of mistrust varies from viewing government as being merely incompetent to government purposefully trying to run them out of business.

The belief that the government is against them is not a recent development - one rancher told me about the government's efforts to regulate the growth of seed potato's during his father's time on the ranch, "my dad was pulling his hair out. About every 4 to 5 years they would change the program and the regulations and stuff and he says 'it is just driving me nuts.' And finally they put us all out of business, the government did...".

The experience many ranchers have had with government changing regulations has created a fear of becoming involved with projects featuring government involvement. Once rancher's concern was that,

> if you have made a substantial investment, to plant a bunch of this stuff, and then found that there was a whole bunch of new costs centered around regulatory regimes, your business model is going to go out the window. So what can you do to reassure me about that? That I am going to be allowed to do this in peace. For whatever number of rotations I need to at least cover my costs (Rancher #7).

Ranchers had very little faith that government would allow this to happen, predicting that the government would eventually create the conditions where they would no longer be able to grow trees. Some ranchers felt the government had abandoned them, and as one rancher said, "I don't

think our government takes care of the people. They take care of themselves or they take care of a handful of people..." (Rancher #14).

Agricultural Land Reserve

Part of the mistrust stems from a desire to be independent and the fact that small ranchers cannot pass on the costs of regulations to consumers. Another factor is that ranchers feel that few regulations, even when they are intended to help the industry, actually do any good. Most, it seems, end up causing more problems than they fix. An example many ranchers used to demonstrate this is the Agricultural Land Reserve (ALR). The purpose of the ALR, is:

a) to preserve agricultural land;
b) to encourage farming on agricultural land in collaboration with other communities of interest;
c) to encourage local governments, first nations, the government and its agents to enable and accommodate farm use of agricultural land and uses compatible with agriculture in their plans, bylaws and policies.

(From: Provincial Agricultural Land Commission, 2003)

Ranchers were concerned with the loss of agricultural land, but felt that the ALR has not accomplished its purpose because they feel it is solely concerned with preserving the amount of agricultural land, but does not take into account differences in quality. One rancher explained that,

> the Agricultural Land Commission is really proud, because they say basically, when you take all the exclusions from the land reserve and all the additions: the area that was originally put under the land reserve is still roughly the same area. Except that if you look at it on a regional basis, all of the exclusions were on the Lower Mainland and all the additions are in the Peace country. Do you mean to tell me that is the same kind of agricultural land? It is just stupid, the whole thing (Rancher #7).

The result of the ALR has been the loss of prime agricultural land in the Lower Mainland while ranches on poorer quality land are restricted in what they can do. In some cases the restrictions on ranchers prevents them from having the flexibility to get through difficult economic times, as explained here,

> ...and it will happen three or four times in your lifetime. If you watch, they will come up with some bullshit story and then it just all evaporates once they get their way, and "oh well, that is not important anymore."Well it is bloody well important when you... Like right now for instance, when things are in the tank, maybe I would say 'well, maybe I'll subdivide five lots around that lake, and come up with $100,000 or whatever the hell, and that will be good enough to get me through.' Can't do it (Rancher #1).

Despite being genuinely angry and frustrated with government and regulations, the ALR is a good example of how ranchers are not philosophically opposed to regulation. Rather, they are opposed to regulations that do not work and end up being a hindrance rather than a help. As one rancher said,

> we are Christians and we read the Bible a lot, and one of the things in there is pretty practical. It says 'the letter of the law kills, the spirit of the law gives life.' And it is the spirit, what do they really want? And the people in the government, that is the problem, they don't have any leeway. Which is unfortunate. And that is the problem, it is the letter of the law, and when there is something that looks reasonable, they can't bend. So that is the way we look at things (Rancher #2).

Balancing the need for government involvement with the desire not to increase the regulatory burden for ranchers may well be one of the most difficult parts of getting ranchers involved with biomass cropping. Ranchers would likely be very hesitant to get involved with something that will put further restrictions on how they can use their land. In addition, care must be taken to ensure that growing trees remains viable for small farmers and does not become something that only large corporations will be able to do, if biomass cropping is to help ranchers

in the Quesnel area to remain on their land.

5.5 Stewardship Ethic

> Well, the thing is, we are growing trees right now. We have 30,000 cubic meters of trees right now, and we are not going to cut them down. If we do anything it will be sustained yield. We don't feel like they are our trees to cut down. They were here when we came, and they will be here when we leave. (Rancher #2)

The quote above commitment to be responsible stewards of their land, as the quote above describes. This responsibility is accompanied by a practical outlook on their interactions with the land. These two components emerged through discussions on the possibility of growing hybrid and non-native species on their land, and the use of biosolid waste from the pulp mill as a soil additive and fertilizer. Though ranchers repeatedly stressed the importance of economics, the conversations about these two topics indicate that the environmental effects of growing biomass crops will likely be nearly as important as economic factors in rancher's decision making.

Ranchers Perceptions of Hybrid and Non-Native Species

Nearly all of the agricultural crops used in the Quesnel area are not native, and many have been hybridized. As the following quote shows, this has led to many ranchers being comfortable with planting the proposed crops: "No. It is not a concern. From an agricultural background, I am pretty comfortable with hybridization of species, forage species; it is no different in trees" (Rancher #7). The majority of ranchers felt this way, as they use so many non-native species anyway, and that trees would likely be relatively easy to control. This is not to say

that ranchers are not affected by non-native species that have become invasive, as one rancher described, "we planted different species of grasses here that are just, we curse them. We curse them. [...] We got advice from the Ministry of Agriculture to plant this on wet ground, and it should have been classed as a weed, not a grass" (Rancher #3).

Rather than being concerned about escapes, ranchers were concerned about new diseases being introduced to native species. As one rancher said, "if you have varieties that you are really not that familiar with, you don't even know what kind of bug is going to be here or whatever disease, it could be fungus or whatever damn thing comes through that they don't know anything about" (Rancher #4). Two ranchers were concerned that tree plantations could create the conditions for insect infestations, as more food would be available. They were concerned that this could create the conditions for an epidemic and damage native species.

The majority of the species selected have been used extensively in BC and other provinces in Canada with no history of escapes or adverse ecological impacts (Powell, 2009). As most ranchers were not too concerned about not relying on native species, this information will likely assuage their concerns. One rancher, however, stated that he would not take part in the program if non-native trees were used as he felt they had the potential to disrupt the ecology of the area.

Mixed Interest in Pulp Mill Biosolids

Biosolids consist of waste from a local pulp mill that is treated and then offered to ranchers and farmers as a fertilizer and soil additive. The first trials were completed in 1993 under the supervision of the Ministry of Environment, and numerous ranchers in the Quesnel

area have since signed on to receive the biosolids, which is currently offered free of charge (Community Representative #10). The material consists of organic wood waste and is, therefore, fibrous, allowing it break up soils heavy in clay and retain moisture in sandy soils. It also contains nitrogen and phosphorus, making it an effective fertilizer (Community Representative #10). Part of the original plan developed by the QCEDC was to use biosolids as a fertilizer replacement, something which may not occur due the pulp mill's plan to use it for energy generation and the refusal of many ranchers to use it on their land.

This refusal of many ranchers to use biosolids shows that concern over potential environmental impact can be a greater priority than the potential for economic gain. Rancher repeatedly stressed that economics would be the primary consideration regarding biomass cropping, yet many ranchers opted not to use biosolids despite the significant increase in yields they could receive. One rancher who is in favour of biosolids describes the results,

> they put sludge on it so it grows. It really grows. That stuff is way better than fertilizer. Yeah, it is great stuff. So they put that on there every spring, they can do it every third year or something and then we plough it under. So even this year, as dry as it was, we had a really big crop there. It holds the moisture for some reason. Because, that place used to be irrigated but since they have been putting sludge on that you don't need irrigation (Rancher #6).

There was no questioning the effectiveness of biosolids, yet many stated they would never use it for fear of the environmental consequences,

> Pulp mill sludge? I am very, very sceptical about that. You don't know, if you go down to the Fraser River where they are dumping that, and you see all the froth balls and the stink coming out of there, they say it is all safe and all this kind of stuff, but I don't think I want it on my land. You don't really know what is in there (Rancher #4).

Some ranchers stated the reason they do not use it is because the public does not perceive it to be safe. One felt that using the sludge would cause him to lose organic certification on his land. Another felt that "...I think probably down the road it could backfire on these places. As far as resale and that, if they find out something that, there is something in this that was not a concern and all of a sudden it becomes a concern then..." (Rancher #3).

Of the ranchers interviewed, those who had used biosolids were very impressed with the results and intended to continue using it, with one exception. One rancher stated that he used biosolids until he noticed some problems with his livestock, problems which ceased when he stopped feeding them forage grown on land treated with biosolids.

Environmental concerns were not considered by most ranchers to be a serious consideration when asked about their thoughts on growing biomass crops. Therefore, it would appear that the success of biomass cropping depends largely on economics and government policy. While these two factors may still be the most important, neglecting to research and educate ranchers on the possible environmental effects may result in them not wanting to become involved, even if there are significant economic benefits. In this case, many ranchers were not willing to risk damaging their land to increase yields despite being assured numerous times by scientists, government, and industry that biosolids are safe. In addition, many ranchers were no longer able to fertilize their land due to the cost, yet still would not consider biosolids, which are provided free of charge.

5.6 Survival

Despite all of the challenges mentioned in the preceding themes, 19 of the 20 ranchers I

spoke with are willing to grow trees if it helped them keep their farms. This reflects the fact that ranchers are facing a struggle for survival and are looking for alternatives. The current recession that has caused the temporary shutdowns of mills in the Quesnel area has given the community a taste of what may happen in years to come, but ranchers have been facing a collapse of their industry for nearly a decade. As one rancher said,

> another little joke we talk about in the cattle industry is; everybody is going 'holy shit! We are in a recession here!' And we're saying, 'shit we've been in it since 2003. Since BSE hit, for the last seven years! What the hell are you whining about?' And that is exactly what we said, 'welcome to the real world'! (Rancher #9)

The basic problem is "Low cattle prices, and high costs" (Rancher #2). Since 2003, cattle prices have plummeted. In the words of one rancher, "the prices we are getting for calves right now, we were getting 40 years ago. So you figure that out. Like there is no bloody way that you can continue to survive with that kind of thing" (Rancher #9). Fuel and fertilizer costs have increased substantially, to the point where some ranchers are no longer able to fertilize their fields, or have had to scale back dramatically, which has resulted in decreased productivity. The other major concern is the lack of access to packing and butchering facilities for cattle, as discussed earlier.

The situation has become so bad that many ranchers are starting to give up hope. One rancher expressed an opinion that was widely shared,

> it is rapidly coming to an end because you can't buy new equipment, you can't upgrade, you can't do anything. What you are producing is just to survive. And that is not going to last much longer because as inflation goes up, and all that kind of stuff, and we keep getting less and less and less for our product, now the gap has got too big and it is going to completely come to a halt. Because you can't do it anymore. And you can only go into debt so far. I mean they will pull the plug on you, that sort of an idea. From a farm that used to support two families no problem and hire help

> and you know, fly along and everything was going great. To now, somebody has to go out and work elsewhere to support the farm and only one family (Rancher #4.

Yet there was some optimism. Two of the farmers that grew vegetables stated that they saw reason to be excited about the future, as the market for local produce has increased. The diversity of agricultural products that is emerging in the Quesnel area is a promising development and will help to increase the resilience of the sector. It was mentioned that there used to be a wide range of agricultural goods produced in the Quesnel area, but that changed as ranchers were required to become more specialized:

> it used to be mixed farming but we have had to drop it all off and channel into one because of equipment. And then, like little producers anymore, become hobby farms so that you have a little bit of this and a little bit of that in the little bit of something else. Which, you know they used to say 'you can't have all of your eggs in one basket'. But now, you are forced to have all of your eggs in one basket so that when the mad cow hit, all of your eggs are in that basket, and they all got broke. It has been a struggle ever since (Rancher #4).

Despite these struggles, most of the ranchers interviewed expressed a strong desire to remain on their ranches and continue their lifestyle. This was especially apparent in multi-generational ranches as the ties they felt to their land were particularly strong. This desire is likely the main reason why so many ranchers were interested in finding alternatives that would help keep their ranches viable. This desire is also why the agricultural community in Quesnel has been able to endure for so long in the face of other challenges and tough times, for the current crisis created by the BSE is not the first difficulty the community has face. The following is a brief description of some of the challenges faced by one of the oldest ranches in the area:

Yeah, we used to have a dairy farm. But we didn't sell milk. We were the dairy farm

> that didn't sell milk, we sold cream. But that was back when... We had cows that produced heavy on the cream side, and then you took the milk and fed it to the pigs, and then you sold pigs. But the milk sales, that was of course before my time, they had a big fire and lost the dairy farm plus all the cows that were in it, so that ended the dairy business [laughs]. So then we entered the cow-calf business, and then we had a big flood. We lost all the facilities, fences, everything, and it was June. And you are trying to grow crops and there was no fences and no way to control cattle, so they just brought trucks in and loaded them up. So that was the end of the cow-calf business [laughs]. So it has had its trials. Then we went into a feedlot after that. And they got rid of the cows in the spring, and by the time we got to the fall, we had enough stock built again so then we would just buy calves and feed them and all that kind of stuff. So then we ran that for quite a while, but it was just so much work that we just... decided to go out of it. Then we got into cows, and then we kept our own calves and finish them. So we kept our calves instead of buying them. And we just got out of that, finishing our cattle, just before the BSE hit so that we weren't stuck with a bunch of finished cattle but we cannot get rid of. [...] So then now we are into the cow-calf again and we sell the calves in the fall, that kind of thing. But we are almost starting to switch now; maybe we are going to sell them in the spring. Calve later, because we can't get any shavings. [In addition] we have the corn maze. And we're also making dog food. Raw meat dog food. We are also selling a bit of meat (Rancher #4).

So while ranchers have tried hard to diversify their businesses and saw biomass cropping as a useful addition to their operations, they also discussed the potential for growing trees as energy crops to hurt agriculture in the long run. Two big concerns shared by both community representatives and ranchers was that growing trees would reduce the amount of agricultural land and impair the ability of ranchers and farmers in the area to produce food.

Concern over the loss of Agricultural Land

There were mixed opinions about the loss of agricultural land. Some were worried that if biomass cropping became profitable, the best agricultural land would be lost to tree production (Rancher # 10). Others felt that this may be inevitable, as so many ranchers are going out of business that if something else didn't come along, ranches would revert back to forests naturally

(Rancher # 4). Another opinion was that the markets would sort it out, as they felt that trees would not be worth as much as food crops, so the best land would be retained in food production anyway (Rancher #11).

> I feel that our good agricultural land should be kept for growing food. The marginal land, I don't have a problem but good ground, I would hate to see it go into trees of any kind (Rancher #10).
>
> It is a crime, but you have to do what you have to do. If you can't make a living out of growing food for people, you have to do something else. So if that is what they want... It would be great (Rancher #4).
>
> Unless it was grass, and irrigated, then we would probably get five or six tons to the acre, fertilized of course. But the value, we are used to getting about $4-$600 per ton. So I don't know if the value of energy would support that kind of price (Rancher #11).

Reliance on the market has turned out to be appropriate for the Poplar Farm program in Athabasca, Alberta. A pulp mill owned by Al-Pac started a program in 2002 where they rent agricultural land for short-rotation plantations of hybrid poplar. They offer ranchers "$26.25/acre/year for land based 100-200 kilometres from the mill. For land within a 100 kilometre radius of the mill we pay $31.50/acre/year. Our rates used to be $25 and $30 respectively" (Community Representative #17). In addition, the mill does all the site preparation, planting, and managing of the plantation, though they offer to pay ranchers additional money if they do some of the maintenance. Initially, the Alberta government put in restrictions on what type of land plantations could be grown on, but after a few years these restrictions were removed because plantations could not match the value of food crops on the best agricultural land (Community Representative #18).

The model developed by Al-Pac alleviates some of the major concerns of ranchers. It

does not add to the regulatory burden, places most of the risk on the company, does not cost the rancher anything to establish the plantation, and provides them with a reliable, set amount of money every year, regardless of market prices or growth of rates of the trees. Rates are re-negotiated every five years to ensure rental prices reflect inflation or increasing land prices. Al-Pac is hoping to eventually have 25,000 hectares in plantations, which makes up only 0.05% of the available agricultural land (Community Representative #18), so the community representatives interviewed felt that there had been no impact on agricultural production. One also mentioned that ranchers in Alberta are facing the same kind of pressures as ranchers in the Cariboo, and these plantations have helped them stay on the land (Community Representative #18).

One significant difference between the program in Athabasca and the one envisioned by the QCEDC is that the trees are grown in plantations and cattle are not permitted to graze amongst the trees. Therefore, land committed to plantations is removed from food production. This aspect of the model may not work for the Quesnel area where agricultural land is in shorter supply, and committing even small portions of land exclusively biomass crops may have an impact on food supply.

Some ranchers felt that the government would need to restrict tree growing to marginal land to ensure that the best land would not be taken over by tree plantations[3],

> and that is why I said if government came up with a plan and said 'okay there is a blue zone, a red zone, a green zone inside the agricultural land reserve and these are the types of things you can do. If you want to take your poorest land and try to grow hay on it, knock yourself out. But we are not going to let you take your prime land

[3] At the time of the interview, the ranchers I spoke with were not aware of Alberta-Pacific's Poplar Farm program.

> and grow trees so you can make ethanol so some guy can drive his Hummer around. We are saying that is not, that is not politically correct, that is not good for the public, that is not good for your community, or whatever (Rancher #9).

Food Security

There was more consensus regarding food production. Ranchers said that although they have land available to plant with trees, it would cause them to reduce the amount of cattle they would be able to raise. However, many ranchers said this would not be all that bad, as there is an oversupply of cows on the market. So if they could make money selling trees, they would be able to hold onto their ranches and still produce food. When asked about the effect growing these crops would have on his ability to raise cattle, one rancher responded, "well, it would cut you back. You know, you're not going to be able to hay, if you take some land out of production and convert it to something else; you are going to feed less cattle. So it would have to be just to diversify your operation" (Rancher #6).

One concern they had was that if the number of cattle in the area dropped too low, the local agricultural industry may lose essential services and eventually collapse:

> so that is what I alluded to earlier when I said that if something like this model you are talking about, and they start reforesting this land, and the cattle industry dies? Or gets too small, then the auction yards close, then the veterinarians close, or they're just having a little clinic to do dogs and cats and stuff (Rancher #9).

Food security was mentioned frequently by community representatives as being very important to the community. They were concerned about the possibility of biomass cropping threatening the ability ranchers and farmers to produce food. Should biomass cropping become a reality, it will have to be watched carefully to ensure that ranchers can use it to supplement their

income yet not have the food-producing capacity of the region lost. Failure to do so could result in the loss of ranching and a subsequent decrease in the resilience of the community.

Ranchers are in need of diversification due to the low costs of cattle brought on by the BSE crisis in 2003, which has been aggravated by high fuel and fertilizer costs. Most of the ranchers interviewed felt that biomass cropping has potential to generate another source of income, but identified numerous factors that made them somewhat sceptical. Chief among those was economics, as many ranchers were sceptical it would ever be profitable. Local trials that could assess the costs of producing trees for biomass as well as the ecological impacts will be required before ranchers would likely agree to become involved. While they were hesitant to commit, many ranchers said they had land that could be used for these trials.

The role of the provincial government will have to be carefully balanced if biomass cropping is to be a positive addition for ranchers. Though younger ranchers spoke less negatively about government, older ranchers were adamant that they would rather not see more government regulations on their land. The need for government regulations may arise through efforts to ensure agricultural land will not be lost to tree production, reducing the ability of ranchers and farmers to produce food. Community representatives and ranchers both stated that the government may need to restrict tree crops to marginal land, yet a hybrid poplar plantation in northern Alberta is relying on the market to keep prime agricultural land for food production, with good results. Given the frustration many ranchers showed towards government regulation, letting ranchers use the market to decide where to plant trees would likely result in greater participation.

Chapter 6 Discussion

This chapter will integrate the information gathered from ranchers and community representatives with the relevant literature to answer the question posed by the research topic and then the specific research questions. Panarchy will be used to provide a definition of resilience, to understand the conditions for change to occur, and the role of hierarchies in community systems. The assessment of the potential for biomass cropping to increase the resiliency of Quesnel will be guided by literature from the study of resilient social-ecological systems.

6.1 Research Questions

This section will focus on answering the research questions laid out in the introduction:

1. Can short rotation biomass crop plantations diversify the income of ranchers?
2. How do ranchers feel about possibly converting some of their land to biomass crop plantations?
3. Are there policy constraints to growing biomass crops on agricultural land?

6.1.1 Economics: Do ranchers perceive short rotation biomass crop plantations as being able to diversify their income?

Ranchers were very open to the idea of growing short-rotation crops on their land and could see the value in diversifying what they produce. However, when it got down to the details they became increasingly sceptical. The chief concern expressed was economics – many did not feel that they would be able to make money growing trees. Part of the reason for this was that there are no local examples of growing deciduous trees for money, but ranchers also stressed that these trees would have to be more profitable than hay crops and coniferous trees.

Al-Pac in northern Alberta is currently growing hybrid poplars on ranch land and offers

between $26-$31 per acre/year, much less than ranchers in the Cariboo can get for hay. The price quoted for hay is high for the area; most ranchers said they get around $200 per ton, with around 400 tons/acre on land of average productivity, meaning that ranchers are accustomed to getting around $8,000/acre/year with irrigation and fertilizer. Unless a company would be able to offer substantially more than Al-Pac, ranchers are unlikely to be interested. The benefit for ranchers in the Al-Pac program is that they get a guaranteed source of income every year without having to perform any labour as all of the maintenance is done by Al-Pac, though they do offer to pay extra if ranchers do the labour. One of the things that make it possible for ranchers to take part in the program is that Al-Pac takes all of the risk and does the work of establishing the plantations, something ranchers in the Cariboo said would have to be done as they have very little capital available for start ups or experimentation. They also stated that they would either have to be paid up front or in instalments as they would not be able to wait until the trees were mature to recoup their costs.

Despite the scepticism about the economics nearly all ranchers felt it could be a good fit with their current operations if they were paid appropriately. Though many had practical questions about the types of species, how they would be harvested, and the maintenance required, they stressed that economics were their primary concern. While this may ultimately decide whether biomass crop plantations will be viable, it will be up to the company to negotiate rates with ranchers. Before this occurs, other issues ranchers felt were less pressing will have to be addressed to ensure the adoption of biomass crop plantations will not cause serious problems down the road. Ranchers saw biomass crops as an addition to what would remain their main focus – food production. While it would increase the economic diversity of the ranch, it would

remain a relatively minor part of their operations. To sum up, ranchers felt that it was unlikely to be profitable enough, but if it was, biomass crops would fit well with their operations and be a good way to diversify their incomes.

6.1.2 How do ranchers feel about possibly converting some of their land to biomass crop plantations?

Ranchers were concerned about losing agricultural land to non-food production. They already deal with increased feed costs due to the use of corn to produce ethanol (see Johannsen and Azar, 2007; Solomon *et al.*, 2007; Gomez *et al.*, 2008), and were wary of both loss of agricultural land and the possibility of hay becoming scarce and, therefore, more expensive. They felt that if growing trees were to become profitable enough people would sell their cattle and the ranching industry in Quesnel would no longer be viable as services such as feed stores and veterinarians would leave town.

Despite this concern ranchers were still supportive of efforts to establish short-rotation forestry plantations, even though nearly all of them acknowledged that it would affect their ability to produce food. The idea to grow these crops on marginal land was generally considered to be sound, except some ranchers had pointed out that marginal land is marginal for a reason. As good agricultural land is scarce in the Quesnel region, marginal land is generally unproductive and used for pasture rather than growing crops. It was pointed out that these areas may not grow anything very well, and they still would not be able to run as many cattle due to the loss of pasture land. That said, few ranchers thought it would be detrimental for each ranch to produce less cattle as they are not currently profitable. In fact, it was mentioned that if an

alternative is not found many ranches may go out of business anyway. The best scenario is one where trees can add extra income without drastically reducing the number of cattle on a ranch, a scenario the majority of ranchers felt was possible.

The potential loss of agricultural land is perhaps the biggest long term social problem with establishing short-rotation forestry. One of the central messages of panarchy is that diversity helps to build resilience in a system (Naeem *et al.*, 1994; Tillman and Downing, 1994; Thrupp, 2000; Holling, 2002). The impetus behind the Bioenergy/Bioproducts Initiative is to increase the economic diversity of the area, but if short-rotation forestry displaces ranching, the area may not have gained in the long run. Losing the ability to produce food would also decrease the resilience of the community, as food security is considered by many to be a crucial part of both sustainability and resilience in communities (King, 2008; Tenenbaum, 2008).

6.1.3 Environment

Concerns over the environmental impact of biomass crops were rarely mentioned by ranchers, but nevertheless will be an important part of a rancher's decision to grow biomass crops. The only issue brought up was regarding introducing non-native and/or hybrid species. Of all the ranchers interviewed only one felt this was a major issue, the rest were very comfortable with the idea, pointing out that many of the grasses on their ranches were non-native. This apparent lack of concern over potential environmental harm is probably due in part due to a lack of knowledge interviewees had about how biomass crops are grown. The industrial model featuring row crops and intensive production requires the application of pesticides, herbicides, and fertilizer; which many ranchers would likely object to. This was shown ranchers

were asked about applying biosolids from a local pulp mill as a fertilizer. Many of them stated that they would never even consider using it. This is despite being advised numerous times by both the government and the company that it was safe. All interviewees acknowledged that it is very effective as it adds nutrients but also can retain moisture in sandy soils and 'break up' clayey soils to improve drainage. Even with the price of chemical fertilizer increasingly rapidly, many ranchers still would not use it despite it being free.

The sense of stewardship this shows indicates that even if growing trees proved to be profitable there may not be widespread participation if environmental problems are perceived. Plans to use biosolids and ash from a cogeneration plant as alternatives to fertilizer may not work on many ranches, and chemical fertilizer may be too expensive to be used. Without fertilizer yields will suffer, especially on lower quality land, making the feasibility of growing trees questionable. Ranchers were also concerned about introducing another monoculture to the area, as they know all too well the perils of relying on a single species. Some ranchers noted that deciduous trees, particularly willows were susceptible to pests and were concerned that adding highly concentrated populations of such trees would create the conditions for a population explosion similar to what has occurred with the MPB which would not only affect the plantations but also trees in the wild. Powell (2009), as part of a suitability assessment, found no adverse environmental impacts, however, there are a number of potential pathogens that do affect poplar and willow; and monoculture plantations would be more susceptible to them than a dispersed wild population (Robison and Kaffa, 1994; Royle and Ostry, 1995; Coyle *et al.*, 2005). Powell (2009) describes agroforestry systems where a diversity of crops are grown in the same area,

alleviating the risk inherent with monocultures. This would help to keep the land available for other uses such as grass production and pasture for cattle, meaning that the land would not be locked away for a single use until the tree is harvested. However, Al-Pac's plantations are grown in monocultures with no opportunities for other species or grazing. If this industrial model is used ranchers will have to commit a portion of their land exclusively to tree growth, something they saw as restricting their flexibility to manage their land and a big business risk.

It is clear that ranchers take a long-term view when making decisions. This has perhaps been misinterpreted by some as mere resistance to change, especially amongst older ranchers. They are trying to determine the impact growing trees will have on the next generation. If successful, a tree plantation could benefit those taking over the farm, but if it does not work out ranchers may have saddled their children with a liability. Those looking to sell are concerned that it may prove to be a hindrance to a sale if growing trees does not turn out to be profitable.

There is perhaps a different level of care in decision making when one's children will have to deal with the aftermath. For many ranchers and farmers and particularly for those whose families have been on the land for many generations, there is deep attachment to the land that was apparent in the interviews and is consistent with the literature (Harder, 2001; Rowe *et al.*, 2001; Wright and Anella, 2007). It is worth stressing that although most interviewees were primarily focused on economics the only person who said they were not interested said so because he was worried about non-native and hybrid trees on his land – an environmental concern. A top priority for future research should be around the ecological effects of establishing tree plantations, not just to provide information to help with rancher's decision

making but also establishing an effective monitoring system to help ensure problems are dealt with as they arise. Though the vast majority of ranchers interviewed did not see any negative ecological consequences to short-rotation forestry, the importance of investigating environmental consequences should not be underestimated.

6.1.4 Government Leadership: Are there policy constraints to growing biomass crop crops on agricultural land?

A point stressed repeatedly by both community representatives and ranchers was that the government would have to be strongly behind biomass crop for it to be successful. Incentives, subsidies or a pricing structure for carbon sequestration must be in effect in order for it to be economical. Policy change would also be required so short-rotation forestry crops would be considered a farm crop and farmers would not be penalized through higher property taxes. Restoration of extension services would also be required to help ranchers acquire the knowledge to grow the crops effectively.

The provincial and federal governments have always had a big influence on agriculture through incentives, subsidies, insurance programs, marketing, international trade, regulations, and research (Barichello, 1995; Lawrence *et al.*, 2001; Machum, 2001). Several experienced ranchers stated that the government ultimately controls who farms and what they produce. Though global markets have played a role in their struggles, ranchers pointed to a wide suite of regulations that made it more difficult for them to operate from a diverse group of government agencies including the Worksafe BC, the Canadian Food Inspection Agency, the BC Ministry of Environment, the BC Ministry of Forests and Range, BC Ministry of Agriculture and Lands, the

Agricultural Land Commission, and Agriculture and Agri-Foods Canada. The burden on small cattle producers is so great one rancher expressed the opinion that "they keep coming up with new stuff and almost like trying to stop you from doing this. Like they want all of the big companies to do it and not the little guy" (Rancher #4).

Machum (2001) describes government policy in New Brunswick as being designed to eliminate small farms in favour of larger, heavily mechanized farms. Qualman (2001) documents how the Alberta government encouraged large scale hog farms through weakening labour and environmental standards at the expense of smaller producers saddled with these regulations. According to Lawrence *et al.*, (2001:94), "during the late 1960s the federal government instigated a major study into the future of Canadian agriculture. The study concluded that there were too many farmers in Canada and recommended that approximately two-thirds of them be eventually eliminated." Duncan (2004) discusses how regulations meant for large egg producers have been applied to small producers in BC, with the effect of strangling them with paperwork and red tape, a situation that is nearly identical to what small cattle producers are facing. Thus it seems that the feeling many ranchers have of the government working actively against them has merit, and helps to explain further why many ranchers were so mistrustful of the government.

As the government is involved with so many aspects of agriculture, it is perhaps not surprising that ranchers felt short-rotation forestry would not be successful without government support. Yet few could identify any specific policies or regulations that would prevent them from growing trees. Community representatives felt that farm status regulations would hinder ranchers from growing trees as the majority of potential species are not considered farm crops.

Ranchers did not feel this would affect them as many are able to claim land that is not used for crop production as farm land, therefore, not having to pay a higher tax rate. This is especially true for an agroforesty system where short-rotation crops could be grown on land still used for pastures or crop production. Ranchers were more concerned with the creeping role of government over time – introducing more regulations or paperwork if the idea proved successful. They were concerned that this would eventually lead to them being pushed out in favour of big corporations that can afford the higher costs and increased labour more regulations usually entail, a characteristic of emerging resource-based industries (Hessing *et al*, 2005). Further, they felt that if government was truly behind short-rotation forestry, the policies and regulations that are in the way would disappear.

One way for the government to demonstrate support is to develop a functioning carbon market that would allow ranchers to be paid for the carbon sequestration services of trees and other crops grown on their land. It is currently very unclear how beneficial carbon credits would be towards the economics of short-rotation forestry. Hernandez *et al.*, (2008) found the economic benefits of willow plantations grown in riparian areas and as windbreaks on farms in Quebec to be negligible and in some cases costly to farmers. In this case agroforestry practices were only found to be beneficial when other ecosystem services such as soil conservation were taken into account. It is likely that a carbon market will only make a small economic contribution to viability of short-rotation forestry.

Ranchers may be able to maximize the carbon sequestration potential of their land through agroforestry as it allows for trees to be grown amongst forage crops such as grasses. In a comparison of the carbon sequestration potential of different cover types, native grasslands and

temperate deciduous forests were found to have the greatest below-ground carbon sequestration ability (Gregorich *et al*, 1995). Grown together, grasses and deciduous trees would sequester more carbon than either on their own, a potential argument for agroforestry systems over straight tree plantations. Were ranchers to establish such plantations, roughly 500,000 to 1,000,000 tonnes of carbon could be offset per year if the fibre was used for energy production (Lonsdale and Kopetski, 2009). The Pacific Carbon Trust prices carbon offsets at $25 per ton, meaning that agroforestry systems could be worth between $12,500,000 to $25,000,000, provided agroforestry plantations meet the Pacific Carbon Trust's requirements. These are very rough numbers but they do show that there is potential to not only reduce carbon emissions with agroforestry, but also to make a profit[4].

A major casualty of the neoliberal agenda of recent provincial governments has been the research and extension services provided to the agricultural communities. There is no longer a Ministry of Agriculture and Lands office in Quesnel, meaning that ranchers have to travel to Williams Lake or Prince George to get access to an agrologist. Ranchers stated that it has become much more difficult to get support and advice as staff are stretched thin serving very large areas. Many ranchers had numerous technical questions and will likely require a great deal

[4] Methodology for determining potential carbon offsets: Production potential was taken from Powell (2009) and converted to an estimate of energy production using the figures of Borjesson (1996) for energy production in Sweden. It was assumed that both Poplar and Willow produced the same energy as the Salix species and that the Aspen, Larch and Silver Birch produced the same energy as woody biomass in the Borjesson study. This energy was then compared with the carbon output of a pulverised coal power plant detailed by Rubin *et al.*, (2004) assumed to be a current worst case scenario for carbon emissions. This gave the carbon offset. The SRC and SRF species were considered separately for harvesting and management. It was assumed that the SRC species were fertilized with a carbon cost calculated from the study in Finland of Karjalainen & Asikainen (1996). The harvesting carbon cost of SRC crops was also taken from Karjalainen & Asikainen (1996) including both felling and forwarding. The harvesting cost was estimated for SRF species using the estimates of the study in Sweden of Eriksson *et al.*, (2007) for felling and forwarding. Transport costs were estimated using the figures of Karjalainen & Asikainen (1996) assuming that the biomass was transported a distance of 100 km by truck to the processing plant/biorefinery.

of help first to decide if growing trees will work on their land, and then how to do it. Further research is also required to determine cost of production, yields, species trials, effects on hydrology, biodiversity, and carbon sequestration before short rotation forestry will be adopted on a large scale. Government funding and expertise will be important to ensure this research in carried out.

It is worth emphasizing again that without substantial government support biomass grown in an agroforestry setting on ranch land is unlikely to happen. Government continues to drive production and shape the composition of producers. For this to succeed, the provincial government will have to:

1. Attract industries that can make use of the biomass.
2. Provide support, through funding or expertise, to research and education.
3. Establish a working carbon market.
4. Remove restrictive policies and regulations.
5. Commit to maintaining a regulatory environment that does not become too onerous for small farmers.
6. Monitor the relationship between tree growth and food production to determine if food production capacity is decreased by tree plantations.

6.2 Timing – Problem, Policy, and Political Streams

The likelihood of these recommendations being implemented will depend largely on timing. As a system reaches the *K* phase of the adaptive renewal cycle potential is released and change occurs as the component parts are reorganized. The community of Quesnel is going through that process, but many residents are finding that it is not quick or smooth. A lot of frustration was expressed at how long it takes for good ideas to be put into action. It was felt that these ideas were being held up by governments that "are fiddling while Rome is burning"

(Rancher #9). Federal and provincial governments have recognized that the MPB has created a crisis situation in forest dependent communities, so why are potential solutions not being put into practice? Part of the reason may be explained by the hierarchical structure of panarchy where larger, slower systems work to prevent change from happening too quickly in smaller systems in case it is maladaptive.

As panarchy only offers a general answer to the question of why progress seems so slow, work by Kingdon (1995) will be examined to get a more complete understanding of how governments move from the *K* phase to the *r* phase and implement new ideas. Kingdon (1995) describes three separate entities that must come together before government takes action or an idea 'takes hold'. Politicians, according to Kingdon, are constantly buffeted by problems that are competing for their attention. These problems rise and fall in importance depending on the awareness amongst politicians and the public, the perceived severity, the ease in which they can be dealt with and the success of governments attempts to fix them. As a problem rises to the top of politicians list of priorities, they search out for ideas and policies to help remedy the situation. These ideas and policies "float around in a policy primeval soup" (Kingdon, 1995:117) where,

> ideas become prominent and then fade. There is a long process of 'softening up': ideas are floated, bill introduced, speeches made, proposals are drafted, the amended in response to reaction and floated again. Ideas confront one another (much as molecules bump into one another) and combine with one another in various ways. The 'soup' changes not only through the appearance of wholly new elements, but even more by the recombination of previously existing elements (Kingdon, 1995:117).

Independent of the problem and policy streams is the political stream. This stream is composed of things such as changes in administration, shifting public mood, and campaigns by special interest groups. The political stream determines the issues that will get government attention. The ideologies of dominant parties determine to a large extent what programs and policies will be pursued. As well, politician's perceptions of the 'national mood' play a large role in determining what will happen.

According to Kingdon, change happens when the three streams intersect around a single issue. A problem meets with an appropriate policy or idea at a time when the political stream is aligned to address the issue. This idea is similar to that offered by panarchy which stresses the importance of timing to make change happen, but offers a more detailed examination of change in social systems. When applied to the Bioenergy/Bioproducts Initiative and biomass cropping the three streams are helpful to understand some of the difficulties and opportunities the initiative faces.

The problem stream consists of the MPB and the subsequent loss of fibre as well as larger scale problems such as climate change and the ever-present risk of being a single-industry town. Politicians are faced with an unprecedented amount of dead trees that represent lost revenue, lost jobs, as well as a significant fire hazard. Communities and large forest companies are applying a great deal of pressure on the provincial and to a lesser extent, the federal government, to provide policy or financial help to deal with the effects of a declining resource base. The initial response of the provincial government was to raise the AAC in the hopes that forest companies could salvage the majority of the pine trees before they began to rot or burn.

The provincial and federal government also provided funding for communities to develop plans, build infrastructure, or start new businesses that could help diversify local economies. This provided a great opportunity for communities to take some control over their own destinies and at least in theory, prevent higher levels of government from pushing developments that are unwanted by communities (Broadway, 2001). Greater local control over decision making is a frequent recommendation in community development literature (DeFillipis, 1999; Epp, 2001; Markey, 2005; Halseth *et al.*, 2006), yet even when communities are able to create a plan and make decisions about their future, the ability to implement their plans is often still held by senior levels of government (Young and Matthews, 2007; Markey *et al.*, 2008) In this case, the community of Quesnel developed a plan to attract a diversified and innovative bioproducts industry that they felt would address the three big problems facing the community – a declining fibre supply, looming oil shortages, and a homogenous economy. However, the provincial government controls 94% of the provincial land base and has not created tenures that would allow for the creation of a bioproducts industry as envisioned by the QCEDC.

In this case the political stream has not yet merged with the policy and problem streams. The municipal government has been described as being lukewarm to the Bioenergy/Bioproducts Initiative as a whole, and knew very little about biomass cropping. Several community representatives stated that the municipal government could be doing more to promote the initiative. One community representative (#11) felt that,

> Municipal governments have not really shifted in the kind of leadership that they get, and the kind of membership that they get on their counsels to the responsibilities that have accrued over the years. So you still get a lot of people in there that think all they are doing is controlling property taxation levels and doing

> official community planning and so on. You don't really get, because they are on a three-year term, you don't get them taking a 30 year view or taking the 100 year view and saying 'where do we need to go in this community?' And that is the kind of thinking that you really need to understand why you would want to get into that kind of game.

Interviewees identified that there was very little appetite to do anything that may go against the wishes of established major industry. One used efforts to get a community forest as an example,

> Right now we go to them they hear "community forest" they think we are going to go out and compete with industry and that was never the intent. It's more like 40 years from now we might have a valuable piece of property that would have some timber on its and we could sell that to somebody else. So let's plan out the next 40 or 50 or 100 years of our community. But that hasn't gone very well (Community Representative #1).

Kingdon (1995:117) describes a long period of "softening up" in political circles before an idea is adopted, particularly those that are novel or controversial. It can take years for an idea to gain enough support to be put into action. This process appears to be underway currently for bioproducts,

> And I think that if you look at what the government did, they shifted in the fall before the election, the fall of 08, to start talking about other things that they could get. Biomass products and thing like that. So I think we did create a bit of a push and a bit of a shift for them to broaden their horizons. From a public policy perspective, they have not. So the public policy is still kind of a 2 x 4 and then let's burn this stuff and create some electrical energy from it. But from a rhetorical perspective, they seem to have opened up a little bit (Community Representative #11).

So while the idea of a bioproducts industry is gaining more support it appears that it will take some time before legislative changes are made to allow for other companies to get access to

forest tenure. Bioproducts industries are promising in that biochemical plants (as an example) are more interested in deciduous species and therefore, are unlikely to be as affected by the decrease in coniferous fibre. While it may be possible for them to work with existing tenure holders to get access to fibre, not having tenure over a land base and a guaranteed fibre supply has been identified by many forest companies as major deterrents to investors, and this will likely apply to other companies as well. Growing short-rotation forestry crops on ranch land was intended to help with this problem, but will likely only supply a portion of the fibre required. One company interested in setting up a biorefinery in Quesnel estimated they would need 100,000 bone dry tons (BDT)/year, Powell (2009) estimated that ranches in the Quesnel area could produce between 20-40,000 BDT/year, meaning that Crown land will likely be needed for such a plant to be viable in Quesnel. Thus there needs to be substantial tenure reform from the provincial government top permit companies interested in the biochemical industry to have access to fibre. The municipal government could help to make this happen by lobbying the provincial government for the reforms required.

6.3 Possible Scenarios for Biomass Cropping

The benefits of change and the dangers of preventing it from occurring have been discussed at throughout this thesis. However not all change is necessarily beneficial. Change that occurs too quickly or is of too large a magnitude can destabilize systems and lead to a decrease in resilience. Biomass cropping represents a significant change to the agricultural community in Quesnel and could, if care is not taken, lead to adverse impacts such as loss of agricultural land, increased use of herbicides and pesticides, and the a loss of forest diversity

through the development of monocultures. Gallopin (2002) describes how creating scenarios can be a useful tool to predict and plan for some of the consequences of different choices. Developing scenarios typically consists of characterizing the current situation (including describing the issue or decision in question), identifying the key trends, and then attempting to predict how those trends may shape the future.

Four scenarios were devised for biomass crops in the Quesnel area. The status quo scenario describes the current situation and projects what may happen if the current trajectory of the community continues. Scenario two describes the possible effect of biomass crops becoming lucrative, allowing for greater industrial and corporate control of agricultural land, a trend that led to decreased biodiversity and ecological resilience Indonesia (Feintrenie *et al.*, 2010). The third scenario involves the application of strict regulations to preserve agricultural land, a trend that many ranchers described as being inhibitory to the development of biomass cropping. The fourth scenario integrates parts of the previous three scenarios and describes a possible way for biomass crops to enhance biological and economic diversity on farmland, drawing upon the lessons of panarchy to increase the resilience of agricultural and community systems.

Scenario 1: Status Quo

This scenario assumes that the trends in existence today will continue, and new innovations, including biomass cropping, do not occur. The population of Quesnel and the surrounding area will continue to get older and smaller. Industry will get more efficient through advances in technology, which may create some jobs through new product development but will ultimately result in a net loss of employment. As the last of the merchantable pine is harvested,

the timber supply will be drastically reduced, putting more pressure on the remaining timber species – primarily spruce, subalpine fire and Douglas fir. These species are still subjected to the same stresses that caused the mountain pine beetle epidemic - climate change and fire suppression. Forest pests such as the Spruce Budworm and Fir beetle take advantage of warmer winters and kill more of the remaining merchantable trees. In addition, the dead pine that is either still standing or fallen remains a significant fire hazard, so the potential for large, intense fires will remain for many years. The timber supply issues will reduce the resiliency of the forest industry in Quesnel as they will be forced to go further to get fibre, increasing costs and making them less able to cope with downturns in the global market. The economy of Quesnel will still be heavily reliant on the forest industry and will therefore remain a single-industry town with little diversity. As the community passes from the *K* (conservation) phase into the Ω (release) phase, the lack of economic diversity will result in few alternatives to take advantage of the release of potential which will then be lost, creating a degraded system.

Agriculture in the area will suffer a similar fate. Though interest in local food and weekly farmers markets have created a market for small scale producers, the majority of the agricultural land and capital in the Quesnel area is oriented to producing cattle for the industrial food system. This system tends to favour large corporations that are able to utilize economies of scale to generate profits from cattle with very tight margins. The small scale producers of the Cariboo will be forced out of business due to low prices, increasing regulatory burdens, lack of processing facilities, and an aging work force that is not being replaced. As ranchers stop ranching, agricultural land will be reclaimed by forests, and years of accumulated knowledge

will be lost. As agriculture slides from the *K* phase to the Ω phase, some of the potential will be reorganized due to the diversity within the agricultural sector, but most will be lost, resulting in a smaller, degraded agricultural community. The small scale farmers reliant on local markets may face further struggles if downturns in the forest industry occur at the same time, for as jobs become increasingly scarce people may not be able to pay the higher costs of local food, and will become reliant on the cheaper industrial food supply.

In short, if changes are not made and trends continue as they are currently, Quesnel is likely to lose potential as it moves from the Ω phase to the α phase. As it reorganizes, the community will not be able to support the same number and types of functions – it will become less diverse and less resilient. This outcome is indicative of a system that holds onto the *K* phase too long, becoming increasingly complex, connected, and brittle. Strong perturbations such as the mountain pine beetle epidemic force the system into release, where due to the lack of diversity, potential is lost and the system is degraded, if not pushed to the point of collapse.

Scenario 2: Large Scale Industry

In contrast to the Status Quo scenario, the Large Scale Industry scenario features biomass cropping as a new fibre source. In this scenario, biomass cropping becomes profitable and companies begin planting trees for fibre on a large scale. This acts as a perturbation, throwing the agricultural system into a period of reorganization, the *r* phase of the adaptive renewal cycle. The potential within the system is channelled into producing biomass. Some ranchers agree to rent their land and convert their pasture and crops to industrial tree plantations. Others sell their ranches, resulting in much of the prime agricultural land in the region becoming dedicated to

biomass production rather than food. The initial stages of the front-loop bring many benefits: ranchers get another income, those looking to sell their land are able to do so, and new jobs are created processing the biomass.

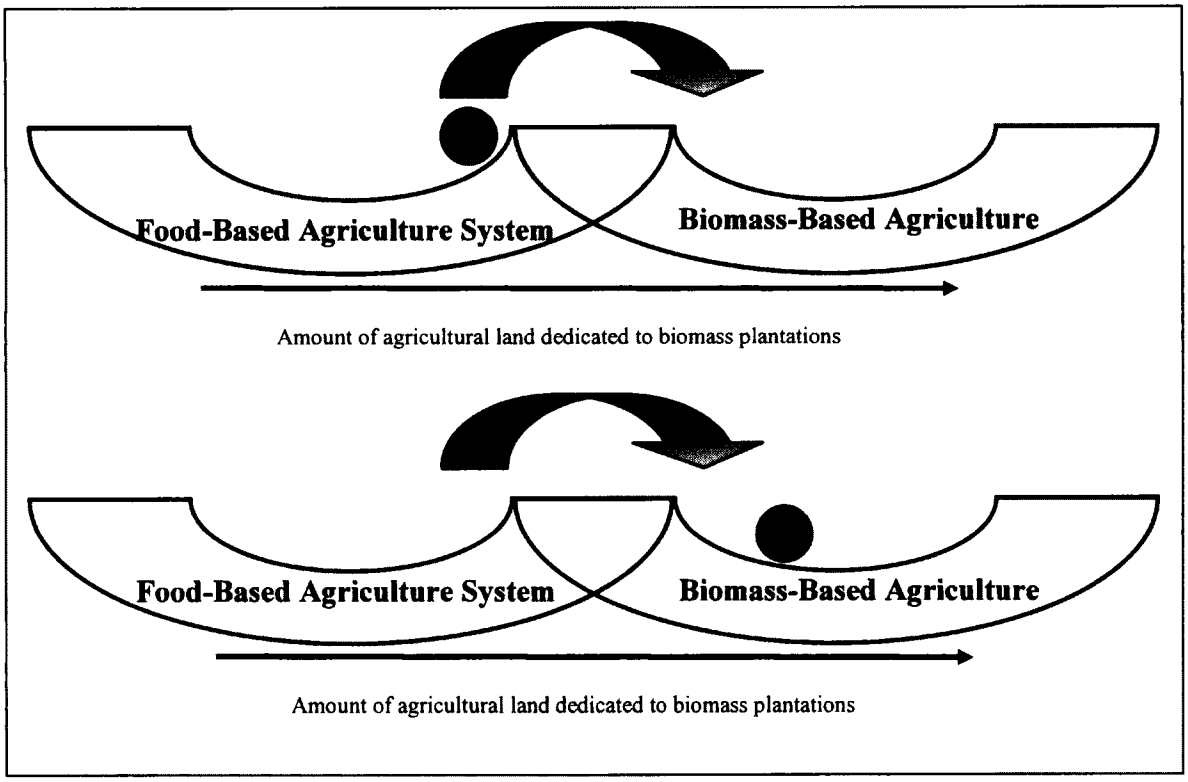
However as the system nears the *K* phase it becomes tightly connected and increasingly homogenous. Nearly all the best land is now owned by industry and committed to tree production. At this stage the system is very close to operating with very little or no food production, and at some point it may reach a threshold where it is very difficult, if not impossible, to revert back. Land committed to growing trees is expensive to clear. Herbicides, pesticides, and fertilizers may make it impossible to grow organic produce. As ranchers sell cattle, support services such as veterinarians and feed and equipment stores disappear. The system has lost diversity and potential, and is therefore less able to respond to changes that may occur. One rancher discussed a possible repercussion of losing agricultural land:

> If the climate change thing continues, the models are showing that California will probably be a desert because they are running out of water now. So where are we going to get our strawberries and all of those things we want to eat? Well they are going to have to come from a little bit farther north. And the Fraser Valley and those areas are basically all pavement now, so they keep coming up into the Okanogan and then they come to here (Rancher #9).

If climate change does have this effect, the agricultural system around Quesnel would not be able to respond and meet the added demand for food. The domain of attraction for a food-based agricultural system would have been exceeded, causing the system to change to a bio-mass based agricultural system. The 'ball in cup' diagram (figure 5.1) illustrates this concept. As more and more land is converted to biomass production, the ball, representing the agricultural

system, moves closer to the threshold where food production is still a viable enterprise. When this threshold is surpassed, the ball rolls over into the domain of attraction of the biomass-based agricultural system. If too much potential is lost, the system will not be able to return to the food-based system.

Figure. 6.1. Domains of Attraction
Modified from Scheffer *et al.*, 2002: 204



The large scale industrial scenario demonstrates how biomass plantation could result in a loss of resilience. If monocultures replaced ecologically diverse agricultural systems, land ownership would be concentrated into a few large landholders and if the best agricultural land would be locked into tree production, causing flexibility and diversity to be lost. With less

diversity, the system will not be able to respond well to perturbations and will be more prone to collapse.

Scenario 3: Regulation

In order to prevent the large scale industrial scenario from happening, regulation may be seen as a solution. One interviewee gave his perspective on how this might work,

> if government came up with a plan and said 'okay there is a blue zone, a red zone, a green zone inside the agricultural land reserve and these are the types of things you can do. If you want to take your poorest land and try to grow hay on it, knock yourself out. But we are not going to let you take your prime land and grow trees so you can make ethanol so some guy can drive his Hummer around' (Rancher #9).

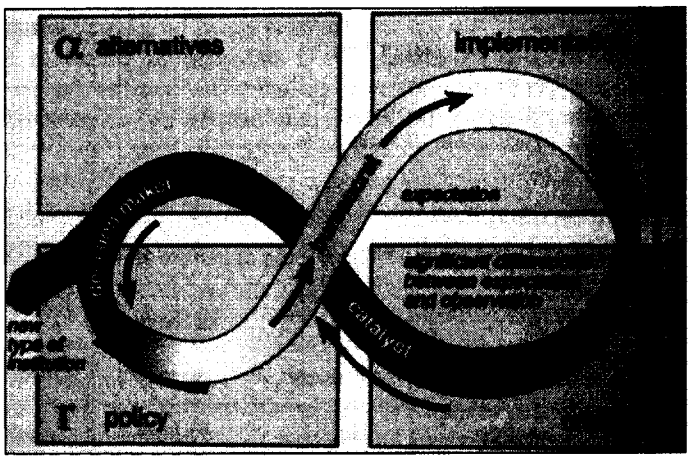
BC already has a program designed to preserve agricultural land, the Agricultural Land Reserve (ALR), and is a good example for what may happen in a highly regulated scenario. The ALR is seen by many of the ranchers interviewed as highly ineffective, political, and bureaucratic. They universally acknowledged that preserving arable land is important, but cited the sprawling residential developments in the Lower Mainland as proof that the ALR does not work. The Fraser Valley region of BC consists of the vast majority of Class 1 land, the most productive agricultural land in the province, but land is consistently being excluded from the reserve. The Agricultural Land Commission (ALC) argues that the net amount of agricultural land in the province has remained the same since its inception in 1973, so therefore it is fulfilling its mandate. Yet land removed from the ALR for development is frequently substituted with lower quality land in the northern region of the province. Between 1974 and 2000, 87% of

inclusions were in classes 4-7, and 98% of inclusions between 1999 and 2001 were classes 4-7 (Green, 2006).

Ranchers feel that the intent of the ALR is just, but has been co-opted by politics and wealthy developers. They note that while exclusions can be secured for housing developments, golf courses, and even industrial land (Green, 2006), they are unable to secure exclusions for their children to build houses on their land to allow multiple generations to live and work on the ranch (Ranching Task Force, 2009, Rancher #1). Many interviewees feel that the ALR is now more of a hindrance to the continuance of the agricultural industry than a help, and was one of the most frequently cited examples of well-intentioned government programs eventually making their lives more difficult rather than easier. For this reason, many ranchers felt that anything that created the need for more regulation is inherently bad. They noted that biomass crops would likely invite more government involvement on their land, and stated that they would not plant biomass crops as a result.

Enacting legislation prohibiting the growth of biomass crops on the best agricultural land may be necessary to keep potential within the system through preserving the best land for food production. However, such measures should be taken with care for in the long term it will likely create more problems

Figure 6.2: The adaptive renewal cycle for institutional dynamics.
Source: Janssen, 2002: 250.



for ranchers. Kingdon (1995) states that policy makers typically pay little attention to an issue once they feel it has been addressed. As a result the impacts and effectiveness of the legislation is not monitored, so when conditions change, regulations are often slow to respond. Janssen (2002) demonstrates how this process works through the adaptive renewal cycle (figure 6.2).

Decision makers are confronted with a problem and given numerous alternatives (the α phase) to solve the problem. One alternative is chosen and drafted into policy (the r phase) then institutionalized by the bureaucracy ($r - K$). The front-loop consists of creation of regulations, enforcement, and growth of bureaucracy to carry out the new policy. All of these actions are based on the original information and expectations of the r phase, not responsive to change as the system progresses. As the system reaches the K phase, the bureaucracy is entrenched, but increasingly confronted with surprise arising from unforeseen events or unexpected consequences of the policy. The result often is that by the time the system reaches the K phase, the environment the policy was originally created in has changed making it ineffective or even punitive. Pressure against the policy builds and if strong enough, forces the system into the backloop, where the policy will be refined or discarded.

Ranchers noted that the progression of policy along the front loop typically led to increased cost and paperwork, and tended to favour large operations that have the money, personnel, and expertise to adapt to a more complex regulatory environment. As examples, exclusions from the ALR are granted to developers that can hire consultants to justify their applications or promise to increase the tax base through expensive housing developments. The Canadian Food Inspection Agency brought in regulations to guarantee food safety after the Mad

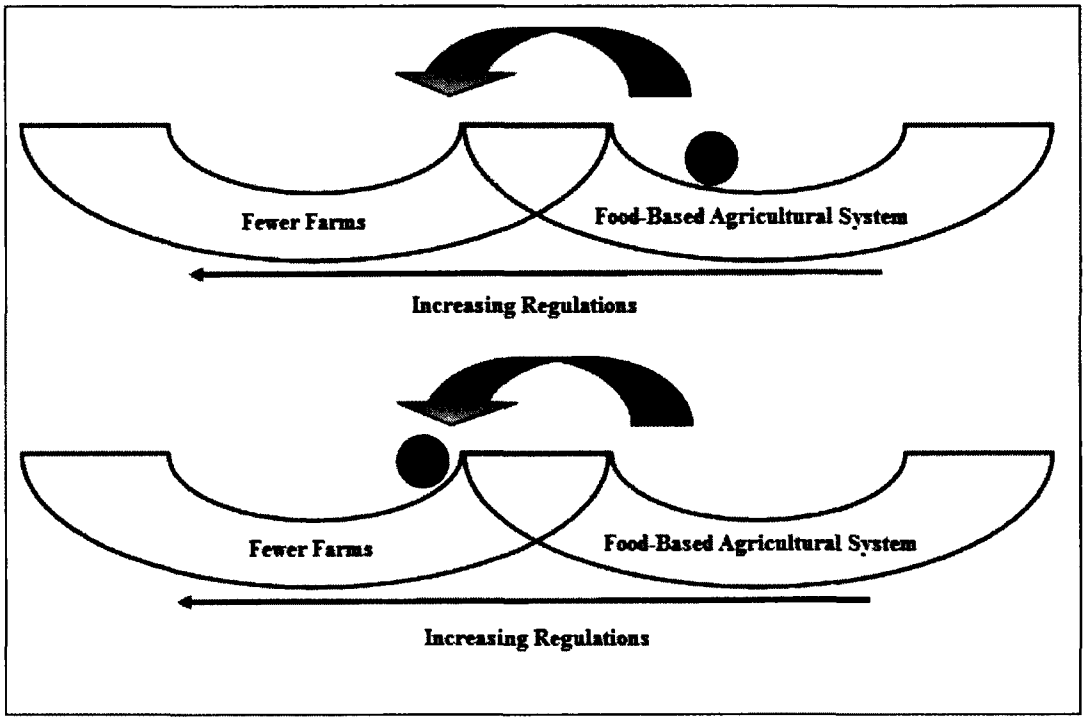
Cow disease scare in order to ensure access to international markets. The result was on-farm meat processing was outlawed and replaced with highly regulated, expensive abattoirs that needed large volumes of cattle and favoured large producers.

The policy loop is a source of great frustration for ranchers. One rancher spoke of his experience with the local Farmers Market:

> Every time we turn around there is another rule or regulation regarding Farmer's Markets. And it is all just going to come to an end. Because they keep changing the rules. But every time they change the rules, who does it cost? It costs the producer the money. It is not any better, it has just created more jobs for them to regulate, and everything else, and I think that is what the whole thing is. It's they have to keep changing so then they can warrant their jobs. But it costs the producers more and more. We are getting fed up, we're just going to throw our hands in the air and walk away, and the Farmer's Markets are going to come to an end (Rancher #3).

As discussed in the preceding chapter, ranchers are not necessarily against regulation, but are wary of how regulatory regimes tend to expand, become restrictive and end up making their financial situation all the more tenuous. Figure 6.3 shows the possible consequences of relying on policy and regulations to control the development of a biochemical/bioproducts industry. Like in the large industry scenario, the cost in money and time of adhering to the requirements of regulations could reach a threshold where biomass cropping is not feasible for smaller ranchers, meaning that they are not able to use them to diversify their production. Without diversification, many ranchers interviewed felt they may go out of business. As regulations increase, the system switches to one with fewer farms and less production – causing a decrease in resilience to the community as a whole.

Figure 6.3: Domains of attraction – regulatory scenario.
Source: Adapted from Scheffer *et al.*, 2002:204



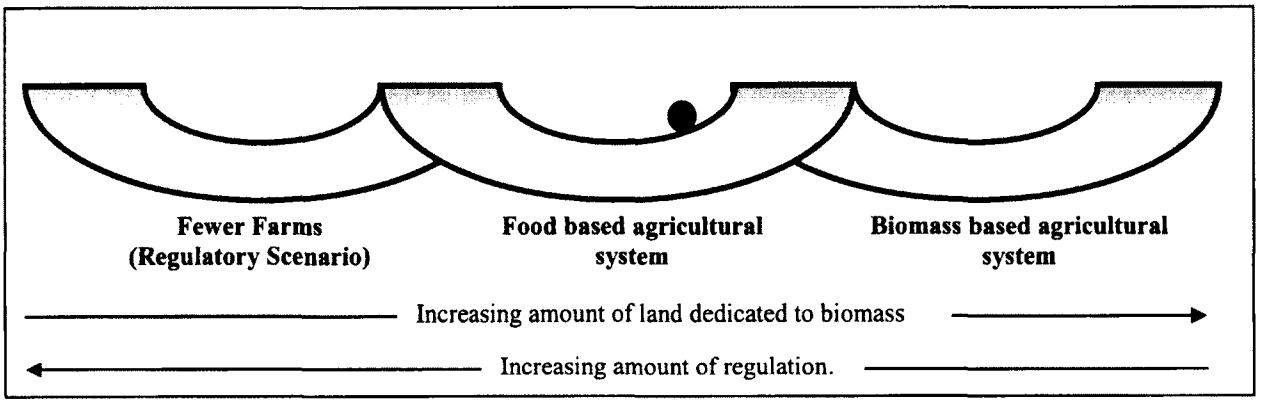
It is very likely that the introduction of regulation will decrease flexibility for ranchers and increase their workload. Over time, it may become a significant impediment to small ranchers and create another burden for people already facing an uncertain future. The tendency for regulation to morph from a solution to a problem makes it likely that the creation of comprehensive regulatory regime will not result in small ranchers being able to diversify and become more resilient. Instead a different approach will be required to prevent the loss of resilience through either the loss of agricultural land or the development of an inflexible bureaucratic regime.

Scenario 4: Integrated, market based, small scale, agroforestry

The scenario with the most promise for building resilience is one which incorporates features from the three previous scenarios. From the status quo scenario, ranchers and farmers would remain on and retain ownership of the land. Food production would still be the primary purpose of agricultural land, and the existing forest industry would still form the economic base. From the large scale industry scenario, large companies would own the production plants and obtain part of their fibre through plantations on rented land. From the regulatory scenario, government would impose restrictions on the use of the best agricultural land for biomass plantations.

The integrated scenario balances the need for some regulation to preserve the best agricultural land with the need to prevent a rigid, inflexible bureaucracy from developing. Figure 5.4 shows where the integrated scenario sits in relation to the large scale industry scenario and the regulatory scenario. As regulations increase, it is more difficult for ranchers to both maintain and establish plantations, taking away an opportunity for ranchers to diversify. Without diversification, the chance that they will go out of business is increased, leading to fewer farms and a switch to the regulatory domain of attraction. At this point, it is very difficult to re-establish a viable agricultural industry, as much of the potential has been lost. On the other hand, having no regulations will likely lead to a switch to the Large Scale Industry scenario and the concomitant loss of agricultural land to tree plantations.

Figure 6.4: Domains of attraction for agricultural systems.
Source: Adapted from Scheffer *et al.*, 2002: 204



Within the domain of the integrated scenario there is enough flexibility to permit individual ranchers to tailor plantations to their own preferences, economic situations, and the idiosyncrasies of their land. Each rancher would be able to choose where they sit along a spectrum ranging from having no plantations to dedicating the majority of their land to biomass (provided it is classed as type 4 or above). Across the region the integrated scenario could range from having very few plantations (nearing the threshold for the regulatory scenario) to having all of the class 4 and above land transformed to plantations. Ranchers would also have a choice of utilizing agroforestry methods or monoculture plantations, so it is possible that much of the current agricultural landscape could be converted to row crops of the same species of deciduous tree, leaving the system teetering on the edge of a tip into the large scale industry scenario.

The integrated scenario is based on how Al-Pac (Al-Pac) set up their operation. Initially residents and farmers were resistant to planting trees on farm land as they were concerned all the best land would be bought up by Alberta Pacific, one of the largest forest companies in North America. The Alberta government worked to remedy these fears through two pieces of

legislation. First, there was already existing legislation prohibiting foreign-owned companies from owning land in Alberta, meaning Al-Pac had to lease land from farmers. The second piece was new legislation preventing Al-Pac from leasing land that consisted of 75% class 1 land (Community representative #18; Neumann *et al.*, 2007). This assuaged fears and allowed the program to get started. In 2006 a review was completed by the Alberta government and found that the legislation prohibiting leasing class 1 land was not required, as it was not economical to start plantations on land better than class 4. The government repealed the legislation, allowing ranchers to use their land as they see fit (Community Representative #18). The Al-Pac program is an example of how the market can keep the best agricultural land in food production as food crops are worth more than the rental rates from Al-Pac. As of February 2010, Al-Pac had 8,900 hectares converted to hybrid poplar plantations, with a goal of 22,000 hectares when the project is at full capacity. This represents only 0.5% of the agricultural land base in the Athabasca area, so there is little concern of a major impact on farm land (Community Representative #18).

While the Poplar Program at Al-Pac provides a good model, there are some differences in Quesnel which will necessitate a slightly different approach. For one, there is considerably less suitable agricultural land near Quesnel. Powell (2009) estimates that there are 38 250 hectares of land suitable for the species selected for the Quesnel area. Of that land, much of it consists of urban and residential areas, roads, and forests, so the actual amount will be much lower. If biomass plantations become popular, there will be much greater pressure on the best agricultural land in the Quesnel area compared to Athabasca.

Another difference is the ability of the major players in the local forest industry to buy land. One of the local timber companies has already purchased prime agricultural land that is being used to grow coniferous trees for seed. It is conceivable that these forest companies would purchase farm land for plantations, provided it is profitable. They have significantly more silvicultural expertise and capital than local farmers and ranchers, whose wealth is in their land and expertise generally in cattle or forage and food crops. Should industry become owners of significant amounts of agricultural land, the system will shift closer to the large scale industry scenario, which replaces rather than diversifies the agricultural sector, and decreases the resilience of the community as a whole.

These two key differences mean some regulation will be required to ensure the system stays within the domain of the integrated scenario. As quality land is so rare around Quesnel, regulation that forbids growing trees on the best land and will be required to prevent its loss. Ranchers made it clear that they do not want to see more regulation, so care must be taken to minimize the impact the regulation will have on the ability of ranchers to use their land as they see fit. This could be done relatively easily as most of the ranches in the area are not located on high quality land. The best land is located on benches along the Quesnel and Fraser Rivers, so it could be possible to restrict the size of plantations in the areas suitable for the widest varieties of food crops. This would keep control of the majority of the land in the hands of ranchers. It is very possible that the regulations will turn out to be unnecessary as economics may prevent prime land from being transformed to plantations, as was the case in Alberta. If rental rates in Quesnel turn out to be similar to those offered by Al-Pac, this will certainly be the case. The

uncertainty around the impact and requirement of regulations points to the need for monitoring to help ensure biomass cropping does not have an adverse affect on ranchers and the wider community.

Thresholds and monitoring in the integrated scenario

A trademark of successful resource management institutions and policies is continual monitoring and responsive governance (Berkes, 1998; Mitchell, 2002; Westley, 2002; Alcorn *et al.*, 2003; Carlsson, 2003). Thus biomass cropping under the integrated scenario will require a system to manage the effects of biomass cropping to prevent the system moving out of the domain of the integrated scenario and losing diversity and potential. For this system to be effective, ranchers will need to be an integral part of this process.

Though the specifics of how this system will be set up are beyond the scope of this paper, it is crucial that farmers and ranchers be given an equally powerful voice as government, industry and other stakeholders. Their accumulated knowledge of local ecosystems plus their ability to detect subtle environmental changes will be vital to ensuring biomass cropping both increases diversity and preserves potential of agricultural systems. Failure to do so will make it more difficult to prevent a shift out of the integrated domain, and possibly into collapse.

Folke *et al.*, (1998) list the use and development of local ecological knowledge as one of the key principles found in social-ecological systems that have proven to be resilient over time. While regulation and monitoring is the purview of government, ranchers feel that government is not responsive to their needs and that they do not have access to government support or the ear of

decisions makers (as discussed in the previous chapter). The consequence of this, according to Alcorn *et al.* (2003: 300) is "if the political system is closed to participants who want to modify institutions in response to negative ecological feedback, then, during crisis, ecological resilience will diminish until the system flips. Resilience depends on a vibrant political life in which multiple interests participate." An example of the failure to integrate local knowledge is the Atlantic Cod fishery, where management regimes based largely on scientific estimates of cod stocks proved erroneous and contributed to the collapse of the fishery. Inshore fisherman had been warning of decreasing yields nearly ten years before the government investigated and found that their models were drastically overestimating the health of cod stocks. By this time, the cod had been fished to exhaustion and the fishery had to be closed (Finlayson and McKay, 1998; Ommer and Sinclair, 1999). Holders of local knowledge are able to quickly notice subtle environmental changes that may signal the beginning of problems. Scientific studies by managers may miss these subtleties and fail to detect changes until the system is nearing collapse, or remediation is prohibitively expensive (Palsson, 1998; Berkes and Folke, 2002).

The inclusion of ranchers in monitoring and decision making is also important to maintain their power through acknowledging their current levels of skill and contributing to further skill development. Stirling (2001) argues that the increasing influence of large agribusiness corporations and technology has decreased the skill required to farm, and taken power away from farmers. For example, grain producers are now forced to purchase seed from companies like Monsanto, told what pesticides and herbicides to buy and use, then harvest the crops with high-tech equipment. The skill required to be successful has more to do with business

than traditional agricultural skill. Power has been lost as farmers have less choice of what to plant and how to manage their land.

While agriculture around Quesnel has certainly not reached this level, there is potential for similar effects to come from biomass crops. Under the Al-Pac system, ranchers rent out their land and in effect cede control over to the forest company. They have an option to do maintenance work, but have little say in the species used, the amount and types of inputs (i.e. fertilizer and pesticides), and the plantation style. Under this scenario the rancher has no active role in the growth of the biomass crops. Ensuring ranchers have the power to influence the development of biomass cropping will help to ameliorate this potential power imbalance. The use of agroforestry systems will also greatly help to keep ranchers as vital parts of the agricultural system. By integrating trees and other crops, ranchers will have to draw upon their existing knowledge base and develop new skills in order to make the new system productive. This is perhaps the best case scenario as it allows for the growth of new ecological knowledge, another principle of resilient social-ecological systems as identified by Folke *et al.* (1998).

These skills will be crucial in monitoring changes as biomass cropping becomes better established. An important task for all stakeholders will be the identification of thresholds that, if reached, could cause a collapse. One example already discussed is the potential for essential services to the agricultural industry such as veterinarians going out of business if the number of livestock falls below a certain point. Once these services are lost, it is much harder for ranchers to operate, causing a positive feedback with the end result being a collapse of the agricultural sector. Once this happens it is very difficult to return to the previous state, as thresholds mark

the transition to alternate states or domains of attraction. So if agricultural services are lost, agriculture may not recover if prices improve, depriving the community of Quesnel of a vital economic and cultural sector.

The existence of thresholds provides an excellent tool for management. As the biomass cropping system moves from its initial stages in the *r* phase to the *K* phase, the changes in certain key variables can be monitored. As it nears the threshold, managers will know that change is required. This, in essence, serves as the perturbation moving the system from the *K* phase to reorganization – the Ω phase. Prior knowledge of the threshold prevented the system from persisting in the *K* phase for too long, and therefore prevented a collapse. As the system reorganizes, regulations can be developed to limit the growth of trees, thereby ensuring sufficient cattle remain to sustain the ranching sector. Thresholds should be developed prior to the establishment of biomass crops. Examples of thresholds include:

- The number of cattle required to sustain veterinarians.
- The amount of land needed to sustain that amount of cattle.
- The volume of fibre required from plantations to make it worthwhile for industry.
- Rental rates for ranchers to agree to plantations.

Chapter 7 Conclusion

The 2010 BC throne speech promised to "commit to sustainable prosperity" (Point, 2010:11). As the provincial economy will continue to be based on natural resources, achieving this goal will require linking socio-economic and ecological systems in a way that is mutually beneficial. Resource-based communities will be the sites where new ideas will be tried, where innovation will be put into practice, and where the successes and failures will be most keenly felt. The roots of an ecologically sound economy for BC will not be placed in the metropolitan centres of Vancouver and Victoria, but instead will be found in the small communities outside of the lower mainland.

Given this context the response of Quesnel to the crisis presented by the MPB has the potential to make a significant impact. As one of the most resource dependent communities in the province, Quesnel has been in many ways the 'poster child' of the Fordist economy on which the province was built. Ever more efficient mills produced ever-increasing amounts of wood products, driving the provincial economy. With the community now facing an 86% decrease in the AAC due to the MPB, it is being forced to find alternatives as the forest industry will not support the community as it has in the past, both through employment and taxation. If it was not clear before, the MPB has shown how closely linked the social and economic systems of Quesnel are to the natural environment - the health of the community is directly related to the health of the forest. With this in mind the Bioenergy/Bioproducts Initiative was developed to diversify the local economy by mimicking natural systems. The district heating system may be the start of an eco-industrial complex where one companies waste is another's raw material, and agroforestry is

an example of a diversified agricultural system. If successful, Quesnel could be an example of a sustainable resource-based community, and a spark to the province's efforts to achieve its goal of sustainable prosperity. It could also show how resource-based communities can continue to be relevant to the province and the world as the need for solutions to global issues such as climate change, peak oil, and resource scarcity become more pressing.

These global issues plus the impending drop in the AAC are forcing Quesnel to undergo a period of drastic change which has the potential overwhelm its ability to cope. Two theories have proven useful to understanding the process of change in complex systems that comprise communities like Quesnel: panarchy and Kingdon's (1995) description of problem, policy, and political streams. Panarchy has helped to define resilience, explain cycles of change, and understand the linkages between economic, social, and ecological systems. The adaptive renewal cycle shows systems moving cyclically from conservative, rigid states to loosely connected, fast moving states where experimentation flourishes. It shows that agents of disturbance that force change upon systems are crucial to system health as it frees up potential which can be reorganized to better suit new conditions. Panarchy describes the characteristics of resilient systems, the central idea being that the more diversity within a system, the greater the chance it will adapt to change. Panarchy provides a great metaphor for the process facing Quesnel as it moves from a tightly-connected, conservative system to one moving towards a period of release, trying to find ways to preserve and increase the diversity of the system to prevent a collapse.

Kingdon's (1995) streams show in more detail how governments make decisions. Problems continually shift in importance to decision makers based on their publicity or urgency. Policies that address various problems are floating around waiting to be used. Politicians address issues based on their perceived importance to the public, the likelihood of a solution, and the financial cost. When the problem is seen as important by politicians and the right policy emerges, political will becomes focused and change can be made. Currently political will is focused on bioenergy as a way to utilize beetle-killed pine, but it may be too late to establish a significant industry. Tenure reform that would allow biochemical and other bioproduct companies to have access to fibre does not have the provincial government's attention, and biomass cropping is not a priority for either the municipal or provincial government. Before the economic recession, the environment and specifically climate change were top priorities. This has changed, meaning that very little attention is being paid to establishing a carbon market or strongly pursuing environmental initiatives without a quick economic payback, particularly at the federal level. One lesson from both Kingdon and panarchy is the importance of having a wide variety of options available when the time is right. Kingdon describes a "soup" of policies that have been prepared in advance, allowing politicians to quickly select and implement the appropriate policy when a problem is considered urgent. Panarchy calls for diversity within a system that allows for a greater variety of re-combinations, increasing the chance of developing a system better adapted to new conditions. Though the political will may not be present to implement all aspects of the Bioenergy/Bioproducts Initiative, including biomass cropping and agroforestry, continued research on the opportunities and challenges of the initiative will allow for quick and effective implementation when the time is right.

This thesis was arranged around a broad research topic and specific research questions. The research topic was whether an industry based on growing fibre for the production of energy or bioproducts can help forest dependent communities become better able to adapt to change by helping to diversify the economy and contribute to the ecological health of the area. The answer to this broad question will be summarized followed by answers to the specific research questions.

The acquisition, use, and transmission of local knowledge are important attributes of resilient social-ecological systems. Biomass cropping that provides another income source for ranchers will help them stay on their land and make it easier to pass on to the next generation. Many of the ranchers interviewed stated that their primary goal was to be able to keep their ranches. Others were hoping to either sell or have their children take over, but the current market for cattle and other food products has made both of these desires doubtful. Ranchers hoping to stay on the ranch are losing money producing cattle, and very few people are interested in becoming involved in ranching as the likelihood of success appears to be quite low. If ranching disappears, the community will lose the generations of knowledge that has been gained from working closely with natural systems. This knowledge is not only crucial for food production, but can be transferred to growing other crops as the need arises. Intimate knowledge of land is something that is very difficult to gain, so beyond supplying fibre the most important aspect of biomass cropping and agroforestry may turn out to be their role in building and perpetuating the local ecological knowledge in the community. If developed according to the conditions of the integrated scenario, biomass cropping will contribute to community resilience.

It will do this by creating the potential for economic diversification through an alternate fibre source and improving the ecological health of the area through increasing biological diversity on agricultural lands and enhancing local ecological knowledge. The following sections sum up the specific research questions relating to biomass cropping.

7.1 Do ranchers perceive biomass cropping as being able to diversify their incomes?

The concepts of biomass cropping and agroforestry are accepted by ranchers. They have suitable marginal land that they would be willing to grow the crops on. It does not appear to be economical based on the prices given by Al-Pac, but if a carbon market becomes well established biomass plantations may be eligible for carbon credits. It appears that these plantations will not be able to compete with hay or other crops, but will replace pasture land meaning that ranchers will have to run fewer cattle. As a result biomass crops should be comparable to the price ranchers can get for cattle. If it proves to be economical biomass cropping has great potential to help ranchers diversify their incomes, though many felt it would be a relatively minor source of income.

7.2 How do ranchers feel about possibly converting some of their land to biomass crop plantations?

Ranchers are concerned about losing agricultural land to tree plantations. As good agricultural land is scarce in the Quesnel area, converting the best land to plantations will have a significant effect on the regions food production. That said, many felt that if the status of agriculture, and particularly ranching, stayed the same, many ranchers would lose their farm and the land might revert back to forests. Ranchers were concerned about the lack of flexibility

inherent in tree crops. The expense to convert land back to pasture or hay fields was considered by some to be prohibitive, while others felt that it would not be a deterrent. If trees could be grown on marginal land ranchers were generally supportive of the idea. They felt this would have a negligible effect on their ability to raise cattle or produce crops, especially if grown in an agroforestry system that would allow cattle to graze amongst the trees.

Though economics was the concern stated most often, the perceived environmental impact of these plantations will also be important. All ranchers but one stated that non-native or hybrid species were not a concern, but the one rancher who did would only plant native species on the ranch. Monocultures and their susceptibility to disease and pests were a concern, but not one that would prevent ranchers from planting the trees. Though it appears an assessment of the environmental impacts of biomass plantations may be of minor importance, rancher's thoughts on the use of biosolids for fertilizer suggest that is not the case. Despite rapidly escalating fertilizer prices many ranchers refused to use biosolids, which they could get for free. This is despite the evidence of its ability to dramatically increase yields and improve soil quality, and repeated assurances from scientists and company officials of its safety. Ranchers felt that it would have long-term negative impacts on their land and some were willing to go without fertilizer before using biosolids, meaning they accepted decreased yields and income. This suggests that even if biomass plantations proved profitable, ranchers may not want to be involved if they suspect detrimental environmental impacts may occur.

The tree species proposed will take between 5-25 years before they can be harvested. Ranchers felt this was risky and many were reluctant to commit to growing crops without an annual financial return. They were also concerned about the market disappearing if a company

goes out of business or finds an alternate fibre source, leaving them with trees that can be very hard to remove. Though all ranchers were interested in diversification, few felt they had the capital to start something new, especially without a quick payback. Guaranteed contracts and/or arrangements with companies to provide yearly income or seed capital will be required before ranchers would be able to plant trees on their land.

To sum up, ranchers are very interested in diversifying and see biomass cropping, particularly in an agroforestry system, as having promise. They are sceptical about whether it would be profitable, are concerned about losing agricultural land, and are worried about the risk inherent with crops that take 5-25 years to be ready to harvest. If ranchers could see that they could make money without having to take on much risk nearly all said they would be interested. They felt they had suitable marginal land that the trees could grow on without having a detrimental impact on food production. More information on the environmental impacts will be required as ranchers have proven to be very reluctant to become involved with opportunities if they perceive there to be the potential for environmental damage. If ranchers could make money growing trees without much risk on marginal land without adverse environmental impacts it likely that a great deal of ranchers in the Quesnel area would be enthusiastic to establish plantations on their land.

7.3 Are there policy constraints to growing biomass crops on agricultural land?

Rather than focus on specific policies, most ranchers talked about the effect of government regulations on their operations. Older ranchers and especially those on multi-generational ranches identified government regulations as being the biggest factor in their

struggles. Younger ranchers stated that their interactions with the government have not been overly negative, and one mentioned that government programs have been helpful in getting established. In general, ranchers found that the sheer mass of regulations from numerous government agencies was time consuming and restrictive. The most common complaint was meat packing regulations that forced ranchers to ship their cattle to licensed abattoirs for slaughter and packaging, something they saw as overkill. The mass of regulations and associated paperwork prevented ranchers from using common sense or time-honoured practices on their ranches. They were concerned that biomass cropping could introduce more regulations and further impair their ability to manage their land as they see fit.

Community representatives mentioned that the *BC Assessment Act* regarding farm status may be a deterrent to ranchers. The majority of the biomass crops proposed are not considered farm crops, meaning that ranchers could lose farm status on land growing biomass crops, which has significant tax implications for ranchers. While ranchers stated they were concerned about losing farm status, many felt that it would not be an issue as they have found ways to get around the regulations on other parts of their ranch that are not used exclusively for growing agricultural crops. If an agroforestry system was to be used, cattle could graze in the plantations, meaning the land is still eligible for farm status. If trees were grown in a monoculture plantation the land may not be considered to have farm status. Some clarification is needed around this point, but ranchers did not consider this a big concern for they felt that if the government was behind biomass cropping, the legislation could easily be changed. Government support was something that was stressed repeatedly; ranchers felt that if the government was truly behind the idea of

biomass cropping they would ensure the regulatory environment would not inhibit them from establishing biomass crops on their lands.

7.4 Recommendations

The following are specific recommendations for the municipal, provincial, and federal government. They are organized in order of what is likely to be the easiest to achieve to what is likely to be the hardest.

Municipal government:

Clearing up the confusion over the role of the municipal government regarding community economic development plans should be the first priority. Councillors and community members need to agree on a clear direction for the community, as well as come to an understanding of what sustainable development would mean. There are a few great local sources for this knowledge – the Quesnel 2020 project created a clear mission statement and identified a vision for the future. The Bioenergy/Bioproducts Initiative lays out a complementary alternative to the current industrial sector based on utilizing waste products to attract new industry. To date, it represents one of the few visions for a more diversified economy. The majority of interviewees knew very little about the Bioenergy/Bioproducts Initiative, which may be a part of the reason it has not been widely accepted. Greater knowledge of the Bioenergy/Bioproducts Initiative amongst community members and especially community leaders would be very helpful to the development of a coherent, unified vision for the community that can be acted upon and advocated for.

The devolution of responsibilities to municipal governments combined with a decreasing tax base forces the municipal government to look for other sources of revenue. Interviewees stated that this has been a difficult transition for the government, as its focus has traditionally been on adjusting tax rates and providing services. If the level of services the municipality provides is to stay the same, this mindset must change to the point where the municipality actively seeks innovative, entrepreneurial opportunities to generate revenue. The reluctance to tread in territory traditionally occupied by private industry, and especially large forest companies, is understandable, but the days of being able to depend on industrial taxation are coming to an end. For this reason, opportunities such as the decision regarding a community forest should be revisited, as it will give some control of resources and the resulting benefits directly to the municipality. While there are certainly drawbacks to the added burden that has been placed on municipal governments, communities that embrace the opportunity to have more control over their destiny will have greater success at finding appropriate solutions to the drastic periods of change many are facing. Quesnel has made good progress in this direction through plans like Quesnel 2020, but needs to act on the ideas proposed in the various plans that have been developed.

Provincial Government

The provincial government will need to be heavily involved if biomass cropping is to be successful. A crucial first step is to provide funding for trials of the biomass crops likely to be the most successful. The trials will help to assess costs and potential profit for ranchers, as well as provide an opportunity to experiment with different harvesting methods. If partnerships can

be established with universities research into the carbon sequestration potential of different crops could be done.

Ranchers felt they needed more support in terms of expertise from the Ministry of Agriculture. There is a need to train or hire agroforestry experts to conduct trials and help ranchers establish biomass plantations. There is currently only one agrologist in Quesnel, an area ranchers felt was understaffed. Ranchers found it difficult to access research or get help with technical questions. The adoption of biomass cropping could be hindered if ranchers do not feel they have easy access to expertise, particularly in areas they have no past experience with.

Ranchers are clearly frustrated with the different regulations they have to deal with. It is crucial to streamline regulations from all ministries that would be associated with biomass cropping, making it clear what ranchers interested in biomass crops are dealing with. Having one agency (Ministry of Agriculture) that is familiar with the regulations would make it much easier for ranchers to get the information they need to begin a plantation.

As biomass crops will need a market, tenure reform must be carried out to allow for tenure to bioproducts companies. They must have a secure access to fibre for and alternate industry to succeed. Part of this discussion may be around creating regulations to govern the harvest of deciduous trees in the Quesnel Timber Supply Area. This will be necessary as only a quarter of the fibre required for a biochemical plant can be grown locally.

The establishment of a working carbon market is important for the viability of biomass cropping. The Pacific Carbon Trust provides a framework that may enable ranchers to profit

from sequestering carbon, one of the many ecosystem services they provide. Sequestering carbon may prove to be lucrative and help to make biomass cropping economical, and help to ensure that tree plantations are established as part of an agroforestry system, maximizing the ecological benefits.

Federal Government

The federal government can do two things to support biomass crops in Quesnel. First, fund research on agroforestry and biomass crops in BC. Local trials are essential to determine the feasibility of growing the crops in the Quesnel area, and funding will be required to set up plantations and perform the necessary research to determine if it can be successful or not. Second, establish a carbon market that would allow ranchers to sell carbon credits on a national and international scale. A larger market may increase the price of carbon, helping to make farming and ranching a more viable endeavour.

7.5 Next Steps

This research has shown that the Bioenergy/Bioproducts Initiative is a promising way to develop an economy that contributes to a resilient social-ecological system. Agroforestry and biomass cropping will likely be taken up by ranchers in the area provided they have more information regarding economics, environmental impact, and practical concerns such as harvesting methods, equipment required, and crop maintenance. Local trials are needed to begin to answer these questions, and if done on local ranch land could also provide ranchers with some income through land rental. Several ranchers indicated they would agree to host trials on their ranches, and having local trials would start to create interest in the idea through word of mouth.

7.6 Future Research Questions

Local trials are essential to answering many of the future research questions. For example:

- What prices can ranchers expect to get from biomass crops?
- How much carbon is sequestered in agroforestry plantations in the Quesnel area?
    - Which trees sequester the most carbon?
    - Do agroforestry plantations sequester more carbon than monoculture plantations?
- How much herbicide and pesticide is used?
- Are plantations having a detrimental effect on the surrounding forest?

As ranchers were very concerned about the economics of biomass plantations, a test plot would help to assess the costs of establishment, maintenance, and harvest. Having these numbers would provide a much clearer picture to ranchers and potential purchasers of the fibre as to the viability of biomass crops. It would also identify some of the practical constraints such as soil quality, irrigation, suitable land, distance to markets, and damage due to cattle and wildlife.

As mentioned, carbon sequestration has the potential to generate significant income to the area, so having a solid idea of how much carbon these plantations are able to sequester will be crucial. Determining which trees sequester the most carbon will help to determine the structure of plantations. If agroforesty systems prove to sequester more carbon than monocultures, it may make it more likely that ranchers will choose them as they would then have both ecological and

economic advantages. Determining the herbicide, pesticide, and fertilizer requirements will aid in assessing the ecological cost of these plantations, and, over time, the impact they have on the surrounding forest and ecosystem.

If trials could be set up on existing ranches it will be possible to determine the effect plantations will have on the ranchers themselves. The impact it will have on their ability to produce cattle and their general lifestyle will be seen. The testimonials these ranchers will be able to provide will likely be the most important factor in the large-scale success of agroforestry or biomass cropping. If it is a positive experience, word will spread and more ranchers will want to become involved. If not, few ranchers are likely to be interested.

While the long term implications of agroforestry/biomass cropping on the community are hard to assess, panarchy provides some guidance on how the impact can be monitored. Panarchy stresses the preservation of function within a system – two primary functions of the agricultural system in the Quesnel area are food production and the generation and transmission of local ecological knowledge. Panarchy suggests that systems reach thresholds where change is too drastic and the system collapses into a degraded state, one that it is very difficult, if not impossible to restore. One rancher suggested indicators that can be used to gauge how close the agricultural system is to reaching that threshold. The agriculture community requires services such as veterinarians, feed suppliers, equipment sale and repair, and scientific expertise. These services, in return, are dependant the local production of a certain volume of agricultural products, which in the case of Quesnel, is primarily cattle. By determining how many cattle are required to keep these services available in Quesnel, it would be possible to monitor the impact

of biomass crops on the primary functions of the agricultural system in Quesnel. The rancher was concerned that if too many cattle were replaced by trees, the essential services would be lost, causing the agricultural system to collapse to a point where it would not be able to recover. The resulting loss of food production and local ecological knowledge would profoundly and perhaps irreversibly decrease the resilience of Quesnel. Establishing the thresholds and monitoring the production of food will help to ensure that biomass cropping/agroforestry will add to the resilience of the community.

7.7 Concluding Remarks

Biomass cropping is clearly not a 'sure bet' to help Quesnel adapt to the challenges posed by the mountain pine beetle. Numerous regulatory and economic barriers will have to be overcome before the trees will be seen growing on ranches around Quesnel. Even if biomass cropping becomes viable, there is no guarantee that it will be a positive thing for the community in the long run. The large-scale industry scenario shows how widespread adoption could result in loss of agricultural land, the proliferation of monocultures, and increased use of pesticides and herbicides. All of these decrease the diversity of social and ecological systems and reduce the ability of the community to adapt to change. The regulatory scenario shows how biomass crops could introduce more regulations on ranchers which many thought would inevitably lead to less freedom and higher costs. Increasing regulations has often favoured larger corporations and could lead to fewer ranchers being able to operate in the region. Yet continuing to depend on the existing forest industry will not lead to a bright future. The integrated scenario demonstrates that biomass grown in an agroforestry system can be beneficial to ecological systems and ensure

agricultural land can still be devoted to food production. Pursuing the further research questions and next steps to provide answers to some of the uncertainties that exist will position the idea for a more favourable political climate. The reduced uncertainty could also help to persuade policy makers to create the conditions for success, 'pushing' the three streams discussed by Kingdon (1995) closer together.

If the integrated scenario can be economically viable, it has great potential to help farmers and ranchers in the area. Though ranching is only be a small part of the community's economy, retaining the land base and the knowledge required to produce a secure local food supply is critical to long-term health of the community. Ranchers have been working to balance social, economic, and ecological systems for generations and represent a wealth of information that will be valuable to the community as it struggles to balance these systems. Rancher's responses to biomass cropping exemplified their desire to find a sustainable balance. Biomass crops grown in an agroforestry system emerged as the best way to limit impact on food production, decrease inputs such as fertilizer and pesticides, enhance biodiversity, and provide an income that would help ranchers stay on their farms and continue their chosen way of life.

Biomass grown in an agroforestry system has the potential to add to the resilience of Quesnel. Ranchers are willing to grow the crops on their land provided it is profitable, meaning that a portion of the fibre required for a bioproducts plant could be grown on ranch land, providing a reliable, easy to access supply. A bioproducts industry would provide real economic diversification and contribute to the success of the Bioenergy/Bioproducts Initiative, which has great potential to help Quesnel adapt to a future with a smaller forest industry but also to remain

important to the future of British Columbia. As there are still important questions to answer, trials should begin to provide ranchers with a full appraisal of economic, practical, and environmental issues. Based on the research from this thesis, ranchers are willing to help with trials and see it as a worthwhile project to pursue, one that could fit well with their existing operations.

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Appendices

Appendix 1 – Interview Script: Ranchers

Social Impacts of Agroforestry - Ranchers

INTERVIEW SCRIPT

Interviewee Name: _____

Interviewee Contact Information: _____

_____

Interviewer: _____

Date: _____

Interview Time: Start_____

Finish_____

Reviewed study purpose with interviewee: ☐

Reviewed consent form with interviewee: ☐

Copy of signed consent form left with interviewee: ☐

Provided contact information to interviewee: ☐

The purpose of my research is to assess the social impacts of agroforestry on ranchers in the Quesnel area. This research will contribute to efforts to assess the feasibility of a bioenergy industry in Quesnel, as well as contribute to discussions on resilience in communities affected by the mountain pine beetle.

These interviews with local ranchers will provide detailed, in-depth information on the specific concerns and/or opportunities that individual ranchers see when considering implementing agroforestry. These interviews will provide valuable information to determine whether or not the bioenergy/bioproducts initiative will be a success.

Background:

1) How long have you lived on the ranch?
2) What do you produce on the ranch?
3) What are some of the key economic pressures you are facing?
4) What are some of the key regulations/policy issues you are faced with?

Bioenergy

1) Are you aware of the bioenergy/bioproducts initiative currently underway in Quesnel?
2) What are your thoughts on growing agricultural crops for energy production?
    a. Prompt: corn for ethanol

Agroforestry

3) Have you heard of agroforestry or short-rotation forestry before?
4) Have you considered growing or harvesting deciduous trees before?
5) What do you think of the idea?
    a. Prompt: Diversify income – ecological and social concerns
6) How do you feel it would affect your ability to raise cattle or grow crops?

7) What do you think about the idea of using 'marginal' land to grow these crops? Do you think there will be enough land to make it feasible for yourself?
8) Would you be interested in growing these crops?
    a. If not, what are your concerns?
        i. Prompt: What are some practical constraints you can foresee (eg. Harvesting, distance, lack of suitable equipment, loss of crops to wildlife/cattle)

Policy

9) How do you think agricultural regulations will affect your ability to grow agroforestry crops, and how do they affect your ability to diversify your business?

Summary

10) Are there any other issues related to agroforestry or agricultural policy that you would like to mention?

Appendix 2 – Interview Script: Community Representatives

Social Impacts of Agroforestry – Community Representatives

INTERVIEW SCRIPT

Interviewee Name: _____

Interviewee Job Title: _____

Interviewee Contact Information: _____

_____

Interviewer: _____

Date: _____

Interview Time: Start_____

Finish_____

Reviewed study purpose with interviewee: ☐

Reviewed consent form with interviewee: ☐

Copy of signed consent form left with interviewee: ☐

Provided contact information to interviewee: ☐

Introduction:

The purpose of my research is to assess the social impacts of agroforestry on ranchers in the Quesnel area. This research will contribute to efforts to assess the feasibility of a bioenergy

industry in Quesnel, as well as contribute to discussions on resilience in communities affected by the mountain pine beetle.

These interviews with representatives from local governments and organizations involved with the bioenergy/bioproducts initiative will help to provide background information on these parties, describe the nature of their involvement, and help to identify some of the policy and practical barriers to the success of the initiative.

Background:

1) What is the general mandate of your organization?

Bioenergy/Bioproducts Initiative

1) Please describe how you/your agency are involved with the bioenergy/bioproducts initiative.
2) From your perspective, how do you think the bioenergy initiative will affect Quesnel?
    a. Prompts: ecological, social, and environmental effects
3) What are some of the policy constraints to the success of the initiative?
4) What are some of the practical/operational constraints to the success of the initiative?
5) What do you think the roles of the federal, provincial, and local governments will be in the development of a bioenergy industry in Quesnel?
6) What will the continuing roles of the 3 levels of government should the industry become established?

Agroforestry

7) Are you familiar with agroforestry or the proposal to grow short-rotation forest crops to provide fibre for a bioenergy plant?
8) What do you think of the idea of growing short-rotation crops for energy?

a. Prompts: Concerns, economical, available land, ecological harm, local strengths/advantages

9) From your perspective, do you see any policies or regulations that may affect the implementation of agroforestry for the production of energy in Quesnel?
10) What do you think the roles of the federal, provincial, and local governments will be in the development of agroforestry in Quesnel?
11) What will the continuing roles of the 3 levels of government should agroforestry become established?
12) What do you feel are the barriers to the success of this initiative?

Summary

13) Are there any other issues related to agroforestry or bioenergy that you would like to mention?