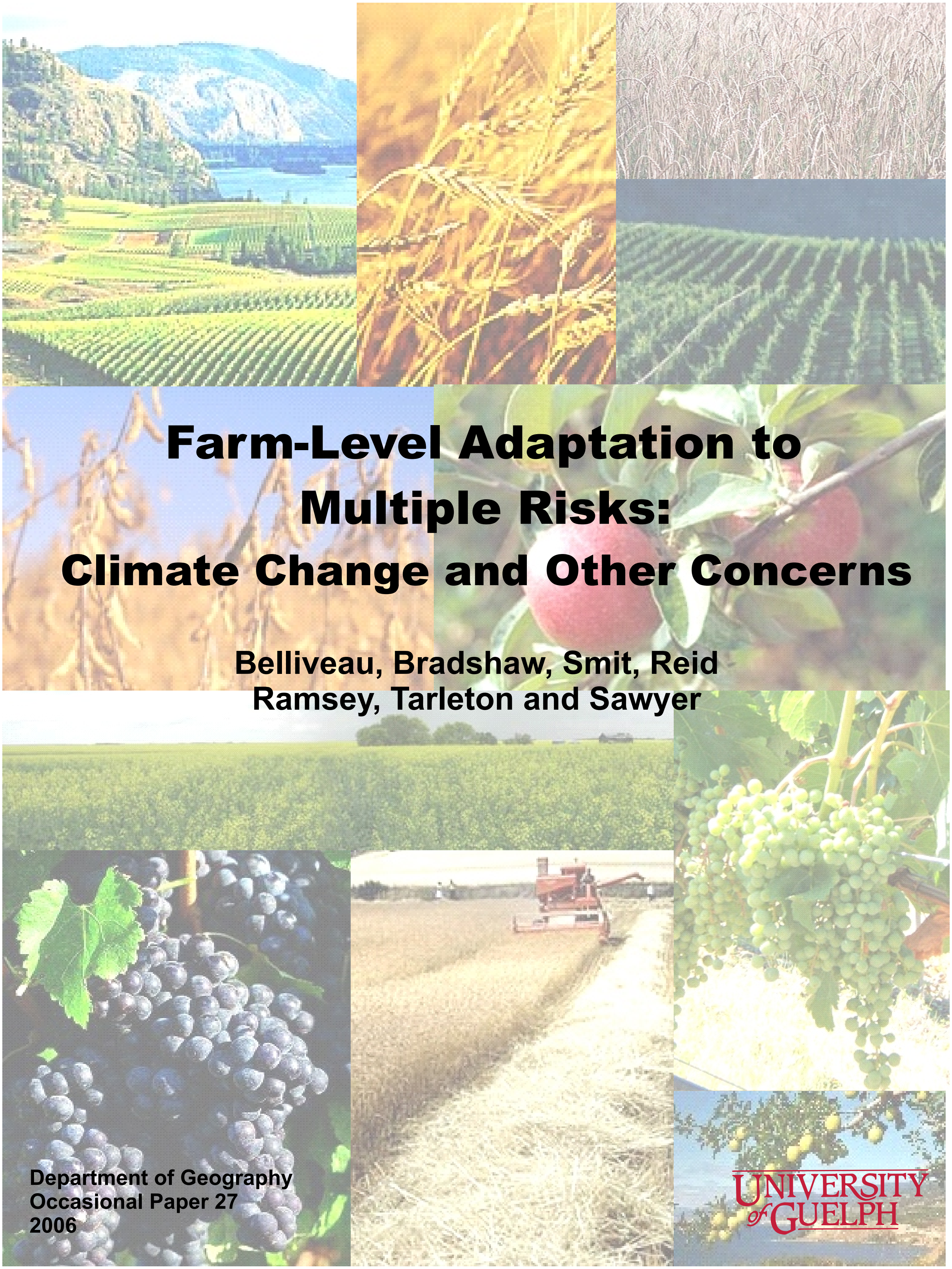

Farm-Level Adaptation to Multiple Risks: Climate Change and Other Concerns

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CHAPTER ONE
Introduction

1.1 Research Context and Objectives

> *Farm incomes have been devastated by the BSE crisis, poor crop conditions, trade actions, record low crop prices, rising energy costs, and a crushing regulatory and legislative burden initiated by the Ontario government.*
>
> Ron Bonnett, President of the Ontario Federation of Agriculture
> (Press Release, Feb. 4, 2005)

Agriculture is inherently sensitive to climatic conditions, and hence is frequently cited as a sector that is potentially vulnerable to anticipated global climate change (Parry and Carter, 1985; Rosenzweig and Parry, 1994). That being said, the degree to which an agricultural system is ultimately vulnerable to long term changes in temperature or precipitation, or changes in the frequency and magnitude of extreme weather events, depends on its adaptive capacity; it is for this reason that the literature on climate change and agriculture has increasingly directed attention to the issue of adaptation (for reviews see Tol *et al*., 1998; Smit and Pilifosova, 2001). While it is widely recognized that farmers have the ability to reduce the adverse effects of climate change and even seize opportunities by adapting to the changing conditions (Easterling 1996; Wheaton and MacIver 1999; Bryant *et al* 2000; Smit and Skinner, 2002), the exact process through which this adaptation will occur, or indeed even does occur presently, is not well understood (Brklacich *et al.*1998; Bryant *et al.* 2000; Lemmon and Warren 2004).

One significant complication is the impact of non-climatic stimuli on adaptation decisions, as climate obviously represents just one of many sources of risk (and opportunity) to which farmers are exposed and respond. As illustrated by Ron Bonnett's comments above, events such as commodity market downturns, changes to government support programs, fluctuations in currency and interest rates, highly contagious livestock diseases, or the loss of export markets due to consumer health concerns, may present significant risks to producers at certain times. More problematically for researchers, it is highly likely that these multiple stimuli *interact* to influence farmers' decisions, including their farm management practices, and hence agricultural adaptations to climatic variability and change cannot be conceived via simple single stress - single response models (Risbey *et al* 1999; Smit *et al* 2000; Bradshaw *et al*. 2004; Adger *et al* 2005). While this point has been increasingly recognized in the climate change literature (see for example Timmerman, 1989; Chiotti and Johnston, 1995; Easterling, 1996; Smit *et al.*, 1996; Smithers and Smit, 1997; Brklacich *et al.*, 2000; Bryant *et al.*, 2000; Eakin, 2000; Kandlikar and Risby, 2000; O'Brien and Leichenko, 2000; Schneider *et al.*, 2000), the complexity of assessing farmer's perceptions of, and responses to, climatic and non-climatic risks, whether empirically or just conceptually, has hindered research.

This is especially true for that strand of climate change research that, consistent with Articles 4.1 and 10, respectively, of the *United Nations Framework Convention on Climate Change* and the *Kyoto Protocol*, has sought to identify possible strategies for adapting to climate change (e.g. Smit, 1993; Carter *et al.*, 1994; Smit *et al.*, 2000; Smit and Skinner, 2002) or the suitability of particular adaptive strategies (e.g. Mendelsohn 2000; Mizina *et al.*, 1999; de Loë and Kreutzwiser, 2000; Dolan *et al.*, 2001). The challenge for such research is identifying 'suitable' farm-level adaptations to climate change that *make sense* to agents in the multi-risk and multi-opportunity context in which adaptation decisions are made (see Bradshaw *et al*., 2004 for further discussion).

This discussion paper presents the findings of a research project that has sought to address these challenges in the climate change adaptation literature. The broad purpose of the research was to assess the prospects for farm-level adaptation to multiple risks in Canadian agriculture, including but not limited to those related to climatic variability and change. More specifically, four objectives were pursued:

1. conceptualize and empirically assess the place of climate related risks relative to other risks of production, marketing and finance in Canadian agriculture;
2. conceptualize and empirically assess the interaction of climate related risks with other risks of production, marketing and finance in Canadian agriculture;
3. assess the suitability of conventional farm-level climate change adaptation options in Canadian agriculture, given other sources of risk; and
4. develop a revised inventory of farm-level options for adapting to climate and other risks in Canadian agriculture.

In short, while the research reported herein was explicitly motivated by the need to assist Canadian agriculture to prepare for and manage anticipated climate change, it commenced from the simple fact that climate represents, and will continue to represent, just one of many sources of risk (or opportunity) to which Canadian farmers are exposed and respond.

1.2 Approach to the Research

The difficulty of accounting for the inevitable compounding effect of non-climatic stimuli represents just one of many barriers to improving our understanding of the likely adaptive response of farmers to anticipated climate change. Another barrier derives from the possibility that farmers will experience and respond to what Yohe (2000) labels 'inter-periodic variability' rather than long term climate change. While a healthy debate persists as to whether or not this is problematic for farmers' future adaptive capacity (e.g. see Schneider *et al.*, 2000; Mendelsohn, 2000 for the 'yes it is' perspective and Downing *et al.*, 1997; Yohe, 2000 for the 'no it is not' perspective), more significantly this speaks to the difficulty of predicting the likely farm-level response to anticipated climate change. A third and more fundamental barrier to improved knowledge of climate change adaptation derives from the simple fact that humans can respond in highly variable ways to similar external stimuli (Bryant *et al*., 2000; Kandlikar and Risby, 2000). This reality of human nature likely represents the greatest test for traditional climate change impact assessments, leading Schneider *et al.* (2000) to suggest that future impact assessments must identify – that is, make explicit - their assumptions regarding human adaptive behaviour, and even offer a variety of outputs based on a variety of assumptions.

In light of these and other barriers to improving our understanding of the likely adaptive response of farmers to anticipated climate change, many in the field have called for empirical assessments of *actual* adaptive behaviour in particular places over particular periods of time (e.g. Smit *et al.*, 1996; Smithers and Smit, 1997; Bryant *et al*., 2000; Kandlikar and Risbey, 2000; Polsky and Easterling, 2001), even though such behaviour is place and time-specific, and likely represents a response to inter-periodic climatic variability, as well as to multiple non-climatic risks and opportunities. In an agricultural context, such case studies, or what Tol *et al.* (1998) label 'temporal analogues', are relatively few. For example, Smithers and Smit (1997) drew on aggregate data representing thousands of producers to look for co-variations in climate stimuli, cropping areas, crop yields, crop insurance and technology over three decades in southern Ontario, and determined that climate stimuli accounted for a limited change in cropping areas, due in large part to the presence of crop insurance. In the cases of Smit *et al.* (1996), Smit *et al.* (1997) and Brklacich *et al.* (1997), a limited number of farmers in different regions in Ontario were surveyed to document specific changes in farm practice over a prior period, and the reasons offered for such changes. In all cases, surveying revealed that some farmers had undertaken tactical and strategic changes in light of climatic stimuli, especially annual conditions, but these changes also reflected the risks and opportunities presented by economic, technological, social and political factors.

The empirical assessment reported herein follows the more intensive approach of Smit *et al.* (1996), Smit *et al.* (1997) and Brklacich *et al.* (1997), in that it draws upon the experiences of a limited number of producers, documenting considerable information for each. However, instead of querying producers about their past actions (read adaptations) and the various reasons for these actions as was done with these earlier studies, this research sought first to identify any and all risks (and opportunities) to which producers are exposed, including but not limited to climatic ones, and then query producers as to their adaptation to said risks (and opportunities). In this, the style of querying is consistent with the so-called 'vulnerability approach' (see Stockholm Environment Institute, 2005).

More exactly, farm-level surveying via both interviews with individual farmers and focus group meetings with 3-8 farmers each was completed in British Columbia, Ontario and Manitoba between the summers of 2003 and 2004 (see Table 1.1). Participants were selected using purposeful sampling methods to get an illustrative selection of producers for each sector. Most typically, recruitment was undertaken with assistance from producer organizations like the British Columbia Fruit Growers Association and the Perth County chapter of the Ontario Federation of Agriculture. Separate pools of participants were created for the interviews and focus groups. Interviews were typically conducted in an interviewee's residence, while the focus groups were typically convened in meeting rooms at local establishments, at which participants were provided with a meal following the formal part of the meeting.

Table 1.1: Surveying Details

Location	*Sector*	*Interviews*		*Focus Groups*	
		Date	*# participants*	*Date*	*# participants*
Okanagan Valley, British Columbia	apples	fall'03	20	summer'04	4, 6 & 7
	grapes/wine	summer'04	22	summer'04	3, 4 & 4
Perth County, Ontario	field crops and/or livestock	summer'03	25	summer'03	7, 4 ,8 & 6
Southwestern Manitoba	field crops and/or livestock	summer'03	25	summer'04	6 & 7

In all the regions and with all producers, a consistent semi-structured questionnaire was used to complete the interview. In other words, a series of open-ended questions were delivered in an established order (see Appendix A). The questionnaire consisted of four sections: farm characteristics; past good and bad years; future risks and opportunities; climate change and adaptation. Section one sought to identify certain key characteristics about the operation, and to create a rapport between the interviewer and interviewee. Section two sought to identify relevant risks and opportunities of the prior ten years, which were captured in terms of 'what makes a bad year?' and 'what makes a good year?'. Note that this approach did not presuppose certain risks or opportunities, but rather allowed the producers to identify those which they saw as largely determining good and bad years. That said, in order to avoid the possibility of an interviewee overlooking a key influence, they were subsequently asked about specific stimuli, including government, economics, technology, environment, and weather. The second section also included questions regarding producers' responses (read 'adaptations') to both bad and good years, and the degree to which their responses were constrained. This enabled a characterization of the producer's adaptive capacity. Section three of the questionnaire sought to identify producers' perceptions of future risks and opportunities, be they related, for example, to commodity prices, weather, or government policy. Among other aims, this offered insight as to the degree to which producers expected climatic conditions to be a source of risk or opportunity in the future. Finally, the forth section asked producers to explicitly reflect upon the issue of climate change (e.g. is it perceivable) and to consider the degree to which certain prescribed adaptations might assist them in managing climatic change.

The focus group meetings not only allowed for verification of some of the answers and insights offered through the interviews, but also revealed new insights, given the tendency of the focus group dynamic to create synergistic thinking as one comment triggers a chain of responses from others. The order of questioning and discussion for the focus group exercises was consistent with the interview questionnaire (see Appendix B). However, the questions were more open, as the purpose was no longer to investigate individual responses to conditions, but rather to have the group members compare and even debate views on risks, opportunities, climate change, and the feasibility of certain farm-level adaptations.

A simple three-step process was used to analyze the data generated through the two survey methods. First, transcripts were generated reflecting the key content of the interviews and focus group meetings. Secondly, summary spreadsheets were generated for each of the four sectors across the three regions. The data was categorized within the spreadsheets based on the questionnaire structure, in order to enable summary counts for questions like, 'what gave rise to a good year in the Okanagan apple sector?'. Thirdly, individual case stories and quotes were compiled by the same categories, so that illustrations and explanations could be drawn upon where relevant. Taken together, the surveying and analysis offers an insightful picture of producers' exposure and response to multiple risks in Canadian agriculture.

1.3 Structure of the Discussion Paper

This discussion paper follows in five further chapters. In the next chapter, three bodies of scholarship focusing on farm-level adaptation to climatic variability and change, government policy change, and the introduction of biotechnology, respectively, are reviewed, as a first step towards conceptualizing farm-level adaptation to multiple risks in Canadian agriculture. The resultant conceptual framework not only provides a rationale for the approach to the research described in section 1.2, but also offers a basis for analyzing the survey results. These results, for each of British Columbia, Ontario, and Manitoba, are presented in chapters three, four, and five, respectively. Each chapter follows a similar format, mirroring the organization of the questionnaire; first, the conditions that created good and bad years for producers, and producers' responses to those conditions, are identified; second, future opportunities and risks as perceived by the producers are identified; and finally, those adaptations to climatic variability and change that 'make sense' to producers in a multi-risk and multi-opportunity environment are identified. However, before any of this is done, each of the three chapters starts with a description of the study area and a characterization of the sector under analysis. Finally, in chapter six, some conclusions are drawn from the cross-Canada findings, in order to offer some broader insights regarding producers' adaptation to multiple risks.

CHAPTER TWO

Conceptualizing Adaptation to Climate and Other Risks

As a first step towards overcoming the complexity of assessing farmer's perceptions of, and responses to, climatic and non-climatic risks, this chapter seeks to conceptualize farm-level adaptation to multiple risks. The chapter proceeds in two parts. First, insights are drawn from past scholarly efforts that have sought to understand how farmers respond or adapt to changes in some common *single* stimuli within agricultural systems, including, for example, climatic changes. Building on these insights, in part two a generic farming systems model is described, to enable the conceptualization of farmers' adaptation to *multiple* stimuli. In short, the framework offers a means of seeing the place of climatic risks relative to other risks in primary agriculture, the interaction of climatic risks with other risks, and the potential means by which producers might adapt to these multiple risks.

2.1 Farm-Level Adaptation to Single Stimuli

There is a long history of scholarship focused on the implications of various stimuli or drivers of change on the condition or structure of agricultural systems. In the context of Canadian agriculture, three individual stimuli that have attracted considerable attention of late include climatic variability and change, government policy change, and (the introduction) of biotechnology. In the next three sub-sections, the associated scholarship is reviewed in order to identify current thinking on how farmers have responded, or might respond, to changes in climate, government policy, and biotechnology, respectively.

2.1.1 Farm-Level Adaptation to Climatic Variability and Change

Farmers have continually contended with, and responded to weather for centuries, thus the interplay between agriculture and climate is not a new phenomenon. In recent decades, however, this relationship has become the focus of much academic research due to the growing concern over climate change (e.g. Parry 1990; Rosenzweig *et al.* 1995; Kandlikar and Risbey 2000). Being inherently sensitive to climatic conditions, agriculture is often considered to be among the most vulnerable sectors to the risks and impacts of climate change (Reilly 1995; Smit and Skinner 2002). Although it is often seen in a negative context, climate change may present opportunities for agriculture, in addition to risks, depending particularly on how farmers are able to adapt to the changing conditions. This uncertainty around how climate change will impact agriculture has prompted a number of studies since the 1980s, the approaches to which have evolved in their scope and methodology.

Early research in this field employed “top-down,” scenario-based approaches to estimate the impacts of climate change on agriculture. Examples of this approach include spatial analysis, climate impact modelling and Ricardian analysis. Spatial analyses were performed to estimate the spatial shift of productive, agricultural regions following a change in temperature and precipitation (Newman 1980; Blasing and Soloman 1984). Climate impact modelling used Global Circulation Models (GCM) to simulate a future climate scenario, usually resulting from a doubling of atmospheric carbon dioxide (Parry 1990; Chiotti *et al.* 1995). The GCM would model the change in agroclimatic conditions, which could then be inputted into crop simulation models to calculate the change in crop yields (Rosenzweig 1990; Brklacich and Stewart 1995), as well as the subsequent economic impacts (Adams *et al.*1990; Arthur and Van Kooten 1992). Ricardian analyses estimate the change in land value resulting from changes in climatic conditions, with the rationale that as land values change, the most profitable use of land also changes (Mendelsohn *et al.* 1994; Weber and Hauer 2003). Impacts of climate change are then calculated, assuming that land use has been adjusted to the new optimal (most profitable) use (Reinsborough 2003).

These conventional approaches were faced with two major limitations. Firstly, these approaches are comparative static, meaning they compare a snapshot of current average temperature and precipitation conditions to the average conditions of a snapshot in time in the distant future, assuming that all other conditions remain equal. However, more recent studies have shown that the principal climatic attributes that are problematic to farmers, and to which they are more likely to respond, is the variability of climate over time and the occurrence of extreme events (Smithers and Smit 1997; Klein and MacIver 1999). A change in average conditions may not be relevant to farmers, because they deal with, and have dealt with greater variations in weather on a daily basis presently and in the past. Furthermore, there may be other conditions that raise concern besides temperature and precipitation, such as the occurrence of frost or pest outbreaks.

Secondly, the approach is limited in its ability to take into account the role of human agency in adaptation and decision-making (Bryant *et al.* 2000). In the 1990s, the importance of adaptation in reducing the negative effects of climate change was realized. Later scenario-based approaches attempted to incorporate adaptation strategies, such as changing the planting date, increasing irrigation or switching to drought resistant crops, into the models to estimate the net impacts (Easterling 1993; Rosenzweig and Parry 1994; Fischer *et al.* 1995). However, there was no evidence that these adaptation strategies were feasible, realistic or even likely to occur. Furthermore, they would only be possible with complete and accurate knowledge of future climatic conditions, which is why these were aptly named “clairvoyant farmer” scenarios (Risbey *et al.* 1999).

More recently the focus of research has shifted from the estimation of impacts, to understanding farm-level adaptation and decision-making. The theoretical work has attempted to “anatomize” adaptation, by categorizing types of responses (autonomous vs. planned; anticipatory vs. reactive), and by identifying the important elements of adaptation that need to be understood, namely the climate-related stimuli, the system that is adapting, and the process and outcome of adaptation (Smit *et al.* 1999; Wheaton and MacIver 1999; Smit *et al.* 2000). Much scholarship has also been dedicated to understanding and describing *adaptive capacity*; that is, the ability of a system to cope with or adapt to risk

(Wheaton and MacIver 1999; Smit and Piliofosova 2002; Yohe and Tol 2002). Adaptive capacity is dependent on a number of factors, such as economic wealth, technology, information, and perception of risk. Taken together with the *exposure* of a system to risk, adaptive capacity can be used to assess the vulnerability of a system (Smit and Pilifosova 2002).

Prompted by the shortfalls of previous studies which attempted to model *assumed* adaptation, a body of literature has emerged that identifies past and potential adaptations in agriculture, whether at the farm-level or by government (e.g. Smit and Skinner 2002; also see Appendix C). Examples may include government initiatives to fund technological adaptations such as crop development (Smithers and Blay-Palmer 2001), or improving the state of weather forecasting (Murphy 1994); farm-level adaptations may include altering soil management practices (Dumanski *et al.* 1986), or diversifying their farm enterprise (Smit 1993; Kelly and Adger 2000). While the identification of options is a useful exercise, it gives no indication as to which measures are most appropriate for dealing with weather risks, and thus which measures *should* be adopted or promoted. To address this shortcoming, a number of studies have sought to evaluate the suitability of adaptations according to criteria such as economic efficiency, effectiveness, flexibility or institutional compatibility (e.g. Carter *et al*, 1994; Fankhauser 1996; Smith and Lenhart 1996; Mizina *et al.* 1999; de Loë and Kreutzwiser 2000; Dolan *et al.* 2001). While such evaluations may be useful for identifying suitable adaptations to manage strictly climate-related risks, Dolan *et al.* (2001) argue that they are insufficient for identifying adaptations that effectively manage multiple risks (and opportunities), which is, of course, what farmers face in the real world. Hence, what ought to happen at the farm level given the risks associated with climatic variability and change, may not match what farmers actually do.

Another strand of adaptation research, consistent with the research reported herein, has sought to investigate ‘actual’ adaptations at the farm level, as well as the factors that appear to be driving them (e.g. Smit *et al.* 1996; Brklacich *et al.* 1997; Chiotti *et al.* 1997). This research uses a ‘bottom-up’ approach, which seeks to gain insights from the farmers themselves through questionnaires, in-depth interviews, and focus groups. From such studies, various conclusions have been drawn, including the fact that many farmers are sceptical about climate change, but are confident they have the tools to adapt if need be (Bryant *et al.* 2000). In the cases of Smit *et al.* (1996), Smit *et al.* (1997) and Brklacich *et al.* (1997), a limited number of farmers in different regions in Ontario were surveyed to document specific changes in farm practice over a prior period, and the reasons offered for such changes. In all cases, surveying revealed that some farmers had undertaken tactical and strategic changes in light of climatic stimuli, especially annual conditions, but these changes also reflected the risks and opportunities presented by economic, technological, social and political factors. Thus it appears that the decisions that farmers make are not prompted by climate in isolation; farmers live in a multi-risk environment, and as such, must respond to various forces concurrently.

2.1.2 Farm-Level Adaptation to Government Policy Change

While farmers make individual decisions concerning the management of their operation, these decisions must be made within a broader political environment. Since the early 1920s, following a collapse in commodity prices, governments in the West have taken an active role in supporting farmers through various programs, such as input subsidies, guaranteed prices, and disaster relief (Ilbery 1985; Bradshaw and Smit 1997). It has often been argued that these programs have created a risk-free environment for producers, which, when coupled with advances in technology, have facilitated the intensification, specialization, and concentration of production; this, in turn, has been implicated as a contributing cause of environmental decline (e.g. Found 1971; Body 1984; Bowler 1985; WCED 1987; de Wit 1988; OECD 1989, 1993; Abler and Shortle 1992; Sopuck 1993; Tweeten 1995; Anderson and Strutt 1996; Lewandrowski *et al.* 1997; Potter and Goodwin 1998).

Although the causal links between government programmes and environmental decline are more complex than is described above, it is nonetheless a commonly held belief that by reducing overall support levels and decoupling remaining support from production decisions, there will be less environmental degradation, as farmers will be compelled to make more efficient use of costly inputs like agrochemicals and, more generally, reduce the intensity of their operations. This belief has been one driver of policy reform at an international scale, which has initiated a trend towards the deregulation of agriculture and market liberalization (Bradshaw and Smit 1997). It is these trends (regulation, deregulation, and liberalization) and their impacts on production, on the environment, and on farmers, which have been the focus of much scholarly literature in the past two decades.

Agricultural economists in particular have paid considerable attention to modelling the production effects of a variety of government policy interventions, such as taxes, tariffs and subsidies (e.g. Heady and Srivastava 1975; Shoven and Whalley 1984; Office of Technology Assessment 1985; Robinson 1989; Stoeckel *et al*. 1989; Gardner 1990; Kerr *et al.* 1991; Meilke and Weersink 1991; Turvey 1992; Massow and Weersink 1993). Typically, the models are calibrated to some benchmark equilibrium, and then a hypothetical change is induced, thereby moving the model to a new equilibrium. As agricultural trade liberalization has been realised through multilateral agreements, such as the NAFTA and GATT, efforts have been made to quantify the global trade, production and consumption impacts of liberalization (e.g. Greenes and Kristoff 1993 for the impacts of NAFTA; see Whalley and Hamilton 1996 for a review of impact models of the GATT Uruguay Round).

A subset of this research has sought to examine the links between liberalized trade and the environment (e.g. Bredahl *et al*. 1996; Krissoff *et al*. 1996). Building on the earlier tax and trade-based general equilibrium models, an environmental component is usually specified through some explicit interaction between physical production processes and the natural resource base, in order to identify impacts such as soil erosion (Whalley 1996). For example, Anderson (1992) builds on a model of world agricultural production to qualitatively assess the environmental impacts of multilateral reform. As an extreme simulation, the model assumes total removal of all farm subsidies worldwide in 1990, and full adjustment in that same year. While the estimated impact on world food output is negligible, the relocation of production would have important environmental ramifications.

The big declines would be in Japan and Western Europe, where current agricultural production is most intensive and dependent on farm chemicals. While these declines would be offset by increasing production in regions such as Australasia and the Americas, thereby causing intensification, the overall environmental impact would be positive (Anderson 1992).

Anderson and Strutt (1996) recognise that these types of models provide only a crude understanding of the environmental effects of trade liberalization. They suggest that future modelling efforts might gain from adding input markets and damage functions to either national or global scale models, so that output changes can be related to input changes, and input changes to environmental changes. By adding feedbacks, these models might be able to capture the production effects of an environmental change such as soil erosion, which might in turn result in market price changes. Furthermore, Antle *et al*. (1996, p.173) recommend the development of models at sub-national scales, based upon the "location-specific nature of the interactions between agricultural production and the environment, as well as changes in the intensity and location of production brought upon by policy liberalization." This point is echoed by Potter and Goodwin (1998) who suggest, using the example of nitrate pollution of groundwater, that it is the location of the occurrence, including the type of soil and hydrological characteristics, that determines the environmental impact. Hence, while global and national scale analysis may be customary for general equilibrium modelling of trade policy liberalization, this type of aggregation may not be appropriate for analyzing the environmental impacts of such a policy change, because the processes that determine these impacts are location specific.

The impacts of policy change will also be location specific due to the fact that individual farmers will respond differently to the change. Recently it has been found that the outcomes of policy change have not been entirely as expected or as modelled, the reasons for which are not fully understood (Winter 2000). This has led to the emergence of research that attempts to discover the impacts of policy change at the farm-level, including how individual farmers respond. Winter (2000), for example, investigated the environmental impact of the CAP reform in 1992 by interviewing British farmers and triangulating the data with policy and market analysis and physical on-farm evidence. While the policy reform was expected to result in a less intensive agriculture, with consequent environmental benefits, this has not been the case. The author suggests that one of the reasons the expected reversal of trends did not unfold was because market developments altered the course of the reforms. He concluded that policy alone does not drive farm management decisions; rather, market signals and a range of factors combine to influence the behaviour of individual farmers.

Based on hypothetical or actual subsidy reform, some analysts have predicted (e.g. Rosegrant *et al.* 1995) or at least implied (e.g. Abler and Shortle 1992; Potter and Goodwin 1998) that increasingly specialized agricultural operations would (have to) shift back towards producing a more diverse range of outputs. Bradshaw (2004) empirically assessed this prediction based on the case of the termination of the Western Grain Transportation Act (WGTA) in Saskatchewan, Canada. Through an analysis of Statistics Canada data, it was found that, at the provincial scale, output has indeed become more diversified; however, at the individual farm scale, the trend of specialization has continued notwithstanding the policy reform. These results, taken with those of Winter (2000), indicate that the response to subsidy removal has not mirrored that which has been predicted by analysts. It may be argued then that policy is not as significant a driver of farm-level change as previously believed. As such, analyses of policy impacts must also take into consideration the myriad of other factors that influence farmer behaviour.

2.1.3 Farm-Level Adaptation to (the introduction of) Biotechnology

The recent emergence of biotechnology innovations in agriculture has added a new element to farming. Following nearly two decades of research and experimentation, the first wave of biotechnologies were commercialized and made available to farmers in the mid-1990s (Kalaitzandonakes 2003). Initial innovations were in crop breeding, which is achieved through tissue culture or micro propagation (see Mannion 1995). Now the agricultural biotechnology industry is dominated by the genetic engineering of organisms through recombinant DNA techniques. In the genetic engineering process, chromosomes are manipulated by isolating genes that exhibit desired characteristics and transferring these into the host organisms. Genetic engineering has been more rapidly adopted than crop breeding because of the reduced time required to identify desirable traits and the greater precision in altering a plants' traits (Fernandez-Cornejo *et al.* 2000).

Genetic engineering can be classified into two "waves" or generations. First-generation products are those with modified *input* traits, the two most common being herbicide tolerance and pest resistance (see Box 2.1). These products are available commercially and have been rapidly adopted, as they are touted to be cost-saving, convenient and environmentally friendly (Hillyar 1999). Second-generation products are those with modified *output* traits (e.g. quality and flavour) and agronomic traits (e.g. salt and cold tolerance) (McDougall and Phillips 2003). These products are not yet commercially available, but they are expected to arrive in the market within the next decade (Kalaitzandonakes 2003). As such, much of the empirical work in this field is directed at first-generation Herbicide Tolerant (HT) and Insect Resistant (IR) products.

Although agricultural biotechnology is a relatively new phenomenon in agriculture, there is a considerable body of literature that addresses the issue. This work can be divided into three categories: commentaries; impact assessments; and adoption studies. The first body of work discusses many of the promises, concerns, and ethical issues of biotechnology in agriculture and food consumption. The main advantages of genetically engineered crops are potential environmental benefits from reduced pesticide use and the use of more benign herbicides (Hall and Crowther 1998; Fernando-Cornejo 2000), decreased pest management costs, increased yields (Klotz-Ingram *et al.*1999), and continuous, target-specific protection from pests (Mannion 1995). Major concerns, however, include the transfer of HT and IR genes to wild relatives, creating herbicide resistance in weeds, and *Bt* (*Bacillus thuringiensis)* resistance in insects. Other concerns and ethical issues include health concerns about consuming Genetically Modified (GM) foods (Mannion 1995; Burkhardt 2001; Fortin 2001), and the unequal distribution of benefits along the supply chain, from the innovators down to the consumers (Reiss 2001). It is speculated that the main benefactors will be the agro-biotechnology companies, rather than the farmers for whom the technologies are created (Peters 2000; Fulton and Giannakas 2001).

Box 2.1: Roundup Ready® Soybeans and Bt-Corn

Roundup Ready® (RR) soybeans are the most widely adopted herbicide-resistant seed. The seed is genetically engineered to be resistant to Glyphosate, a herbicide developed by Monsanto in the 1970s and given the commercial name Roundup®. Glyphosate is a non-selective herbicide that effectively kills virtually all plants and is more benign than other herbicides, as it breaks up quickly into naturally occurring compounds once in the ground. Monsanto researchers identified an enzyme which is unaffected by Roundup® and introduced it into soybeans, corn, canola, and cotton allowing the plant to continue its metabolic functions in the presence of the herbicide (McBride and Brooks 2000). The RR soybeans became commercially available in 1996, and within four years were estimated to account for 51% of total soybean acreage planted in the US. This rapid adoption is presumed to be primarily due to the simplicity and flexibility of the weed control program, since it only requires the application of one herbicide, which can be applied to the crop at any stage of growth (Carpenter and Gianessi 1999).

Bt- crops are bioengineered seeds that contain genes from the soil bacterium Bacillus thuringiensis, bacteria which produces a protein that is toxic when ingested by certain Lepidopteran insects (Klotz-Ingram 1999). The inclusion of this gene gives the crop the ability to produce its own toxin, thereby providing continual protection throughout the entire plant. Currently, Bt- crops, including predominantly corn and cotton, are the only type of insect-resistant seeds that are commercially available. The seeds are resistant to specific insects; for example, Bt- cotton is resistant to the tobacco budworm and the bollworm, and Bt-corn is resistant to the European corn borer and to some extent the corn earworm (Fernandez-Cornejo et al. 2000). Although adoption rates of Bt- crops are not as rapid as Roundup Ready® soybeans, they are nonetheless significant. Within four years of it's introduction, for example, Bt- cotton made up over 25% of total cotton acreage planted in the US (Kalaitzandonakes 1999).

Some research has sought to assess the impact of biotechnology adoption on, for example, crop yields, farmers' costs, the environment, and the distribution of benefits. One common means for undertaking such impact assessments has been to investigate input substitution. Carpenter and Gianessi (2003), for example, analyzed pesticide and herbicide use among adopters and non-adopters of genetically engineered cotton, corn and soybeans. Among adopters, overall use of pesticides declined. Further, while herbicide use increased slightly, the mix of herbicides changed; the use of Glyphosate increased, while all others decreased. Impacts have also been assessed through the use of econometric models (Lin *et al.* 2001). For example, Fernandez-Cornejo and Klotz-Ingram (1998) estimated the impacts of HT corn adoption on yields, profits and herbicide among US producers. The authors found that the effect on yields and profit was small, and that the use of herbicides rose. These results concur with McBride and Brooks (2000), who determined that HT corn offered neither a cost advantage nor disadvantage. Econometric models are also used to estimate the distribution of benefits. Price *et al.* (2001) found that the farmers receive considerably less than half of the benefits, contrary to popular belief, while the bulk of the benefits go to the gene supplier, seed companies, and the consumer. Similar results were found by Moschini *et al.* (2000) and Falck-Zepeda *et al.* (2000).

While studies like these are useful for determining the economic impacts of adopting biotechnology, they have some limitations. Firstly, the studies have a very narrow focus, in that they only consider one innovation at a time and ignore the possibility that complementary technologies were adopted simultaneously. Secondly, these studies seldom if ever consider exogenous factors that might impact upon adoption (e.g. a change in infestation levels, or personal views) (Kalaitzandonakes 2003). Thirdly, many of the studies simply group sample populations into adopters and non-adopters, and thereby fail to recognize that the population is made up of a mix of non-adopters, early adopters, late adopters, dis-adopters and partial adopters (Barham *et al.* 2002).

These limitations have led to a growing number of studies that attempt to explain the rapid adoption of certain biotechnologies. Such work has largely assumed that adoption is based on perceived economic benefits related to pesticide cost reductions, yield increases, improved risk management, and so on (Kalaitzandonakes, 1999). Surveys of growers have confirmed some of these benefits, but also revealed other rationales for adoption. Pilcher *et al.* (2002), for example, found that the primary reason for adoption of Bt corn was to prevent yield loss from pests. The study also found that obtaining a better yield was an important advantage, but not a key driver of adoption, and that there was a perceived economic advantage only in years where infestations were high. The Canola Council of Canada (2001) conducted a similar survey with canola growers in western Canada and found that their primary reason for adoption was not economic, but rather due to more efficient weed control and ease of herbicide management. Conversely, the main reason *not* to adopt was because of the greater costs incurred. The study also showed that farmers experienced a number of benefits, including a slight increase in yield, reduced herbicide costs, reduced tillage, and therefore reduced fuel use.

Studies of biotechnology adoption and farmer behaviour are still in their infancy, but preliminary results reveal interesting findings about the drivers of adoption. While surveys have been effective for gaining insights into adoption, they are limited in the information that they can obtain. There is a need for studies that explore the attitudes of farmers towards biotechnology, the reasons for adoption, and how decisions are made relative to the various other sources of risk and opportunity that farmers face.

2.2 From Single to Multiple Stimuli

Based on the preceding reviews of the literatures on farm-level adaptation to climatic variability and change, policy change, and (the introduction of) agricultural biotechnology, respectively, it appears that past efforts to understand the system impacts of individual stimuli generally reflect what Wenger et al. (2000) disparagingly label the 'single-stressor single-endpoint' paradigm. To be fair, however, little if any of the above reviewed research has regarded the additional stressors influencing the systems under investigation as extraneous or insignificant. A more common practice has been to control for these compounding variables through declarations of *ceteris paribus*; however, even in these cases, multiple system stimuli are usually recognized. Indeed, in much of the recent climate change adaptation research, non-climatic stimuli have been explicitly incorporated into the conceptual frameworks that guide data collection and analysis (e.g. Smit *et al.* 1996; Brklacich *et al.* 1997; Chiotti *et al.* 1997).

These agricultural system frameworks, the most rudimentary form of which was conceived by Olmstead (1970:32), start with the recognition that, “no farm exists unto itself”. Rather, individual farms exist within, and hence are exposed to, a spatial hierarchy of biophysical, political, social and economic influences, including for example inter-periodic climatic variability, interest rate shifts, changes in consumer preferences, or new environmental regulations (see Figure 2.1). The responses of many individual producers to these external influences can be highly variable given differing perceptions and sensitivities, both of which are likely a function of the particular attributes of individual farms and farm operators. Finally, according to the framework, farm-level decisions produce impacts for the individual, as well as aggregated economic, environmental and social impacts, all of which can be expected to create system feedback.

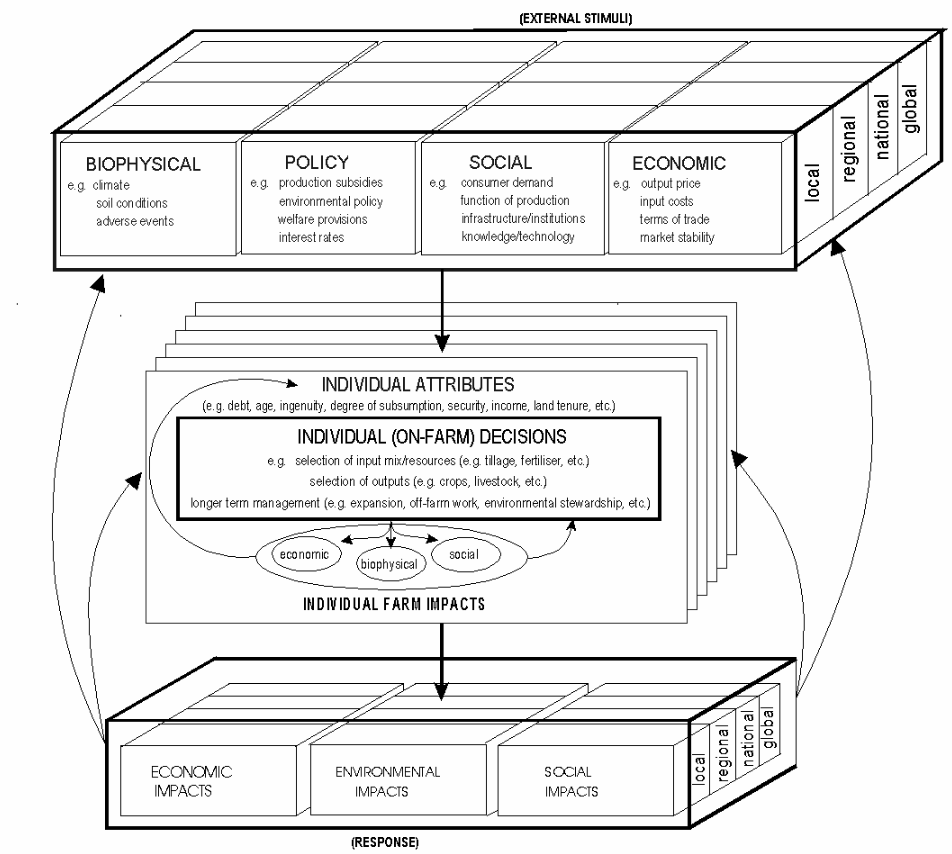


Figure 2.1: A Generic Agricultural Systems Framework (Bradshaw and Smit 1997)

This agricultural systems framework effectively *places* climatic risks relative to other risks of production, marketing and finance in primary agriculture, and does so in a way that at least enables one to envision certain *interactions* among various external stimuli. That is, it makes it possible to see a producer’s larger context within which any perceived change in climate will be experienced and potentially addressed. Further, the potential *means* by which a producer might respond to climatic and other stimuli, be it through changing outputs or taking off-farm work, can also be identified in the framework, though these are not itemized in Figure 2.1 (see instead Appendix C). In these regards, it appears to satisfy the conceptual needs of this research effort.

A complimentary framework that similarly satisfies the conceptual needs of this research effort, but also offers direction for empirically investigating producers' adaptation to climate and other risks, is implicit in the so-called 'vulnerability approach' (see Stockholm Environment Institute, 2005). As per this approach, the vulnerability of a system - that is, the degree to which it is susceptible to injury, damage or harm (Smit and Pilfisova 2001) – is a function of two main elements: the *exposure* of the system to an external stress; and the ability of the system to *adapt* to the stress (Wheaton and MacIver 1999; Smit and Pilifosova 2003; Yohe and Tol 2002). The two elements have an inverse relationship: as the exposure of a system to risk increases, *ceteris paribus*, so does the vulnerability; conversely, as the adaptive capacity is enhanced, *ceteris paribus*, vulnerability is reduced (Smit and Pilifosova 2003). In the context of assessing an agricultural producer's vulnerability, the approach directs researchers to make use of 'bottom-up' data gathering techniques in order to identify: (1) (just) those risks that are deemed problematic by producers; and (2) the specific actions that producers have undertaken to try to manage these risks.

As with the agricultural systems framework, the greatest insight offered by the 'vulnerability approach' derives from its application in particular places and times. The results of such applications in each of British Columbia, Ontario, and Manitoba are presented in the following three chapters with the aim of documenting how producers experience and respond to climatic and other risks in Canadian agriculture.

CHAPTER THREE

Exposure to Multiple Risks: Evidence from the Grape and Apple Sectors in the Okanagan Valley, B.C.

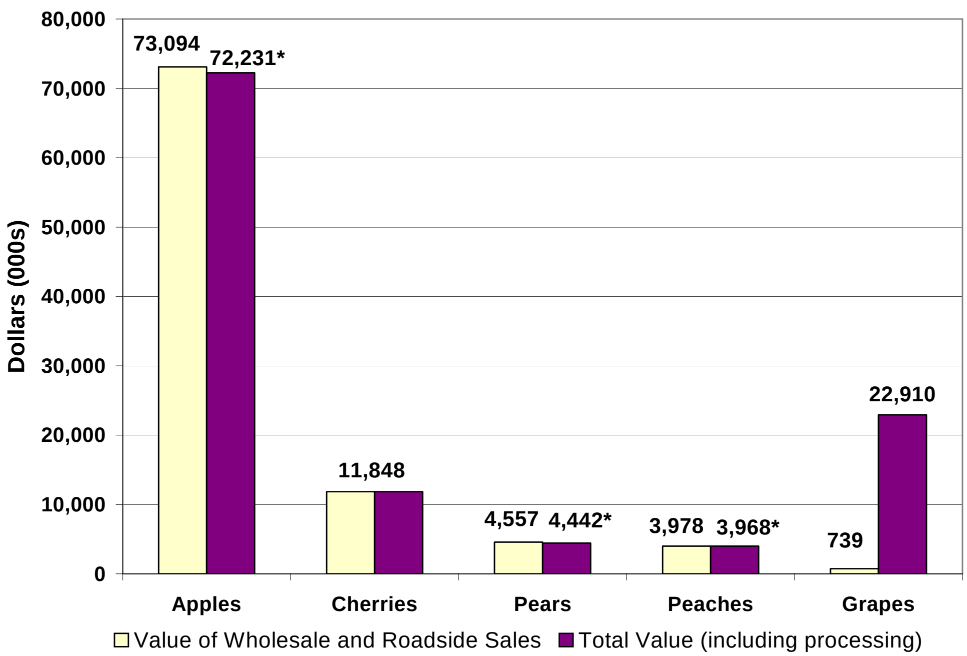
This chapter is the first of three chapters that report on the findings of farm-level surveying across Canada. Again, this surveying aimed to gain insights from producers regarding the risks and opportunities that they face, and how adaptation occurs at the farm-level. In all locales, a similar approach was employed, combining individual interviews and focus group meetings. In the case of the Okanagan Valley, B.C., two sectors, grape/wine and apples, were targeted, with each subject to distinct analysis. The purpose of this chapter is to summarize the results of these two analyses. The results are discussed consistent with the format of the interviews and focus groups, starting with what conditions make a 'good' or 'bad' year and how producers respond, what are seen as future opportunities and risks, and what adaptations to climatic variability and change 'make sense' in a multi-risk and opportunity environment. Prior to this discussion, this chapter begins with a brief description of the Okanagan Valley.

3.1 Study Area: The Okanagan Valley

The Okanagan Valley is located in the southern interior of British Columbia, stretching 250 km north-south, down to the border of the United States. The narrow valley is situated in between two mountain ranges and contains a system of oblong lakes, the largest being the Okanagan Lake (Canadian Geographic 2004). The combination of the rain shadow effects from the mountains and the moderating effects of the lakes create a climate in the valley that is ideal for fruit production. It is a semi-arid region, with a long growing season, warm temperatures, and mild winters; the average annual temperature is 10ºC. The valley receives very little precipitation, with average annual precipitation ranging from 300-750mm, depending on the location; precipitation increases to the north of the valley, and with elevation (Wilson 1996; Neilson *et al.* 2001). Despite the near desert conditions in some regions, agriculture is made possible by irrigation. Water for irrigation comes mainly from snow melt from the adjacent mountains, either as runoff or groundwater recharge (Neilson *et al.* 2001).

Figure 3.1 Okanagan Valley, BC

Agriculture in the region consists mainly of cattle and tree fruit production. Cattle production occurs mainly in the north end of the valley, where meadows do not need to be irrigated, while tree fruits and grapes are produced throughout the remainder of the valley. As Figure 3.1 shows, apples are the highest valued tree fruit in the Okanagan Valley, grossing over $73 million in 2002 in wholesale and roadside sales; this is six times the value of the next highest grossing tree fruit, which is cherries, and sixteen to eighteen times the value of peaches and pears, respectively. If only wholesale and roadside sales are considered, then the value of grapes seems trivial in comparison, earning only $739,000. However, when the value added from processing fruit is calculated, three of the four tree fruits operate at a loss, while the value of grapes rises considerably. When the processing value is included, grapes become the second highest earning fruit in the Okanagan, with a total value just shy of $23 million (BCMAFF 2002). Also, since it is an industry that is highly reliant on agri-tourism, the fruit's economic importance to the valley is even greater. Furthermore, it is an industry that has been rapidly expanding over the last 15 years, with the number of wineries in the valley increasing from 4 to 59, and which is expected to expand further in the next decade (MKWS 2004).



*Processed price to tree fruit growers is negative, in that packinghouse charges exceed the price paid by the processors for the fruit

Figure 3.2: Value of Fruit Sales in the Okanagan Valley in 2002

3.2 The Grape and Wine Sector

This case study reports on results from 22 interviews and 3 focus groups, conducted with both winery operators and independent growers from small, medium and large operations, whose acreage ranges from as little as 5 to approximately 800 acres in order to get a sample of producers that is illustrative of the industry. Two of these interviews were held with producers who grew both fresh market grapes and wine grapes, to compare the risks and opportunities of the two commodities.

3.2.1 Good and Bad Years

Respondents were first asked to identify years that were good for their operation and what conditions lead them to be good. As Figure 3.2 shows, 81% of respondents indicated weather as one of the conditions that characterize a good year. These conditions include a hot and dry summer, an early spring, and a long growing season (see Table 3.1). Two of the respondents differentiated between conditions that were good for red grape varieties and white grape varieties, indicating that white grapes actually perform better under cooler summer conditions. When winery operators were asked what makes a good or bad year, a third of them made the distinction between years that were good for the vineyard and years that were good for business; the former were characterized, not surprisingly, by weather conditions, and the latter by market conditions, in terms of increased sales and financial growth.

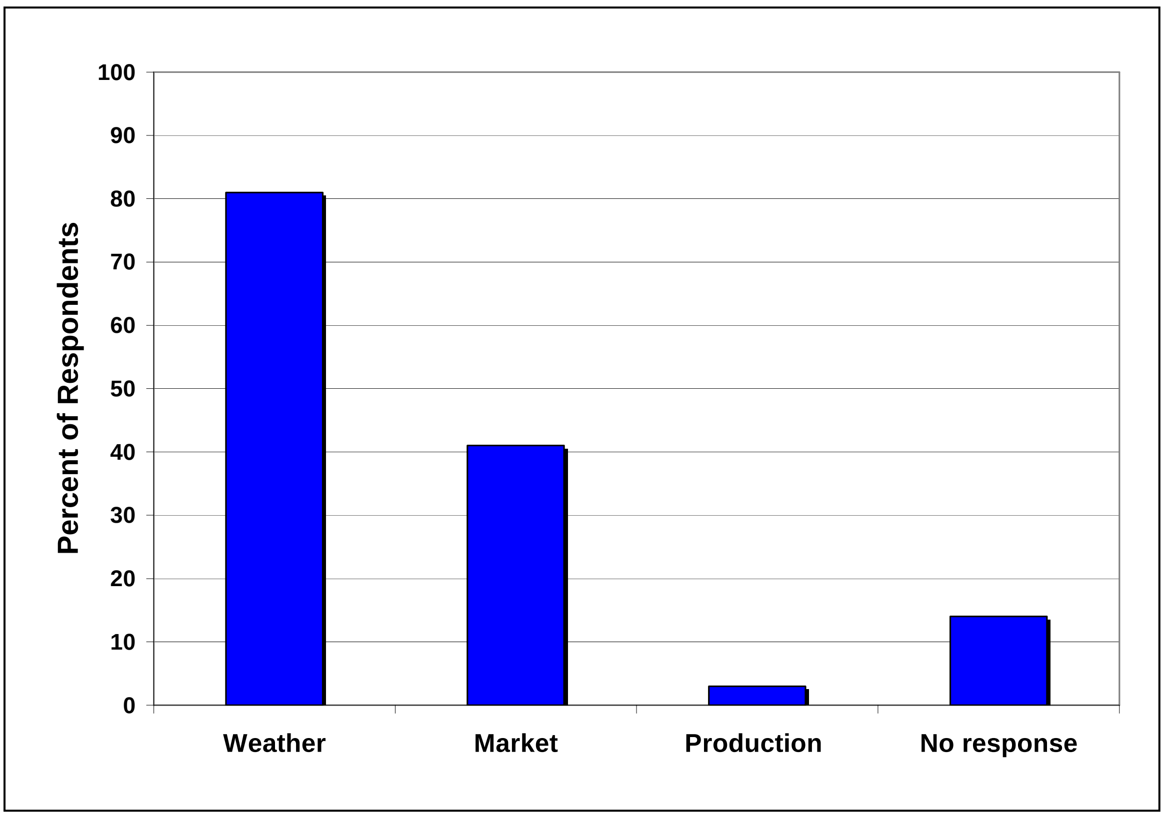


Figure 3.3: Conditions that Characterize a Good Year for Grape Growers

Table 3.1: Conditions That Characterize a Good Year in the Grape Sector and their Associated Adaptations

Condition	*Adaptation*
Weather	
Hot and dry summer	Manage water
Long growing season	Irrigate
Early, warm spring	Monitor for mildew
Weather in general	Keep a heavier crop
Cool season (for white grapes specifically)	Do not let the grapes over ripen
	Alter spraying practices
	Next year do extra fruit thinning
	Next year leave more buds on
Market	
Continual growth	Expand operation, renovate
High sales and profit	Buy fewer grapes from growers
Better recognition of the industry or winery	Buy equipment
High grape prices	Put money away
	Put money into NISA
	Prune, thin, spray
Production	
Getting closer to full production	
Learn more every year	[No response]
Improve quality	
No Answer	
All years are the same	Reduced risk from the beginning

Two of the market conditions that were identified as important were related to the price of grapes and, interestingly, these were identified by both of the fresh market grape growers. Prices for fresh market grapes are more variable than wine grapes because they are sold on the free market. Wine grape prices, on the other hand, are determined through negotiated contracts between the growers and the wineries. The price is typically based on the quality of the fruit, but may also depend on the working relationship between the parties, and the skills of the grower. It should be noted, however, that although the prices for fresh market grapes are more variable than wine grapes, they are nonetheless more stable than prices for tree fruits. This is because there are so few fresh market grape growers, in comparison to other tree fruits, and the demand of the grapes is greater than the supply.

Interviewees were then asked how they respond to good years, with the purpose of discovering how producers adjust their practices, and what their capacity is to respond to external forces. From the adaptations listed in Table 3.1, it is evident that the two principal types of response following a good year are viticultural practices and financial management. In good (hot and dry) years, there are more heat units available for the grapes, so producers are able to mature a heavier crop and still maintain quality. Although more irrigation is required, several producers said they preferred to irrigate because that gives them greater control over the quality of the grapes. Following a good year for the business (good market conditions), producers tend to reinvest money back into the operation or put money away for the bad years. It is important to mention that while all of these adaptations are a reaction to climate or market conditions, producers also reduce risk through anticipatory management. This is exemplified by a respondent who did not identify conditions for a good year, saying that all years were the same (see Box 3.1).

Box 3.1: Anticipatory Adaptation: One Winery's Self-Insurance Policy

When one interviewee from a medium-sized winery was asked to identify a good year in the last 10 years, he said that there were none that were better or worse than others; there were "no peaks, no valleys." He explained that his strategy is to avoid being put in a high risk environment, through knowledge, and good vineyard husbandry, thereby creating his own insurance policy. Knowing he was going to get into the wine industry, he took his time to "do his homework," and to minimize risk from the beginning. He studied enology and viticulture in Germany for 6 years, and then worked on a local vineyard for 5 years before opening up his own business. During this time he conducted a 7 year microclimate study of the valley to determine the best location to plant his vineyard, by avoiding areas prone to spring and fall frost and hail. The site chosen is located on the west side of the valley so that the vineyard is shaded in the evening, slowing down the development of grapes, and allowing them to achieve a better balance of sugar, acid, and pH and more complex flavours. He also minimizes risk through the selection of grape varieties, choosing ones that are more winter tolerant and are on grafted rootstock which are resistant to the pest Phylloxera vastatrix. The development of his business occurred slowly and gradually, to avoid getting into debt. While he does acknowledge that despite his efforts he is still highly vulnerable to a severe winter, so is the entire valley. If a disaster were to occur, he would not be alone, and presumably the government would aid the industry until it is able to get back on its feet.

A similar trend is seen when respondents were asked about bad years. In this case 77% of the respondents identified weather as one of the conditions leading to a bad year (see Figure 3.3). The most common answer was a cold and wet summer (see Table 3.1). A cool summer means there are less heat units available, which is particularly problematic for red grape varieties that require a lot of heat to ripen the grape and to produce sugars. Although cool conditions are favourable for white grape varieties, when combined with too much rain at certain developmental stages, difficulties are created. For example, rain before harvest time causes a rapid uptake of water, which dilutes the flavour of the grape. Flavours are found in the skin of the grape, so the smaller the berry, the higher the skin to juice ratio, and the stronger the flavour. It should be mentioned, however, that the opposite is desired for fresh market grapes – the larger the berry the better.

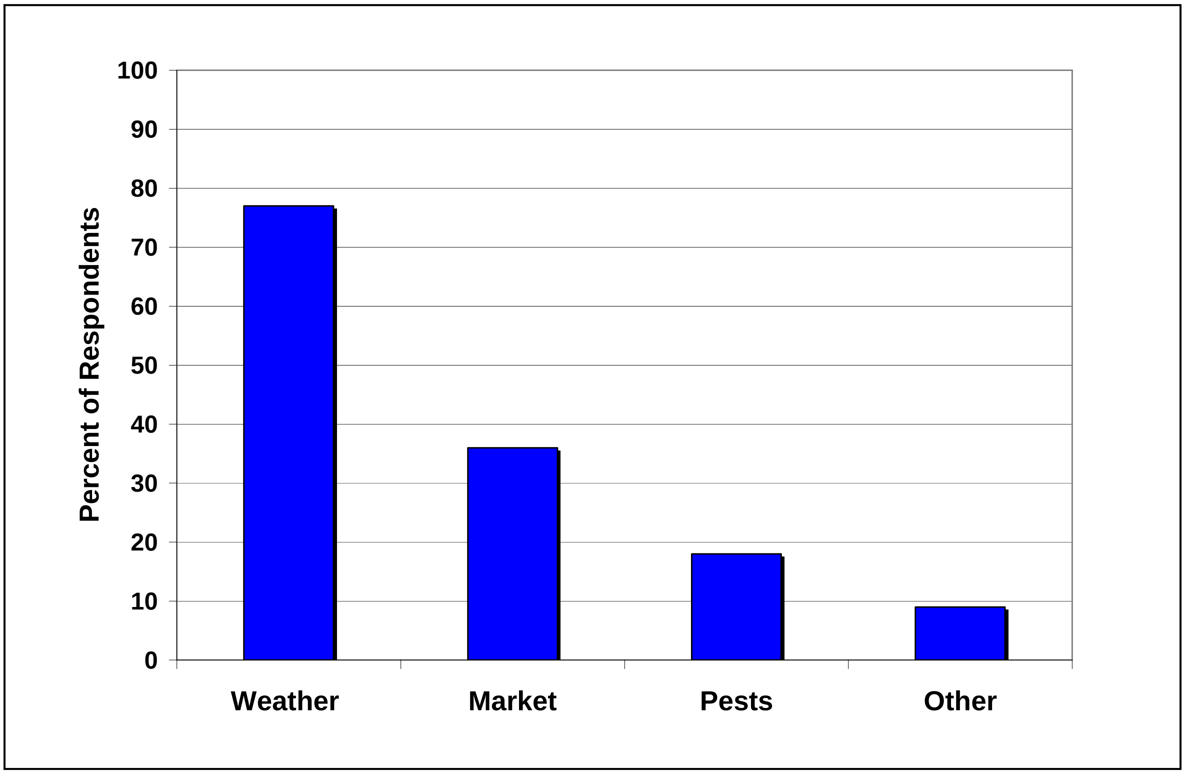


Figure 3.4: Conditions that Characterize a Bad Year for Grape Growers

Spring and fall frosts were often cited as a concern as well. Spring frosts kill the shoots so that no crop will be produced; fall frosts will burn the leaves off the vines, so the plant will not produce any more sugar and the berries will not mature. Other weather conditions that were identified include a late spring and a short growing season, extreme heat and fires. Although fire is not a weather condition *per se*, it is categorized here as it is partly a result of hot, dry conditions. Extreme heat is problematic for white grape varieties because at temperatures above 35°C the vine will shut down, stopping photosynthesis and berry development for a period of a few days to a few weeks. As one medium winery respondent explained: "*Whites are like Caucasians- anything over 30 degrees and we're not working outside anymore- we need shade and a beer. Siesta time. Red grape varieties are like Jamaicans- they just love the heat.*" If the vine shuts down, then maturation is delayed in an already short season, increasing the risk of fall frost damage and reducing the chances of getting a fully matured crop.

Thiry-six percent of the respondents were concerned with factors that affect the market, refering to factors that hinder the purchasing of either the wine or the grapes. For the most part, these factors include significant events that have a negative impact on tourism: SARS, Mad Cow disease, 9/11, and the 2003 forest fire in Kelowna. It should be mentioned that forest fires are categorized separately under both weather and market, depending on what the interviewee identified as the impact – smoke taint in the grapes or reduced tourism, respectively. Market prices were again a concern for one of the fresh market grape growers, and the increase in fuel prices was mentioned by a small winery owner due to both increased input costs and the affect to tourism. In one case, an independent grower gave an account of a particularly bad year in which the winery did not pay him for his grapes (see Box 3.2).

Box 3.2: Breaking the Contract: A Grower's Nightmare

The price that independent growers receive for their grapes is typically based on a written contract that is negotiated between the wineries and the grower, and the grower receives this payment within a month of delivering the grapes. One independent grower, however, was confronted with the unwelcome situation of the winery breaking its contract. At the end of the season, the grower delivered the grapes only to find out afterwards that the winery could not pay them: "*They took the grapes but they didn't have the cash flow to pay us. So we had to take them to small claims court and harass them. I would go to the winery with a sleeping bag and a pack, being prepared to wait until something happened. That was a serious event that took a lot of time. It also took a lot of mental energy to deal with it. You lose time around here trying to deal with that... Within 6 months we had half of it, but the other half took another year and they sold the place and it all worked out."* The saving grace for the grower was that they had a written contract, giving them legal recourse.

Producers more readily identified adaptations to bad years in comparison with good years, the responses for which were more variable (see Table 3.2). Similar to good years, adaptations to cold and wet conditions involved greater micromanagement of the vineyard. The most common adjustment is to lighten the crop load, so that the limited energy that is available in a cold year is divided into a fewer number of berries, thereby enhancing the quality of a small quantity of fruit. Other techniques are to shoot thin and lighten the canopy in order to get more sunlight to the leaves and to increase air circulation, drying the grapes and reducing the risk of disease outbreaks like powdery mildew. Wineries have an added advantage of being able to adjust the type of wine produced and the marketing of the wine. One small winery respondent, for example, used the grapes to make a sparkling wine: "*While it was a poor year for the ripening of the Pinot Noir as a Pinot Noir wine, it was exceptional for a bubbly*."

In order to prevent frost damage, many of the respondents irrigated the vineyard because as the water on the grapes freezes, it transfers latent heat into the grape, preventing the berry itself from freezing. This method is only effective, however, if temperatures stay above -4°C and if the irrigation system has the capacity to irrigate a large acreage at once. Also, if frost occurs near harvest time, adding irrigation would cause the grapes to swell, diluting the flavours. Large operations are able to put in costly wind machines into frost prone areas, which pull down the warm air from above to raise the temperature in the vineyard.

Table 3.2: Conditions That Characterize a Bad Year in the Grape Sector and their Associated Adaptations

Condition	*Adaptation*
Weather	
Cold and wet	Drop/lighten crop
Spring and fall frost	Shoot thin
Bad winter	Lighten canopy to dry
Late spring	Spray more for mildew
Short season	Wind machines
Fire	Irrigate
Extreme heat	Pick fruit early to force the vine into dormancy
	Replant next year
	Do not overspend
	Borrow money
	Pay back next year
	Crop insurance
	Make sparkling wines
	Market wine differently
	Drop the price of the wine
Pests/Disease	
Pests (e.g. cutworm, leafhopper)	Integrated Pest Management
Powdery mildew	Sticky tape
	Spray sulphur
Market	
No tourists (fire, SARS, 9/11, rain)	Convince people to buy wines
Grape prices	Be more aggressive in other market channels
Fuel prices	Increase tourism by putting up new signs
Winery did not pay for grapes	Work on local sales
	Took winery to court
Other	
Water pump broke	Replaced with an automatic pump
Dwindling profits when selling through the LDB	Increase sales at door

This variety of adaptations that producers have at their disposal indicates that there is a relatively high capacity to deal with weather risks. However, when significant events affect tourism there are fewer options to adapt. Smaller wineries are greatly affected by decreases in tourism, as they rely on on-site sales for a larger portion of their income. Larger wineries, on the other hand, distribute the majority of their wines through the Liquor Distribution Board, to beer and wine stores and to restaurants. Thus, for larger operations, a decrease in tourism may not present a significant risk, but rather it prevents them from seizing an opportunity. Options for adaptation include efforts to promote more local sales and to sell through other marketing channels, such as restaurants. One event that had a significant impact on both tourism and the vineyard was the large forest fire in Kelowna in 2003 (see Box 3.3). This event illustrates that impacts and adaptations to the fire differ depending on the size of the winery and the availability of resources.

Box 3.3: Adapting to Fire: Perspectives from a Small and Large Winery

The fire that swept through the Okanagan Mountain Park and into the periphery of the city of Kelowna in the summer of 2003 had considerable impacts to local residents and business. Vineyards in the vicinity of the fire were filled with smoke, which tainted the flavour of the grapes and wine. As a small winery respondent described:

If you think about how fish is smoked, it doesn't take 24 hours and the fish is desiccated and has fully absorbed the smoke flavour. Well, our flavours weren't as nice as apple or mesquite, they were more like vinyl siding, carpet, trestle, and pine. All these can be picked off the aromas of some of our grapes from last year.

The other major impact that the fire had was in reducing tourism. The fire occurred in late August, people were evacuated from there homes, and there was a general travel warning for people outside the region, which deterred the majority of tourists for the remainder of the season. September, however, is typically the month with the greatest sales, as it is the more serious wine buyers who come through the valley at that time.

Knowing that the grapes would produce a tainted wine, the small winery opted to write off the crop through crop insurance. The insurance covered 60% of the value of the crop (which is significantly less than the value of wine), less the charges to pick the grapes, which is approximately $20-25,000. To save this expense, the winery instead decided to leave the fruit on the vine and let the birds, normally considered a major pest, eat the spoiled crop. The winery cut costs further by temporarily laying off the winemaker. Efforts were also made to encourage people to buy wines from the previous vintage.

The larger winery, on the other hand, had a greater range of options to deal with the event. In the first place, it was less affected by the fires because it was further away than the smaller winery, and the vineyard that was affected represents only a portion of the acreage of vineyard owned by the winery; it owns acreage all along the length of the valley. Nor was the winery affected greatly by a reduction in tourism, as it distributes the majority of its product within and outside of Canada. With its greater resources, however, the large winery was able to salvage a portion of the crop. A high pressure washer was rigged up and the entire vineyard was sprayed with water to get rid of the film of ash and some of the smoke taint. Then the grapes were hand picked to ensure that the skin of the grapes did not break, letting the smoke taint into the juice. Finally, the winery was able to purchase a Reverse Osmosis machine, which in short filters out the smoke particles while still retaining the wine flavours and constituents.

3.2.2 Future Opportunities and Risks

Although weather was identified as the number one condition that makes a good or bad year, when asked about future opportunities and risks, weather was no longer predominant. In fact, it was not even mentioned as a future opportunity (see Figure 3.4). Instead, the two most common opportunities identified were market and production related, with a response rate of 59% and 45%, respectively. Market opportunities included a greater recognition and acceptance of the wine industry in B.C, increased tourism in the valley and to the wineries, and getting consumers to pay more for the wines. Production opportunities were associated with the individual operations and included mainly the prospects of expanding the operation, increasing efficiency and improving the quality of the wines. Additionally, three producers mentioned personal opportunities, including retiring, getting out of grape growing, and spending more time travelling and with family.

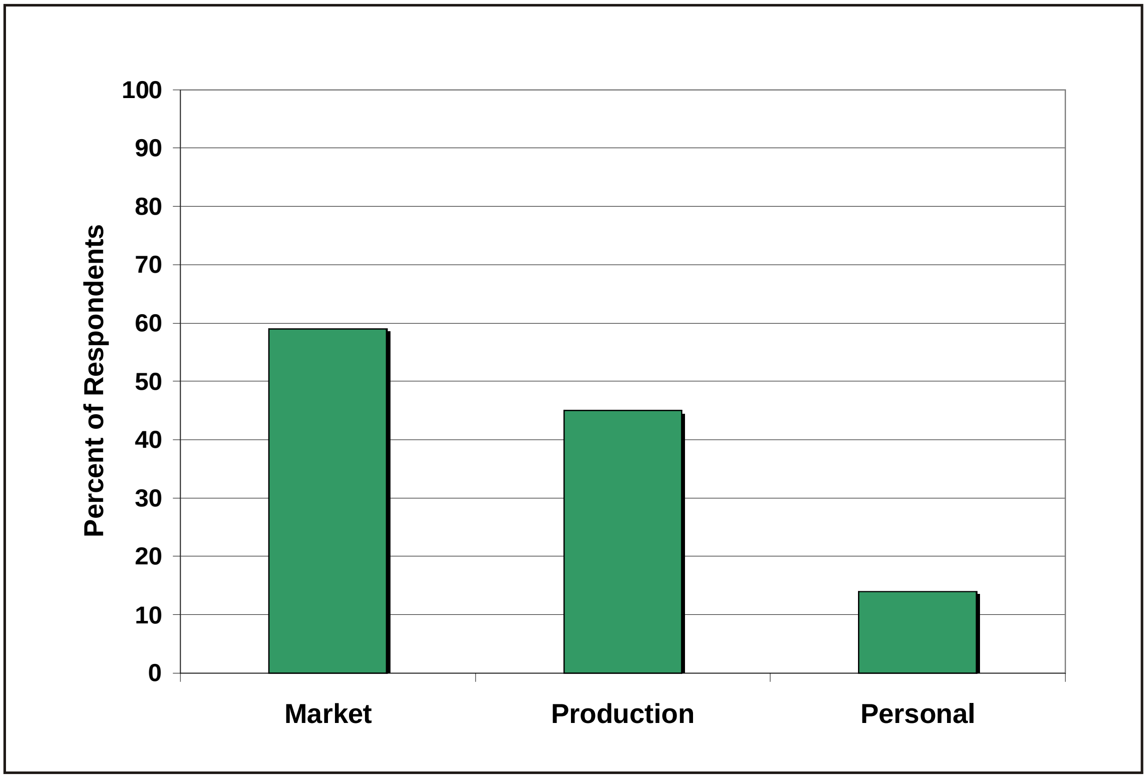


Figure 3.5: Future Opportunities for Grape Growers

The responses for future risks were more varied than the opportunities, but nonetheless market (and economic) conditions were again the primary, identified by 63% of respondents (see Figure 3.5). Market risks here refer to a surplus of grapes, either within B.C. or worldwide, increasing competition and putting downward pressure on grape and wine prices. Both fresh market grape growers were concerned with surpluses of grapes from California and China, because of the effect to commodity prices and the direct competition in the marketplace. There was also a concern about a downturn in the economy, reducing the amount of disposable income available to spend on wine. Given that wine is a luxury item, it has an elastic demand that fluctuates with the economic circumstances of a population. There was also concern about increased interest rates and the occurrence of another major event that would reduce tourism in the valley.

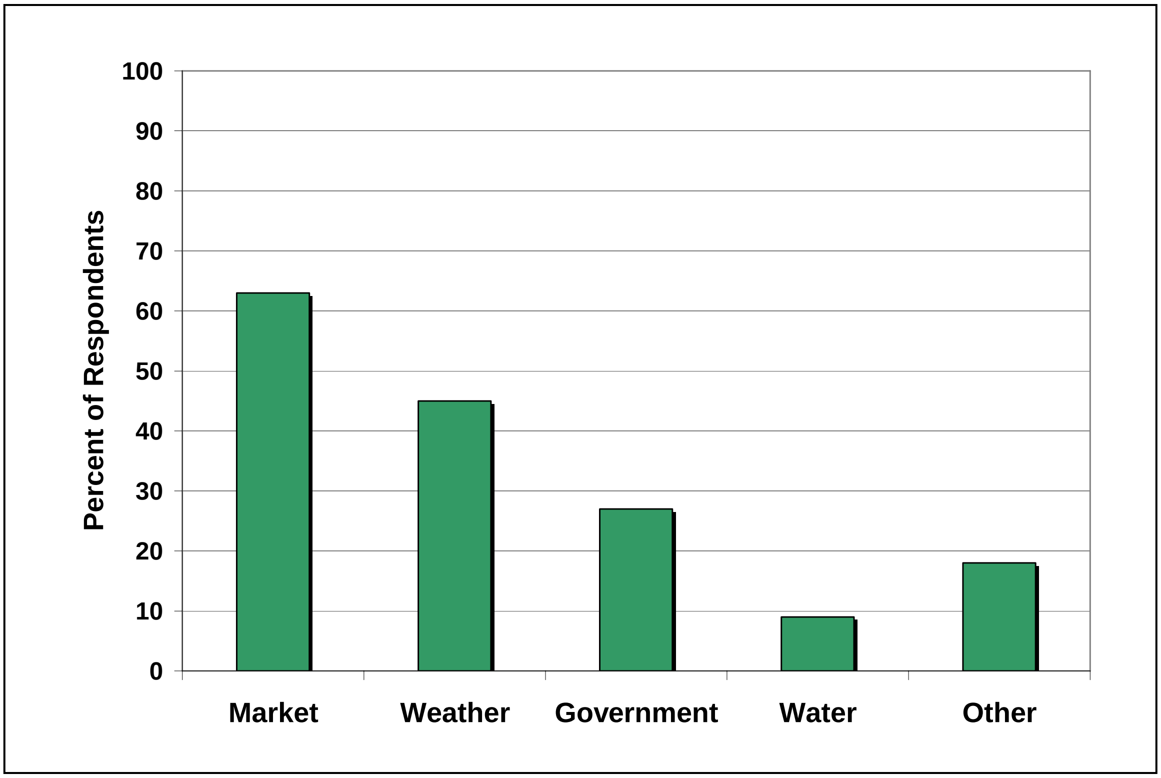


Figure 3.6: Future Risks for Grape Growers

Weather was the second most common risk identified. Of these ten respondents who cited weather (45%), two brought up climate change, which is discussed in more detail in Box 3.4, and six were concerned with a severe winter. A cold winter, with temperatures below -23°C for a few days straight, would be devastating to the industry. Prior to 1989, the valley grew predominantly French hybrid grapes because these were the only varieties that could endure the harsh winters of the Okanagan. Following the free trade agreement, however, these varieties were pulled out and replaced with the tender European Vitis vinifera grape varieties, which are more sensitive to cold conditions. Coincidentally, since the pullout occurred, the valley has not experienced a very harsh winter. As such, many growers have become complacent and have attempted to grow tenderer, riskier varieties, such as Syrah. As one independent grower explains:

> *Since we have not had any significant winter weather, people believe we can grow almost anything. I think we're seeing that out there. We have so many new growers out there that believe this is normal and that we don't have bad weather. Sooner or later there will be a reality check that says no, this does happen.*

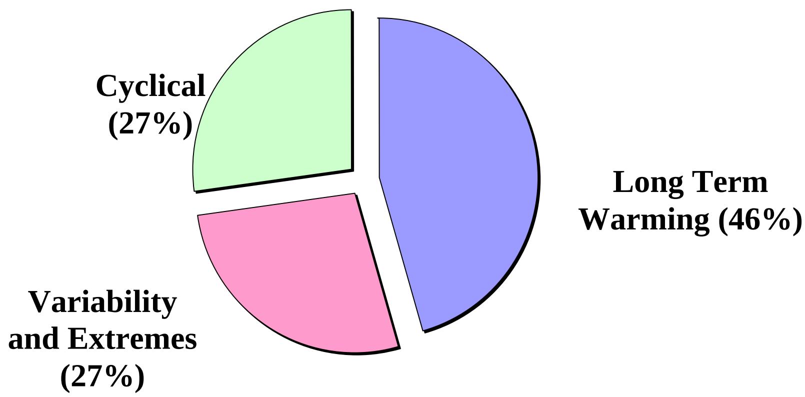
Now, if a severe winter were to occur, many of the grapevines in the valley would be killed. This would have long lasting effects because the vines would need to be replaced, and it takes five years before the vines come into full production.

Although only 27% of the respondents identified government as a future risk, many concerns were expressed throughout the interviews and focus groups about changes in policy and the "whim of government". The primary concern was an increase in taxation, reducing the producer's profit margin, and having a trickle down effect to independent growers who would receive less for their grapes. Being an alcoholic product, wine is heavily taxed, and the degree of taxation depends on the location of the sale. Wine that is sold through the Liquor Distribution Board (LDB) has a 100% mark-up in addition to GST, PST and a Federal Excise Tax, whereas with on-site sales the winery receives the mark-up value. Thus the most profitable channel through which to sell wine is at the winery door. As one medium winery respondent notes: "*Last year, 50% of our profit came from sales at the wine shop from 15% of our product.*" As such, producers were concerned about increased taxes on these on-site sales in particular, as well as the potential removal of licensing that allows wine to be sold at the winery. Another worry is that the government would take away the Vintner's Quality Alliance (VQA) program, which would devastate the industry. VQA products contain 100% BC-grown grapes, and thus a removal of the program would mean that wineries would purchase cheap grapes from other grape growing regions like California or Chile.

From the results of these two sections, a number of conclusions can be drawn. Indeed, weather is an important condition for grape producers; weather has a direct effect on the quality of wine. This emphasis on quality, however, is driven by the market and the desire to compete in the marketplace with wines from traditional or renowned grape growing regions, such as Italy, California and Australia. Currently, the demand for B.C. wine is greater than the supply, which may explain why market is not a prominent issue when discussing conditions that have previously characterized good or bad years, but comes to the forefront when future risks and opportunities are being considered. Thus, while weather is a major concern, it is only so because it affects the producer's success in the marketplace.

Box 3.4: Grape Growers' Perceptions of Climate Change

Producers' perceptions of climate change in the Okanagan Valley are quite divided. As the graph below illustrates, when asked what climate change means to them, nearly half of the respondents associated it with a long-term rise in average temperatures. These respondents referred to the phenomenon specifically as 'global warming' or made such comments as "*Less risk, less frost, more heat,"* which implies an increase in temperature. The remaining interviewees were evenly divided into those that recognized that climate change would include more extreme events and "erratic weather," and those that were sceptical about climate change, attributing the current climatic trends to a natural, long-term climatic cycle. The sceptics were in part unconvinced about the science behind climate change, indicating that 100 years of weather data is insufficient to draw conclusions about climate change, and that, regardless, it cannot be attributed to humans.



Regardless of their perception, however, the majority of producers did agree that, cyclical or not, it is the mild winters that the valley has been experiencing in the past two decades that have made the industry possible, and that a continued warming could allow them to grow new varieties and achieve quality on a consistent basis. Producers were able to also identify risks associated with climate change, including the potential for more extremes, more frost damage, more fire, less snow, new pests and greater difficulties producing ice wine. When asked directly if they were concerned about climate change, half were unconcerned, in part because it was out of their control. Of the other half of the respondents, only three were overtly concerned with climate change, all of whom had perceived climate change as an increase in extreme events and variability. The remainder of the respondents were only concerned if climate change resulted in a decrease in water supply or an increase in winter events.

3.2.3 Adaptations that Make Sense

During the interviews, producers were provided with a list of potential adaptations in agriculture, compiled from the climate change and adaptation literature (see Appendix B). They were asked to review the list, and identify practices that had previously been adopted and for what reasons. The focus groups partook in a similar exercise in which a revised list of possible adaptations following the interviews was provided, and participants were encouraged to discuss and debate the feasibility and effectiveness of each. Table 3.3 shows the revised list of adaptations that were given to producers; adaptations in italics will be discussed here.

Table 3.3: List of Adaptations Provided to Participants

Farm Production Practices
Change crop hybrids
Change crop types and varieties
Change intensification of production
Change the location of production
Add or change irrigation systems
Change timing of farm operations
Make use of weather information systems
Farm Financial Management
Purchase crop insurance
Participate in income stabilization programs
Cut costs
Diversify household income

In terms of farm production practices, the primary method for dealing with variable weather is through daily precision viticulture techniques. This was made evident in the discussions on changing the timing of farm operations and weather information systems, and is further confirmed by the adaptations to good and bad years that producers identified in the interviews (see Tables 3.1 and 3.2). Adjustments such as pruning, shoot thinning, crop thinning and irrigating all follow the stage of growth of the plant and daily weather conditions. As a large winery respondent noted:

> *Pretty well everything we do, we have to time it with the stage of growth the plants are at. This year we're a week to 10 days early. So every operation that we're doing is determined by the stage the plants are at, rather than the day on the calendar.*

Weather conditions and forecasts direct what techniques need to be applied and when. Following periods of rain, for example, producers will do additional shoot thinning because the vines become extra vigorous, and they will spray sulphur to prevent Powdery mildew outbreaks, a disease that thrives under wet conditions. Producers also admitted to checking weather forecasts three or more times a day, an action that determines the timing of irrigation, sulphur sprays, fertilizer application and canopy management.

Adding an irrigation system will be one potential measure for dealing with moisture related problems. The majority of the vineyards use overhead irrigation (77% of interviewees), which is a water inefficient system as compared to drip irrigation. Changing over the entire system to drip irrigation, however, is not recommended, as overhead irrigation is used to reduce a number of weather and non-weather related risks. During times of extreme heat, the vineyard is cooled down using irrigation; overhead irrigation is required for maintaining cover crops between the rows which harbour beneficial insects and suppress pest populations; to prevent frost damage, the vineyard is irrigated so that as the water on the grape freezes, it transfers heat into the grape, preventing the berry itself from freezing; similarly, once the grapes are harvested, the entire vineyard is irrigated for a few hours to raise the moisture level in the root zone so that as the water freezes, it minimizes the root damage. The combination of overhead irrigation and either drip or "micro-jet" irrigation (a system that is located under the canopy and sprays water on and between the rows) would reduce water consumption and allow for protection at critical times. The major constraint to this adaptation, however, is financial – both of these irrigation systems are very costly and require more regular maintenance.

There are also technological innovations which could reduce water consumption. Telemetry-based weather and moisture reading devices are now available, which record real-time data and send the information to a central computer. The moisture device consists of soil probes that are placed in the ground and that read moisture at four depths – at 10, 40, 60 and 100 cm below the surface. This information allows producers to "*irrigate to the need of the vine, rather than recreational irrigation*" (Medium winery respondent), thereby conserving water. As one large winery respondent explains:

> *The probes tell us exactly what our soil moisture is, so we're not wasting water. We water what we need to, when we need to and the amount we need to. We know that an eight hour irrigation is going to give us water all the way down the root zone. So there's no point in putting on twelve because you're wasting water.*

Further, technologies such as wind machines can reduce water use, as it would substitute for overhead irrigation as a frost prevention tool. In both instances, however, these technologies are highly expensive (one wind machine costs $25,000), and as such are only economical on large operations.

Changing crop hybrids and varieties are less feasible adaptations. Changing varieties of grapes is more of a means of seizing opportunity than managing risk. Producers agreed that the choice of variety is dependent more on market demand than climate concerns. "*The varieties that can be grown have nothing to do with reality; it has to do with market. Regardless of how good the variety is, if there's no demand, it's not economical"* (Focus group participant). The changes in climate already experienced in the valley have allowed producers to seize the opportunity of not only growing *Vitis vinifera* varieties, but predominantly red *vinifera* varieties, which has in fact increased their susceptibility to weather risks.

Changing crop hybrids was not seen as a favourable option, because 'hybrid' is associated with the French hybrid grape varieties that preceded *vinifera* varieties in the valley. The equivalent to 'hybrid' in wine grape terminology refers to varieties that have been grafted to a rootstock that possesses a certain trait (e.g. drought-resistant, or de-vigourating). While it is feasible to change rootstocks to manage a particular climate risk (e.g. more frequent drought), there are many factors to consider, and most rootstocks only exhibit one specialized trait. This difficulty is illustrated by one focus group respondent who, after being asked if he would consider switching to drought-resistant rootstock, said:

> *I think the answer is yes, but it is dependent on - it's going to be dryer, but is the growing season going to be longer? Just having drought is not the only factor that drives that decision. If you could guarantee 200 frost free days instead of 160, that could be a factor that would drive a person to say I'm going to try out these drought resistant rootstocks.*

In both instances, whether changing crop hybrid or variety, producers pointed out that this adaptation may be one of the last options considered because replanting is an expensive process – one producer estimated between $10-15,000 per acre. Furthermore, it would mean that the area would be taken out of production during the replanting and then it would take 5 additional years before the plants reach full production.

With regards to farm financial management, several producers mentioned individual cost hedging and self-insurance techniques. Several producers mentioned putting away money in the good years to insure for bad years. In bad years, no new equipment or unnecessary inputs are bought to reduce spending. Aside from this, however, producers indicated that cutting costs is not feasible. To cut input costs would result in a reduction in quality, which would significantly lower the return on the grapes and/or wine. Furthermore, as one respondent noted: "*If you had a bad year, like winter damage, your costs* increase *because you need to nurse the plants back to health."*

Nearly 80% of the respondents carried crop insurance, but the views about it were rather divided. Many of these producers carried the minimum coverage because it is quite inexpensive. However, the system was criticized by some as being "insignificant," because it requires a >60% loss of the crop in order to be applicable, and the payback is only a portion of the value of the crop. This troubled some of the small winery owners because the value of the wine that is lost is significantly higher than the value of the crop, and thus of the returns from the insurance. On the other hand, independent producers viewed crop insurance more favourably, considering it a safety net. As one independent grower expressed: "*It is [a safety net], in the sense that we at least can contemplate re-establishing our vineyard. It gives us options. If you have no money, your options are limited."* Income stabilization programs were also seen favourably by most independent growers (wineries are not typically eligible to participate in these programs), especially NISA; some producers were discouraged by the complexity of the new CAIS program and had recently opted out.

Diversification of the business is a strategy that is quite evident in the valley. Wine grape production is a very unique agricultural industry because it is based on the sale of the value-added product (wine), rather than the commodity itself. As such, diversification into winemaking is a natural occurrence in the industry. It has also become in part an agri-tourism based industry, prompting further diversification in the form of restaurants and wine shops or gift stores. In this sense, however, diversification is more of a business strategy, responding to market forces and seizing opportunities, rather than a risk management strategy. A few independent growers and small winery owners, however, did indicate that although finding off-farm employment is not feasible for themselves to do, their spouses worked off-farm, supplementing household income.

3.3 The Apple Sector

The results in this section are based on information obtained from 20 interviews and 3 focus groups held with apple producers in the Okanagan Valley. With the exception of one producer who grew primarily peaches and prunes, apples represent the primary source of income for all interviewees. The sizes of the operations are in general much smaller than those in the grape and wine industry and range between 5 and 50 acres, with an average size of 21 acres. For this discussion, growers managing 25 acres or less will be considered small and those greater than 25 will be considered large operators.

3.3.1 Good and Bad Years

When apple producers were asked what conditions led to a good year for their operation, every respondent identified apple prices as a factor (see Figure 3.6). The majority of these respondents (60%) noted that prices were a function of supply from other apple producing regions, namely Washington and to a lesser extent eastern Canada. A small grower remarked: "W*e're only four percent of what Washington State is. They set the tone of the market and we get dragged along and there is nothing we can do about it.*" These producers reported that they received good prices for their product in years when Washington State had a short crop, often as a result of a weather event, such as frost. The other respondents who gave an explanation for high prices stated that it was a result of the new varieties that they had recently planted (e.g. Gala) with the help of the government sponsored Replant Program. The new varieties consistently yielded higher prices than the older varieties like Macintosh. According to a large grower: "O*nce I started getting into the newer varieties, I always made profits*."

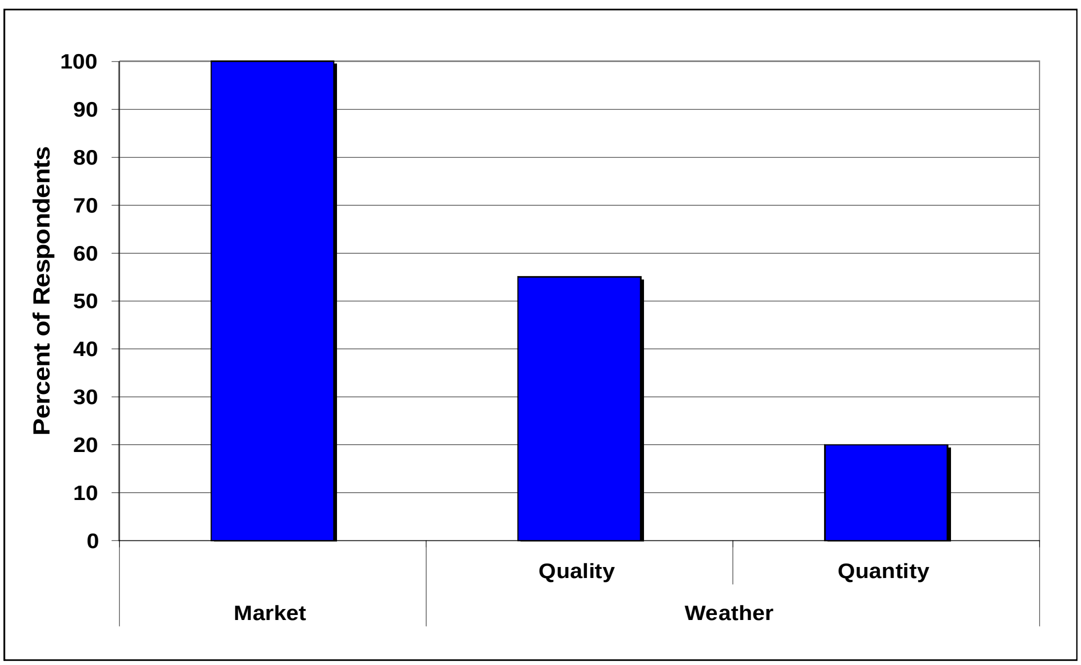


Figure 3.7: Conditions that Characterize a Good Year for Apple Producers

Nearly two thirds of the respondents, however, identified two conditions that make a good year. These producers identified good years as being a combination of high prices with either a large quantity of apples or a high quality crop, both of which are largely a function of weather. A large grower responded:

> *You need two things to happen to have a really good year because we tend to have two highs in this business. One is when you produce a really good crop – you know, lots of fruit of high quality. That's very satisfying. And the second one is when you get paid for it.*

Some of the producers who cited quality related it directly to weather; however, rather than describe favourable weather conditions, they explained that quality was achieved through a lack of unfavourable conditions, namely frost, hail and extreme heat. While not always addressed explicitly, it is acknowledged here that quality is also influenced by factors such as soil conditions and farm management practices.

Favourable weather conditions also tend to produce bumper crops. Of course, quantity is also a function of the biannuality of apple trees, which is a natural cycle where a large crop in one season is followed by a small crop in the next. The importance of a large crop was acknowledged by four producers who rationalize that having a large crop allows one to take full advantage in high price years, and that even in a low price year, a high volume will bring in a high enough income to survive that year. These producers did, however, acknowledge the irony of producing a large crop where the greater supply, the more downward pressure it will have on commodity prices. "*Generally, the way it works is if you have a big crop, normally the rest of the valley has a big crop too. Prices are consequently lower.*"

The adjustments that were identified for good years, as listed in Table 3.4, tended to be in response to a to a good year in general rather than a particular condition, and as such are categorized by the type of adaptation rather than the condition to which it is in response. The most common adaptations were financial. With growers having more money to spend, most indicated that they would reinvest money back into the operation by purchasing new equipment, "*not skimping*" on inputs like fertilizers and sprays, repaying debts or replanting old orchards with new, higher paying varieties. One respondent did report that although he replanted the orchard in a good year, it would not generate income for two years following, and so he had to participate in off-farm work during that period. The remaining respondents either did not do anything differently and tried to achieve the same quality they did every year, or they changed their farm practices slightly, often with the aim of achieving better quality each year through continual learning. A small grower explains: "*The whole thing is evolving and as we learn more about it, we learn better ways of doing it and certainly in the last five years I've changed my opinion on the density of the trees and how to prune them just by experience.*"

Table 3.4: Apple Producers' Adaptations in Good Years

Type of Adaptation	*Adaptation*	*Percent of Respondents*
Change Farm Practices	More thinning, pruning, irrigation Better nutrient management	35
Financial Management	Catch up on repairs Buy new equipment Purchase more inputs Finance replanting of orchard Pay debts Work off-farm while orchard is being replanted	55
Nothing Different	Continue routine practices (e.g. thinning, pruning) Always try to achieve quality	20

Similar results are found for bad years, as respondents tended to identify conditions that were the antitheses of those that make a good year; in other words, low prices, poor weather and low yields. Figure 3.7 illustrates that market is again the most common of these with 85% of the responses. The majority of these were related to the price of apples, but one respondent identified difficulty in dealing with the packinghouse (see Box 3.5). A bad year for Okanagan growers is typically one that is good for Washington State where a large supply of apples is produced. Washington State grows a lot of the traditional varieties like Red Delicious and Macintosh and has not yet moved into production of Gala, which are currently being planted in the Okanagan. Thus, it is not surprising that many of those respondents who identified low prices still have a portion of their orchard planted in traditional varieties and are in direct competition with the U.S. A small grower states:

> *The major factor is price. There are some years where Macs and Spartans were paying down to ten, twelve cents a pound on average and red delicious down around six, seven cents a pound. You can't even get your production costs back with prices like that.*

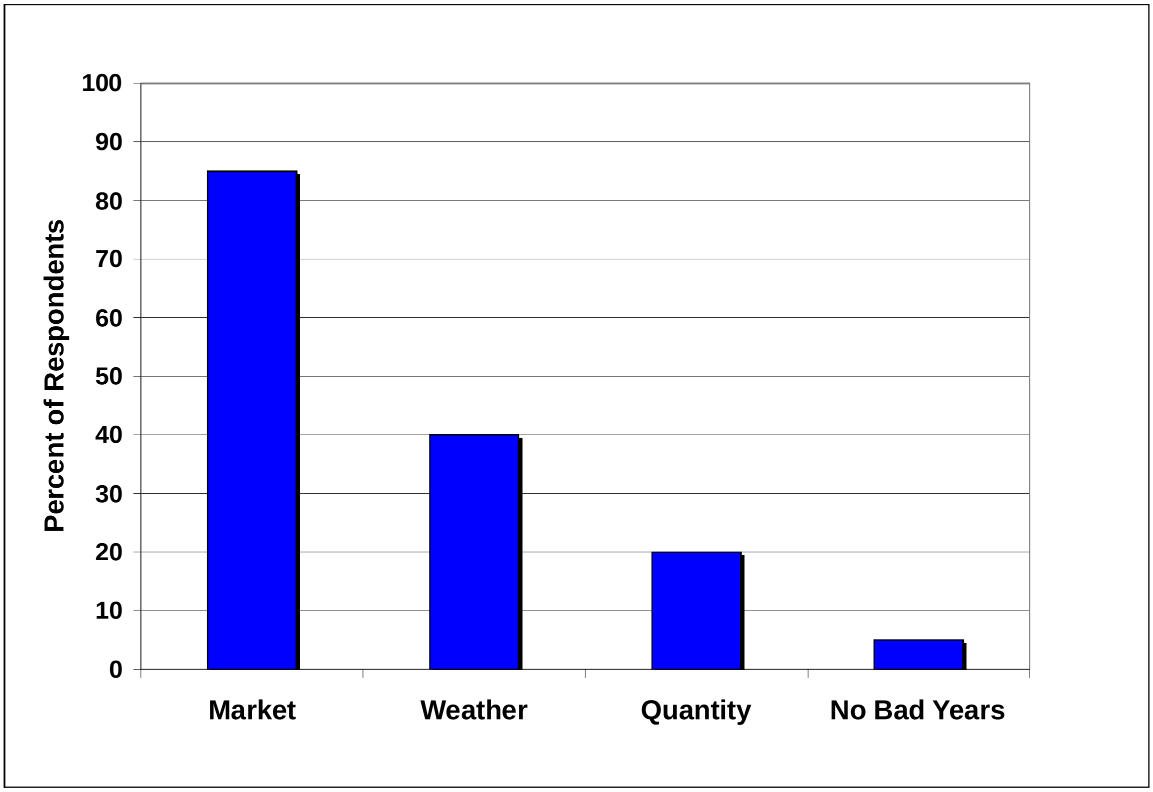


Figure 3.8: Conditions that Characterize a Bad Year for Apple Producers

This grower went on to explain that the Galas that he grows sell for thirty-five cents a pound, showing the disparity in price between varieties. Focus group respondents identified additional market risks, including the loss of their Asian export market as China increased their supply, and the consolidation of major wholesale chains, which increase their purchasing from large international markets who can more easily meet the demands of quality and quantity on a consistent basis.

Box 3.5: Packinghouse Problems

Many apple growers in the Valley sell their fruit to a packinghouse. While the growers then receive a smaller portion of the food dollar, it takes out the risk of storing, packing, distributing and selling the fruit. One small grower, however, did not anticipate the risk involved in a change in management. The grower recounts his experience in 1988, where a new manager took over the packinghouse. It turned out that the previous manager was a poor bookkeeper and had overpaid the producers. When the error was realized, the producers were required to return the difference, which in this case was $30,000. This created a huge hardship for the grower, who was obligated to take up some off-farm work in order to keep the farm afloat.

The second most common answer was weather, identified by 40% of the respondents, only 10% of whom mentioned weather alone and not in combination with price. The weather conditions that were problematic were primarily incidences of extreme heat and hail, but of mention as well were high winds, which knocked half the fruit off the trees, and frost. The effects of extreme heat were described by a small grower, who recalled a year when: "a*ll the fruit was sunburned or physiologically over mature and it broke down in storage and tons of the fruit just rotted in the bin and never even got packed."* Hail was the most commonly cited risk because it ruins the cosmetic appearance of the fruit and becomes unmarketable to consumers. However, several producers were quick to remark that they were not overly concerned with hail, because there was good crop insurance coverage for hail, and that in some cases producers even benefited from it. A large producer claimed: *"A lot of people got hailed, which in my case is never a bad thing to be hailed because I always do better with the crop insurance than I would have."* This has caused the insurance to earn the name "white harvester" and perhaps is one of the reasons why there seemed to be only moderate concern for weather risks.

Twenty percent of producers noted that a low crop yield, especially in combination with a low price, caused a bad year. However, a low quantity was more often attributed to the biannuality of the trees rather than to weather. With a short crop, the producer has virtually the same input costs as other years, but does not get the same returns. One producer stated that he had not experienced a bad year in the last ten because of a combination of prices, yield and government support programs that had stabilized his income (see Box 3.6).

Box 3.6: Recipe for a Stable Income: Price, Yield and Support

A small grower could not identify one bad year in ten. He found that, for the most part, in years that the crop yield was low, prices tended to be high and vice versa. In other years where the crop was low as a result of poor weather, he took out crop insurance, which covered the amount that the crop was down. Consequently, he says: "*So my income actually just keeps going up. At least over the last ten years it's been going up every single year, so I can't say there's been a bad year."* This rising income is also largely a result of his own efforts in the orchard. While commodity prices are influenced by supply and demand relationships, it is also based on the variety and quality of fruit. As such, the producer explains: "*I've been trying to focus on the higher paying size and colour ranges in the fruit, so you try and grow a certain kind of fruit and you end up getting much better returns for it. Where the average in the packinghouse might be ten cents a pound, I was getting fifteen, so it's a huge difference just by focusing only on those ones that are high paying ones. That means summer pruning and doing a whole bunch extra work in the orchard, but it really pays off."*

Adaptations in bad years, as shown in Table 3.5, were primarily financial. Crop insurance was cited by 20% of the respondents who identified weather, and in each case it was to insure hail damage. To deal with low prices, however, there are fewer options. Ten percent of producers noted that the reason they were able to persist was because their wives had off-farm employment. A small grower commented:

> *I don't know how guys without outside income could survive. Actually not many farmers now don't have one of the spouses working outside, because there is no way you can rely on fruit growing to make your living.*

Table 3.5: Conditions that Characterize a Bad Year in the Apple Sector and their Associated Adaptations

Conditions	*Adaptations*
Weather	
Hail	Use damaged apples for apple juice
Extreme heat (sun scald)	Crop insurance
	Salvage fruit not damaged by hail
	Spouse works off-farm
Market	
Low market price	Income stabilization
Low price from older varieties	Diversified crop types
	Produce high quality fruit (size and colour)
	No extra purchases, no new equipment, cut costs
	Replant to higher paying varieties
	Farm as usual
	Diversified income sources (off-farm employment)
Quantity	
Small crop due to weather or biannuality of trees	Chemical thinning or pruning to reduce biannuality
None	
Income is stable	Focus on higher paying varieties, size, and quality

Similarly, one grower noted that his off-farm work offset the low prices; however, in this case his off-farm employment is his primary source of income. Two other growers stabilized their income by diversifying the farm operation; one rented accommodations on the farm, the other started a 'farm market' (see Box 3.7). Diversification of apple varieties was also suggested as a strategic adaptation and was further emphasized in focus groups, because it is unlikely that all varieties will experience low prices in the same year, and because varieties have different weather tolerances.

Twenty-five percent of producers stated that in low income years they try to reduce spending and tighten the budget. However, it was clarified that it is primarily personal spending and unnecessary purchases that are cut, rather than cutting input costs, because as Box 3.6 illustrated, a higher price is received for high quality products. A large grower argued:

> *I don't normally hold back. I spend the money to produce a good crop even if it's a poor year because I am better off in the top end than anywhere else, irregardless of what the market returns.*

This is why a few producers stated that they do not do anything different in bad years; they have to "*still keep up all the practices you would keep up. Otherwise the next crop suffers"* (small grower).

Box 3.7: Adapting to Market Pressures by Building a Market

One small grower decided to reduce risk by diversifying the farm and building a farm market. The market is a unique, straw bale building that is versatile in its function, but is currently used as a farm market. As the grower describes: "*We've done it in such a way that it could become anything. It could be a front end for a small winery or anything. It could be a guest cottage...It's not a really cheap fruit stand… we built in such a way that the local people would come up here. We get a lot of people just coming up here after supper and sitting outside. We have three big subdivisions right next to us and we've been really well received."*

The decision to build the market was made following a year of low apple prices. The grower explained that his reasons behind the diversification were: "*I think the main thing for us was the low prices on apples and we just decided that we had to try to sell a bit of those…We chose to take some control over parts of our product. It just wasn't working. We were just getting too frustrated waiting a year, a year and a half to get money*." Half of the farm's apples are still sent to the packinghouse, but the earlier varieties that are more tender and do not store well are sold at the market. The farmer also decided to replant three acres of the orchard to soft fruits, specifically for sale at the market. Although the decision to build the farm market was prompted by price variations, it also enhances his ability to deal with weather risks. The operation is equipped to make apple juice and so following a hail storm, the grower uses the damaged fruit that is not marketable and turns it into apple juice to sell at the market. "*1996 was the first year we've really had hail so that probably 80% of the apples went into juice apples. That was the year we started to make apple juice, so that is part of what we do now is we make an apple juice, just with our own fresh apples at that time of year. And that's worked really well for us."*

Those producers who cited the quantity of apples as an important factor, responded with attempts to keep the orchard production level from year to year or keeping it "*out of synch*" (small grower) with other regions or orchards. This is achieved through chemical thinning or hard pruning, to limit the biannuality of the trees. Although in oversupply years the income will be tight, in other years producers will greatly benefit. One producer explained that if the competitors are biannual, and have 20% below their big years, then he will really gain from keeping production level.

In both good and bad years, apple growers put a significant emphasis on price, which is similar to the two fresh market (table) grape growers in the previous section of this chapter, but a stark contrast to the wine grape growers who never mentioned price unless asked directly. This is because apples and table grapes are sold in commodity markets, whereas wine is sold to a specialty niche market where the demand is currently high. Furthermore, wine grape growers are able to reduce price risk by negotiating contracts with wineries prior to the growing season. Figure 3.8a illustrates this by using the example of a Chardonnay wine grape, showing that there is a large range of prices received, represented by the minimum and maximum values, because the final price is influenced by the quality of the crop and by the working relationship between the grower and the winery; the *average* price of the grape, however, has stayed stable since 1999. Apple prices on the other hand experience greater fluctuation. Figure 3.8b shows the prices for traditional Macintosh apples and the newer Gala apples since 1993, indicating that while Gala consistently receives a higher price, both are subject to significant variation. Also as the supply of Gala apples increased following the replant program, prices seem to have been declining.

When comparing apples to table grapes, apple prices experience greater variation because the apple sector is competing directly with many growers, both within the Okanagan and internationally, where large quantities of the same varieties of apples are being produced. The table grapes, on the other hand, are produced by few growers in the valley, so the supply is limited, and while they do have competition from the U.S. and Chile, for example, these regions produce a different variety of table grape than what is grown in the Okanagan. As such, commodity prices for apples are as unpredictable and variable as weather conditions, yet there are fewer options to cope with market, as was revealed in the discussion on adaptation. A small grower illustrated this point, by explaining that for weather risks she has reasonable crop insurance, "*but low market return – it just sucks. What can you do? Go get an off farm job?*" Wine grape growers, on the other hand, were more concerned about weather because, with prices being largely predetermined, their interest is in being able to sell the end product, which is influenced by the quality of wine, which is in turn a function of weather conditions.

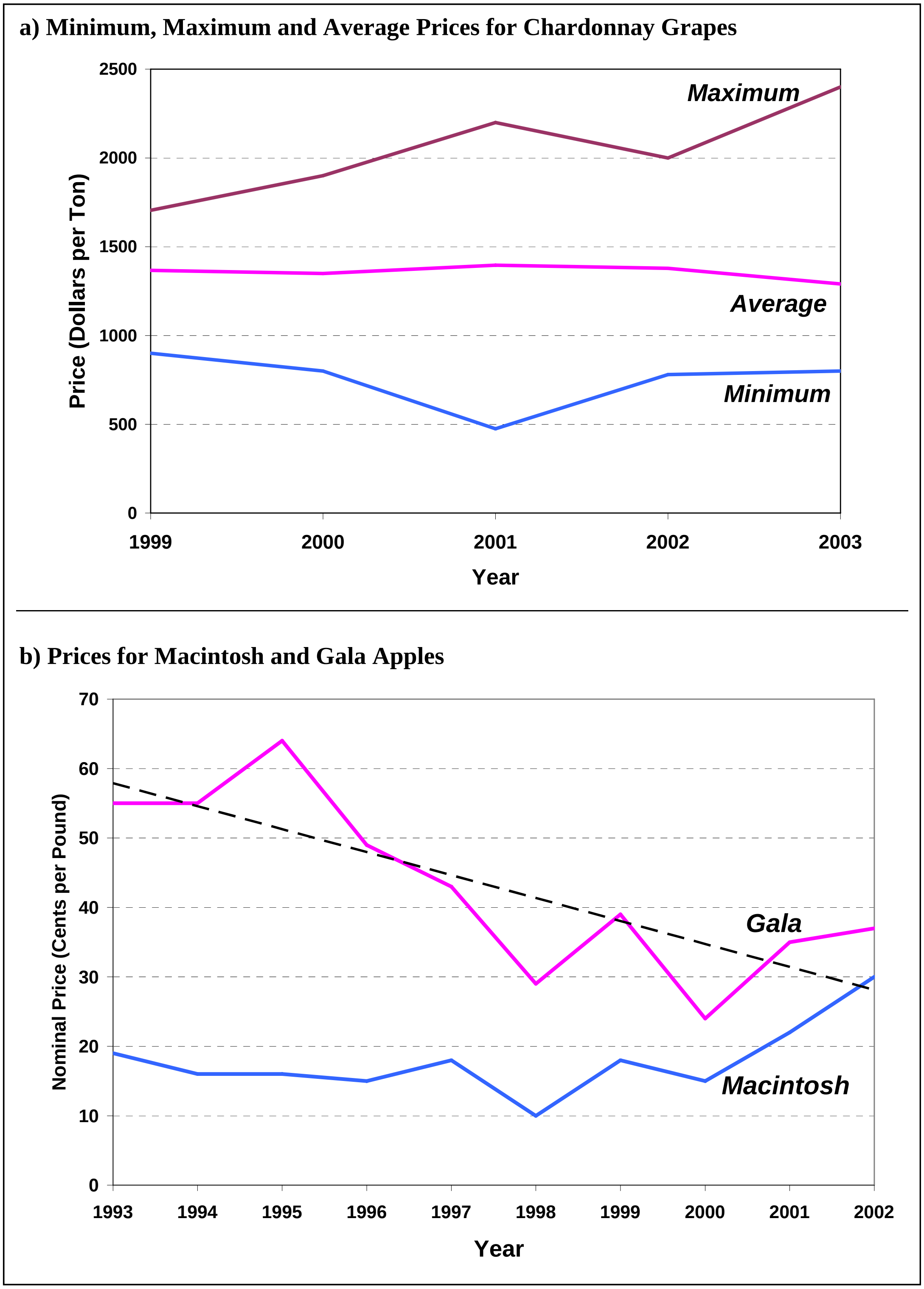


Figure 3.9: Comparing the Prices of Apples and Wine Grapes

3.3.2 Future Opportunities and Risks

The majority of the responses (70%) for future opportunities was again market-related and is displayed in Figure 3.9. The market opportunities that were identified relate to either agri-tourism or apple prices, both of which received seven responses each. There was much optimism about the possibility of increasing agri-tourism in the apple industry and to create value added products, such as cider. However, only two producers have or seriously plan to act on it, one of whom was the interviewee from Box 3.7 who had created a farm market. The remainder of the interviewees recognized the potential for tourism, but were not willing to pursue it personally due to the added costs, effort and stress that would accompany it. Those producers who saw opportunities in apple prices were hopeful that the new varieties that they replanted to will continue to receive high prices, that consumers will continue to demand these varieties, and if not they will replant to the higher paying, higher demanded varieties

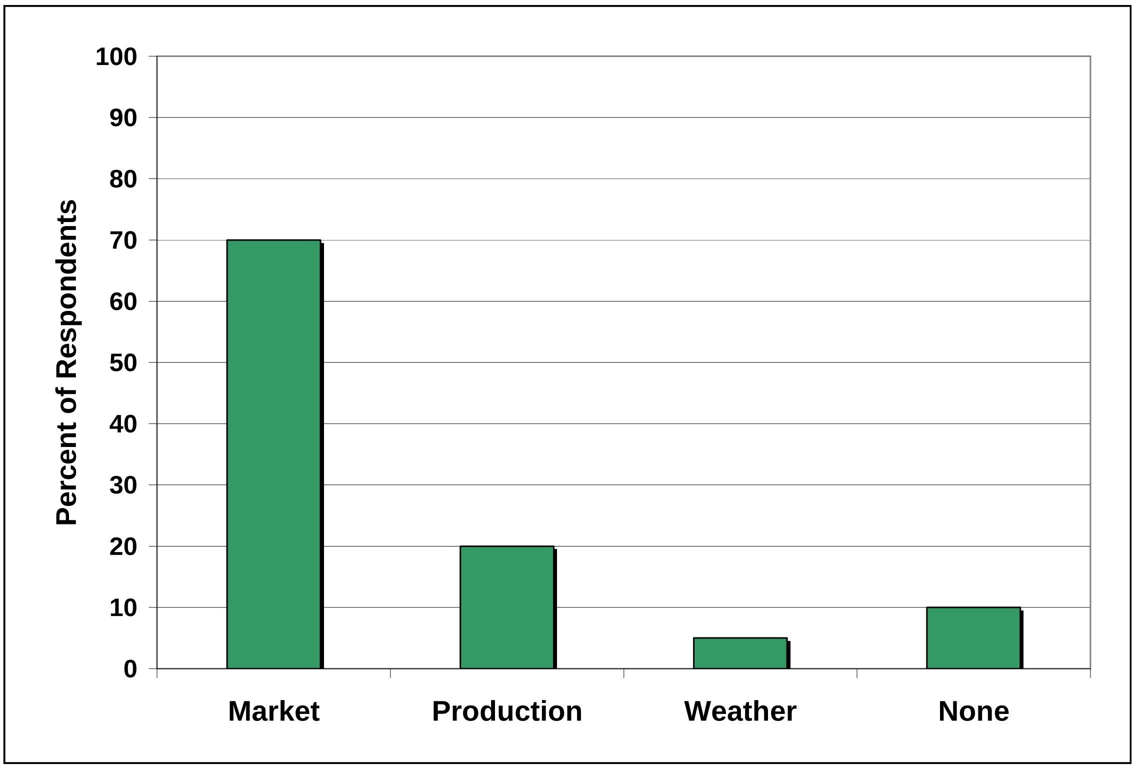


Figure 3.10: Future Opportunities for Apple Producers

Twenty percent of interviewees cited production-related opportunities. Fifteen of the twenty percent looked forward to an increase in crop load as their trees come into full production which, in conjunction with high prices, will increase their income. *"We just look forward to more fruit, better fruit and good prices"* (small grower). The other five percent anticipated downsizing the operation, by dropping the leased orchard. The sole producer who mentioned weather, was currently in a financial situation that placed him in a highly vulnerable position where weather could make or break him. The small grower stated: "*I am saying that if the next two years are good, I might survive another ten years. If the next two years are bad, I'm out. It's big gamble, only because you are dealing with nature.*" Ten percent of producers could not identify any future opportunities because they have already fulfilled the opportunity of planting to the higher paying varieties.

Concerns about future conditions were equally divided among the market, the government and the weather, each identified by 45% of the respondents (see Figure 3.10). The market concerns were related to an oversupply of apples and increased competition, especially as regions like Asia and South America increase their production. One respondent also cited a change in the value of the dollar as a potential threat because it would affect business with the U.S., their major market. The two main governmental threats that were brought up were associated with the future of crop insurance, and the Agricultural Land Reserve policy (ALR). There was much worry that the government would cut back on crop insurance, that it would become privatized and/or that it would become more expensive; in any case there was concern that it would increase their vulnerability to weather risks. A large grower remarked: "*I see government cutting back the crop insurance program as probably one of the biggest threats to the viability of this industry, because crop insurance is the backbone of your whole operation.*" A few producers also feared that the ALR policy would be dismantled, allowing residential development within agricultural areas, and creating urban/rural conflict.

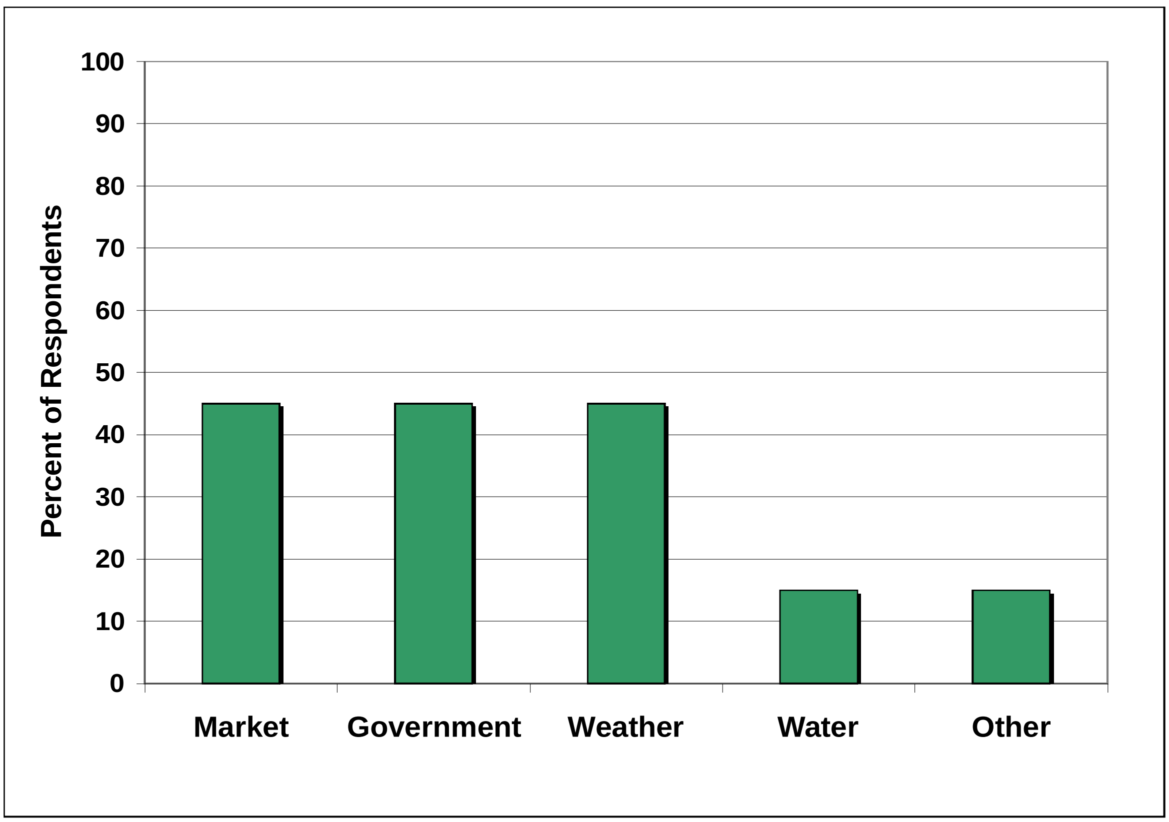


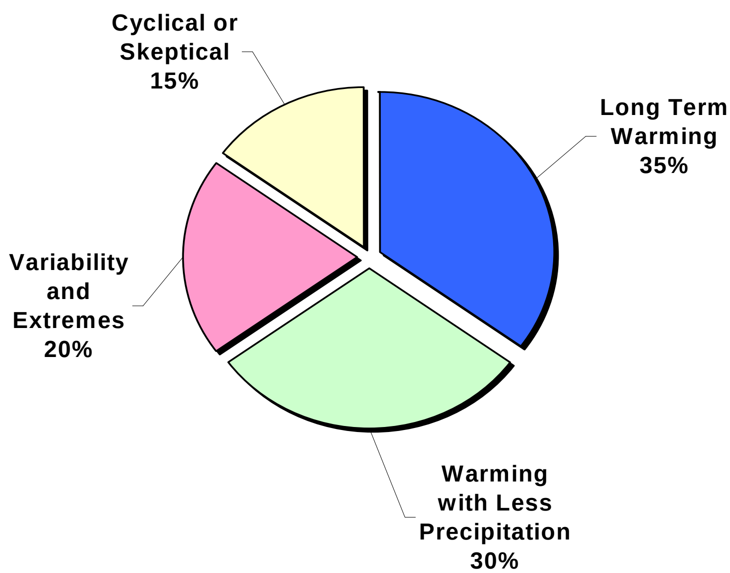
Figure 3.10: Future Risks for Apple Producers

The weather conditions that interviewees cited, were the potential for more frequent or more severe hailstorms, the occurrence of a harsh, cold winter and climate change (see Box 3.8). The threat of a winter was greatly emphasized in all three focus groups. Participants acknowledged that the new varieties that are being planted are all on dwarfed rootstock, where the roots are near to the surface and are more susceptible to winter and frost damage. Thus, just like the wine grape industry, adaptations to the market have heightened the apple industry's vulnerability to weather conditions. Heat stress was also cited as a concern because of sun scald, stem cracking and a reduction in the size and quality of fruit.

Box 3.8: Apple Producers' Perceptions of Climate Change

Five producers brought up climate change prior to being asked, three of whom viewed it as a potential threat, one of whom was in favour and the other who was sceptical. This division of opinions about climate change was further evident when interviewees were asked directly about climate change. As the chart below indicates, a small portion of growers (15%) were sceptical about climate change, one of whom felt that the time frame of available data is insufficient to substantiate the claim. Another small group acknowledged that climate change would be accompanied by more variable weather and more extremes, or that it could '*swing both ways,'* meaning that they could just as easily experience severe winters.

The majority of producers, however, viewed climate change as a long-term warming, usually referring to it as global warming. Half of this group stated that not only would temperatures rise, but the amount of precipitation, especially in winter, would decrease. "*Personally, I think of scorching hot summers and dry winters and water issues"* (small grower). Similar to the grape growers in the Okanagan, it is the potential reduction in the water supply that was the basis of concern about climate change. Half of the producers expressed at least moderate concern for climate change, and of these, six were concerned about the future water supply. Reasons for the lack of concern include confidence in their adaptability, the availability of crop insurance as a safety net, and/or that climate change is a long term process and will not affect them. "*In my lifetime there may be a 3 or 4 degree change…It might affect somebody 2 or 3 lifetimes down the road"* (small grower).



In addition to winter, participants in the three focus groups stressed that shortages of water and labour will create challenges in the future. While water and labour were mentioned in a few interviews, they were not given their due consideration. The participants in the Summerland region were especially attuned to the water supply issue because they had faced water restrictions in the last two summers. There was acknowledgement that there will inevitably be disputes over water between agriculture, the fisheries and residential use, especially because the population is expected to increase substantially in the next 15 years. The availability of water at critical times in the season will be a significant challenge, especially nearing the end of the season and during times of excess heat, as irrigation is used to prevent sun scald. In terms of labour, some producers already have experienced difficulties in finding skilled workers, a problem which they feel will only get worse and which will result in increased labour costs.

3.3.3 Adaptations that Make Sense

Apple producers were provided with the same list of adaptations as grape growers (refer to Table 3.3), and asked to discuss whether any of these had been employed and whether the adaptations were suitable for managing risk on their operation. Drawing from these results and from the previous discussion on adaptation in good and bad years, the most suitable or most common adaptations are:

- Changing crop varieties and hybrids
- Diversifying crop varieties and types
- Adding an irrigation system
- Adding inputs/focus on quality
- Crop insurance
- Income stabilization programs
- Replant Program
- Diversify household income

Changing crop varieties with the help of the government sponsored Replant Program was viewed as a very beneficial adaptation. While some producers stated that without the Program, changing varieties is not feasible because of the expense and effort involved, several countered this, saying that they would have replanted regardless and they will continue to replant in the future, albeit the process will take much longer. The latter group argued that it is necessary to be in tune with market demands, and that the replant will pay for itself in the end because of the higher returns received from the new varieties. With the change in varieties, producers have concurrently changed the crop hybrids and intensification, by switching to high density trees on dwarfed rootstock, which achieve higher quality more consistently and are less labour intensive at harvest.

Changing varieties and hybrids, while essential for responding to the market, was not typically cited as a way to manage weather risks, and in fact may have the opposite effect. When a small grower justified his reasons for changing varieties, he states: "*For economics. That is the only thing. Trying to grow something that actually pays. So, we do like the grape industry and grow things that we really shouldn't be growing here.*" By replanting to dwarfed rootstock, growers in effect increase their vulnerability to weather because the roots are closer to the surface and are more susceptible to frost and winter damage, and because the apples are more exposed, they also increase the chance of sun scald. A handful of producers did, however, acknowledge that they had or could change varieties in order to avoid apples that are more susceptible to sun scald, such as Jonagold.

Having a diversity of apple varieties was a strategy to deal with both market and weather risks. The rationale being that, in a given year, it is likely that at least one variety will pay well, compensating for those that do not. Similarly, each variety has a different weather tolerance, and thus having several varieties increases the likelihood of achieving one or few high quality crops. Diversifying crop types incited mixed opinions. Several producers grew a combination of tree fruits and were of the mindset that it was a good self-insurance technique. Others argued that it is a hassle to have different types, it requires more expertise, equipment and effort, and it takes away from the quality that could be achieved if all efforts were focused on one type. Participants also argued that being too diversified can work against you, if you are involved with the new CAIS program. They explained that if one crop is lost and the rest are fine, then it is not a big enough loss to make a claim. Also, if your acreage in each variety is small, then it will be very difficult to find labour at harvest time.

Irrigation, just like in the grape industry, is a necessity for apple growers. All respondents had at least one system, and nearly half of them reported having added a second system. Those who had added a system had a combination of drip, because of its greater efficiency, and either overhead irrigation to prevent sun scald and frost, or microjet, to have cover crops in between the rows. Having the combination of systems is one way to manage water supply issues, if drip irrigation is used as the main system and overhead is used as a backup system to prevent weather damage.

Whether in a good year or bad year, however defined, producing high quality fruit on a consistent basis is a strategy that is effective for apple growers. The better the size, colour, and overall appearance, the greater returns producers will receive. Thus, rather than cutting costs, which was one of the adaptations that was discussed, it is preferable to maintain the same or more inputs in any year in order to achieve a high level of quality. In years of low income, however, cutting personal or unnecessary expenses seemed to be a routine practice.

Crop insurance was generally seen as fundamental to farming and a necessity for managing weather risks in particular. The majority of the producers (90%) had at least basic crop coverage, which was mainly for insurance in the case of a hail event. Two major shortcomings of the crop insurance program that were identified were, for one, that it is not sufficient if the producer experiences two or more years of crop loss in a row. A small grower remarked: "*Even with crop insurance, the more loss you have, the less you can access the program later. Your premium goes up or your proceeds decline*." One producer explained that he was going into the season without crop insurance because the previous year he had suffered major losses, and his premiums doubled so he could no longer afford the insurance. The second drawback to the program is that it deterred producers from diversifying locations. If a producer had two orchards in separate locations in order to self-insure against hail damage, both plots would have to be covered under one policy. If one orchard loses its crop from hail damage and the other doesn't, then it would be considered a 50% loss and producers would not be able to make a claim. The only way producers can insure each orchard separately is if they pay a 20% premium on their insurance.

The income stabilization programs were also viewed positively, with 65% of the interviewees acknowledging that they participated. The majority viewed it as an important safety net. However, some producers expressed displeasure with the new CAIS program, finding it more complex than NISA. In terms of diversifying the household income, very few felt that getting an off-farm job was feasible, nor were they willing to move into agritourism, but seven of the interviewees did mention that their spouse works off farm, which in some cases was the reason they were able to persist following bad years.

CHAPTER FOUR

Exposure to Multiple Risks: Evidence From the Mixed Farming Sector in Perth County, Ontario

The third study in this series was undertaken in a selected farm community in Perth County, Ontario and was conducted in the summer of 2003. The participants in the study are involved in a mix of farming activities, primarily field crops and/or livestock production, activities that are illustrative of the county's agricultural sector. This chapter has the same objectives as the previous, and will follow the same structure; it begins with a description of the study area, followed by a reporting of the results of the conditions that make a good and bad year, future risks and opportunities and adaptations that make sense.

4.1 Study Area: Perth County, Ontario

Southwestern Ontario is a distinct agricultural region, containing over half of the Class 1 agricultural land in Canada and whose total farm cash receipts account for almost one-quarter of all farm revenue in Canada (Government of Ontario 2004). The region has a mild climate with a high number of growing degree days and ample precipitation throughout the year (Warkentin 2000). This combination of good climate and soils has made the region suitable for a diverse array of agriculture, the primary activities being livestock production and cash crops (e.g. soybeans, corn, and wheat).

Perth County (see Figure 4.1) is a productive agricultural region that is characteristic of farming in southwestern Ontario, with 90% of its area classified as Class 1, 2 or 3 agricultural land (Perth County 2003). Although agriculture is second to manufacturing in employment, agriculture nonetheless comprises 13% of all employment in the county; this is well above the provincial average of 2.4% (Cummings *et al.* 2000). The county is fairly specialized in the 'traditional' farming activities of field crops, dairy, and hog, which make up 27%, 22% and 17% of farms, respectively (Cummings *et al.* 2000). In 2001, these activities produced total farm cash receipts totalling over $506 million, almost half of which were derived from the dairy and hog operations (see Figure 4.2). This is quite significant for the province, especially with regards to hog production; total hog production in Perth County accounts for 17% of the provincial total, while field crop and dairy receipts account for 10% and 7% respectively (OMAFF 2004).

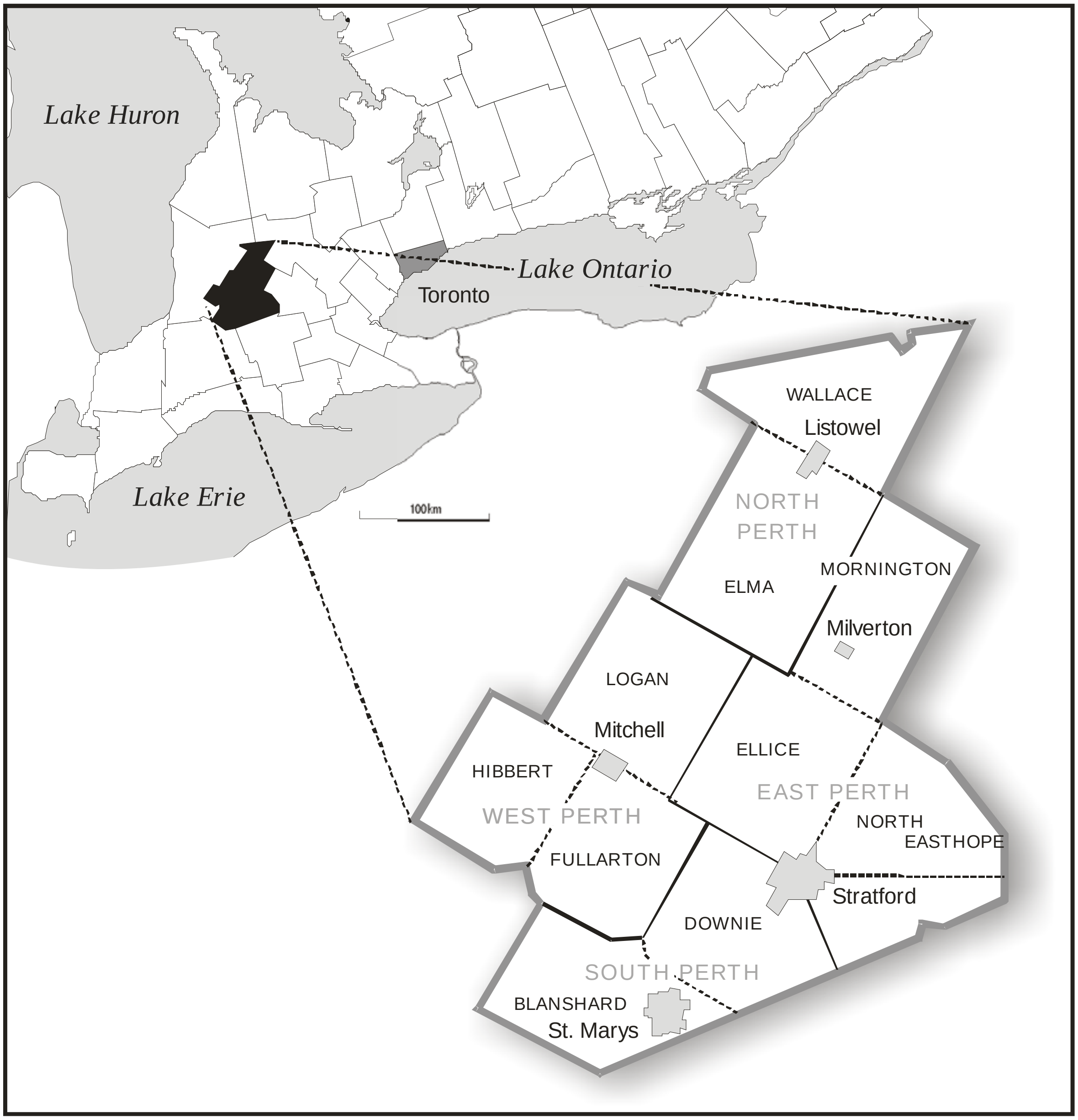


Figure 4.1 Perth County, Ontario

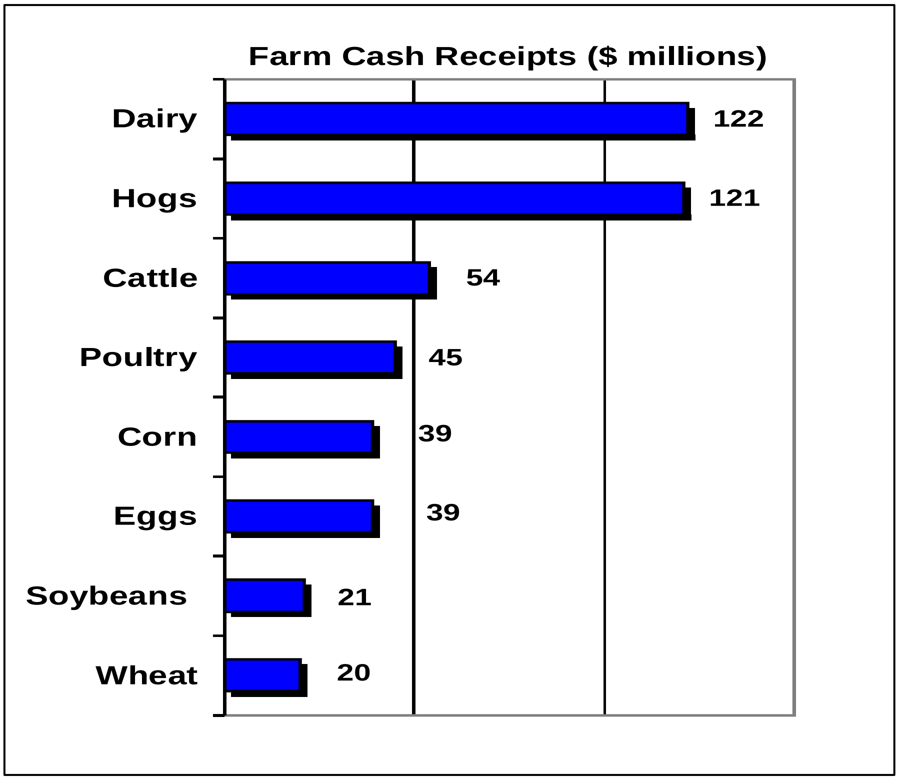


Figure 4.2: Farm Cash Receipts for Main Commodities, 2001

4.2 The Mixed Farming Sector

This case study reports on findings from 25 interviews and 4 focus groups that had a total attendance of 25 additional producers. Participants included farmers in the region that were representative of 'typical' Perth County farmers, with regards to farm size and type. These included individuals from predominantly small (up to 179 acres) and medium (180 to 759 acres) farms, and who were involved in either field crops, dairy, hog, beef, or poultry farming, or some combination of these.

4.2.1 Good and Bad Years

The primary response to what makes a good year was market conditions, cited by 52% of respondents (see Figure 4.3). The favourable market conditions that were identified were primarily related to high prices for the commodity being produced. Over half of these respondents were hog farmers, who were concerned with either hog prices alone, or the combination of hog prices with either high crop prices or low feed prices (see Table 4.1). Conversely, one respondent indicated that a good year was one when cattle and hog prices were low, because he could then buy the livestock cheaply. As he explains, a good year consists of: "*Buying cattle when the price is low – cattle and pigs. I can make more money when times are tough than when they are good because you buy low and you have to sell high…I make more money with everyone else losing.*"

The secondary response was weather (36%), which usually meant receiving enough heat and rain at the right times throughout the season. Although weather and market are separated into two distinct categories here, it was often the combination of the two that make up a good year. However, weather conditions were almost always related to the success of the crop, while price was mentioned for both livestock and crops. One exception to this was a cattle producer who noted that weather affects both the cattle and the crops: *It just makes everything so much better when you have a good year. The cattle are better.*

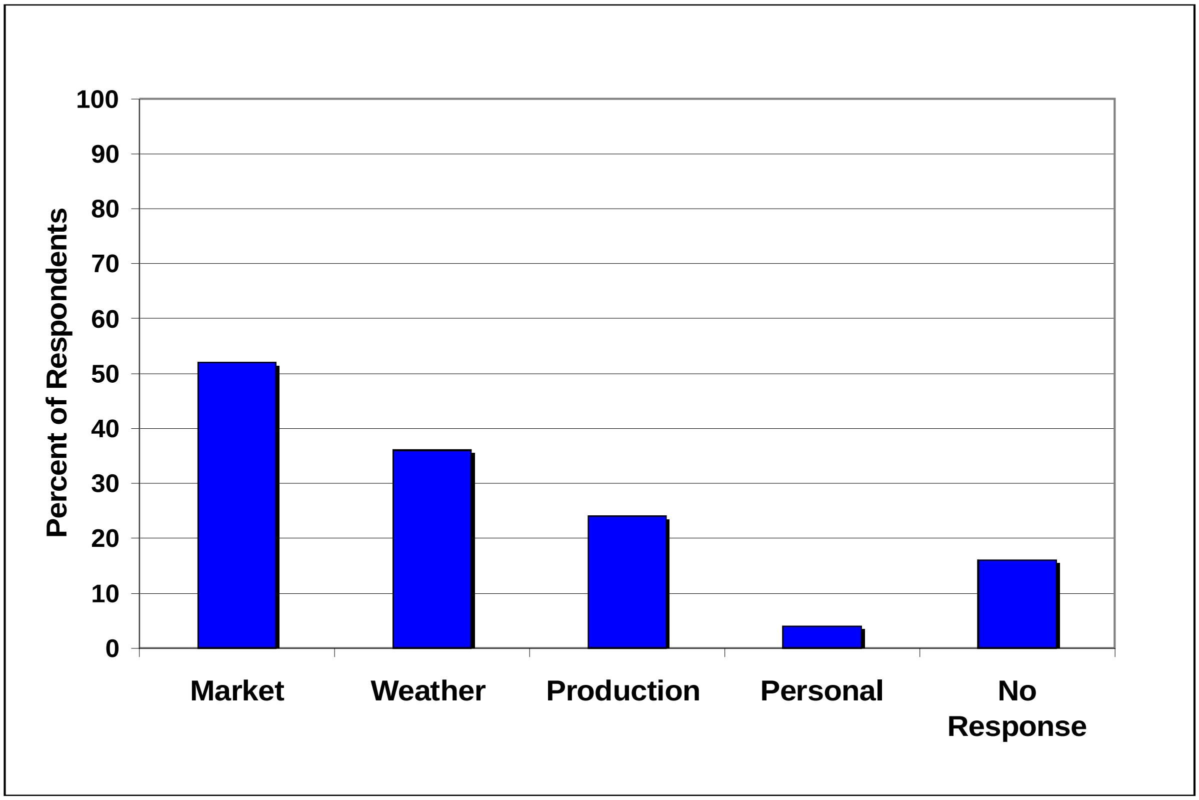


Figure 4.3: Conditions that Characterize a Good Year in the Mixed Farming Sector

Table 4.1: Conditions that Characterize a Good Year in the Mixed Farming Sector and their Associated Adaptations

Condition	*Adaptation*
Weather	
Moisture and heat at the right time	Stockpile hay
Timely rain	Build more storage
Weather in general	Buy more equipment
	Repay debt
Production	
Increase production of milk	Put money back into the farm
Expansion of operation	Buy more quota
Good growth and management of chickens	Buy more cows
High hog production	Expand operation
Started renting out farmland	
Market	
Hog prices	Buy more land
Commodity prices	Buy another farm
Cattle, hog and crop prices	Repay loans
Cheap feed and good hog price	Catch up in repairs and maintenance
Good price and good crop	Buy more equipment
Low prices for cattle/hog	"Lock in" more of the crop
	Invest money in real estate
	Have Market Revenue and GRIP as buffers
	Buy more cattle or hogs and sell when prices are high
Personal	
Rented land from father	N/A
No response	
Dairy is a constant income	N/A

If the calves are stressed when they are out in the pasture because it's raining all the time, they don't grow as well. In a nice year, you make nicer hay, and the calves don't get rained on."

Twenty-eight percent of the respondents own either dairy or chicken operations, which are both supply managed systems. These respondents had more difficulty singling out good (or bad) years because their income is less variable and their product is not entirely dependent on weather. As one dairy farmer explained: "That one is kind of a tough one to answer – shipping milk is a constant income. The only variables that I have income-wise are those two cash crops and they are not a major contributor to my income." As such, respondents either chose not to identify a good year, or they indicated a string of good years where production and income were increasing following either an expansion (e.g. bigger barn, more quota), or improvements in the operation (e.g. new feeding system, breeding better cows, genetic improvements).

The adaptations that were made in good years, regardless of the condition identified, were essentially all financial adjustments, save for one respondent who mentioned stockpiling hay to ensure a sufficient supply for the following year. The remaining adjustments involved either reinvesting money into the operation, or efforts to stabilize income in order to prepare for bad years. The former includes activities such as expanding the operation, buying or repairing equipment, repaying debts that accrue in bad years or, in supply managed systems, buying more quota. Efforts to stabilize income include involvement in income stabilization and insurance programs (e.g. Market Revenue Insurance, crop insurance), or through contracting (see Box 4.1). Diversification of the income was also an option. One respondent reported that following a year when hog prices were high, he decided to invest in real estate so that he was not as reliant on the variable hog market. Furthermore, the majority of the producers interviewed produced a mix of livestock and crops so that they are not entirely reliant on one or the other. "That's why we have three businesses here, consulting, beef, and crops. It's about not having all my eggs in one basket. It is for interest sake as well as for weather and price. I wouldn't want to do any one of them. So that is personal choice as well as strategy" (Cattle and crop producer).

Box 4.1: Agricultural Contracting: Moderating Income Variability

Contracting is a form of risk management where contracts are established between producers and companies (e.g. processors and packers) or other farmers, where an expected crop is sold before it is produced. For producers, this assures the price for the commodities in advance, reducing the risk of unknown income; for contractors, this assures a supply of high-quality, uniform farm products (Perry and Banker 2000).

Contracting can occur with either crops or livestock. One mixed producer (cattle and cash crops) mentioned "locking in" a portion of his spring wheat crop at the beginning of the season when the price was high. In this instance, locking in crop was beneficial: *With the good prices we should have locked in more of this year's crop. With the spring wheat in the ground, we had an opportunity to sell up to $234/tonne. We should have done a lot more, now it is down to about $125-$150. But you have to watch it, because you have to have the crop to sell.* While locking in crops gives the producer security, knowing a given income will be received, they also run the risk of losing profit if prices subsequently go up: *You try to lock in profit, but sometimes you lock in a small loss.*

One hog producer opted to partake in contract farming from the beginning of his career to ensure a constant cash flow. I went into contracting because it offered continuity; I haven't lost money on a pig that we shipped since I started in 1992. When the prices dropped in 1998, I was insulated. The contract also enabled him to start off the business, as it placed much of the financial risk onto the contractor. I don't know where I would be today, given the prices, if I had done all the financing myself and carried the risk as opposed to the contract. In this producer's view, contracting is similar to a supply managed system because it moderates price variability, and guarantees a yearly income, so long as production obligations are met.

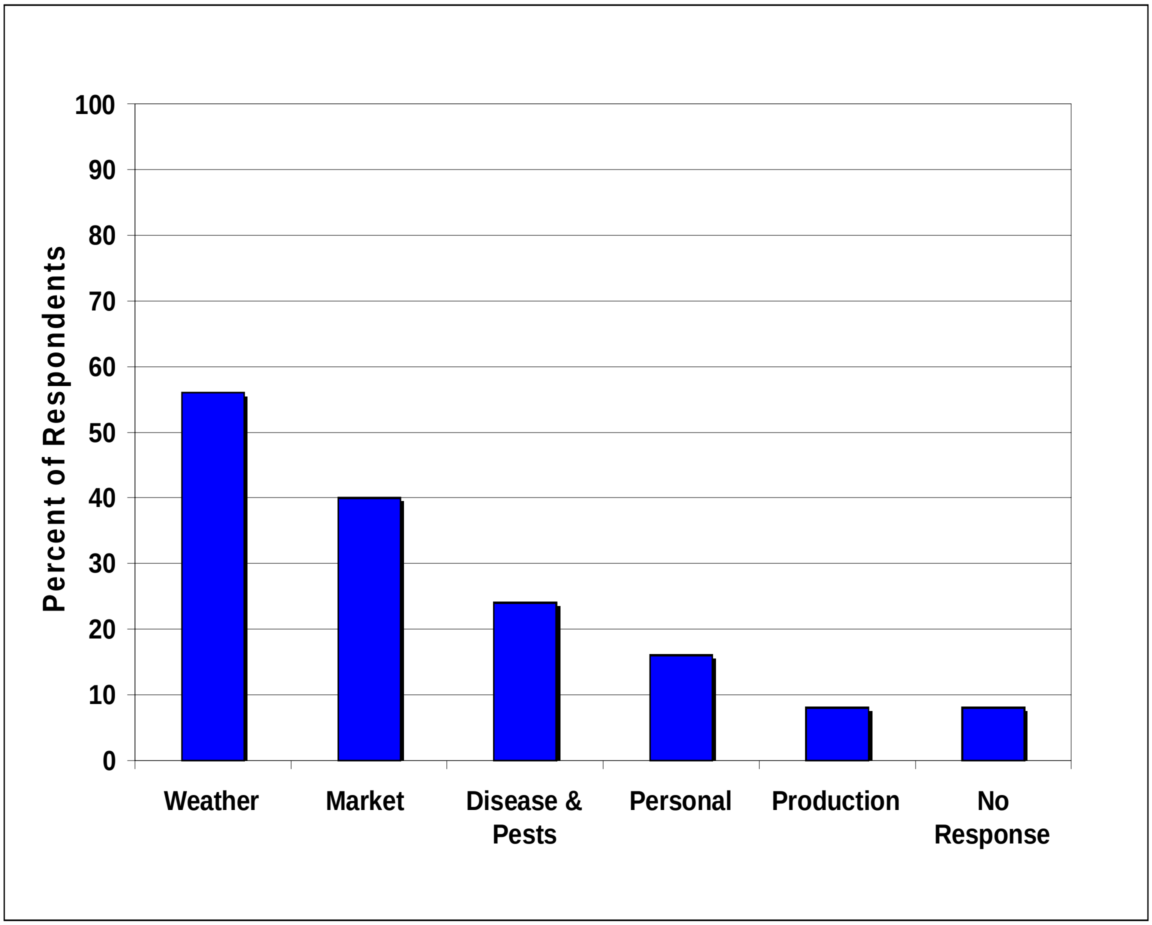


Figure 4.4: Conditions that Characterize a Bad Year for the Mixed Farming Sector

When asked what conditions make a bad year, the most common response was the weather with 56% of the responses, placing market in second with 40% (see Figure 4.4). The main weather conditions that were identified as problematic were the two moisture extremes – either not enough water (drought conditions) or too much water (excessive rain), especially when combined with cool summer temperatures. Similar to the good years, weather conditions were largely cited as problematic for the crops, rather than directly for the livestock. Since most of the interviewees (92%) produced at least some amount of crops, respondents were able to identify weather as contributing to a bad year, even by those involved in supply managed systems who had previously indicated that their income was stable (3 dairy farmers and 1 chicken producer).

However, the point should be clarified that weather is not irrelevant to livestock or dairy farmers. For one, many of them grow their own feed, and so weather will determine the quality and amount of feed produced, or whether additional feed has to be purchased. One dairy producer, who grew both hay and grains to feed the heifers, stated: "*The forage is the backbone, no matter how you manage it nutritionally; that is the heart of the operation – the feed.*" He went on to explain that a dry year tends to produce less hay; wet years produce less grain and more hay. In wet years, however, the quality of the hay may be reduced, a challenge which, in his view, creates greater difficulties than the shortage of feed. Weather also has some direct effects on livestock, as excessive rain influences the growth of calves and excessive heat has been implicated as one contributing factor in reduced conception rates in pigs (see Box 4.2)

Box 4.2: (Re)Production Challenge: Low Conception Rates in Hogs

While price is an important factor for hog producers, so too is the successful production of hogs; the fewer the hogs produced, the less the income received. One hog producer emphasized this point by recounting a bad year that he recently experienced. *In the last 10 years, the year 2000 was the most difficult. We had been on a down part of the price cycle in the hog sector. Combine that with some production challenges too. The success of a soy farrowing operation hinges on a number of things: you have to have successful conception rates, which leads to farrowing rates, and numbers born. Summer mating didn't pan out. I'm not sure of the factors around that totally, but heat was definitely a factor. We had a hot summer last year. But we also experienced difficulties in the fall, so I can't attribute it all to the heat. Conception rates were down for four to six months*.

To respond to this challenge, the producer combined a few management techniques. In order to recoup the number of hogs, the producer attempted to subsequently over-breed hogs. However, it was not possible to increase breeding by more than 10%, because the barn had a limited number of farrowing crates and would not have the capacity to hold more hogs than that. The producer relied more on artificial insemination because it was presumed that the heat reduced the quality of semen from the boars. The heat also affects the sows, however, by prolonging the time it takes to get back into their regular cycle and are able to breed again. This problem is normally addressed by bringing in cooler air from the outside; the machine that does this, however, was broken that summer, another factor which likely contributed to the reduced conception rates. Finally, the producer adjusted his regular management techniques, conducting more diligent routine pregnancy checks and *making a decision to market the animal, if she is what I call a 'repeat offender.'*

Market conditions were another concern for producers, especially for those producing hogs (24% of respondents). The main concern was low commodity prices, for crops, beef and hogs. In addition, two producers identified increased feed and other input costs as a challenge (see Table 4.2). Similar to the good years, however, it is not market prices alone that are problematic; rather it is the combination of weather and market. This importance is captured by a quote from a hog and cash crop producer who states: "*If I get a good yield, I can live with it. If I have a good price, I can live with it. A low price and a low yield is a crippling factor. We had that in 2001.*"

Although market and weather are the most common conditions cited as making a bad year, there are a number of other factors that affect producers, listed in Table 4.2. Several producers experienced crop or livestock losses from outbreaks of either pests or diseases. In 2001 there was an unusual outbreak of aphids in the area which, in several cases, wiped out over half of the producer's soybean crops. Being an unfamiliar occurrence in the region, producers did not know how to adapt and most made crop insurance claims. Diseases may also cause major setbacks, such as in the case of a hog producer whose sows contracted the Porcine Reproductive and Respiratory Syndrome (PRRS), and a chicken producer who had a full rotation of straw spoiled by botulism. Interestingly, it was all dairy producers who mentioned more personal reasons for having a bad year, mainly relating to additional stress either from the expansion of the operation or financial troubles. One dairy producer was frustrated because he had put a lot of time and money into the operation, with the expectation that his son would take over the business. Instead, his son purchased a different farm.

Table 4.2: Conditions that Characterize a Bad Year in the Mixed Farming Sector and their Associated Adaptations

Condition	*Adaptation*
Weather	
Rain and cold	Crop insurance
Dry/Drought	Next year plant corn with less heat units
Too much rain	Plant a different maturing variety
	Buy supplements for feed
	Add grain to hay to feed to heifers
	Store extra grain/hay for feed
	Experiment with varieties suitable for drought
	Maintain high soil organic matter
	Put more acres into forage
	Lower the pipe on the well
	Do not cut hay all at once
	Plant crops later
	Put drainage tiles in
Personal	
Borrowed money and had trouble paying it back	Sold land
Added stress due to expansion	Share cropping
Son pulled out of the business	
Market	
Low hog and cattle prices	No extra purchases
Low commodity prices	Borrow money, cut costs
Increased costs	Diversify to spread risk
Increased feed prices	Get out of hog farming
High cattle prices	Have off-farm jobs
	Hedge feed
	Stopped buying cattle
Production	
Low conception rates in hogs	Overbreed hogs
Barn burnt down	Artificial insemination
	Insurance
	Rebuilt barn
Disease/Pests	
Disease (Pork Reproductive and Respiratory Syndrome)	Vaccinate sows
Botulism	Upgrade technology
Aphids	Crop insurance
Fusarium in wheat	Spray Folicur on wheat
No Response	
Dairy is a constant income	N/A

To deal with bad years, interviewees listed a variety of adaptations. Those that grew crops, either cash crops or feed, applied predominantly farm production practices to adapt to unfavourable weather conditions. In years where there was a shortage of hay, producers could supplement feed either with other crops that they grew (grain, corn), with stored feed, or with purchased feed. In a subsequent year, this shortage prompted one producer to put more acres of land in to forage in the place of wheat and beans. Two other producers noted adaptations that were influenced by the previous year's weather, including planting corn with lower heat units or that mature earlier following cold growing seasons. Respondents also mentioned changing the timing of practices. For example, to reduce damage from rain, one cattle and crop producer described cutting his hay gradually rather than all at once:

> *I tend to be very cautious when I am cutting hay and I don't cut a whole lot at a time so that is doesn't get spoiled. Being a beef farmer I like my hay a little bit more mature, because I am feeding it to cows. I am lucky, in that if it is wet I can leave it standing. Dairy farmers want to get it earlier for more nutritional value, so it is a little more critical… If you see guys who go out and cut a hundred acres of hay, and it rains for two weeks, and it gets spoiled; they do a lot of complaining… I only cut about 10 acres at a time. It's just insurance for me.*

While most of these adaptations are reactive, one producer explained his on-going management strategy of reducing weather risks by maintaining healthy soils (see Box 4.3).

To respond to unfavourable market conditions, the adaptations were mainly financial. This includes reducing spending and tightening the budget. A cash crop and beef producer explained that in difficult years he: "*Borrowed money where we could, refinanced, cut expenses, held back, no expansion, extended our accounts payable. All the kind of stuff you do to maintain cash.*" One couple that is just beginning their farming career, has decided to reduce the financial strain by easing into the business and keeping their off-farm jobs as they gradually increase production. Following the collapse of hog prices in 1998, a former hog producer decided to alleviate the financial stress of the hog market by removing himself completely from hog production and instead expanding beef and cash crop production. Adaptations to all other conditions (disease, production and personal), were predominantly reactive and specific to the event in question (e.g. claiming insurance and rebuilding a pig barn that had burned down).

Box 4.3: Reducing Risk with Healthy Soils

A mixed cattle and crop producer cited weather conditions as creating a bad year because of the difficulties it creates for crop production. In addition to purchasing crop insurance, the producer manages weather risk through on-farm practices. He reduces the effects of moisture extremes on crop production through the maintenance of a healthy soil, high in soil organic matter (SOM). To maintain high SOM, he employs a combination of no-till practices and manure applications, a technique that is facilitated by the cattle farming component of his operation. In dry years, the additional nutrients and organic matter help to absorb additional moisture in the soil. According to the producer, the no-till practices help manage risk in both wet and dry years:

No-till leaves a residue on the surface and reduces the evaporation. Every time soil is cultivated, it dries out. In a dry year, like last year, I think the best crops were probably no-till, because only one pass went through the field. There was less traffic and less compaction. In the wet year, the residue on the surface keeps the soil from drying out more, so at planting time maybe we have more problems; maybe we are delayed. But once it dries out enough to plant, I think that no-till probably leaves a better chance of having a good crop. On a no-till field, there are more earthworm holes, and so it is more likely that you are going to get excess moisture down into the subsoil, and more likely you will grow good crops.

The producer has also reported on a number of added advantages that accompany the use of no-till practices. The fuel savings are enormous. One pass of the tractor as opposed to four has a major impact on cost… I have been no-tilling for 13 years, and I would never go back. It is convenient and the yields are increasing.

4.2.2 Future Opportunities and Risks

Although the conditions that make a good or bad year are predominantly weather- or market-related, neither of these conditions made the top two positions in the future opportunities category. Instead, the two leading opportunities were personal, familial reasons or were related to production potential; these were followed closely by market opportunities. Of the 44% of respondents who gave personal reasons, 32% noted that future opportunities are dependent on whether their children want to get into the farming business. Should the children want to enter, several producers noted that they would likely expand, upgrade or diversify the business to accommodate the decision.

> *My son will be done university in 2005. It will depend on what direction he wants to go, whether he wants to come into the business. The dairy business could do with some upgrading, but it depends on whether we want to stay with the same business, or whether we want to expand. My brother has a son too; if he comes into the business, we will probably expand a bit.*
>
> (Mixed cattle, hog and crop producer)

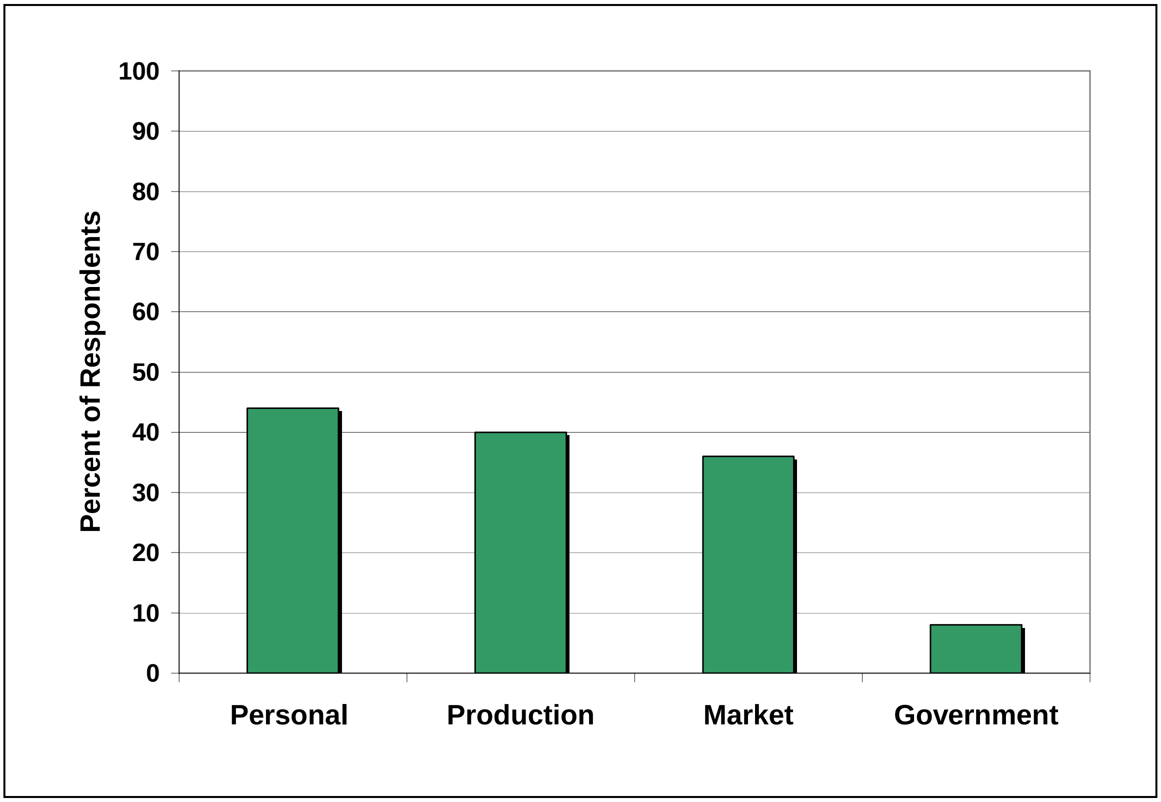


Figure 4.5: Future Opportunities in the Mixed Farm Sector

The other option, as one dairy producer explained, would be to wind down the business by selling cows and quota, but maintaining cash crops in order to prepare for retirement. The remaining three respondents saw opportunities as retiring or moving into consulting as well.

Forty percent of interviewees indicated that there was the potential to enhance production on their operation, either through expanding the business, improving quality, or increasing yield, the latter two of which could be achieved through the adoption of new technologies. A dairy and crop producer saw the combination of these as opportunistic: *"The whole genetically modified cropping should give me more yield in corn and hay. It will likely come for the hay… I will continue to increase the herd size; the barn was built to accommodate growth. I don't have to increase acreage; I can rent more land or buy more feed, one of the two."*

Producers also perceived potential opportunities in the market. Almost half of the market opportunities identified were related to the *non-* adoption of technologies, specifically genetically modified foods. These producers felt that the by producing non-GMO crops and/or by moving into organics, they would be able to be competitive in the marketplace. "W*e really have to go the route of fitting into a niche between organic and conventional; I see ourselves in the middle of that. We are hoping that identity preserved is an opportunity…Identity preserved is non-GMO – it gives you a bit of an edge where prices are better"* (Cattle and cash crop producer). The other market opportunities included the maintenance of a successful industry and good prices. These responses came mainly from producers in supply managed sectors, who foresaw continued opportunity so long as the system remained and the growth of the industry continued.

The market was also perceived as a potential risk in the future, but this was superseded by concerns about government regulations (see Figure 4.6). The main concern was about the implementation of the Nutrient Management Act and the uncertainty of its effects to farmers, an account that is detailed in Box 4.4. The other answers came from dairy and chicken producers who worried that the government would take away the supply management systems, placing the commodities into a competitive marketplace. Also, one cattle producer cited the government's lack of involvement as a risk. His/her concern was that if the government does not put a cap on the number of livestock permitted on each farm, then it compromises the safety and comfort of locals by increasing the risk of spills, pollution and water contamination.

Market conditions were a secondary risk (52%), which was mostly related to price. This includes a decline in commodity prices, particularly in the hog and beef sector, an increase in dairy quota prices and a decrease in milk prices. A significant increase in interest rates is also viewed as a potential threat, due to its impact on those that must borrow money to survive: *"I know personally 150 farms, people I have worked with, that will disappear if the interest doubles from 6 to 12%. Double their interest cost, and they will be out of business or they will have to change drastically what they are doing"* (Cash crop and beef farmer). The other concern was expressed by two small livestock producers who felt that they would not be able to compete with the large industrial farms who are able to operate at economies of scale and sell at lower prices.

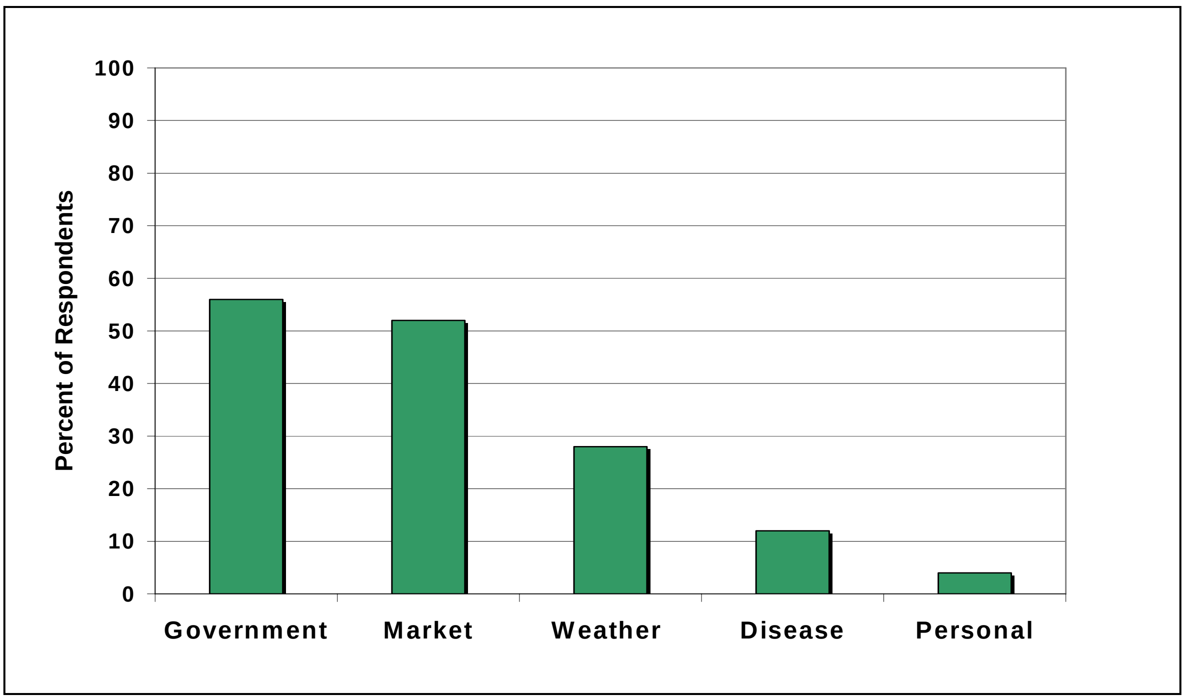


Figure 4.6 Future Risks in the Mixed Farming Sector

Box 4.4: The Nutrient Management Act and its Perceived Implications

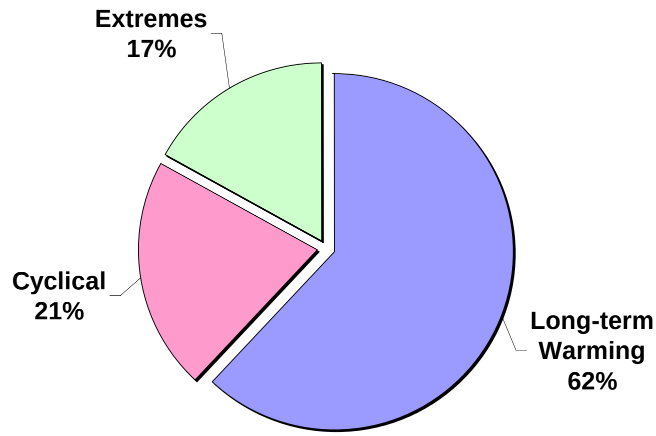
The purpose of the Nutrient Management Act (NMA) is to regulate the management and storage of manure, as well as its land application. The Act was passed in June 2002 and is being introduced in stages according to the size of the operation. The first regulations came into effect September 30, 2003, and these apply to new and expanding livestock operations. As of July 2005, all large livestock operations will be subject to the NMA (Fraser 2003; Government of Ontario 2004b).

Concerns about the implementation of the Act arose many times throughout the interviews. The interviews were conducted prior to the implementation of the first regulations and so there was much uncertainty about the effects to the individual producers. In some cases it was this uncertainty that was the concern: "*There are all kinds of different things that could be happening. Not knowing is more of a concern to me*" (Dairy farmer). A few of the producers recognized the environmental benefits of the Act and saw it positively overall. However, these and other producers expressed concern about the costs of compliance, since it is likely that they will be the ones bearing the costs of installing or upgrading manure storage facilities. Many producers fear that without government assistance, it will not be an affordable venture. "*We are hoping that with the nutrient management we can get assistance. Cure us or kill us. If there is no funding, and they want us to do something, we won't be able to keep doing it. You want to spend money on things that makes you money. Fencing in the manure makes us no money*" (Dairy and crop producer). Although one producer saw this as advantageous because it would prompt large livestock producers to limit or reduce the number of livestock, a small hog producer felt that the costs incurred by the Act may force him to sell his pigs and get out of hog production entirely.

Weather was mentioned as a potential risk by 28% of the producers, but was often spoken of generally; i.e. specific weather conditions were not cited as posing future risks. One of these producers brought up climate change, but did not seem overly concerned, being confident that he could adapt: *"Global warming is a risk; to change the climate, it will change what we do. It will probably happen gradually, and we can adapt"* (Chicken farmer). This perception of climate change as a gradual warming, discussed further in Box 4.5, is perhaps one of the reasons that producers do not view it as a future risk.

Box 4.5: Perth County Perceptions of Climate Change

The view that climate change is a long-term warming trend is very common among Perth County farmers. As illustrated in the chart below, nearly two thirds of the respondents held this perception, referring to climate change as global warming or the greenhouse effect, or indicating it is reflected in a change in temperature alone, e.g. "*warmer winters, hotter and drier summers.*" Of those that did hold this perception, one third of them were not entirely convinced of its reality, making comments such as "*I am somewhat sceptical about the hype over it, quite frankly.*" Seventeen percent of producers were entirely sceptical about the issue, stating that the changes were cyclical.



Twenty-one percent of producers considered climate change to be a combination of a warming, and a change in variability and extremes. Only 8% of these producers, however, mentioned extreme events; the others alluded to temperature extremes: "*You get more swings in the temperature – higher highs and lower lows.*" Those producers who mentioned extreme events were also overtly concerned with climate change. Another 8% expressed genuine concern either for their children or if there were to be more incidents of drought. Thirty-five percent of producers were moderately concerned, indicating that climate change was not their biggest concern, or that they are concerned to the extent that it will potentially make weather harder to predict. Forty-two percent of interviewees, however, were entirely unconcerned with climate change. This indifference may be fuelled by the way it is viewed as a long-term trend – an event that may happen in the distant future. "*It will be so far down the road that I will be long forgotten.*" Thus, some producers do not feel that it will affect them and instead are worried about the more pressing issues that they must deal with.

4.2.2 Adaptations that Make Sense

The last exercise that interviewees and focus group participants were asked to partake in, was to review a list of adaptations (Appendix B) and discuss whether the adaptations ‘made sense’ for their operation. The following discussion will draw on both interview and focus group data to highlight the adaptations that arose that were most useful to producers in Perth County. This will be preceded by a brief discussion on the rationale behind farmer’s decisions.

In the focus group sessions, the issue was raised of how producers make cropping decisions. The majority of producers were committed to a crop rotation schedule, and their decisions were framed within that schedule; a select few were of an opposing position, where decisions were primarily influenced by market prices. Those producers of the former standpoint, planned for the next year based on the rotation schedule. Due to financial incentives offered by seed companies for ordering seeds early, many farmers have their cropping decisions planned by the end of the year. One dairy farmer explained:

> *Usually by December I have everything booked: fertilizer, seeds and everything. As far as what crops I am going to grow, that is pretty much set. I have a strict crop rotation. I don’t jump around from crop to crop, thinking about what it is going to be next year. It is a basic five-year crop rotation. It is easy to plan that way*.

The few producers of the opposing view indicated that they changed their crops every year, but their choices for the type and quantity of seed were influenced by market prices rather than adhering to a strict schedule.

In addition to guiding decisions, crop rotation is itself an adaptation used to deal with risk, a point which was emphasized more in the focus groups. In the interviews, crop rotation was brought up when asked if the location of crops was changed. While the majority of interviewees stated that they did not change the location of crops, five interpreted this adaptation as rotating their crops within the field. This practice is done to maintain soil quality, to reduce pest, disease and weed infestations, to manage nutrients and to ensure an adequate amount of feed for livestock. This strict planning of crop rotation, however, reduces producers’ flexibility to respond to weather conditions, save for in the beginning of the season when there is the opportunity to change corn heat units or change crops before planting.

Changing crop hybrids or varieties was a common adaptation; this involves choosing a variety of corn with certain heat units, planting a variety that matures earlier, or using genetically modified seeds. The choice for corn heat units is influenced by previous years’ weather, by spring weather conditions and by the riskiness of the farmer. In the first instance, it was mentioned that following one or more cool summers, some producers tend to cut back on the corn heat units. Those producers that are on a rotation schedule are influenced by both previous year’s weather and spring conditions because the seed companies allow them to replace seeds with lower corn heat units if, for example, spring conditions are poor.

The decision for what heat unit to plant, however, varied by producer and depended on their willingness to take risks. Some producers admitted to being cautious and planting the variety that was suitable for their region: "*We always plant 2600 heat units. It is helpful because you get the crops off earlier. I have seen people around here plant crops and not be able to get them off. It is safer to plant 2600 heat units.*" Other producers were more willing to take risk and push the limits of what could be grown. To manage the risk, producers from two focus groups explained their strategy of planting a range of heat unit corn. These producers divided their acreage to plant a combination of high, average and low heat unit corn so that in ideal growing conditions they optimize their yield, but in a normal or cooler year they are still protected. A hog farmer explains:

> *We believe there is a longer growing season available to us. We have 500 acres. Instead of growing 2700 heat unit corn, we grow 100 acres of 2900, really high heat unit corn, and another 100 acres of 2850 h.u. We take 15-20% of our acreage and push it, if the weather is a little extreme, a lot of heat and enough rain, then those crops will give just a huge amount. If it is just a normal year we won't get the extra benefit, but they have the potential.*

Producers in Perth County were divided on the issue of biotechnology and the use of genetically modified crops. Forty percent of interviewees acknowledged their use of Roundup Ready® soybeans or *Bt*- corn, either in the past or currently. Reasons for use include increased yields, reduced pesticide and herbicide costs, and drought tolerance. In the focus groups, a hog farmer was partial to the use of GM crops because the pest management it provided, allowed him to reduce his dependency on a crop rotation schedule and instead respond to market forces. On the other hand, reasons for non-adoption were that producers did not agree with the use of biotechnology, they were displeased that it was the seed companies who benefited rather than farmers, they felt that crop rotation was a cheaper, more beneficial pest management strategy, or they could receive premiums for identity preserved (non-GMO) commodities.

The adaptation which received consensus as being effective for dealing with moisture related risks was drainage tiles. The majority of the interviewees have systematically tiled most, if not all, of their land and that which has not been tiled is scheduled to be so in the near future. Farmers have found that the tiled land improved crop yields in both wet and dry years. In some cases, the incidence of wet years prompted farmers to tile more land. Praise for the drainage tiles is exemplified in such statements as "*it is the best money we ever spent*" and "*Drainage tiles – there should be no end to things like that.*" This adaptation is a stark contrast to the grape and apple industries that make no use of drainage tiles and instead are reliant on irrigation.

A final farm management practice that is widely adopted is no-tilling. Nearly 70% of the interviewees stated that they practiced no-tilling on at least some of their land. The primary reasons for adoption were to reduce fuel costs and to reduce soil erosion and compaction. Similar to the producer in Box 4.3, some respondents maintained that no-till helped manage weather risks by keeping moisture in the ground in dry years. However, many others felt that its main benefit was its cost-savings, and were unconvinced of the ability to deal with weather risks, especially in wet years. "*In a really wet year you are better with conventional than no-till. In a normal year, no-till yields much the same crop; you just cut your costs down.*" Another producer noted that in a dry spring, no-till fields are actually disadvantageous because it is difficult to open and close the trenches and plant seeds. With the arrival of the Nutrient Management Plan, the use of no-till practices will be hampered due to the difficulties of applying liquid manure.

In section 4.2.1, producers identified various financial management techniques employed in good and bad years, including strategies to stabilize income and to manage their budget to self-insure for bad years. In addition, three notable adaptations are forward contracting, participation in income stabilization programs and crop insurance. Forward contracting, discussed in Box 4.1, is a relatively new practice of selling some or all of an expected crop before it is planted. While only eight interviewees were involved in forward contracting, it received greater attention in three of the four focus group sessions. The perspectives of forward contracting, however, remain divided; in one session, contracting was foreseen as being a necessity in order to obtain a decent profit margin; in another, contracting was viewed as a gamble. One beef producer recounted his negative experience of forward contracting with a US company that he had been selling to for eight years; this year the company is refusing to accept Canadian beef due to source of origin labelling.

There was a general consensus, however, around the utility of the NISA program. Seventy six percent of interviewees participated in the program, all of whom indicated that they appreciated the program. One hog farmer referred to the program as a 'no-brainer,' and that it acts like a financial cushion with returns better than mutual funds. NISA was a vital program in particular during the collapse of hog prices in 1998 and 1999. The remainder of the producers who were not involved in NISA were all from supply managed sectors and were restricted from participating. Some dairy producers expressed the desire to be eligible for the program, but others preferred the supply management system.

Finally, crop insurance was a viable option for many producers, particularly cash croppers; 70% of producers with crops purchased crop insurance. By and large, those producers who did purchase insurance were supportive of the program, recognized its utility in dealing with bad production years, and tended to insure at least one crop with up to 80-90% coverage. Of those farmers that did not carry insurance, some felt that the cost wasn't justifiable: "*I always think one in ten years are bad, and the money you save in crop insurance will buy you the feed in the one year*" (Dairy farmer); another had quit buying insurance following a bad year where yield was drastically reduced, but not to the point where he was eligible to make a claim, despite his 85% coverage. In the focus groups, concerns were raised about the insurance program, noting that coverage would not be effective for repeated disaster years.

CHAPTER FIVE

Exposure to Multiple Risks: Evidence from the Livestock and Grains/Oilseeds Sectors in Southwestern Manitoba

This chapter reports on the Manitoba portion of the cross-Canada studies, where field work was undertaken in the summers of 2003 and 2004. Participants included a mix of cattle producers, grains and oilseed producers, and those who produce some combination of these. The chapter follows the same format as the previous, beginning with a description of the study area. Following this, the conditions that characterize good and bad years are identified, as well as their associated farm-level adaptations. Future risks and opportunities are then identified, followed finally by the a review of the adaptations that make sense to cattle and/or grain producers in Southwestern Manitoba.

5.1 Study Area: Southwestern Manitoba

Agriculture is an important contributor to Manitoba's economy, accounting for approximately one-fifth of the province's exports and 4.7% of the provincial GDP (IEDM 2005). Agricultural activities are restricted to the southern end of the province where fertile grassland soils are found; the northern two-thirds of the province are located on the uncultivable rock of the Canadian Shield, shown in Figure 5.1 (Corkery 1996). The continental climate of Manitoba is characterized by extremes and remarkable variability, with very low temperatures in the winter and high temperatures in the summer. The growing season in the south is short, with an average of 115-125 frost-free days a year, and it is during this period that most locations receive two thirds of their annual precipitation (Blair 1996). Overall, the Manitoba climate is fairly dry, with precipitation increasing towards the north and east, with the west experiencing extended rain shadow effects from the Rocky Mountains. It is because of this restrictive climate that the primary crops that are grown are grains and oilseeds (Carlyle 1996).

5.2 The Livestock and Grains/Oilseeds Sectors

The producers that were targeted for this study are located in the southwest corner of the province, in the Westman and Parkland regions. In both regions, the dominant agricultural activities in 2003 were beef cattle production, followed by grains and oilseeds (a combination of oats, barley, flaxseed and canola) and wheat production (see Figure 5.2). All 25 interviewees and 13 focus group participants (from two focus group sessions) represent typical farmers in this area, producing either grains/oilseeds or beef cattle, or a combination of both. Interviewees' range of experience in farming is between 6 years to 53 years, with the majority farming for 20-35years.

Figure 5.1: Regional Map of Manitoba (Manitoba Community Profiles 2005)

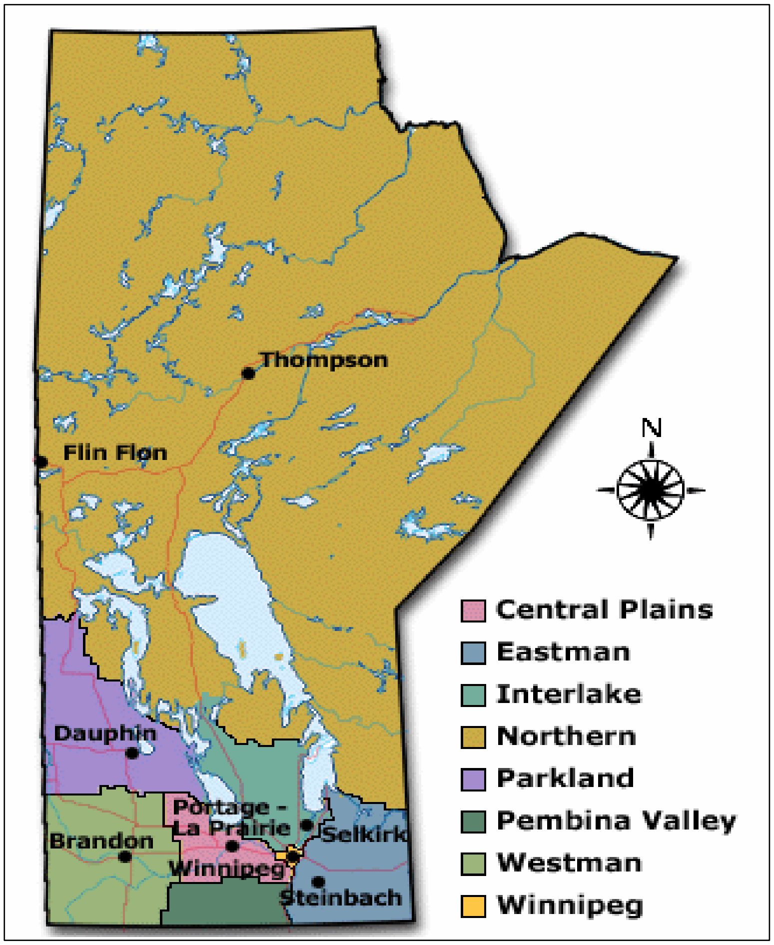
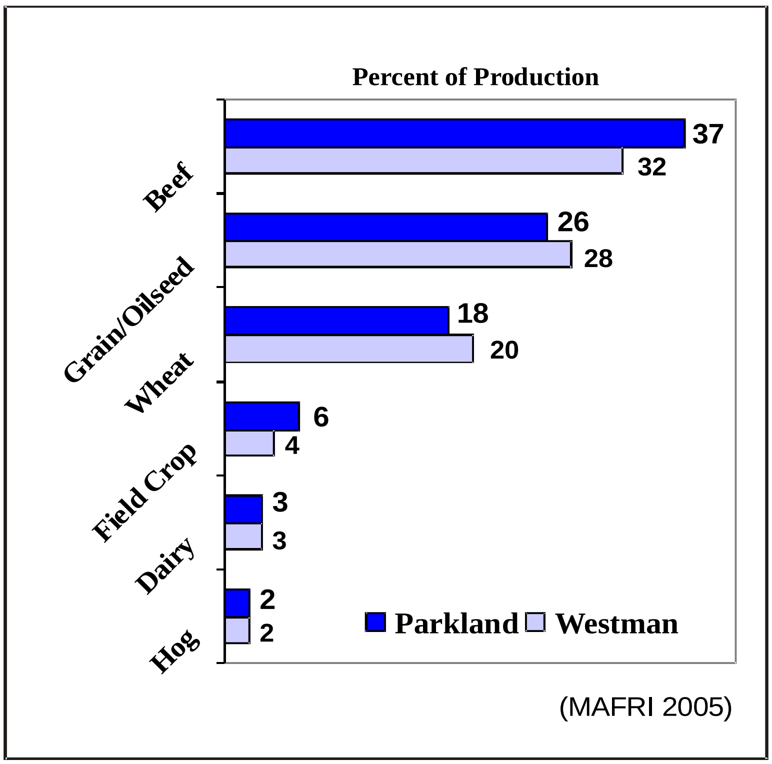


Figure 5.2: Main Agricultural Commodities Produced In Parkland and Westman Regions In 2003



5.2.1 Good and Bad Years

Good years for Manitoban farmers were characterized primarily by the weather and the market (Figure 5.3). Fifty-six percent of the respondents identified weather conditions, citing generally good weather, leading to high crop yields and a high quality or grade of crop. Timely and adequate rains were favoured, with sufficient moisture in the spring to get crops started. A mixed farmer explains: “spring rain is very important. It’s good to get it after [the crop] is sowed to make sure you get good germination... It’s just when you get 3 or 4 inches of rain at a time, you get in trouble; when you only have an inch it’s just perfect.” Growing seasons without excessive heat and without early frosts in August were opportunistic, as were more mild winters, which are beneficial for the cattle. 56% of respondents who identified market conditions, noted that a good year consisted of high prices for grain and/or cattle, depending on the operation, particularly when high prices coincide with high yields. Thus, similar to the apple growers in the Okanagan Valley and mixed farmers in Ontario, it was the combination of high commodity prices with good weather and high yields that characterized a good year for many. Cattle farmers, however, did identify low grain prices as beneficial, because it reduced feed costs.

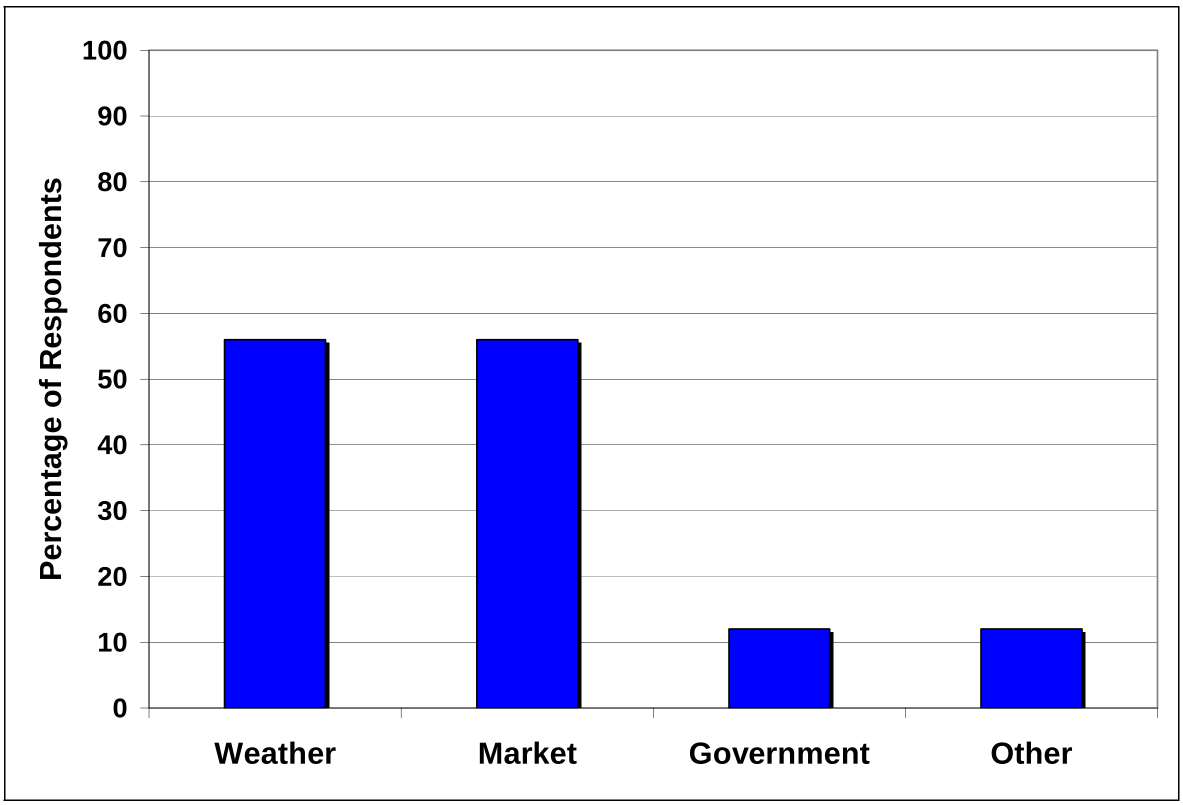


Figure 5.3: Conditions that Characterize a Good Year for the Livestock and Grains/Oilseeds Sectors

In addition, 12% of producers mentioned the Gross Revenue Insurance Plan (GRIP), a government support program intended to stabilize revenues of grain and oilseed producers. Respondents suggested that years that GRIP was in place (1991-1997) were good, because it provided a safety net to maintain relatively high income levels. Low input prices and a weak Canadian dollar were also identified as favourable. A few producers noted that all years were good, which is attributable to good financial management and the diversification of their operation (see Box 5.1). In the focus groups sessions, technology was cited as a source of opportunity for producers over the last ten years. Producers found that zero-till practices and improvements in equipment has reduced seeding time, improvements in seed varieties have resulted in increased yields and better storage capabilities, and genetically modified canola, in particular, has provided better weed management and options in rotation.

Box 5.1: Strategies to make every year a good one: Debt management and diversification

Two respondents stated that all years were good for their operations. A mixed farmer explained that their strategy was to stay out of debt, which afforded them greater flexibility in their farm management practices. “*Because one of the things we don’t do, is we don’t borrow money and so it leaves us a huge option going with the flow. So if it’s a wet spring we can change our plans right around …It’s not a huge crisis if it doesn’t work.*” The operation is diversified, producing a mix of grain and livestock (pigs, cattle, chickens), and is certified organic, supplementing their income with an added premium. They are not involved in any government programs, assuring that their debt free lifestyle provides stability. “*If things get tight, we tighten up. We don’t spend money; we don’t do anything; we just suck it in and carry on. But we are able to do that because we don’t have any payments.*”

Another respondent diversified the cattle operation to include an apiary, which provides a more stable income. “*I’m lucky to be a beekeeper. I’ve never had a bad year.*” The producer noted that he/she was also fortunate because his operation has never suffered from drought, and cattle prices have only fallen below average on a few occasions. Even still, he notes, “*On a year where the cattle has been poor, I’ve had a good year with bees. I’ve never had both sides of the operation having bad years.”*

Adaptations made in good years were primarily strategic, financial management practices. The common responses were to:

- pay off debt;
- put money away for retirement;
- buy new equipment and/or upgrade machinery;
- buy extra inputs;
- buy additional land; and/or
- buy additional cattle.

In response to favourable market conditions, one cattle producer bought more land for pasture in order to increase the herd size; he explained, however, that this was a potentially risky venture, because it meant that ‘all his eggs are in one basket,’ which could be devastating if the herd is affected by disease. Others planned for poor years by purchasing additional grain storage equipment, stockpiling hay, and purchasing extra inputs, like fertilizer, for the next season.

Unfavourable weather was the most common cause of a bad year for Manitoba farmers, with nearly 70% of respondents identifying at least one problematic weather condition (Figure 5.4; Table 5.1). The most frequently cited conditions were those related to excess moisture, particularly in the spring or fall, and 1999 was repeatedly identified as an extremely wet year. Heavy rains in May and June delayed or inhibited planting for many farmers. Those who got their seeds sowed before June 20th, the deadline to claim crop insurance for unseeded acreage, planted early maturing varieties, despite which problems were encountered with seeds not germinating, or crops not fully maturing. Those who did not get their fields planted by that date were able to collect insurance for the unseeded acres.

> *I should have done like everyone else and taken my money from the government and not sowed them. Instead of that, I tried to seed them all in, and we didn't get much of a crop; but because I made the effort, we didn't get any compensation.*

Wet falls can reduce the grade of grain and delay harvest, due to the inability to get machinery into the muddy fields without getting stuck; delays in harvest in turn increase the risk of frost. Livestock are also affected by wet conditions, being at higher risk for foot rot, an infectious disease of cattle causing lameness in one or more feet. Humid, hot conditions are conducive to fusarium, a disease in wheat and other grains that reduces yield and grade.

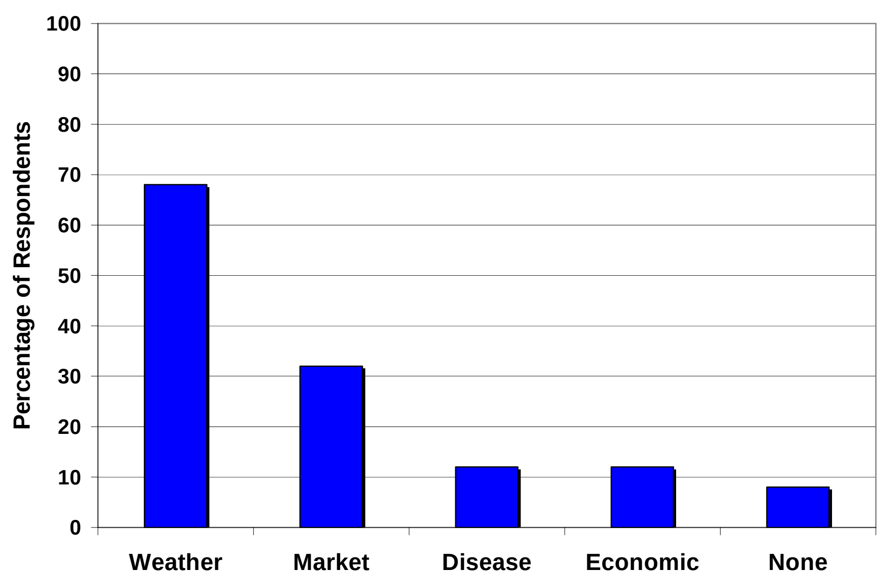


Figure 5.4: Conditions that Characterize a Bad Year for the Livestock and Grains/Oilseeds Sectors

Table 5.1: Conditions that Characterize a Bad Year in the Livestock and Grains/Oilseeds Sectors and their Associated Adaptations

Condition	*Adaptation*
Weather	
Wet spring	Crop insurance/ Hail insurance
Hail	Custom grazing
Excess moisture	Delay seeding date, stagger seeding dates
Humid, warm fall	Choose early maturing varieties
Drought	Blend grain with higher grade
Frost	Limit spending
Variable spring and fall temperatures	Minimum tillage
Market	
Low grain prices	Expand cattle herd, cut back grain
Low cattle prices	Rent land
Border closed to cattle	Custom work
Loss of market (local creamery closed down)	Diversified to horse operation
	Operating loans
	Store grain
	Income stabilization
Economic	
High input costs (fertilizer, fuel)	Change to low-input crop
High interest rates	Use wheat for feed
Pests and diseases	
Fusarium	Pesticides, sprays
Footrot	
Grasshoppers	

Dry/drought conditions were mentioned less frequently, which may in part be because producers' inherently plan for drought (see Box 5.2). Dry years were mentioned primarily by cattle producers, because the conditions led to reduced quantity of hay and pasture. Dry years were also associated with grasshopper outbreaks, which eat both the crops and the grass for pasture; one producer indicated that grasshopper outbreaks were becoming a more frequent problem for his operation. Other producers suggested that their supply of water is dissipating, which is attributed in part to reduced snowfall in the winter.

We are starting now to see our reserves being used up. They're not being recharged and regenerated by rainfall and snowfall. We're becoming more and more dependent on rainfall.

Other problematic climatic conditions were hail, spring and fall frost, and 'erratic weather.' Both frost and hail have damaged crops, causing farmers to lose between 10%-100% of their crop. However, if either condition occurs early enough in the spring, farmers can reseed the fields; if it occurs later in the season or in the fall, then the crop is lost. A few producers noted that weather seemed to be getting more erratic and more extreme.

Box 5.2: Conditioned to drought

Few respondents implicated drought in causing bad years, but it nonetheless came up in discussion. It is not that producers were unconcerned with it, but rather that their practices were adjusted to plan for drought. One mixed farmer stated: "*Generally where we are, every decision we make is based on drought. You assume you're going to have a drought so you bank for a dry year, and you make your decision based on that. If it rains it's a bonus. If it stays wet you'll have to make different decisions, but I'm going to be making drought decisions for a while yet.*"

One practice is to stockpile hay. The producer noted that he/she tried to maintain a hay supply that would last two years; the hay can be used as feed for their own livestock or sold to others in need. In addition to stockpiling, another producer limits the number of livestock owned, having more than can be carried in a drought year, but less than can be carried in an excess year. In spite of these practices, it was stated: "*One year of drought really won't hurt [the operation] that bad; it'd be the second year of drought that would really hurt it.*"

Another common practice is to employ minimum or zero tillage to conserve moisture and reduce soil erosion. A grain producer felt it was so effective that: "*The no-till component has made me feel quite comfortable about drought. I have never had to re-seed a crop.*"

This variability creates difficulties, particularly in the spring and fall, where temperatures straddle the freezing point. One producer recounts:

> *This spring, I lost all my winter wheat that I'd sown last fall because the last week of March was plus 15. The first week of April was minus 15. The snow cover was all gone and it froze all the plants down. So I reseeded all of my winter wheat.*

Low market prices and high input costs were also identified as problematic. Those with mixed livestock and grain operations found that usually prices were down in one commodity or the other; really poor years occurred when both were low. The international subsidies provided to American and European farmers were identified as a contributing factor to suppressed prices. Wheat producers, however, have the advantage of selling through the Canadian Wheat Board (CWB). While most crops (e.g. canola, soybeans, corn) are sold on the open market where prices are continually fluctuating, the CWB reduces financial risk through 'single desk selling' and 'price pooling', which means that producers sell as one through CWB, rather than compete against each other, and that farmers delivering the same grade of wheat receive the same price, regardless of when the grain is sold during the year (CWB 2005). A mixed farmer explains:

The Wheat Board is good… they set the price in the fall or the spring – whenever they set it. If they set $2.00 a bushel for barley, you know you get the whole year at that price. It's like shipping cream – you knew you were going to get what they set; you were going to get that type of money all year round.

Poor weather conditions can reduce the grade of the wheat, however, reducing the price received through the CWB. Hence producers explained that the combination of low grain prices and weather conditions that reduce grade or yield caused financial strain; the same amount of inputs (e.g. pesticides and fertilizers) were purchased and used, keeping expenses high but revenue low. Rising input costs are exacerbating the problem; "*You can't sell a cow and get 45 gallons of gas.*" The price of fuel and other associated transportation costs have been a greater concern since the removal of the Crow Rate in 1996 (see Box 5.3). The rise of input costs has influenced producer's choices. One producer, for example, no longer grows canola because of the high cost and high risk associated with the crop; the canola was replaced with a pea crop, which does not require fertilizer and even adds nitrogen back into the soil.

Box 5.3: Changing Policies: Removal of the Crow Rate

(For more detail see Ramsey and Everitt 2001, and Schmitz et al. 2002)

The Crow Rate was a subsidy and rate-control agreement made by the Canadian Pacific Railway in 1897. The agreement reduced freight rates on specific products, such as wheat, in return for a subsidy to construct a rail line from Lethbridge, Alberta to Nelson, B.C., through Crow's Nest Pass. This made shipping wheat relatively cheap for Prairie farmers, and hence net prices were relatively high. As transportation costs rose, the railways incurred losses from shipping grain, and in 1983, the Western Grain Transportation Act (WGTA) was introduced, which intended to gradually shift the burden of the costs to grain producers. In 1996, the Crow Rate subsidy was removed completely, and farmers received one payment based on acreage and land quality.

The removal meant that producers were faced with significant increases in transportation costs, a lower net price for grain, and a different price ratio between cattle and grain. Because of these outcomes, the elimination of the Crow Rate was identified as a risk by Manitoban farmers, a risk that prompted changes to some operations. A producer estimated that the removal added approximately $1/bushel in transportation costs, a significant increase when wheat prices fluctuate between $3-5/bushel. In response, producers have opted to either grow different crops or use the wheat for feed, especially when prices are low. By using the wheat for feed, the quality/grade of wheat is less of a concern, and hence so are climatic conditions that reduce quality. Conversely, those selling wheat through the CWB strive for high grade wheat in order to be in the highest price bracket, in which case they are more sensitive to climatic variability.

Producers have employed a range of financial practices to manage the risks identified (Table 5.1). Crop insurance was purchased by many as a safety net that enabled them to recover the costs of inputs used; claims were made in response to wet springs, frost, hail, and drought. In some cases, a severe weather event, such as a hailstorm, prompted farmers to begin purchasing crop insurance. Income stabilization programs were drawn on when inputs were high and prices were low. A producer indicated that NISA allowed him/her to stay in business following the removal of the Crow Rate. Some farmers borrowed money each year to cover initial costs; one producer felt that running an operating loan was the only way he/she was able to continue farming. *"You're always running an operating loan. There is no other way to do it. You're fighting to stay above, to keep your head above water; it's just the way it is."*

A few producers chose to reduce production on their own farms and instead do custom work on other farms to stabilize their income. In one case, following three years of low grain prices, the producer quit farming, rented out the land, and went into full-time custom work and silage. Another began custom work in addition to farming his own operation, but found that he was then less qualified for government support:

> *There were government policies out to compensate people who had a lower income. I didn't rely on my farm making any money for me and I went and did more custom work. So they penalized me for it. My farm actually made less. I made more money because I was working for other people, but custom work was shown as part of my farm income. It wasn't part of my farm income; it was my income, not my farm's income.*

In response to continually weak prices for grain, one fifth of the respondents gradually increased the cattle portion of the operation and cut back on grain. The grain fields were converted to pasture and/or hay, used to feed the cattle. Another producer opted to store the grain in steel bins on his/her operation until the price increased at least above the cost of production; the bins were holding two years worth of grain at the time of the interview. When questioned about the ability to afford to store grain for so long, he/she replied:

> *I might not have money very long if I sell it for less than it costs me to grow it. If you're losing money when you sell it, you lose money. If you keep it, you haven't lost money. If you can keep it until you can make money on it, then it works. I don't know how many years I'll have to keep it.*

Storing grain also occurred in response to poor weather conditions. If the grade of corn was lowered, the grain could be stored for a year and blended with next season's crop, assuming that it is a higher grade.

5.2.2 Future Opportunities and Risks

The majority of opportunities identified by Manitoba farmers were production-related (Figure 5.5); producers saw opportunity in either the expansion or contraction of their operation. Expansion opportunities included increasing herd size, purchasing land from an aging population that is retiring, and expanding to a point of higher efficiency, in order to recover from the effects of the Crow Rate removal. Others looked forward to contracting their businesses or getting out of farming by turning it into a hobby farm and working elsewhere, renting the land to pay off debts, reducing production to reduce costs, or preparing to hand over the business to the children.

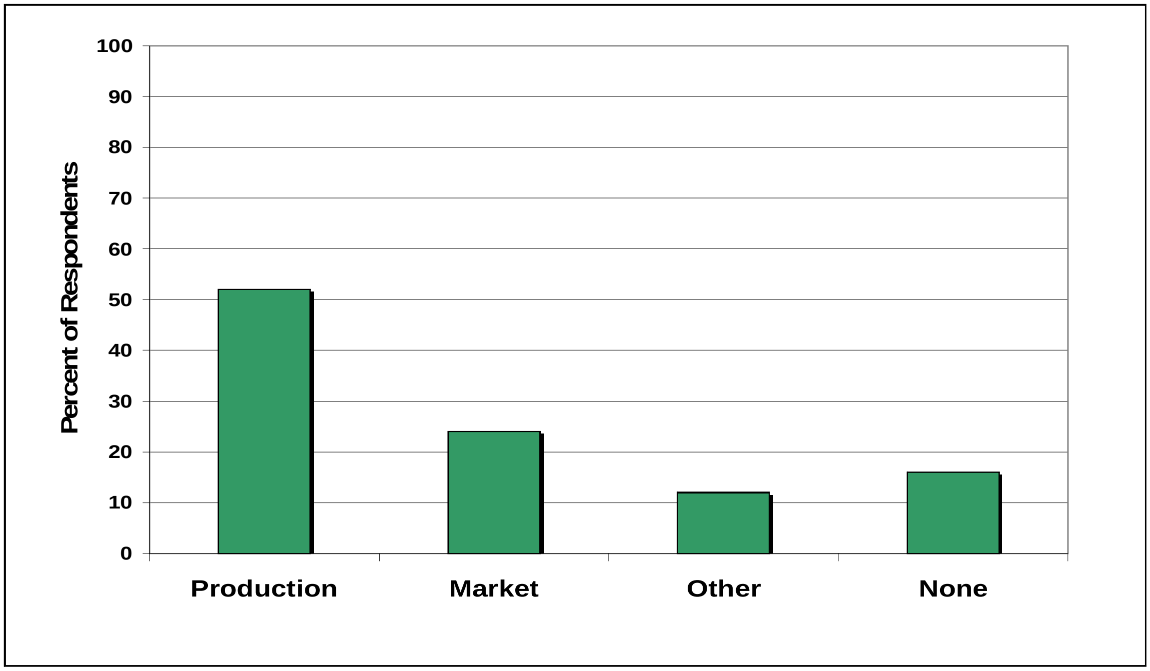


Figure 5.5: Future Opportunities for the Livestock and Grains/Oilseeds Sectors

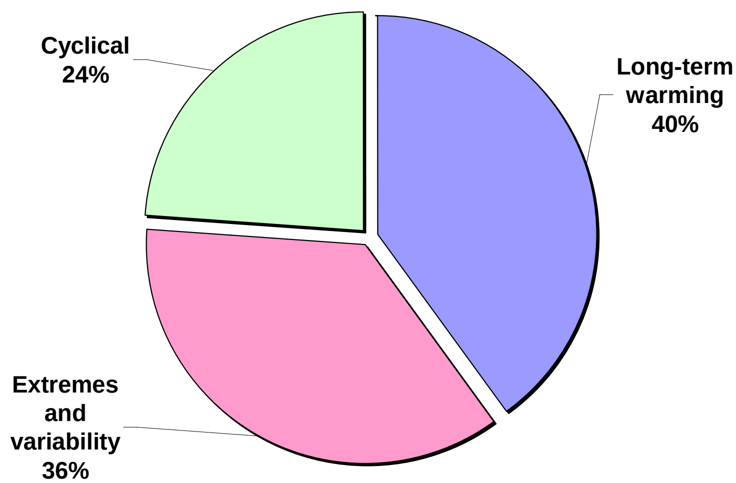
Approximately one quarter of respondents identified market opportunities in the next 5-10 years, including higher commodity prices, finding new markets for their products, and in one case maintaining stable honey prices. A new market that was identified was the ethanol plant built in Minnedosa, Manitoba, which would enable producers to grow and sell new, high yielding wheat varieties that are not licensed to be sold through the CWB; the proximity of the plant would also reduce transportation costs. The prospect of receiving carbon credits was also mentioned; the credit could be received by changing practices to sequester carbon, or by renting property to Manitoba Hydro for wind farms. The other opportunities that were identified include improved government support programs that target smaller, family farms, and the development of new varieties, such as early maturing soybeans and Genetically Modified Organisms (GMOs) that allow for decreased inputs and production on marginal land. Additionally, focus group participants identified opportunities relating to climate change, such as reduced frost risk and a longer growing season; however, views on climate change varied among producers (see Box 5.4).

Box 5.4: Manitoba farmers' perceptions of climate change

Views on climate change were divided. Forty percent of producers viewed climate change as a long-term global warming, providing mainly opportunities for Manitoba farmers: longer growing season, fewer frost days, milder winters, and the ability to grow new varieties. An additional 36% indicated that accompanying the warming would be greater extremes, more erratic weather, and more pest problems, with several producers suggesting that this is already occurring:

> *It seems to me to be a lot more variability, highs and lows, more vicious storms, more extremes. Like last spring – pretty extreme cold – it didn't warm up and so nothing was growing…I was a month late getting on grass.*

Twenty-four percent of producers, however, were sceptical about human-induced climate change, and that any difference in the weather to date can be attributed to cyclical weather changes.



The degree of concern about climate change also varied. Over 1/3 of respondents were unconcerned with climate change; these respondents either viewed climate change as cyclical, or believed that the effects would be positive for farmers in the region. An equal number of respondents were concerned with climate change, particularly with the prospect of more frequent and severe drought, floods, severe winters, extreme heat, and drier conditions, challenging the ability to produce a crop and reducing the water supply:

> *When we look at the water situation, it is a direct result of climate change. We're seeing wells go bone dry. We're seeing it further in western Canada where guys are having to get rid of their herds because of three years of drought. You keep wringing your hands and wondering if it's our turn next.*

There were an additional 28% of respondents who expressed only moderate concern. The mild concern is due to the perception that there is nothing they can do about it and that it will not affect them in their lifetime, or due to the confidence in their adaptability.

A greater range of future risks were identified, with market being the most frequently cited by 40% of the respondents (Figure 5.6). The greatest concern is being unable to compete with large farms who can withstand lower commodity prices because of their economies of scale. A mixed producer notes: "*It's a scale thing; you've got to be big. It will be bigger operations that will eventually take over and the little guy is just going to end up not having any choice and throwing in the towel.*" Other anticipated market risks include the continual suppression of prices, in combination with rising input costs, and the loss of foreign markets. Although GMOs have been opportunistic for farmers, facilitating the production of crops and the management of climate-related risks, there is the threat certain export markets will be lost. There is controversy in particular over the development of GM wheat, which can easily spread and regenerate in other fields; Europeans and Asians have already indicated that they will not accept it. The loss of markets by the re-closure of the Canada-US border to livestock is also a concern, one that is related to disease outbreaks.

Diseases were the second most common risk identified (20%), especially the threat of Tuberculosis (TB) and Bovine Spongiform Encephalitis (BSE) or 'Mad Cow' in the cattle. Risks associated with disease outbreaks are reduced cattle prices, insufficient government support, and more stringent regulations regarding food safety and monitoring for diseases, which can come at a cost to the producer: "*A risk is definitely TB and being monitored for that… it affects cattle prices if we are in a TB identified zone. Other people's cattle prices may go up but ours may be significantly lower*." Other government-related risks identified include zoning laws which permit large-scale hog operations to be situated near the smaller farms, or environmental regulations coming in at the farmer's expense.

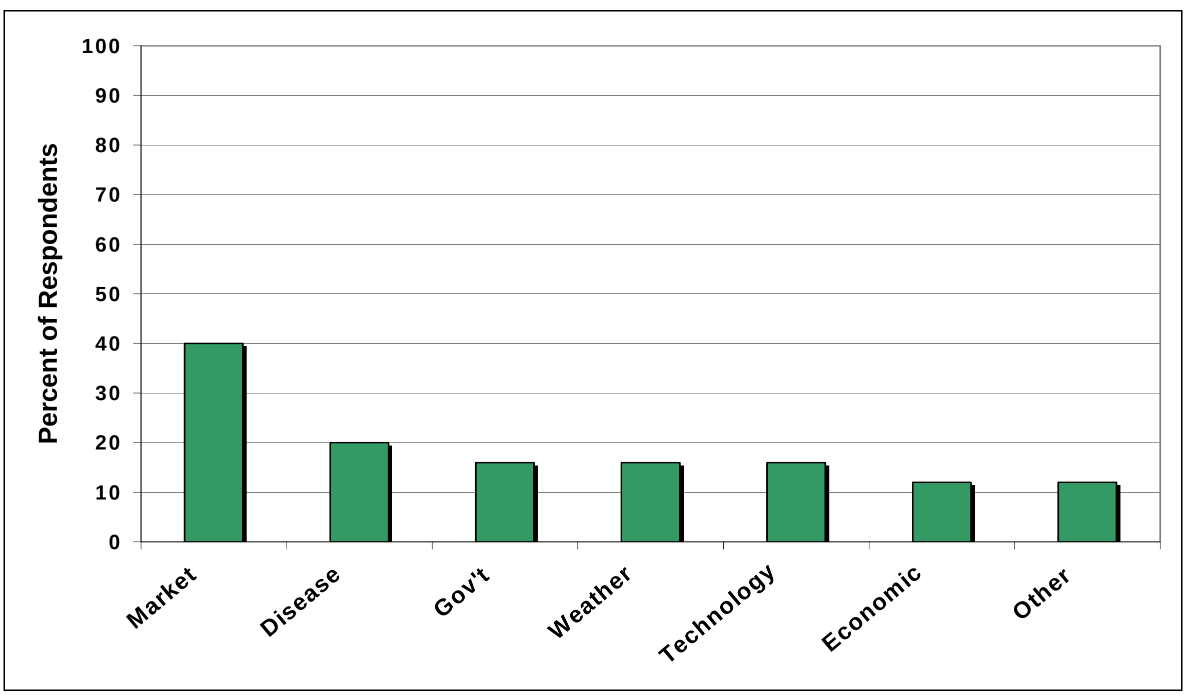


Figure 5.6: Future Risks for the Livestock and Grains/Oilseeds Sectors

Climate-related conditions were identified as a future risk by 16% of producers, with the main concern being more incidences of drought and the region becoming drier. The other risks identified related to an aging farm population, with few young people interested in taking over or working on farms.

5.2.3 Adaptations that Make Sense

The adaptations that were most frequently employed by producers in Manitoba were:

- Change varieties
- Adopt Genetically Modified varieties
- Diversify and rotation varieties
- No-tillage and direct seeding
- Crop insurance
- Income stabilization
- Off-farm employment

The selection of crop varieties to plant each year was an important practice to manage risk. Varieties can be chosen based on the date of planting and on anticipated climatic conditions. The selection of early maturing varieties was common to avoid frost damage in the fall, or to respond to late planting; if wet springs delayed planting or caused crops to be reseeded, then planting early maturing varieties increased the likelihood that a crop would be matured. Conversely, some producers planted later maturing varieties in response to the already extended growing season. Varieties were also chosen based on their moisture tolerance or to reduce risk of disease outbreaks. Thatcher wheat, for example, is a variety used traditionally in the forties, but that was reported to be more drought tolerant than some newer varieties; forage oats were planted because they grow well under moist conditions. One producer that was having difficulties with fusarium outbreaks, switched from hard red spring wheat to winter wheat:

> *Because flowering [of winter wheat] happens early in the season, I do tend to minimize the impact of fusarium head blight. And I market that grain either for ethanol production or feed in southern Manitoba. So I can minimize my requirement for fungicides there by just growing a different crop.*

In conjunction with variety selection, a few producers staggered seeding dates, to spread out the timing of farm practices (e.g. spraying, harvesting), and to spread risk from frost or moisture problems.

Genetically Modified varieties were adopted by many producers, although it was a contested practice. Roundup-ready varieties were the most commonly used because it allowed for easy and effective weed management, it is a relatively safe chemical that does not leave a residue, and it facilitates no-till practices because weeds can be controlled without working the soil. A producer reported that the development of Roundup-ready canola enabled him/her to plant the crop in marginal land where weed control would have otherwise been a problem. However, the downsides of growing GMOs were recognized, including the evolution of resistant weeds, the spread of GMOs into non-GMO fields and crops (including organic crops), and the loss of or limited markets for the product; thus it is not a practice adopted by all.

The majority of producers grew a diversity of crops, including a combination of grains and oilseeds (e.g. canola, wheat, barley and oats) primarily, but with others experimenting with horticultural crops and grasses. Some producers experimented with different crops (e.g. peas, faba beans, alfalfa), to find what grows best in their fields, and/or because legumes have nitrogen fixing properties, which can improve soil conditions and reduce input costs. Having a diversity of grains and oilseeds is common because producers then rotate the crops; rotation breaks pest, disease and weed cycles, improves soil conditions and reduces input costs. This is particularly important for no-till farms, because there is less weed control when fields are not tilled. A few cattle producers mentioned that they practiced rotational grazing, where you rotate the pastures in which cattle graze in, to keep the soils and grasses healthy.

The majority of the producers indicated that they employed zero tillage practices or direct seeding practices. Both practices aim to minimize soil disturbance (>40% if soil surface is worked up) and maintain crop residue cover, but direct seeding is more flexible and allows for some tillage to deal with unusual conditions. Producers found that no-till practices worked well to manage dry/drought conditions because the practice reduces moisture loss in the soil. Other benefits include reduced wind and water erosion from the protective cover of the residue on the soil surface, higher soil organic matter, potential for reduced weed growth, the ability to "get on the land faster" in the spring, and reduced input use and costs. There is also potential for producers to obtain carbon credits for carbon sequestration. Producers did note, however, that under wet conditions, no-till practices were not opportunistic:

> *Zero till leaves such a mat of residue on top, it seals that soil and it is very tough to get on. You're two or three, maybe even a week behind a lot of the other farmers, to get on to that field because it is just so sloppy, so soggy underneath.*

It also creates difficulties managing some native grasses, like foxtail barley and skunk grass, which are better managed with tillage.

Government support programs like crop insurance and income stabilization were widely used for financial management. Over two-thirds of respondents carried at least basic crop insurance as a safety-net. One producer described its utility as "*one of those things that you don't get rich on but it sure keeps the wolf away from the door.*" The Net Income Stabilization Account (NISA) program had almost equal support (just under 2/3 of respondents), although not all of those who carried crop insurance participated in NISA, and vice versa. Another financial management practice was to have off-farm employment, and almost half of the respondents indicated that they did have some source of external source of income. While this often meant a spouse worked off-farm, several indicated that they worked both on and off the farm, some taking part in agricultural politics, some in custom work, others in unrelated employment. Although this was not necessarily a shared sentiment, one respondent replied: "*For us as young farmers, we wouldn't be able to survive without the off-farm income.*"

CHAPTER SIX

Farm-Level Adaptation to Climate and Other Risks in Canadian Agriculture

The preceding three empirical chapters have offered a wealth of insights to the ways in which Canadian farmers are currently experiencing and responding to a variety of risks (and opportunities), including those generated by climatic variability and change. In light of the challenges faced by climate change impact research, especially with regard to the uncertain role of human adaptation (Brklacich *et al.*1998; Bryant *et al.* 2000; Lemmon and Warren 2004), such insights are critical for better understanding the likely net effect of climate change for Canadian agriculture. This chapter primarily serves to identify these insights, offering generalizations about Canadian producers' adaptation to climate and other risks. Before this is done, some reflections on the approach to the research are offered with the aim of improving our methods of investigation in climate change adaptation research.

6.1 Reflections on the Approach

As identified in the introduction, the research presented herein has adopted what Tol *et al.* (1998) label a 'temporal analogue' approach to climate change impact assessment, in that we have sought to understand the likely implications of future climate change, especially with regards to the adaptability of Canadian farmers, by documenting farmers' *actual* adaptations to current climatic and non-climatic conditions. This was achieved through both individual interviews and focus group meetings with producers in three agricultural regions of Canada. While this approach is largely consistent with the work of others in the field (e.g. Smit *et al.* 1996; Brklacich *et al.* 1997; Smit *et al.* 1997; Smithers and Smit 1997), it varied with respect to its sequential querying of 'cause' and 'effect'. That is, rather than question producers about their past actions ('effect') and the various reasons for these actions ('cause'), this research first identified any and all risks (and opportunities) to which producers are exposed, consistent with the so-called 'vulnerability approach' (see Stockholm Environment Institute, 2005), and then queried producers as to their adaptation to said risks (and opportunities). This approach offered many insights, some of which are distinct, and all of which are identified in the next section. One particular feature of this approach, is its highlighting of stressors that producers deem to be significant, be they related to climate, markets or family. That is, rather than presuppose the importance of certain external stimuli within agricultural systems (e.g. change in average temperature), as is the necessary requirement of modelling exercises, the vulnerability approach enables the identification of pertinent stimuli, which are, most likely, the drivers of change (e.g. extreme heat events).

At the same time, this approach has certain limitations, which should be reflected upon in future research. For example, this approach necessarily focuses on stimuli of relevance to producers of which they have experience, but offers no insight to the likely impact of future stimuli of which they have no experience (e.g. new pests). Another concern relates to the varying adaptive capacity of producers, which can be expected to alter individuals' perceptions of 'good' and 'bad' years; by asking a producer to identify a 'bad' year as a means of unearthing perceived risks, certain risks may have been downplayed or overlooked in interviews or focus groups (e.g. hail) by those producers with the capacity to manage them (e.g. crop insurance). Similarly, some adaptations, such as farm enlargement or intensification, or the securing of off-farm income, may not have been vocalized in interviews or focus groups, if producers have come to see them as simply a regular or expected part of farming. Lastly, as with all studies that ask producers to reflect on conditions and actions in their past, more attention was likely given to more recent events than those of the more distant past. This could result in the downplaying of risks or opportunities that, in fact, were significant when first experienced.

Notwithstanding these limitations, an insightful picture of producers' exposure and response to multiple risks (and opportunities) in Canadian agriculture, including climatic ones, was generated through the British Columbia, Ontario and Manitoba field work in the summers of 2003 and 2004. It is to this that the next section turns.

6.2 Generalizing Canadian producers' adaptation to climate and other risks

A number of key insights, or rather generalizations, about Canadian producers' adaptation to climate and other risks emerge from the cross-country field work.

- Weather, which is a reflection of climate, is important to producers in all three regions and in all four sectors. More specifically, weather was deemed the primary cause of 'bad' years among three of the four sectors (see figure 6.1). That being said, the interviews and focus groups made it clear that weather is intimately linked with market conditions and other forces that influence production and farm income (e.g. cool and wet weather can result in slightly reduced quality in apples, thereby penalizing producers selling into increasingly competitive and demanding markets). In short, producers are sensitive to the economic effects of weather.
- The climatic conditions to which producers in all three regions and all four sectors are sensitive, are the extreme conditions or events (e.g. extreme heat or cold, moisture deficits, extreme precipitation, etc.). To the degree that climatic change increases the frequency, extent or severity of these conditions, producers will become increasingly sensitive to climate.

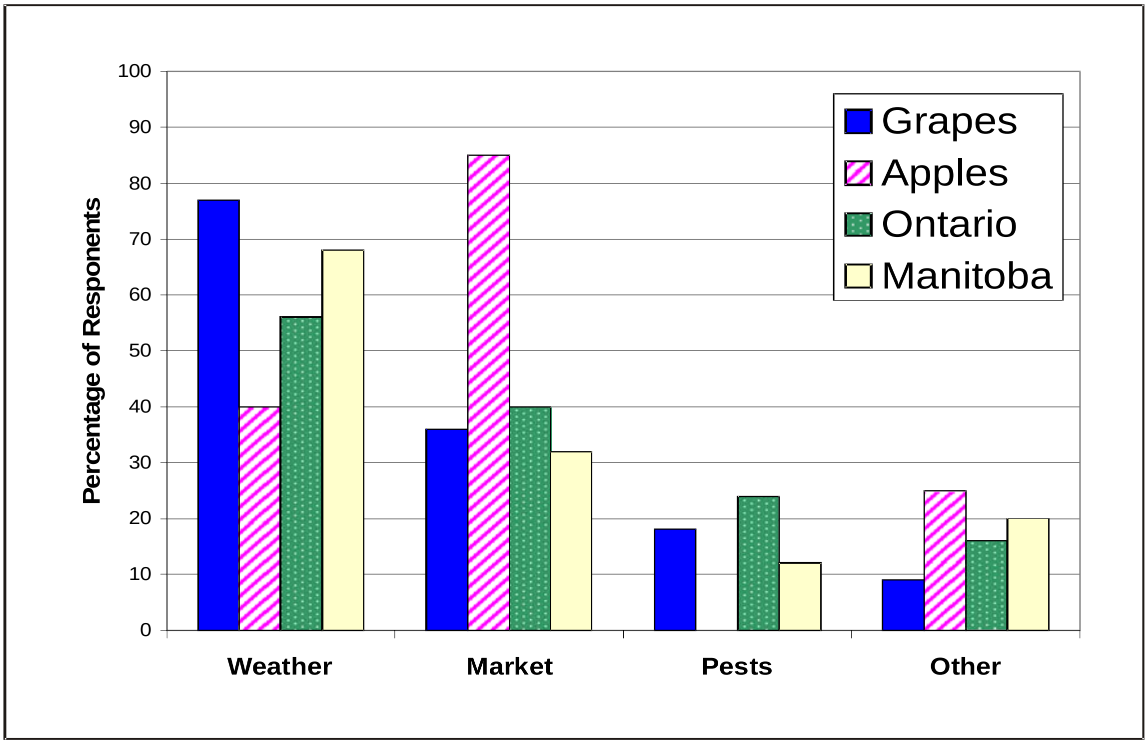


Figure 6.1: Conditions that Characterize a Bad Year – All Sectors

- Producers are continuously adapting to the conditions to which they are exposed, be they related to climate, markets or government policy, and this adaptation ultimately determines the degree to which they are vulnerable to such conditions. This ongoing or tactical adaptation, which occurs within one growing season or from one season to another, was variously identified by producers as ‘farm management’, ‘routine management’, ‘crop management’, ‘risk management’, ‘financial management’, ‘viticulture’, etc. and included such practices as dropping or lightening the crop (when wine grape producers experience a cold season), producing extra feed crops (when producers on mixed farms experience a season marked by high hay prices), making juice (when apple producers suffered from greatly deteriorated quality due to a hail event or an extended cold and wet season), and securing short-term financing (when any producer had insufficient revenues to cover current expenditures).
- Longer term or strategic adaptations, which extend over many seasons, were less frequently reported as a response to a ‘good’ or ‘bad’ year, but were nevertheless evident. These included, for example, purchasing wind machines (to enable grape and apple producers to mitigate frost events), purchasing irrigation (to enable grain producers to mitigate dry seasons), purchasing crop insurance (to enable any and all producers to mitigate extreme events such as hail), and changing varieties (when a grape producer wants to capitalize on perceived increases in available heat units to produce more lucrative varietals). Again, these adaptations were largely initiated for economic reasons, with weather/climate as a significant underlying cause.

- While weather conditions were identified as a future source of risk for producers in all three regions and all four sectors, nowhere was it the number one concern of a majority of producers (see Figure 6.2). The sector in which weather was identified as a future concern by the most number of producers was the apple sector; however, an equal number of producers foresaw market conditions and government policy as equally problematic.

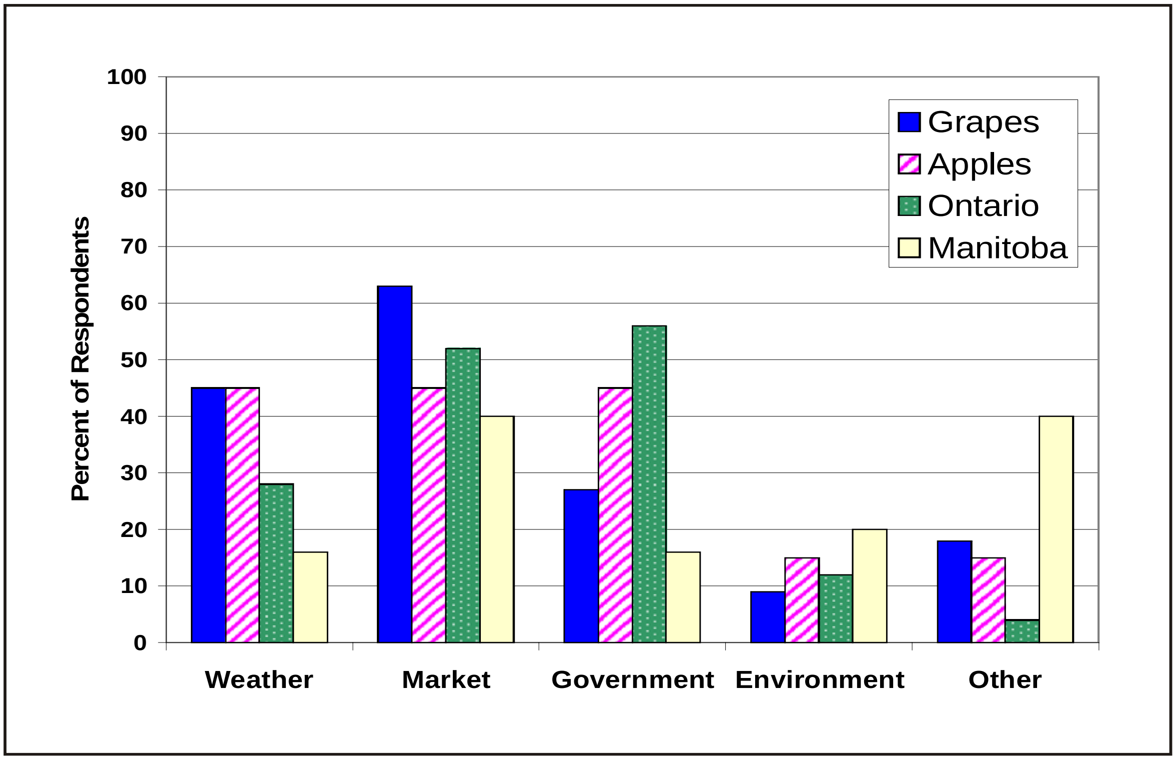


Figure 6.2: Future Risks – All Sectors

- While not a key feature of the research, the individual interviews queried producers on their perceptions of climate change. For most producers across the three regions and four sectors, although not a majority in two sectors, climate change is most clearly manifest in long-term warming; a smaller proportion perceived climate change in terms of increased climatic variability and extremes, while a near similar proportion were sceptical of the theory (see Figure 6.3). Given the sensitivity of producers to extreme events relative to long-term changes in climatic conditions such as temperature, producers' perception of climate change as primarily the latter may account for their modest identification of weather as a future risk.

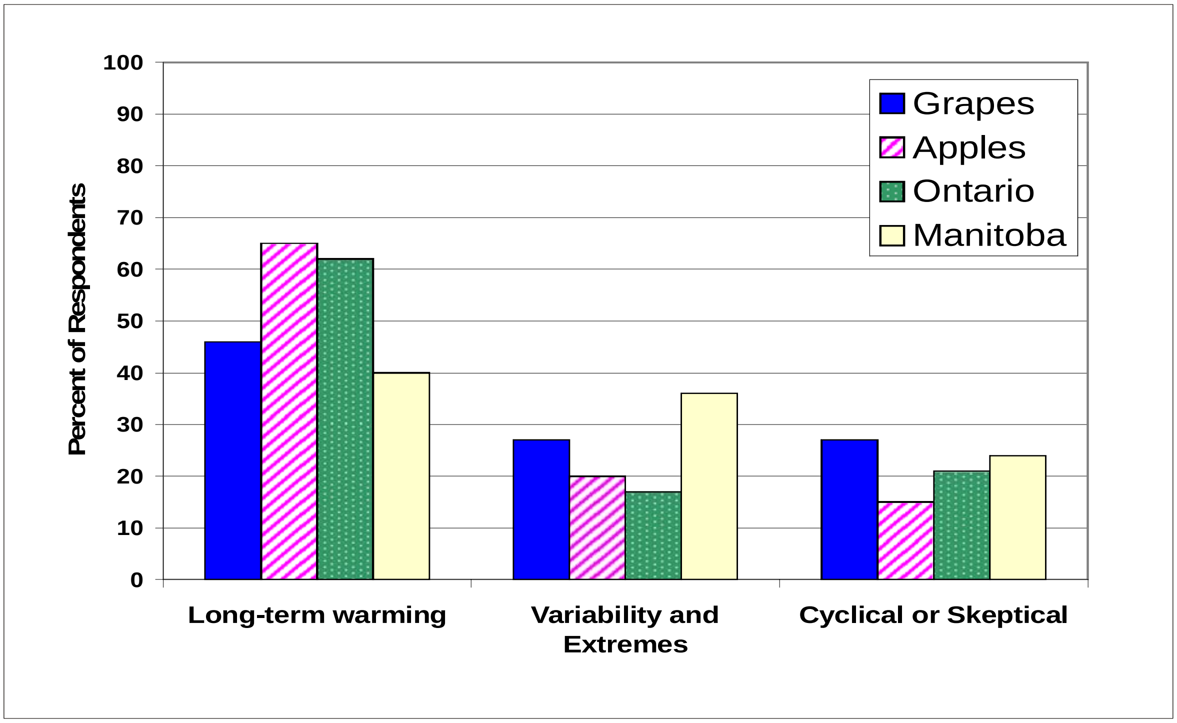


Figure 6.3: Perception of Climate Change – All Sectors

These six key insights from the cross country field work have implications for producers managing climate and other risks, researchers seeking to better understand the likely adaptation of producers to climate and other risks, and government agencies and policy makers charged with mitigating the likely impacts of climate change in Canadian agriculture. The discussion here focuses on those that are most profound. For producers, the research suggests that they may face greater climatic risks in the future than they currently anticipate, given: (1) their particular sensitivity to extreme events; (2) their perception of climate change as primarily manifest in long term changes in temperature; (3) the high probability that future climates will be marked by more variable conditions in terms of both magnitude and frequency; and (4) their reliance on collective adaptation mechanisms like inexpensive irrigation water and subsidized crop insurance, which will likely be less available in the future. For researchers, this work highlights the need for further documentation of producers' current vulnerabilities to climatic and other risks, in order to better project future vulnerabilities. Lastly, for government agencies and policy makers, the research suggests that, while producer-driven adaptation to a variety of changes in climate, markets and technology may be well advanced at present, certain gaps in adaptive capacity may emerge if future climate and other risks have been underestimated by producers (e.g. likelihood of extreme events), or if certain mechanisms of adaptation (e.g. inexpensive irrigation water) become less available. However, if government authorities want to address such gaps or to assist with climate change adaptation in agriculture more generally, their efforts should be incorporated into, or at least coordinated with, existing support programs, as there is little evidence that suggests that producers separate their adaptation to climatic risks from that undertaken to manage other risks of production and marketing in Canadian agriculture.

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APPENDIX A
Questionnaire (for Okanagan Grape Sector)

Section 1: Farm Characteristics

1. a) What type of operation do you have? How many acres?

   [b) What type of grapes is produced? Do you process wine on farm?]

   c) Have you increased/decreased acreage over the past ten years?

   d) How long have you farmed? How long have you farmed here?

   e) Did your parents farm here?

Section 2: Past Good and Bad Years

2. a) Over the past 10 years were there years that were good for your operation?
   b) What conditions lead to them being good?
   c) How did you respond to this situation?
   d) Did you do anything differently that year?
   e) Did you do anything differently in subsequent years?
   f) Were there any factors that facilitated or constrained the response?
   g) How effective was your action?
   h) Did it have any other implications?
   i) Would you respond differently if the same event happened again?

3. a) Over the past 10 years, were there years that were a problem for your operation?

   b) What conditions lead to the problem?

   c) How did you deal with this problem?

   d) Did you do anything differently that year?

   e) Did you do anything differently in subsequent years?

   f) Were there any factors that facilitated or constrained the response?

   g) How effective was your action?

   h) Did it have any other implications for your operation?

   i) Would you respond differently if the same event happed again?

4. a) Have government policies (federal, provincial or local) had any influence on your farm operation over the past 10 years?

   b) Have economic or market conditions had any influence on your farm operation over the past 10 years?

   c) Has technology (including biotechnology) had any influence on your farm operation over the past 10 years?

   d) Has environment (soil/water/pests) had any influence on your farm operation over the past 10 years?

   e) Has climate and weather had any influence on your farm operation over the past 10 years? For each influence identified, explore the conditions and response using questions in (2) above.

Section 3: Future Risks and Opportunities

5. a) What do you see as the major opportunities facing your operation over the next 5-10 years?

   b) What do you see as the major risks facing your operation over the next 5-10 years?

Section 4: Climate Change

6. a) What does climate change mean to you?

   b) Are you concerned about climate change?

   c) Do you think that climate change will affect this region? If yes, what do you think the main impacts will be?

   d) People have suggested a number of measures to deal with weather related risks, (examples of measures are listed below). Has anyone working on your operation made any of these changes? Why or why not? How useful was it?

      i. Changed crop hybrids
      ii. Changed intensification of production
      iii. Changed crop types and varieties
      iv. Changed the location of crop production
      v. Diversified the farm business, such as adding another enterprise or adding value (expand into wine production as well)
      vi. Used alternative fallow and tillage practices
      vii. Change land topography to address moisture deficiencies
      viii. Added or changed any drainage tiles
      ix. Added any irrigation systems

x. Changed timing of farm operations to address changing duration of growing seasons, temperature and moisture

xi. Purchased crop insurance

xii. Invested in crop shares and futures to reduce the risks of climate-related loss

xiii. Participated in income stabilization programs to reduce the risk of income loss

xiv. Found off-farm employment

xv. Any others?

7. * In your opinion,

   a) Has the incidence of drought changed over the past ten years?

   b) Has the incidence of heavy rain and ponding of water in fields changed over the past ten years?

   c) Have winter temperatures changed over the past ten years

   d) Have summer temperatures changed over the past ten years?

   e) Has the length of growing season changed over the past ten years?

* Note: These questions will only be asked if this information did not come up in the earlier questions.

Section 5: Conclusion

8. Last question: In your opinion, how do the risks/opportunities that farmers face today compare with the risks/opportunities of 25-30 years ago? Or of when you first began the operation?

APPENDIX B

Focus Group Questions
(for Okanagan Grape Sector)

Section 1: Risks and Opportunities

1. Over the past ten years, what conditions have been associated with good years and bad years for your operations?
2. What are the major risks and opportunities for agriculture in the next five to ten years?
3. What does climate change mean to you?

Section 2: Adaptation

4. Producers were given the following list of adaptations, which was revised following the completion of interviews.

Farm Production Practices

- Changed crop hybrids, types and varieties
- Changed intensification of production
- Changed the location of crop production
- Added any irrigation systems
- Changed timing of farm operations
- Make use of weather information systems

Farm Financial Management

- Purchased crop insurance
- Participated in income stabilization programs
- Diversified household income
- Cut costs

For each adaptation, producers were asked to discuss whether they have been employed on the farm, whether they are useful for dealing with risk (primarily weather risk) and why, and how feasible are they for dealing with climate change.

APPENDIX C
Adaptation Options in Canadian Agriculture
(from Smit And Skinner, 2002)

TECHNOLOGICAL DEVELOPMENTS

Crop development

• Develop new crop varieties, including hybrids, to increase the tolerance and suitability of plants to temperature, moisture and other relevant climatic conditions.

Weather and climate information systems

• Develop early warning systems that provide daily weather predictions and seasonal forecasts.

Resource management innovations

• Develop water management innovations, including irrigation, to address the risk of moisture deficiencies and increasing frequency of droughts.

• Develop farm-level resource management innovations to address the risk associated with changing temperature, moisture and other relevant climatic conditions.

GOVERNMENT PROGRAMS AND INSURANCE

Agricultural subsidy and support programs

• Modify crop insurance programs to influence farm-level risk management strategies with respect to climate-related loss of crop yields.

• Change investment in established income stabilization programs to influence farm-level risk management strategies with respect to climate-related income loss.

• Modify subsidy, support and incentive programs to influence farm-level production practices and financial management.

• Change *ad hoc* compensation and assistance programs to share publicly the risk of farm-level income loss associated with disasters and extreme events.

Private insurance

• Develop private insurance to reduce climate-related risks to farm-level production, infrastructure and income.

Resource management programs

• Develop and implement policies and programs to influence farm-level land and water resource use and management practices in light of changing climate conditions.

FARM PRODUCTION PRACTICES

Farm production

• Diversify crop types and varieties, including crop substitution, to address the environmental variations and economic risks associated with climate change.

• Diversify livestock types and varieties to address the environmental variations and economic risks associated with climate change.

• Change the intensification of production to address the environmental variations and economic risks associated with climate change.

Land Use

• Change the location of crop and livestock production to address the environmental variations and economic risks associated with climate change.

• Use alternative fallow and tillage practices to address climate change-related moisture and nutrient deficiencies.

Land topography

• Change land topography to address the moisture deficiencies associated with climate change and reduce the risk of farm land degradation.

Irrigation

• Implement irrigation practices to address the moisture deficiencies associated with climate change and reduce the risk of income loss due to recurring drought.

Timing of operations

• Change timing of farm operations to address the changing duration of growing seasons and associated changes in temperature and moisture.

FARM FINANCIAL MANAGEMENT

Crop insurance

• Purchase crop insurance to reduce the risks of climate-related income loss.

Crop shares and futures

• Invest in crop shares and futures to reduce the risks of climate-related income loss.

Income stabilization programs

• Participate in income stabilization programs to reduce the risk of income loss due to changing climate conditions and variability.

Household income

• Diversify source of household income in order to address the risk of climate-related income loss.