CROP INSURANCE AND FARM MANAGEMENT OF WEATHER-RELATED RISKS

A Thesis

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CINDY SMITHERS

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Abstract

Crop Insurance and Farm Management of Weather-Related Risks

Cindy Smithers
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Supervisor:
Barry Smit

Agricultural crop-based operations inevitably experience risk related to weather variability. How farmers cope with these weather-related risks, both throughout the growing season and from year to year, is not well understood due to the complexity of the decision making process. Farmers may choose from a range of production, financial and marketing strategies that function to alleviate the risk associated with weather.

One option currently available to farmers to manage the risk associated with weather is crop insurance. This research addresses the question of how farmers employ crop insurance in the management of weather-related risks. Soybean production, in particular, is examined as it is sensitive to weather and because it is a major cash crop in Ontario.

Provincial level data are employed to provide an understanding of the types of relationships which may be expected to occur between weather variability and crop insurance use. However, this level of examination relies on assumptions about behaviour and decision making. A farm level survey of soybean producers in Middlesex County provides an improved understanding of how crop insurance is used to manage weather-related risks by farmers.

This research concludes that soybean producers in Middlesex County employ crop insurance to manage the weather risks which predominantly interfere with the planting schedule. While some soybean producers in Middlesex County tend to employ crop insurance as part of a suite of risk management strategies, others are substituting alternative income protection strategies to alleviate the risk associated with weather.

ACKNOWLEDGEMENTS

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1.0 INTRODUCTION

1.1 The Research Problem in Context

All major industries involve a certain degree of risk. What distinguishes agriculture is a continuing sensitivity to weather-related risks. While advances in technology, the introduction of new cultivars, and refined management practices have allowed producers to adapt and adjust to some degree, weather variability continues to confront farmers with uncertainty and risk.

The Canadian federal and provincial governments have a long standing tradition of providing financial aid for crop losses due to weather-related risks in the form of *ad hoc* payments and subsidized insurance schemes. Early government support was prompted by severe drought conditions which affected the prairies in the 1930s. The loss associated with the drought led to the formation of the *Prairie Farm Assistance Act* (PFAA). Interest in an organized crop insurance scheme escalated, and the PFAA was succeeded by the *Federal Crop Insurance Act of 1959* (Turvey 1989). In 1991, the Federal Crop Insurance Act was repealed, and restructuring left crop insurance as a component of the *Farm Income Protection Act*. Despite the various changes it has undergone, the crop insurance program has invariably depended upon government subsidies.

However, recent trends in the global political and economic environments may effectively change the way producers and governments deal with weather-related risks. The future implications of global political agreements such as the General Agreement on Trade and Tariffs(GATT) and the North American Free Trade Agreement(NAFTA) on Canadian agriculture and subsidies are still unclear. Farmers may be forced to rely increasingly on other risk management strategies (Bradshaw and Smit 1997).

There are presently a number of financial, marketing and production strategies available to farmers to manage weather-related risks. Crop insurance represents one type of financial strategy. Yet the manner in which crop insurance is employed as a management strategy for climate related risks is not well understood. While documentation of participation, premiums and payouts is accessible, there is little empirical research on the role of crop insurance in the context of other risk management strategies.

1.2 The Research Problem Defined

The broad aim of the research is to identify the role of crop insurance in farm level management of weather-related risks. The empirical component of the research focuses on Ontario and particularly soybean production. Within Ontario, and more specifically Middlesex County, soybeans represent a significant cash crop which is sensitive to weather. One strategy currently available to farmers to manage the risk associated with weather is the use of crop insurance.

The bodies of literature pertaining to farm level decision making, risk management in agriculture, natural hazards, climate and agriculture, and political economy provide a basis for specifying expected relationships with regard to the use of crop insurance in managing weather-related risks. The empirical testing of these relationships could then follow a variety of approaches including time series analysis, spatial variations, participation analysis or farm modelling. However these approaches often rely on basic assumptions about human behaviour. To avoid this problem the main empirical contribution of this research draws upon direct information provided by farm operators as to why they purchase crop insurance, for what crops, and how this decision is related to the perception of weather risks and the use of other risk management strategies. A context for this analysis will be established through the documentation of trends in crop insurance participation and claims within Ontario and more specifically Middlesex County.

1.3 Objectives of the Research

1. To design a theoretical model of the relationship between weather variability, farm level decision making and crop insurance as a risk management strategy.

2. To document the aggregate trends and relationships between soybean production, weather-related risks and crop insurance within Ontario.

3. To empirically identify the role of crop insurance in farm level management of weather-related risks for soybean producers within Middlesex County, southwestern Ontario.

1.4 Thesis Outline

This thesis has 6 chapters. Chapter 2 provides a review of the various bodies of scholarship that have contributed to the development of a conceptual model of agricultural decision making under risk and uncertainty. This includes a review of the literature pertaining to agricultural systems, agricultural decision making, risk management, natural hazards research, agriculture and climate, and the political economy of agriculture. The relationship of the main empirical objective of this research to the broader framework of agricultural decision making provided by the conceptual model will also be addressed.

Chapter 3 presents an aggregate analysis of soybean production, the weather-related risks to soybean production, and crop insurance within Ontario. Soybean production relative to other cash crops within Ontario is detailed, followed by a discussion of the weather related requirements and restrictions to soybean growth and production. Lastly, an overview of the Canada-Ontario Crop Insurance program is provided, with particular attention to how it applies to soybean production.

Chapter 4 describes the empirical methodology used to satisfy empirical objective 3. This includes a description of the farm level analysis, an overview of the survey instrument, sample group, time frame, and questionnaire implementation. Chapter 5 discusses the attributes of soybean production, weather-related risks and crop insurance as identified by 79 farmers who participated in the survey. These results are presented within the broader context of Middlesex County to provide some perspective regarding the representativeness of the study group. A discussion and explanation of the trends and patterns among producers is provided. Chapter 6 summarizes the results of this research and offers conclusions about the role of crop insurance in the management of weather-related risks.

2.0 AGRICULTURAL DECISIONS AND WEATHER RISK MANAGEMENT

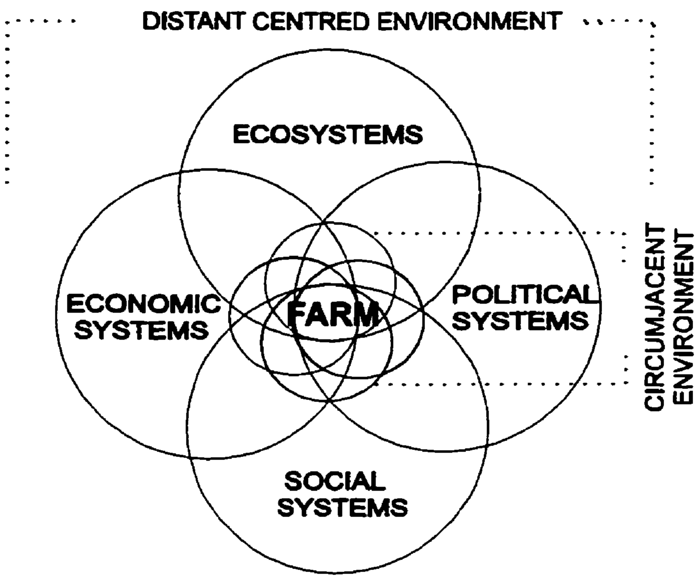
Agricultural operations are influenced by a wide range of forces both within the immediate farm environment (*endogenous*) and from the broader political, social, technological and biophysical environments (*exogenous*). There are a number of bodies of scholarship which contribute to our understanding of these forces and how they affect farm level decision making and the management of weather-related risks. The objective of this chapter is to explore the literature pertaining to agricultural systems, agricultural decision making, agricultural risk and risk management, natural hazards research, agriculture and climate, and the political economy of agriculture in order to illustrate the broad theoretical context of the research problem. Based upon this review, a conceptual model of agricultural decision making and risk management is constructed. This model suggests the kinds of relationships that can be expected in the study of soybean production, weather risks and crop insurance use.

2.1 Agricultural Systems

Agricultural systems have been identified in the literature as everything from individual farms to national agricultures (Smithers and Smit 1997). Yet, regardless of scale, all agricultural systems may be recognized as existing within a nested hierarchy of systems which include various forces with varying degrees of influence on farm level decisions. At the farm level, Olmstead's (1970) systems approach summarizes of the various forces which affect agricultural operations (Figure 2.1).

Olmstead's systems approach recognizes the farm as a basic unit that includes both the farm operator and the farm's resources. In Olmstead's model, the farm interacts with surrounding agricultural and non-agricultural phenomenon (*circumjacent environment*), which in turn interacts with policy makers and technological innovators (*distant centered environment*). The farm is recognized as a hierarchy of four functioning systems (*economic, political, social and ecological*) which have varying degrees of influence. There exists a flow of energy, ideas and materials through this hierarchy as well as between the farm and the external economic, political, social and ecological systems.

Figure 2.1
The Farm within Systems of the Environment



(Olmstead 1970)

This recognition of the broad political, economic, ecological and social environments within which farmers operate has become widely acknowledged in the literature pertaining to agriculture and weather risks (Chiotti and Johnston 1995; Smit, *et al.* 1996A; Chiotti , *et al.* 1997; Smithers and Smit 1997). For example, how a farmer chooses to respond to a particular weather risk may depend upon the availability of policy initiatives, market conditions, and the nature of the risk itself. The complexity of the inter-relationships between these forces is critical to the decision making process with regard to how weather risks are managed.

2.2 Agricultural Decision Making

Early theories of agricultural decision making focussed on economic principles and production processes. This is reflected in theories of *economic rent* developed by both Ricardo and Von Thunen, which focussed on the premise of comparative advantage with respect to the production and transfer of goods (Ilbery 1985). These models provide an understanding of some of the factors which affect decision making with regard to economic rationality. However they assume that farmers possess a complete knowledge of weather conditions and hence yields. The tendency to rely upon a number of basic assumptions has been widely criticized (Found 1971; Ilbery 1985). The essence of these criticisms is reflected in the ideas of Simon which have since gone on to influence later decision making models.

Simon (1957 in Ilbery 1985) argues that decision makers seek to satisfice rather than maximize. This is due to the limitations imposed on them in terms of the availability of information and the capacity to process it. Ongoing changes in market conditions, weather, societal preferences and technology make it impossible for any decision maker to possess complete knowledge at any given time. Decision makers are therefore incapable of weighing all options and selecting the most profitable course of action. This inability to possess complete knowledge forces individuals to operate within the limitations of their own decision environment. Found (1971) describes the decision environment as being affected by a farmer's perceptions and value systems. A farmer's choices are therefore affected by a wide range of influences including cultural and psychological factors, prejudices and motivations, and learning experiences.

Agricultural decisions are made in the context of an individual farmer's decision environment as modified by a range of political, social, economic, technological and biophysical exogenous influences. How these influences are perceived differs from farmer to farmer, thus the decision making process under the same conditions may yield different results. Just as variation exists within the decision making environment depending upon the characteristics of the individual, it also exists with regard to the nature of an associated risk.

2.3 Agricultural Risk and Risk Management

Risk is defined as "the possibility of a range of possible outcomes resulting from decision or course of action when known probabilities can be assigned" (Smith 1992, p412). Uncertainty exists when one cannot establish probabilities. Within agriculture, Sonka and Patrick (1984) identify 5 sources of risk: *production or technical; market or price; technological; legal;* and *social and human*. The risk associated with each of these sources cannot be divorced from value judgements or personal choices, but are rather viewed through a filter of human perception (Smith 1992). This perception or attitude towards risk also affects how the risk is managed.

Fleisher (1990) identifies 3 attitudes towards risk: *risk averse, risk neutral* and *risk preferring*. A *risk averse* individual will forgo gains in order to avoid losses, while a *risk neutral* individual responds in a way which will provide the highest expected value. Finally, a *risk preferring* individual will not give up the possibility of gain to eliminate risk, yet will not forgo a lower than expected return if the outcome of an action were certain. Within agricultural operations, the response to risk depends upon the risk attitude of the individual as well as factors such as the farm's resource base, financial condition, organization, local and national markets, and stage in the farmer's life cycle (Fleisher 1990). The influence of these factors varies depending upon the nature of the risk and the expected vulnerability to the risk. With regard to weather risks, how individuals perceive and respond to risk may be better understood in terms of the literature pertaining to natural hazards. While not all weather risks may be categorized as extreme or hazardous, this body of research is useful in its ability to improve our understanding of the associated impacts and human responses to them.

2.4 Natural Hazards

Within the natural hazards research, Burton, *et al.* (1993) describe seven attributes of hazardous events: *magnitude, frequency, duration, areal extent, speed of onset, spatial dispersion* and *temporal spacing*. Each measurement is significant in terms of the response it evokes in a society or individual to either reduce the loss or to increase the benefit associated with the extreme or hazardous event. When people are committed to a resource use such as agriculture, they incorporate many social, psychological, cultural and personal mechanisms in order to discount or accept the associated loss. This may be visualized as a choice tree of adjustment, where one option is to choose to accept the loss or *bear the impact* without transferring the consequences. If the appropriate social, economic or political institutions exist, it may be possible to *share the burden*, as in the case of insurance coverage. Others may choose to reduce the loss by *preventing* the event from happening in the first place. Finally, people may *choose change*, either in *use* or *location*, in order to avoid further loss (Burton, *et al.* 1993).

With regard to agriculture, how a farmer chooses to cope with risk may be characterized in terms of the three organizational areas of the firm: production, marketing and financial (Castle, *et al.* 1987). Response in each of these areas may then be characterized as *strategic* or long term management strategies, and *tactical* or short term coping strategies (Smit, *et al.* 1996B). Examples of production strategies include *strategic* decisions such as farm type and crop and livestock diversification, and *tactical* decisions such as reseeding and spraying. Market strategies aim to reduce the risk associated with fluctuating market conditions by stabilizing the market value of a commodity through the use of price hedging, forward contracting and government price support programs (Fleisher 1990). Financial strategies alleviate risk by providing alternative sources of income or financial relief to compensate for risk such as crop insurance. Depending upon the nature of the risk a farm operator may choose one or a combination of strategies. For example, both production strategies (i.e. diversification of crops) and financial strategies (i.e. crop insurance) may be used simultaneously by farmers to manage the weather-related risks to crop production.

2.5 Weather and Agriculture

Parry and Carter (1988) define weather as the prevailing state of the atmosphere measured on a day to day basis. For the purpose of this research, *weather* is used to address the variability in climatic conditions experienced throughout the study period (1992 to 1997). Climatic variability is used to refer to the year to year changes in climatic variables (i.e. precipitation, temperature) over extended periods of time, while climate change refers to the long term alteration of average climatic conditions (Wheaton 1991). A change in average climate inevitably results in a change in the magnitude and frequency of climatic events. At a certain level of climate change, the magnitude or frequency of stress events becomes critical.

The critical nature of the climate is a function of the rate of change relative to the rate the system adjusts to this change (Parry, *et al.* 1996).

Changes in climate and the critical nature of climate have sparked growing concern among scientists, politicians and the general public as to the possible effects of global warming on a number of activities, industries and areas (Hare 1991; Smit 1991; Fernau, *et al.* 1993; Parry, *et al.* 1996). The potential consequences of climatic change for agricultural systems and food supplies are considered to be immense at both regional and global scales. It could effectively rearrange the map of agriculture by altering patterns of comparative advantage of important crops and livestock (Lewandrowski and Brazee 1993).

Research on climate and its impact on agriculture has tended to focus on crop yield studies (Goudriaan and Hunt 1995; DeGaetano 1996), the impact of climate on global food supplies (Kane *et al* 1992; Downing and Parry 1994), and the implications of policy and policy responses (Gardner, *et al.* 1984; Vanderveer and Loehamn 1994; Lewandrowski and Brazee 1993; Offut 1996). A large portion of the research has focused on conventional approaches to climate impact assessment that make bold assumptions about the nature of climate change and human response (Smit, *et al.* 1996A). For example, many studies have based their results on predictions obtained from GCMs (*global climate models or general circulation models*). These scenarios generally focus on climate change at broad spatial and temporal scales and do not account for variability at regional levels (Glantz 1988; Smit 1991; Goudrian and Hunt 1995).

In the same way that assumptions are made about the nature of climate in GCMs, adaptation studies have tended to adopt the EERE (*everything else remains equal*) approach while ignoring the multiple climatic and non climatic stresses on agricultural system over time (Watson , *et al.* 1996). In this respect, the Missouri-Iowa-Nebraska-Kansas (MINK) study is worth noting. Rather than imposing a climate change scenario on future conditions, assuming they exist as they do today, it used a baseline of the economy of a particular region as it might be in 2030. It took into account inter-regional connections and the impacts of climate elsewhere, as well as future trends in demographics, income, trade and technology. The MINK study adopted the standpoint of the *clairvoyant farmer* who is able to adapt using new technologies and ideas, unlike the often assumed *naive farmer* scenario where adaptation by farmers is not taken into account. While the MINK study is significant in its acknowledgment of the capabilities of farmers to adapt, it is still based upon assumptions of how they will adapt (Rosenberg 1993).

Two views of agricultural adaptation to climatic variability can be identified in the literature (Smit 1993). One view holds that agriculture is adapting to variation in climate due to the availability of new cultivars, equipment, better farm practices and an improved understanding of climatic processes. Proponents of this view believe that our understanding of climate and climate forecasting will continue to improve and that agriculture will continue to adapt and adjust to any changed conditions. The second view is that agriculture is not well adapted to climatic variability. This is reflected in the frequent and devastating losses associated with climatic variability. There are a number of reasons for lack of adaptation, including the availability of government support programs and compensation. The implications of this broad political and economic environment within which farmers operate are explored in more detail in the following section which addresses the political economy of agriculture.

2.6 Political Economy of Agriculture

One facet of the systems approach pertaining to the adaptability of agricultural systems to weather risks is the political economic environment within which agriculture functions. This approach focuses on the broad economic and policy environments within which farmers operate (Marsden , *et al.* 1986). One prominent theme within the field of the political economy of agriculture is the role of agribusiness, marketing boards, consumers, etc, as a constraint on decision making and behavior within the agricultural industry (Troughton 1989; Le Heron 1993). The latter theme argues that government intervention through regulatory measures and subsidization decreases the element of choice and essentially governs the decisions made by farmers.

Within Canadian agriculture, the federal and provincial governments have intervened extensively (Strick 1994). These interventions have taken the form of marketing boards, organized compensation programs for losses due to market conditions and production losses, and finally *ad hoc* payments in extreme situations. Compensation for weather risks is provided through the crop insurance program, but *ad hoc* payments have been used to compensate farmers for extreme, intermittent losses due to weather, such as those occurring on the prairies in 1988 following severe drought conditions (Turvey 1989).

Research pertaining to agricultural compensation programs generally takes one of two opposing views. One view is that government funded compensation is necessary in order to ensure a stable market economy; the other view holds that government compensation programs have the potential to hinder adaptation to various sources of risk by discouraging the adoption of other risk management strategies (Fulton 1989; Lewandrowski and Brazee 1993; Gardner, *et al.* 1984; Smit 1994). The latter view is defined explicitly in the literature with regard to crop insurance as *moral hazard* and *adverse selection*.

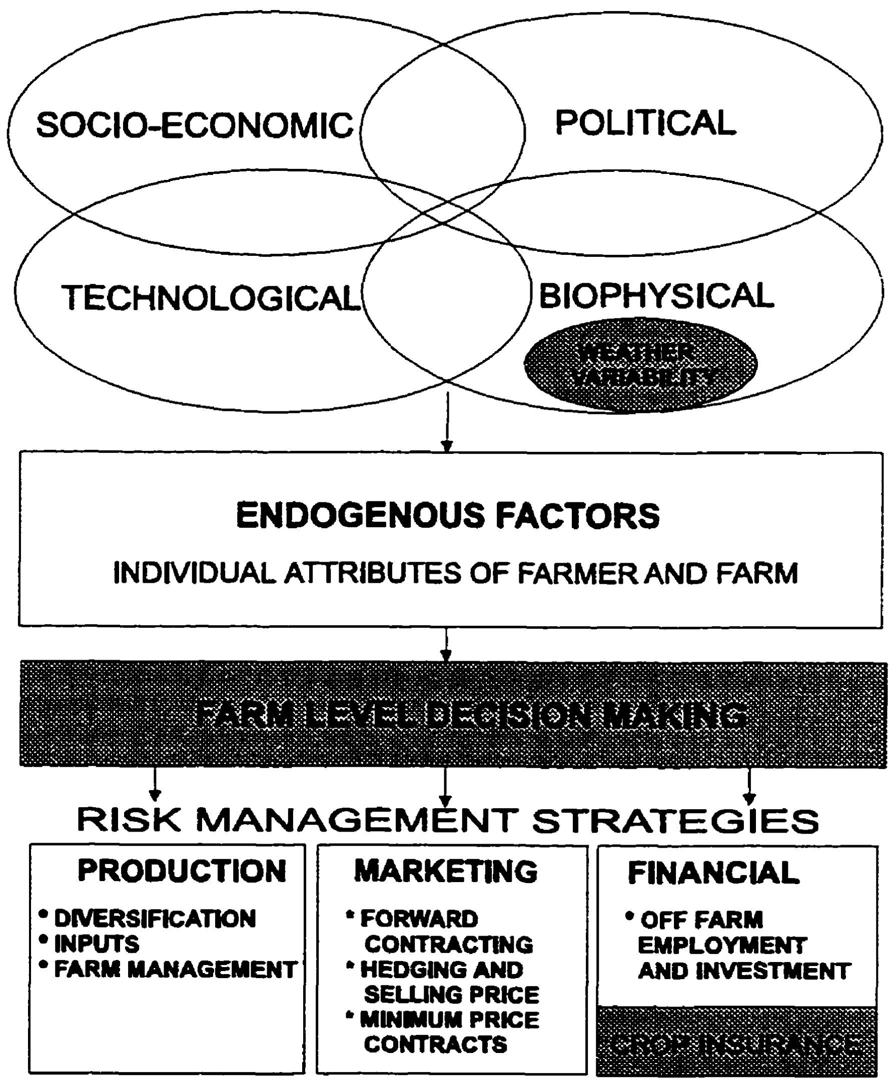
Moral hazard is referred to in the literature as "the fact that the insured person's optimal decision may change as a result of taking out insurance." (Quiggin, *et al.* 1994, p254). In this sense, a farmer may choose not to implement other risk-reducing strategies knowing that crop insurance will ultimately compensate for loss. The failure to manipulate other risk- reducing strategies may then contribute to the probability that the insured event will happen. For example, if a farmer knows that he may receive compensation through crop insurance for loss due to crop disease, he may be less inclined to use chemicals to prevent the disease from occurring. As a result, it may then be possible that the farmers more likely to experience adverse conditions will also be more likely to insure (*adverse selection*). While these phenomenan have been analyzed separately in the literature, it often is difficult to distinguish between the two due to the complex nature of agricultural operations (Quiggen, *et al.* 1994).

It is this complexity that differentiates crop insurance from many other forms of insurance. Unlike automobile or house insurance, crop insurance takes place in a production context where losses depend upon the a wide range of endogenous and exogenous forces. On the basis of all of the ideas related to these forces discussed in this chapter, a conceptual model is developed.

2.7 The Conceptual Model

Models of agricultural adaptation to weather and climate have recognized the broad endogenous and exogenous influences on management decisions(Smit, *et al.* 1996; Chiotti, *et al.* 1997; Smithers and Smit 1997). This chapter has reviewed a number of bodies of scholarship which contribute to our understanding of these influences with regard to the use of crop insurance in the management of weather-related risks. The types of relationships which may be expected to occur are examined through the conceptual model (Figure 2.2).

Figure 2.2
The Conceptual Model



This model is capable of demonstrating how various sources of agricultural risk may affect the decision making process, as well as guiding our understanding of the relationship between weather risks and crop insurance use. Here, strategic decisions are made in the context of an uncertain exogenous environment where the implications of the socio-economic, political, biophysical and technological environments are not completely understood. The interaction of these environments (including weather variability) creates conditions which influence farm level decision making. Decisions are further influenced by the endogenous attributes of the farmer (*personal goals, experiences, preferences, risk taking behavior and so on*) and the farm operation (*farm type, farm size, spatial distribution of crop land, income and so on*). These influences shape the overall perception of a risk (such as the risk associated with weather) and how an individual farmer chooses to manage the risk. How a farmer manages risk is also related to the availability of appropriate management strategies. The management strategies available to farm operators are characterized in Figure 2.2 as financial, marketing and production. Depending upon the type of strategy, it may be employed within the affected growing season (tactical), or to reduce the risk associated with subsequent growing seasons (strategic). For example, a farmer may choose to decrease the risk associated with weather by securing off-farm employment to provide a stable income, or by diversifying the farm operation to include different crops and livestock. Crop insurance is another management strategy available to farmers to ensure some level of return should a weather risk result in loss.

How a farmer uses crop insurance to manage the risk associated with weather is a function of both the availability of other management strategies and the interaction between them. For example, one farmer may substitute off-farm employment or investments for crop insurance use (Leathers 1994), while another may employ crop insurance as one component in a suite of available weather risk management strategies (Blank and McDonald 1996).

This chapter has reviewed various bodies of scholarship pertaining to the farm level management of weather-related risks and specifically crop insurance use. A conceptual model of agricultural decision making and risk management demonstrates some of the possible relationships that might be expected to occur in the management of risk, including weather-related risks. To test this model, an empirical analysis of the use of crop insurance in the farm level management of weather-related risks was undertaken. In order to provide a context for the empirical component of this research, chapter 4 documents aggregate trends in weather, soybean production and crop insurance use in Ontario.

3.0 SOYBEANS, WEATHER AND CROP INSURANCE

An objective of this research is to document trends and patterns of soybean production, weather, and crop insurance use within Ontario. This chapter relies on information gathered from the Ontario Soybean Growers Marketing Board (OSGMB), the Ontario Ministry of Agriculture and Rural Affairs (OMAFRA), AGRICORP, the Canadian Crop Insurance Commission, Environment Canada, and Statistics Canada.

3.1 Characteristics of Soybean Production and Growth

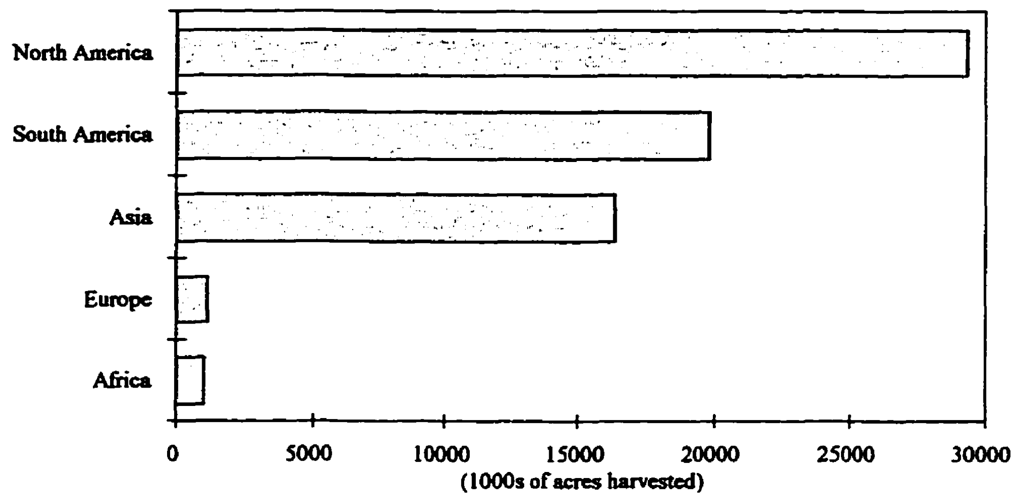
The soybean *(glycine max)* is a bushy, green legume related to clover, peas and alfalfa. It is widely accepted (although rarely documented) that the soybean plant is one of the oldest cultivated crops, originating in China as early as 2838 B.C. The soybean was introduced to North America in the early 1800s, and later to Canada, near the end of the century (da Mota 1978).

3.1.1 Soybean Production

World soybean area harvested approached 67,750,000 acres in 1997 which represents an increase of over 100% since 1967. North America presently harvests the highest acreage among all continents, followed by South America, Asia, Europe and Africa (Figure 3.1). Canadian soybean production accounts for approximately 3% of the total acres harvested on a global level (FAO 1998).

Within Canada, soybeans production is most prominent within Ontario and to a lesser extent, Quebec. While all provinces have reported soybean production within the past 30 years, none approach the acres harvested by Ontario and Quebec.

Figure 3.1
Global Soybean Area Harvested, 1997

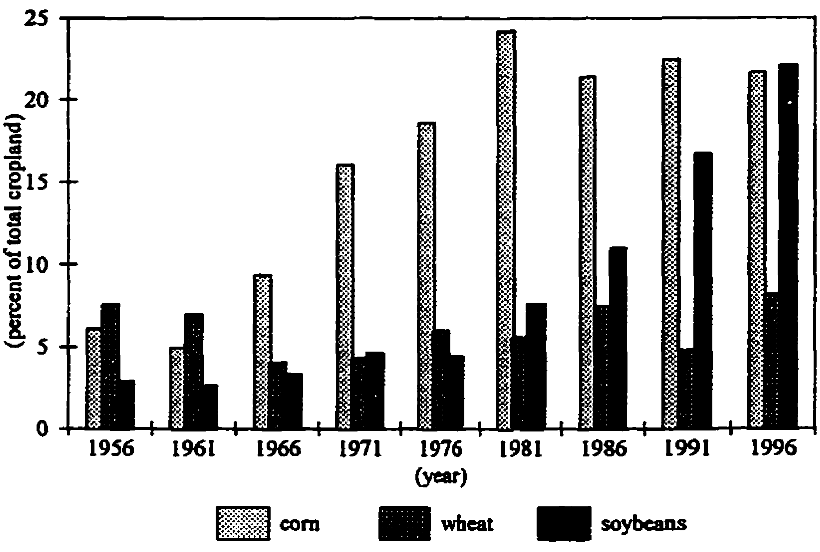


(FAO 1998)

Soybean production in Ontario has enjoyed a steady increase throughout the last 3 decades. Expansion in production may also be seen in terms of soybeans as a percentage of total crop land. Figure 3.2 provides a comparison to grain corn and winter wheat, two cash crops which share similar environmental growth requirements as soybeans. As a percentage of total crop land, winter wheat has remained relatively constant. Grain corn continued to rise until the early 1980s and has since tapered off, while soybeans have remained on a steady rise since the mid 1970s. By 1996, soybean production in Ontario accounted for 22% of total crop land, greater than both winter wheat and grain corn (Statistics Canada 1996).

Soybean production has also expanded spatially within Ontario. While production in Ontario originated in the counties of Essex, Kent and Lambton, soybeans are currently

Figure 3.2
Soybeans, Grain Corn and Winter Wheat as a Percentage of Total Crop Land* in Ontario, 1956 to 1996



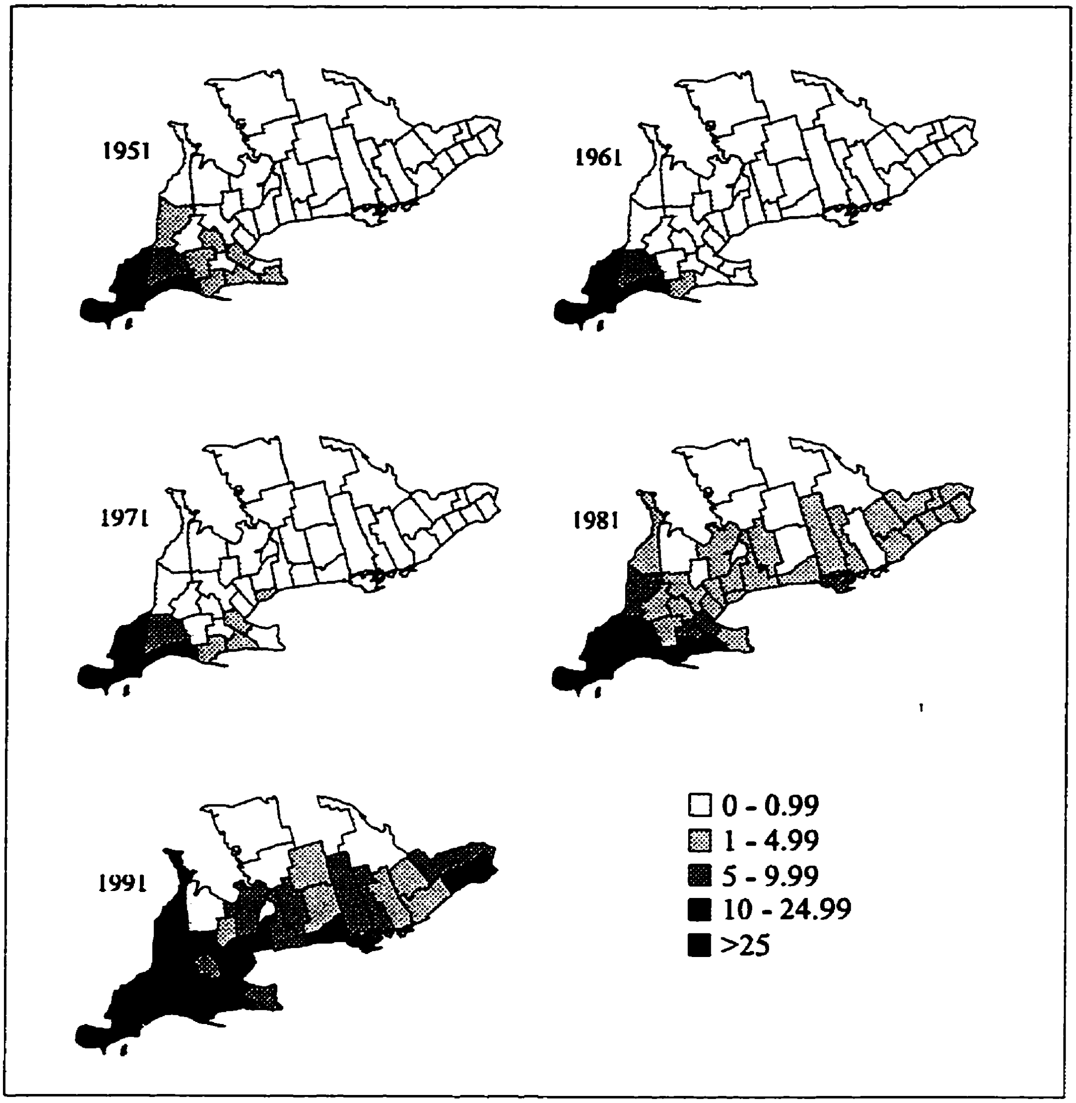
**crop land includes field crops, vegetables, fruit crops and nurseries. In 1981 this classification was expanded to include sod.*

(Dominion Bureau of Statistics 1957-1963; Statistics Canada 1973-1997)

planted as far north as Nippissing. Figure 3.3 illustrates this expansion of soybean producers into the northern and eastern areas of Ontario since 1951.

These increases in production over time and space may be attributed to a number of factors. Advances in technology have contributed to the creation of new refinement processes and markets for soybeans thereby increasing demand. Today soybeans are used in a wide range of products including foods, plastics, pharmaceuticals, fuel and many other whole soybean and soybean derived goods (OMAFRA 1997). At the same time, spatial increases in production have resulted from technological advances which have allowed for the introduction of shorter season varieties. This has effectively decreased the geographical limitations on soybean growth.

Figure 3.3
Percent of Farmers Reporting Soybeans in Ontario: 1951, 1961, 1971, 1981, 1991

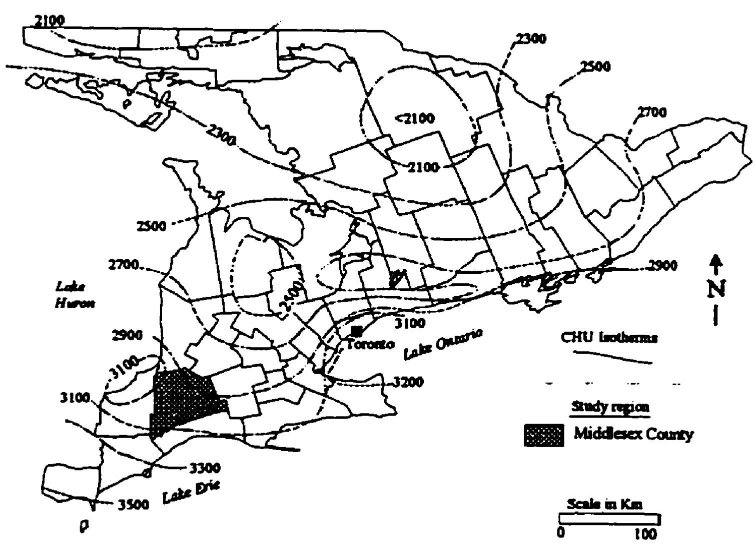


(Dominion Bureau of Statistics 1953-1963; Statistics Canada 1973-1997)

3.1.2 Soybean Growth

Soybean growth is characterized by three specific stages of development, including blooming, pod formation and maturity. The length of the development cycle varies depending upon day length and available heat units. As such, soybean varieties are characterized by the day length and temperature requirements necessary for initial floral development, and by their morphological growth habit (da Mota 1978). While varieties are rated according to the corn heat unit system (Figure 3.4), soybeans differ from corn in that flowering is also related to the photoperiod (the length of daylight and dark periods) and not totally dependent upon temperature (Garner and Allard 1920). Even so, the growth, development, and yield of the soybean plant depends upon how a given variety interacts with ongoing weather conditions.

Figure 3.4
Ontario Corn Heat Unit System



(Brown and Bootsma 1994)

3.2 Soybeans and Weather

3.2.1 Weather Risks to Soybean Production and Growth

At a rudimentary level one could consider any deviations from the optimum weather conditions for soybean growth as weather risks. However, it is important to recognize the compounded nature of weather risks to soybean production in terms of both the direct risks to plant growth as well as to the associated farm practices. For the purposes of this research, the weather risks to soybeans will be characterized here in terms of the amount of available light, temperature and moisture throughout the growing season. While these parameters are specific to soybean growth, examples of the associated risks to production will also be discussed where applicable.

Light: Light is essential for photosynthesis and is a fundamental source of energy for numerous growth processes (Hicks 1978; da Mota 1978). Simply understood, if a particular growing season experiences a low amount of sunshine, soybean yields may decrease or exhibit relatively poor quality.

Moisture: Moisture is considered the primary limiting factor in soybean growth. Seed germination is dependent upon approximately 50% moisture content, although excessive moisture may inhibit germination and root growth. The susceptibility of soybean plants to insufficient moisture varies throughout the growth cycle. However the number of flowers, percentage of pod set, number of seeds and seed weight are all positively related to soil moisture (Hicks 1978; da Mota 1978).

In terms of production risk, excessive moisture may inhibit the efficiency of farm equipment such as planters, and contribute to the growth of diseases and pests at various stages of the growth cycle (Table 3.1). A lack of moisture may also adversely affect production practices as some pesticides require moisture for activation.

Table 3.1
Disease and Pest Risks to Soybean Production

	May	June	July	August	September	October
DISEASES	*seedling diseases* *Phytophthora root rot* *rhizoctinia root rot*	*seedling diseases* *Phytophthora root rot* *rhizoctinia root rot*	*Phytophthora root rot* *rhizoctinia root rot* *leaf spot*	*Phytophthora root rot* *rhizoctinia root rot* *leaf spot* *stem canker* *white mold* *stem rot* *mildew* *stem blight*	*Phytophthora root rot* *rhizoctinia root rot* *leaf spot* *stem canker* *white mold* *stem rot* *mildew* *stem blight*	*stem canker* *white mold* *stem blight*
PESTS	*seedcorn maggot* *slugs*	*cyst nematode* *seedcorn maggot* *slugs* *spidermites*	*cyst nematode* *slugs* *spidermites*	*cyst nematode* *spidermites* *grasshoppers* *cloverworm*	*cyst nematode* *grasshoppers* *cloverworm*	*cyst nematode*

(Adapted from OMAFRA 1997)

Temperature: While soybean growth is characterized to some extent by day length, temperature also plays an important role. Varieties are rated according to the amount of accumulated heat units necessary for maturation. Both temperature and day length govern the development of the plant throughout the growing season. In relation to other field crops, the soybean plant has been found to be generally very tolerant of temperature extremes. Plants have been observed to recover on occasion from both frost and high temperatures. (Hicks 1978; da Mota 1978). However extreme temperatures may prove detrimental to both soybean growth and production practices if compounded by other adverse climatic conditions such as insufficient moisture due to a lack of rainfall.

Although not discussed above, one cannot discount the importance of the catastrophic weather conditions such as hail, floods, or high winds. While short lived in nature, the implications of these events for soybean production may be immense in terms of the associated crop loss. Regardless of the scale of a particular weather risk to soybean production, the variability associated with its occurrence makes it impossible to predict.

3.2.2 Climatic Variability in Ontario

As discussed in chapter 2, climate is inherently variable. Within Ontario, variability can be demonstrated using the previously mentioned parameters specific to soybean growth and production: temperature, available moisture and available sunshine. Figures 3.6 through 3.9 show the growing season conditions for these parameters between 1968 and 1995 at London and Exeter weather stations (Figure 3.5). Examples of variability over time are demonstrated by the differences in average growing season (or May to October inclusive) high temperatures in 1991 and 1992 at London weather station (Figure 3.6). Here, the average growing season high temperature differs by approximately 3 degrees Celsius from 1991 to 1992. This variability is also displayed in the average growing season lows at Exeter weather station for

Figure 3.5
London and Exeter Weather Stations

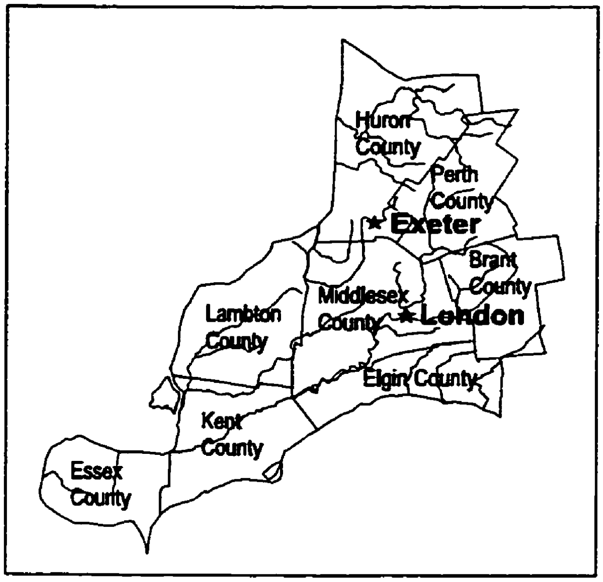
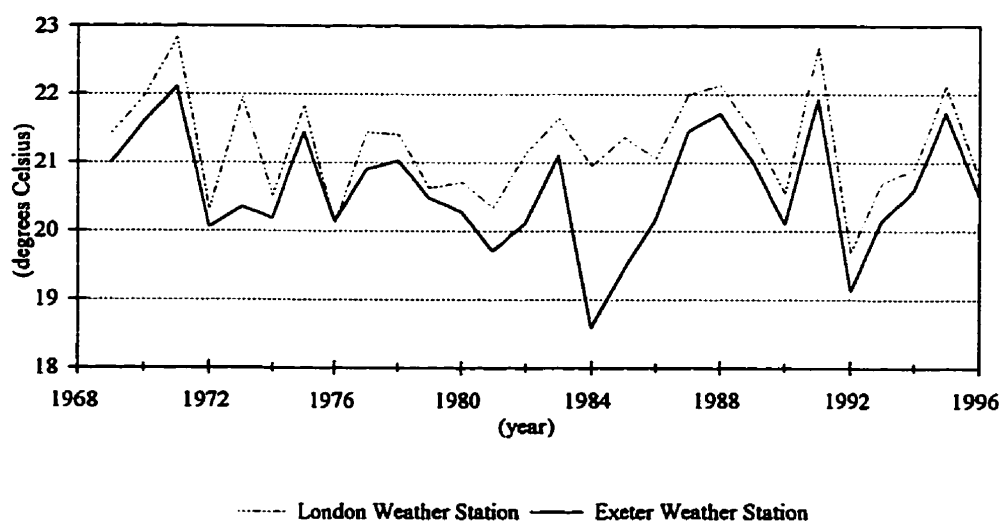
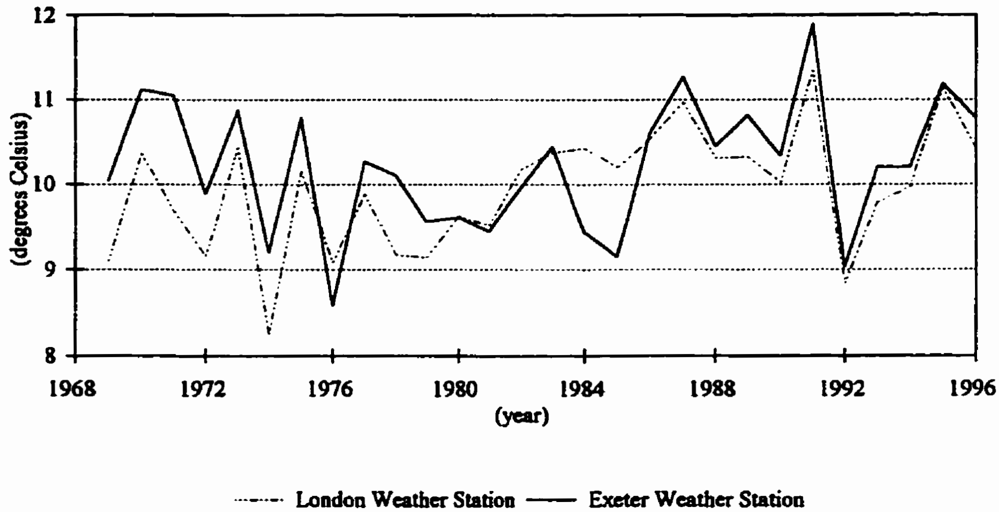


Figure 3.6
Growing Season Average High Temperatures, 1969 to 1996



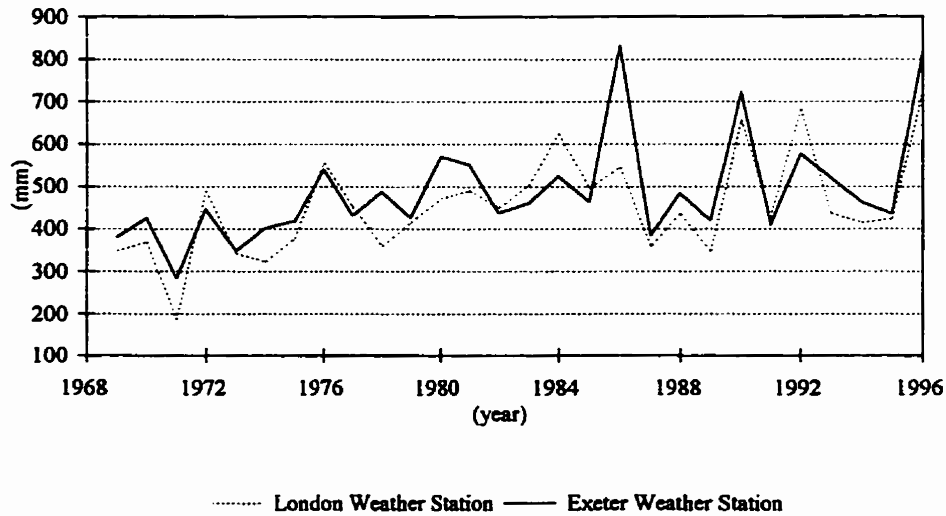
(ClimateSource 1997)

Figure 3.7
Growing Season Average Low Temperatures, 1969 to 1996



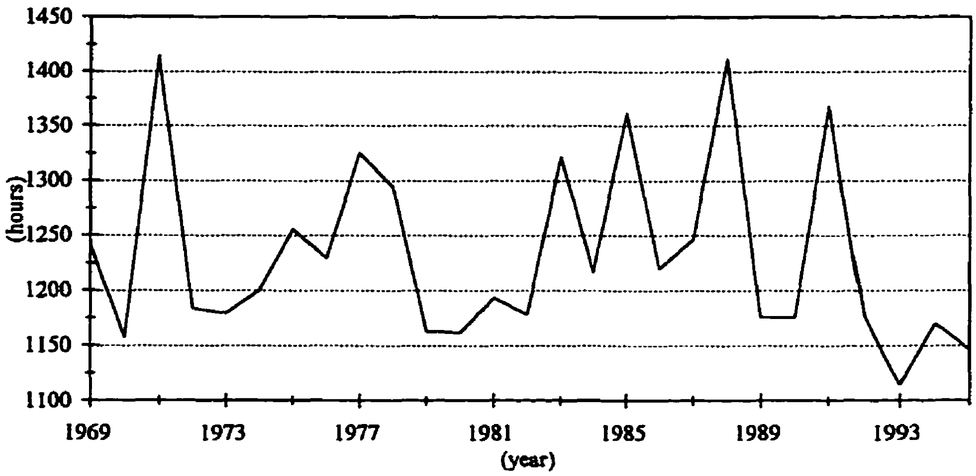
(ClimateSource 1997)

Figure 3.8
Total Growing Season Precipitation, 1969 to 1996



(ClimateSource 1997)

Figure 3.9
Growing Season Average Hours of Bright Sunshine: London Weather Station, 1969 to 1995



(ClimateSource 1997)

the same years (Figure 3.7). An examination of the precipitation data exhibits extreme fluctuations in the years 1986, 1990 and 1996 for Exeter weather station and in 1990 and 1996 at the London weather station. Extreme variation is also exhibited in the average hours of bright sunshine recorded at London weather station throughout the 1969 to 1995 period.

This variation in temperature, precipitation and amount of available sunshine from year to year may affect the quality and yield of a soybean crop depending upon the timing and combination of weather conditions. For example, 1971 displays low precipitation, high average growing season temperatures and relatively high average hours of bright sunshine. This particular year may not have produced high yields if there were no timely rainfalls to ensure plant maturity. In this sense, variability throughout the growing season may be as significant as variability from year to year. The variability of weather from season to season creates an atmosphere of uncertainty and risk within agricultural operations which ultimately depend upon suitable conditions. This risk can be managed through a number of production, marketing and financial strategies discussed earlier in chapter 2, including crop insurance.

3.3 Crop Insurance

3.3.1 Background of the Crop Insurance Program

Canadian policy intervention to provide compensation to farmers for losses due to weather began in 1939 with the creation of the *Prairie Farm Assistance Act* (PFAA). The act was a response to devastating drought conditions in the 1930s which are sometimes referred to as the most disastrous period in Canadian agriculture. While the objectives of the PFAA were never clearly stated, it was meant to act as an acreage insurance plan and offer income protection (Sigurdson and Sin 1994). As time passed, the PFAA was criticized for requiring a standard levy from all participants yet failing to recognize the regional variation in pay outs. Farmers also criticized the use of average township yields rather than individual farm yields to calculate pay-outs. Many felt that the PFAA had become obsolete in a new era of agriculture, and demand for a new and better program escalated (Sigurdson and Sin 1994).

In 1959, the *Federal Crop Insurance Act* was passed. This legislation allowed the federal government to provide contributions and loans to provincial governments for crop insurance. The program has undergone many changes over time, as outlined in Table 3.2. This table summarizes the policy amendments to program over time in terms of financial support and policy amendments to make the program more accommodating to producers and thus to increase participation. Crop insurance programs are presently funded by both federal and provincial governments in all provinces, although provincial governments are responsible for the implementation of the programs. Within Ontario crop insurance became the responsibility of the crown corporation AGRICORP on January 1, 1998.

Table 3.2
History of the Canadian Crop Insurance Program

1939	Introduction of Prairie Farm Assistance Act	Crop loss disaster insurance available to farmers in the Prairies and Peace River area funded by 1% levy to be matched by government contribution.
1959	Crop Insurance Act	Allowed the federal government to enter into agreements with provincial governments to provide 60% coverage on crop yield losses. The federal government incurred 20% of premium costs and 50% of administration expenses.
1964	Amendment to Crop Insurance Act	Provision for reinsurance fund to assist provinces when major crop failures provoked claims to exceed premiums collected.
1966	Amendment to Crop Insurance Act	Introduction of the concept of long term average yields and extended coverage. Coverage level were increased to 80% for eligible crops based on long term average yields. Federal contribution level increased to 25% of premiums.
1970	Amendment to Crop Insurance Act	Introduction of unseeded acreage benefit
1973	Amendment to Crop Insurance Act	Revised federal/provincial cost sharing agreement: 1. Federal/provincial governments each pay 25% of premiums and 50% of administration costs, or 2. Federal contribution of 50% of premiums and provincial contribution of all of administration costs.
1990	Amendment to Crop Insurance Act	Coverage level for low risk crops increased to 90%.
1993	Repealed Crop Insurance Act	Introduction of Farm Income Protection Act with no substantial changes to crop insurance.
1998	AGRICORP introduced in Ontario	crown corporation takes over crop insurance, January 1st within Ontario

(*Adapted from:* Agriculture and Agrifood Canada 1995, p35-36)

3.3.2 Crop Insurance, Ontario, Soybeans

The Crop insurance Act was first introduced in Ontario in 1966 with the implementation of a coverage plan for winter wheat. Insurance coverage for soybeans began in 1968, at which time the provincial and federal governments absorbed 30% of the premium, requiring each farmer to pay the remaining 70%. The available coverage level for soybeans was 70% throughout Ontario at this time. In 1971, the *Crop Insurance Act* underwent a number of changes, including a decrease in premium rates payed by farmers to 50%, with the federal and provincial governments assuming 25% each. A new approach to insurance coverage was also introduced which allowed for high and low range coverage levels for insured acreage. This meant that farmers could choose the level of coverage they wanted to purchase. Another change to the program was the incremental increase of insurance coverage levels without increasing the premium rate for farmers with no claim history. This means that the premium paid by a farmer is discounted or surcharged depending upon claim history, thus discouraging farmers from filing claims unless absolutely necessary.

Under the 1997 Ontario Crop Plans, there are 4 levels of coverage (defined here as the level of compensation purchased by an insured individual) available to soybean producers ranging from 75% to 90%, at 5% increments. It is currently the only crop for which 90% coverage levels are available, with most crops being offered only up to 85% levels of coverage. Premium rates for soybeans are comparatively low as displayed in Table 3.3. This may be due to the associated market value of the crop, as well as to the relative resiliency of soybeans to weather which in turn results in fewer claims by participants compared to other cash crops.

The crop insurance program is based upon the premise of individual farm yield. As a result, each farmer who participates in crop insurance must provide an accurate account of their annual yield as it will determine their payout if a claim is issued. A payout is granted when a farmer files for a valid claim, although it may also be granted automatically in a case where a regional extreme event is assumed to affect all farmers in the area. In any case, the payout is determined based upon the farmer's ten year average. For example: assume a farmer has a ten year average farm yield of 8000 bushels per acre of soybeans and has purchased crop insurance at the 85% coverage level option. The crop insurance program then guarantees the farmer 6800 *(.85*8000)* bushels per acre.

Table 3.3
Selected Crop Insurance Premium Rates *(per acre)*, 1997

Crop	70%	75%	80%	85%	90%
soybeans	*N/A*	*$5.80*	*$7.55*	*$9.75*	*$12.50*
corn	*$7.35*	*$8.90*	*$10.80*	*$13.05*	*N/A*
white beans	*$15.20*	*$17.85*	*$20.90*	*$26.00*	*N/A*
coloured beans	*$15.20*	*$18.10*	*$21.70*	*$27.00*	*N/A*

**winter wheat is handled under a separate insurance program*

**under the 1998 crop insurance plan, corn and soybeans customers are given the choice of a floating insurance price or a fixed insurance price for two levels of coverage only*

(Agriculture and Agrifood Canada 1997)

Consider a year where due to adverse weather conditions, the farmer's soybean crop yields only 5000 bushels per acre. Crop insurance will pay out on the difference between the actual yield and the guaranteed yield, or 1800 bushels per acre (6800-5000). This amount is multiplied by the floating market price of soybeans to calculate the final payout (Agriculture and Agrifood Canada 1997).

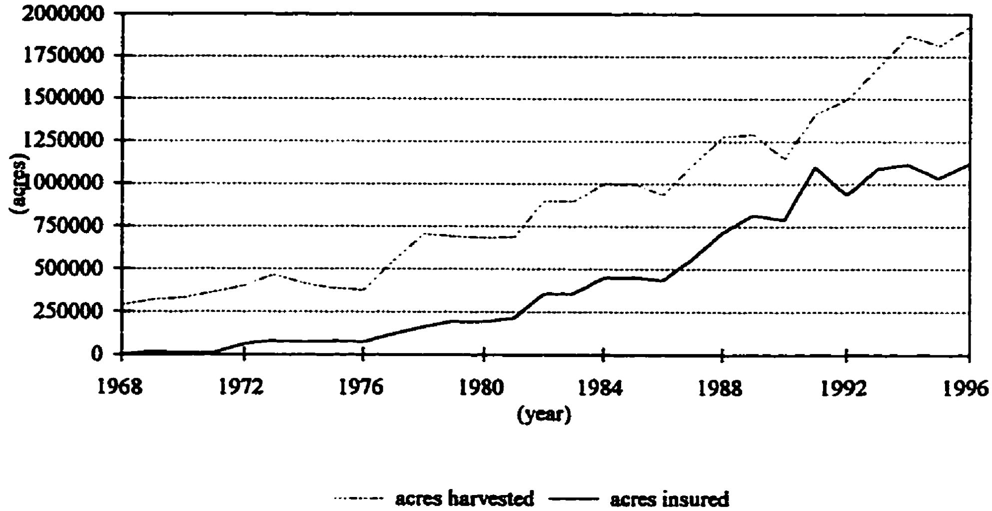
New participants to the program are underwritten until they can establish a 10 year average farm yield. Due to improvements in cultivars and production technologies, a trend adjustment is applied to soybeans for years three through ten for participants in the 1997 plan. This adjustment compensates for increased soybean yields over the past ten years when calculating an insured farmers average yield for claims.

3.3.2.1 Participation

Participation in the crop insurance program in Ontario in terms of acres insured relative to soybean acres harvested appears to have steadily increased since the beginning of the program until the late 1980's. However participation after the late 1980's did not keep up pace with the ongoing increase in acres harvested (Figure 3.10). An examination of the acres insured as a proportion of acres harvested reveals a steady increase from 1969 until 1986 (Figure 3.11). After this time, the proportion of total area insured rose quicky from 45% in 1986 to 78% by 1991. However after 1991, the total proportion of soybean acreage insured began to decrease. By 1996, only 56% of the total acres harvested were insured. While a similar pattern is exhibited in Ontario winter wheat acreage, grain corn appears to be more variable over time.

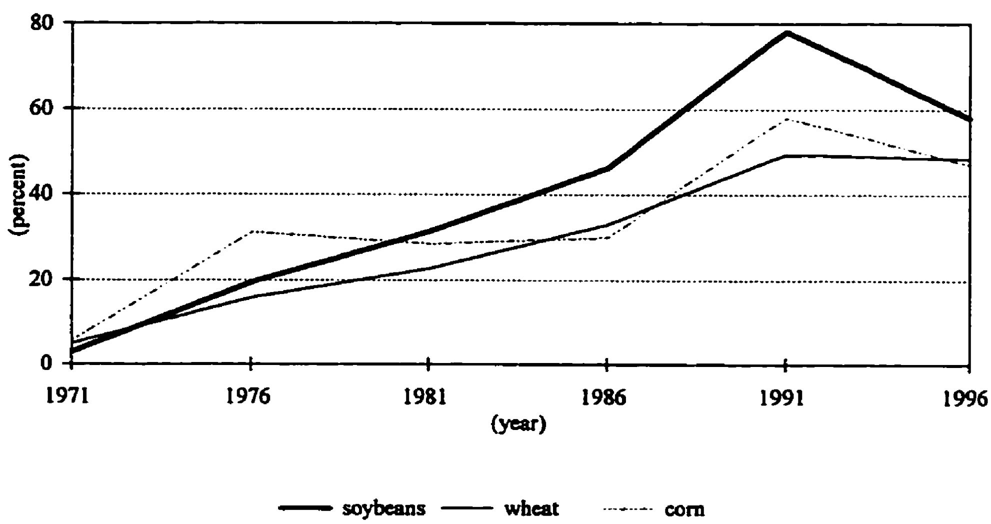
The recent decline in the proportion of soybean acres insured may be the result of a number of factors. One reason may be that farmers are substituting other production and financial based management strategies for crop insurance. It is possible that farmers may perceive the cost associated with purchasing crop insurance to be too high. A second reason for the decrease in acreage insured may be attributed to a reduction in claims. As discussed in chapter 2 with regard to the natural hazards research, the perception of risk tends to decrease as time passes (Burton, *et al.* 1993). A relative decrease in the number of crop

Figure 3.10
Ontario Soybean Acres Harvested and Acres Insured, 1968 to 1996



(Agriculture and Agrifood Canada 1969-1997)

Figure 3.11
Ontario Soybeans, Winter Wheat and Grain Corn: Acres Insured as a Percentage of Acres Harvested, Census Years 1971 to 1996



(Agriculture and Agrifood Canada 1969-1997) insurance claims in recent years suggests that the associated risk may have also decreased. It is therefore possible that participation in crop insurance may have declined as a result of a decrease in the perception of the associated risk. An examination of crop insurance claims as they relate to soybeans, grain corn and winter wheat will provide further insight.

3.3.2.2 Claims

Soybean claims under the Ontario Crop Insurance Program have varied greatly year to year, especially over the past ten years. Table 3.4 displays for grain corn, winter wheat and soybeans the percentage of pay-outs to farmers and the associated peril to which the loss is attributed. The perils associated with soybean claims in Ontario reveals that a high proportion of soybean claims are related to high levels of rainfall and excessive moisture. Between

Table 3.4
Ontario Crop Insurance Payments for Perils (*as a percentage of total payments*): Grain Corn, Winter Wheat and Soybeans, 1967 to 1997

Peril	grain corn	winter wheat	soybeans
rainfall/excessive moisture	51%	18%	54%
drought	21%	4%	18%
frost	23%	<1%	5%
insects and disease	<1%	70%	13%
hail	<1%	<1%	3%
floods	<1%	0	0
wind	1%	<1%	0
wildlife	<1%	0	0
extreme temperatures	0	<1%	<1%
winterkill	0	4%	0
other*	2%	1%	6%

* *refers to perils not identifiable due to AGRICORP system conversions*

(AGRICORP 1998)

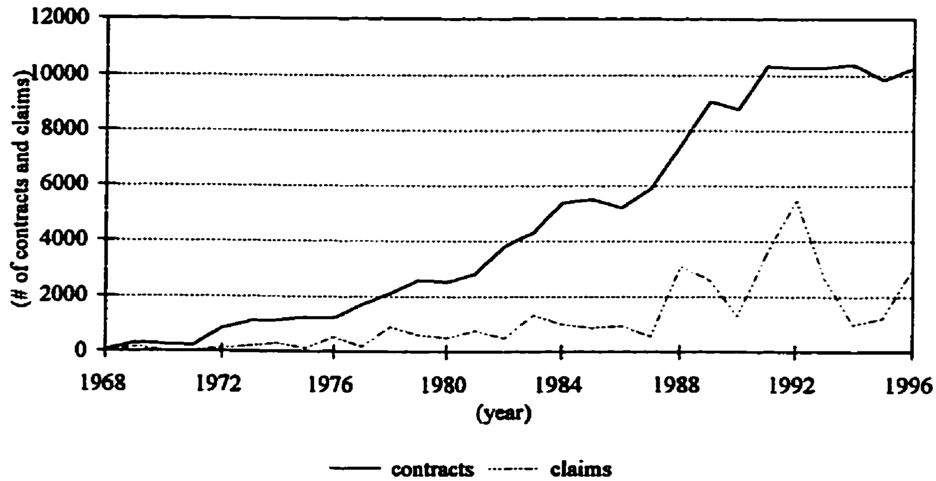
1967 and 1997, 54% of all soybean claims were attributed to excessive moisture. Drought conditions and damage due to insects and disease account for some soybean claims, yet not to the same extent as excessive moisture. The perils associated with soybeans are similar in part for grain corn, although grain corn appears to be more susceptible to frost (presumably a result of the associated earlier planting date). Winter wheat exhibits a relatively high number of claims related to insects and disease.

Crop insurance claims as a percentage of contracts purchased for soybeans have varied over time in Ontario (Figure 3.12). However this variability is not consistent with the pattern of decline displayed in crop insurance participation (Figure 3.11 and 3.13). It is speculated that this decline in participation may not be attributed to an associated decline in the overall number of claims. If this is the case, it raises the question as to why fewer soybean farmers are insuring their crop. One possible explanation may be the availability of alternative weather risk management strategies.

3.3.3 Three Lines of Defense: Farm Management, Policy and *Ad Hoc* Payments

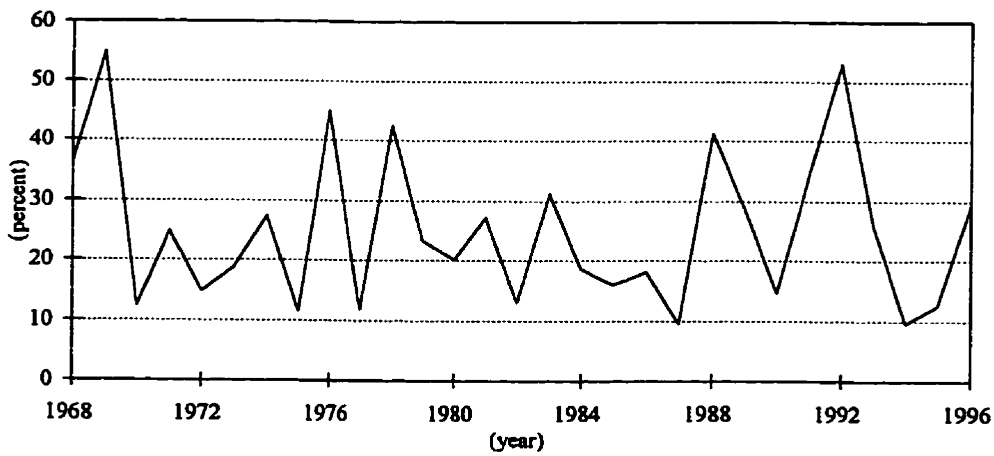
In an effort to achieve a greater level of predictability with regard to agricultural expenditures related to compensation for loss due to various sources of risk, the federal government commissioned a policy review in December, 1989. The following spring a report was presented to federal and provincial agriculture ministers which outlined three lines of defense in the management of agricultural risk. The first line of defense was to encourage and support the implementation of better farm level risk management practices. The second line of defense included policy initiatives which would alleviate the risk associated with the production, financial and marketing aspects of agriculture. Finally, *ad hoc* payments were

Figure 3.12
Crop Insurance Claims as a Percentage of Contracts Purchased for Soybeans, 1968 to 1996



(Agriculture Canada 1968-1996)

Figure 3.13
Crop Insurance Contracts Purchased and Claims for Soybeans, 1968 to 1996



(Agriculture Canada 1968-1996)

considered to be the final line of defense to be used only when absolutely necessary.

The policy initiatives recommended in the second line of defense included the Gross Revenue Insurance Plan (GRIP) and the Net Income Stabilization Account (NISA) to be used in conjunction with existing provincial Crop Insurance Programs (National Library of Canada 1991). While the NISA program has existed as a federal initiative aimed at reducing the risk associated with income, each province was held responsible for customizing their GRIP programs to reduce the market risk associated with their regional agricultures. In Ontario, this was achieved by replacing the GRIP initiative with the Market Revenue program (Grenier 1998). Both programs were offered in Ontario starting in 1992.

3.3.3.1 Market Revenue

Like the crop insurance program, Market Revenue program payments are calculated using a farmer's individual average farm yield. Payments are triggered when the price of a farmer's crop falls below 85% of the fifteen year average Ontario market price. The guaranteed yield under the Market Revenue Program is 85% of a farmer's average farm yield. For example: if a farmer has 8000 bushels of soybeans and the market price falls to $7.00 per bushel when the calculated average support price is $9.00 per bushel, market revenue pays out $13, 600.00, or ($9.00 - $7.00) * (85% of 8000 bushels). One third of this total amount is deducted in lieu of premium payments, and the farmer receives the remaining two thirds. Before 1994, the program had required farmers to pay premiums in advance similar to the Crop Insurance Program. Although farmers no longer pay premiums beforehand, they are required to enroll in the program in advance of the growing season. Participants are also required to enroll the total acreage of each crop enrolled in the market revenue program. If payments from the market revenue program exceed the program's balance, pay outs will be lowered to accommodate the lack of funds (Agriculture and AgriFood Canada 1998).

As the program does not require farmers to pay premiums unless a payment is made, it is speculated that most farmers participate in the program regardless of crop insurance use. While it appears as if participation in the program has tapered off (Figure 3.14), the acreage enrolled has remained steady over the past few years (Lowen 1998). It is important to note that the Market Revenue Program is designed to alleviate only the risk associated with market conditions (ie, price). Therefore it does not have the potential to function as a substitute for crop insurance in the same way as income protection initiatives such as NISA.

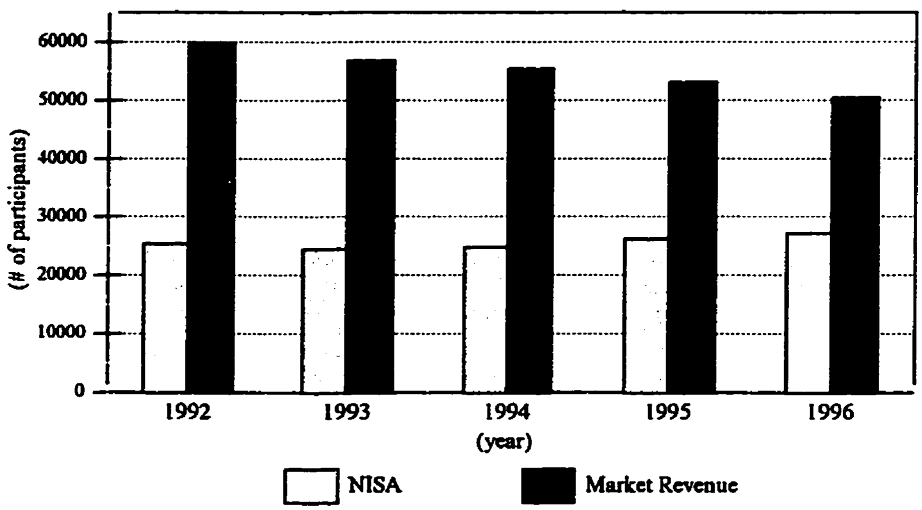
3.3.3.2 Net Income Stabilization Account (NISA)

NISA is a voluntary program designed to help agricultural producers stabilize their income. Participants may deposit up to 3% of their eligible net sales, to be matched by a federal/provincial government contribution. The balance of the account earns 3% interest over and above the competitive rate paid by the federal and provincial governments. Producers may also deposit an additional 20% of their eligible net sales, but this amount is not matched by the government. A withdrawal may be made when an individual producer's minimum net income falls below a threshold value.

The NISA program was introduced in July of 1991, retroactive 1 year. Participation in the program immediately escalated due to various incentives offered in the first few years and has since shown an increase as public awareness of the program has heightened (Grenier 1998).

This increase in participation in NISA is accompanied by a decrease in participation in crop insurance (Figure 3.12). It is speculated that an increasing number of farmers are substituting NISA for crop insurance. Unlike the Crop Insurance Program, NISA allows farmers to get a return on their investment and have greater control over their money. Since weather risks directly affect income, NISA allows farmers to compensate for weather-related losses without purchasing crop insurance. However the effectiveness of the NISA program is largely dependent upon the length of time a farmer has participated in the program, and the amount of money deposited into the account.

Figure 3.14
Participation in NISA and Market Revenue in Ontario



(Grenier 1998)

3.4 Soybeans, Weather and Crop Insurance: A Summary of Relationships

This chapter has documented patterns in soybean production, weather variability, weather risks to soybean production, crop insurance, and other agricultural risk management policy initiatives presently available within Ontario. When observed in relation to one another, these patterns aid in the understanding of how farmers are employing crop insurance to manage the risk associated with weather variability. The objective of this section is to summarize the relationships observed in this chapter.

Within Canada, soybean production has been shown to occur mainly within Ontario, where acres harvested surpassed those of both winter wheat and grain corn by 1996. Some of the weather conditions which may hinder soybean production and growth within Ontario were documented in this chapter in terms of light, moisture and temperature. Variations in these weather conditions may ultimately decrease the overall yield and quality, depending upon their sequence and timing. An examination of past weather conditions as recorded at two weather stations within the study area has shown that this kind of variability in weather does indeed exist. As a result, farmers are continuously faced with management decisions regarding the possible adverse effects of weather variability.

One way in which farmers are managing these weather risks is through crop insurance. Crop insurance use among soybean farmers in Ontario increased steadily over time since 1968 particularly in the late 1980's. Since 1991, however, the number of contracts purchased has remained relatively constant, while the proportion of the total area in soybeans insured has declined. As the number of claims has been highly variable throughout this period, it is speculated that the decline in soybean acres insured is not attributable to a diminishing perception of risk as discussed in chapter 2 with regard to the natural hazards research. As weather variability within Ontario has been shown to continue throughout this period, it is possible that farmers may be substituting other strategies to manage the risk associated with weather.

One possible strategy farmers may be substituting for crop insurance is the Net Income Stabilization Account. Not only does NISA provide farmers with a self-directed risk management strategy, it ensures that participants can receive a return on their investment. Also, since the NISA program is based upon income protection, a farmer may make a withdrawal regardless of whether the loss was production (yield) or market (price) related. The recent increases in NISA participation in relation to patterns of crop insurance use support the speculation that some farmers may be substituting NISA to manage the weather risks associated with soybean production.

However many farmers continue to purchase crop insurance. In order to understand how these farmers are using crop insurance to manage the risk associated with weather, and alternatively what management strategies farmers who do not purchase crop insurance are substituting for the program, it is necessary to talk to the farmers themselves. The following chapter will discuss the methodology employed for the farm level analysis.

4.0 EMPIRICAL METHODOLOGY

An objective of this research is to empirically identify the role of crop insurance in the farm level management of weather related risks to soybean production within Middlesex County. This can be achieved through a variety of methods including time series analysis or farm models. However, in order to understand the farm level decision making process without assuming behavior and motivation, farmers have to be contacted directly. While this may be accomplished through a variety of methods, personal interviews using a structured survey were employed for this research.

4.1 Survey Research

There are many approaches to survey research. For the purpose of this research, personal interviews using a structured survey were used for a number of reasons. One reason for this is that face to face interviews encourage maximum motivation of participants while providing the opportunity to probe unclear responses (Schuman and Kalton 1985). For this reason, personal interviews were chosen instead of mail or telephone surveys. Once contacted, structured interviews were conducted whereby participants were asked identical questions using identical wording. This was necessary in order to facilitate numerical summaries for analysis (Nachmias and Nachmias 1976). Non-structured interviews would have been more difficult to document and more difficult to compare, as questions would lack consistency from respondent to respondent.

4.1.1 Asking Questions

Structured interviews may involve the use of both closed and open ended questions. Closed ended questions generally require the respondent to provide a specific answer based upon acceptable options (Jones 1996). As questions which require recall of past experiences have been shown to provide incomplete response, the use of personal records, prompts and cues has been suggested to increase the recall of respondents (Sudman and Bradburn 1974). Open ended questions provide freedom for the respondent to volunteer what they believe to be appropriate. While open ended questions are generally considered more difficult to analyze than closed questions, they do provide an opportunity to probe detailed explanations (Jones 1996).

For this research closed ended questions were used to document easily comparable information about the farm level management of weather-related risks. Open ended questions were used to explore identified relationships by drawing upon personal opinions and experience (Sproull 1988). All questions were administered orally with the interviewer recording all responses. At no time were the participants in the survey asked to refer to documents or any other records which might have to aided in their recall of events.

4.2 Questionnaire Design

The questionnaire was composed of three sections and structured to logically address the research objective while establishing a sense of a rapport with respondents (Jones 1996). This section will discuss the layout and content of the questionnaire (Appendix 1) in detail.

4.2.1 Time Frame

In order to identify the role of crop insurance in the farm level management of weather -related risks, it was necessary to define a suitable time frame which reflects variability in weather. Taking into consideration that the level of recall generally decreases with the length of time since an event occurs (Sudman and Bradburn 1974), a six year study period from

1992 to 1997 was chosen. It was believed that this time frame was short enough to gather accurate information while long enough to accommodate change and variability.

4.2.2 Questionnaire Structure

The first section of the questionnaire employed closed ended questions to obtain information about attributes of the participant's farm operations such as farm type, total acreage, and spatial distribution of farmed land. This section focused on current information about the participant's farm operations only.

Section two required respondents to comment on the sensitivity of soybeans to weather relative to other field crops (in their own experience). Respondents were then asked to identify what they believed to be the main weather related risks to soybean production. If no response was offered initially, a list of possible weather-related risks derived from the literature was used to stimulate recall. Responses to this question were then used to prompt a more in-depth examination of specific weather related risks experienced by each participant during the past 7 years. If specific risks were identified, respondents were asked to recall the year and associated weather conditions. This was followed by an investigation of how they responded to the risk in the short and long terms, and what effect their response had on their farm operation and crop quality and yield.

Section three used mainly closed ended questions to document experience with crop insurance since 1992. Farmers were asked to disclose their soybean acreage for each year, type of seed used, whether or not they purchased crop insurance, applicable coverage levels, claim history and consequences, and participation in other agricultural safety net programs. In closing, respondents were asked a series of open ended questions about what they believed to be the relative strengths and weaknesses of the current crop insurance program, premium prices, and their opinions on privatization. Each respondent was given the opportunity at the end of the survey to contribute additional comments, questions or ideas about the questionnaire or research. The questionnaire was pretested with two local farmers and a Middlesex County Crop Specialist to ensure that the questions were understandable and appropriate.

4.3 Sample Selection and Questionnaire Implementation

The sample group was selected via a mixed strategy. Initially a master list of soybean producers in Middlesex County was purchased from Farm Business Communications. The list provided names of farmers with various acres of soybeans. Using this list as a guide, a series of introductory letters was prepared and distributed to farmers. The letter outlined the purpose of the research as well as its affiliation with the University of Guelph, the Ontario Ministry of Agriculture, Food and Rural Affairs, and the Ontario Soybean Growers Marketing Board (Appendix 2). The letter stipulated that farmers would be contacted within a few weeks of receiving the letter to ask if they would be interested in participating. However it became increasingly difficult to contact people using the master list. Respondents were then selected by driving to different areas throughout Middlesex County and simply knocking on doors. If home, farmers were asked if they produced soybeans and would be interested in assisting the research project by completing a questionnaire. In order to participate, a farmer must have reported soybeans at one time during the six year study period. While this approach did not follow a systematic sampling procedure, it is assumed in the end this mixed strategy provided an essentially random sample. Participants in the survey were located throughout

Middlesex County, reported various acres of soybeans, and represented a diverse sample group in terms of farm type and organization. In total 79 interviews were completed during the survey period. All interviews were conducted by the researcher and were administered between July 1 and August 30th, 1997.

5.0 SOYBEANS, WEATHER AND CROP INSURANCE: MIDDLESEX COUNTY

The objective of this chapter is to describe the ways in which soybean farmers in Middlesex County employ crop insurance in the management of weather-related risks. This will be achieved through the documentation of the results of the survey administered to 79 farmers reporting soybeans at various locations throughout Middlesex County. Datum at the county level are examined in conjunction with the survey results (where applicable) to provide insight into the overall representativeness of the study group. A comparison of the production, financial and marketing attributes of the farm and farmers participating in the survey is employed to identify how crop insurance is used to manage weather-related risks.

5.1 Soybean Production: Middlesex County and the Study Group

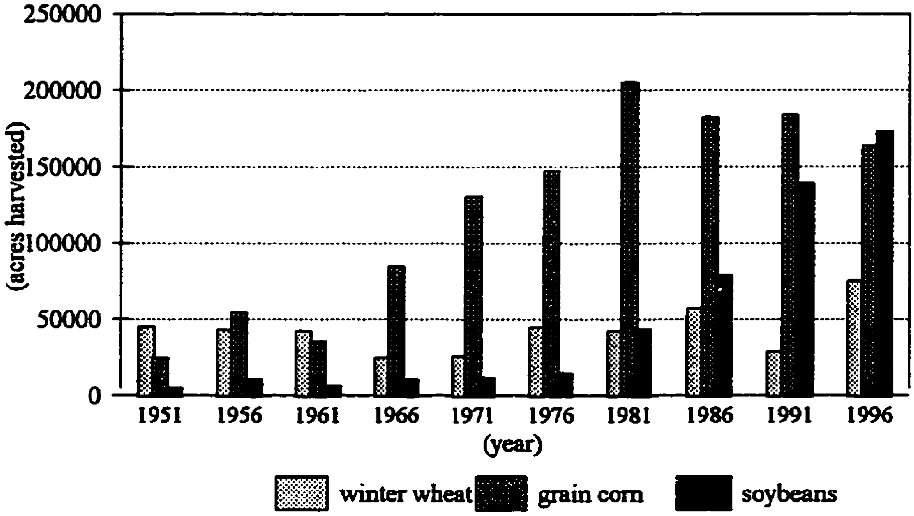
Soybean production in Middlesex County has increased considerably since 1980. Figure 5.1 displays the soybean acreage harvested in comparison to grain corn and winter wheat for all of Middlesex County. By 1996, soybean acreage in Middlesex surpassed that of both other crops. Soybean production by the study group also displays a steady increase over time. Figure 5.2 displays the average yearly acres harvested from 1992 to 1997 reported by farmers participating in the survey group. This pattern of soybean production among the study group is consistent with information reported for Middlesex County from 1991 to 1996.

The total soybean acres reported among survey respondents in 1997 ranged from less than 50 acres to over 2000 acres. A plurality of the farmers surveyed reported between 100 and 200 acres of soybeans in total (Figure 5.3).

5.2 Weather Related Risks to Soybean Production

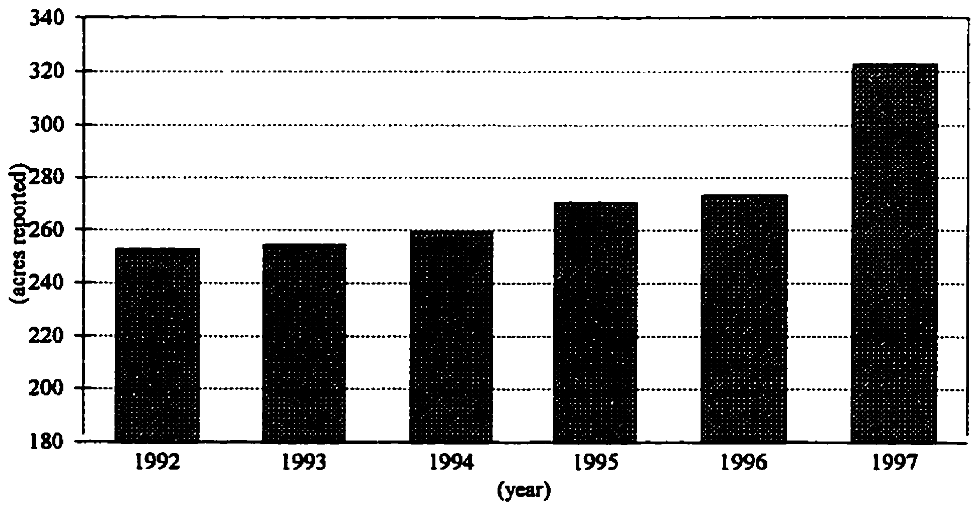
Participants in the survey were asked to identify what they believed to be the main

Figure 5.1
Middlesex County Acres Harvested: Soybeans, Grain Corn and Winter Wheat, 1951 to 1996



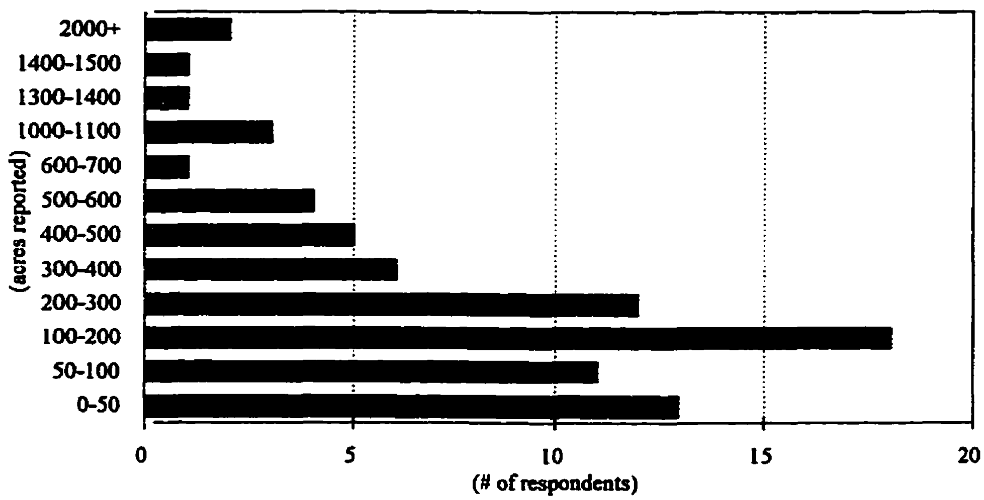
(Dominion Bureau of Statistics 1953-1968; Statistics Canada 1973-1997)

Figure 5.2
Study Group Average Soybean Acres Harvested, 1992 to 1997*



* *1997 refers to acres planted*

Figure 5.3
Distribution of Soybean Acres Reported by Study Group, 1997 *(n = 77)*



weather related risks to soybean production. If no response was offered initially, a list of possible weather related risks derived from the literature was used to stimulate recall. Participants were then asked to recall if any of the risks they had identified had affected their soybean crop between 1992 and 1997. Participants were then asked to specify the year the risk occurred and a description of the associated weather conditions. The information gathered from the study group is documented in Table 5.1.

These results indicate that the greatest weather related risks to soybean production within the sample area are the cold and wet conditions which interfere with the planting schedule (May and early June), especially in 1996. Late maturity due to dry conditions was also identified, although only in 1995 and 1996. White mold (which is associated with cold and wet conditions as well) is consistently recognized as a risk to production in every year surveyed. Late harvest due to wet and cold conditions was identified to a lesser degree throughout the study period, as was Phytophthora root rot (which is associated with wet conditions as well as soil type).

Table 5.1
Weather Risks to Soybean Production as Identified by the Study Group: 1992 to 1997

Weather-related risk	weather condition	1992	1993	1994	1995	1996	1997	# of mentions
late plant	*wet/cold*	1	0	0	6	43	48	98
	wet only	0	0	1	0	0	1	2
late/no germination	*wet*	0	0	1	0	2	0	3
late/no maturity	*dry*	0	0	0	3	11		14
	wet/cold	1	0	0	0	0		1
late harvest	*wet/cold*	2	1	1	0	2		6
	wet only	2	0	0	0	5		7
white mold		4	10	5	6	6		31
Phytophthora root rot		1	1	1	2	4		9
hail		0	1	1	0	0	N/A **	2
Total number of risks mentioned:		**11**	**13**	**10**	**17**	**73**	**49**	
Total # of farmers mentioning at least 1 risk:		**10**	**13**	**9**	**16**	**56**	**49**	
Number of farmers reporting soybeans:		**71**	**72**	**71**	**74**	**74**	**77**	

**Farmers may specify more than one risk per year*
*** data not available* for 1997

A comparison of the recollection of weather conditions by the farmers surveyed to weather data obtained from Environment Canada for London weather station, and the weather reports supplied by the Annual Crop Insurance Reports are similar for the years 1996 and 1997. The high level of precipitation and the low temperature for the 1996 planting period identified by the study group are reflected in the Environment Canada (Table 5.2) and

Table 5.2
Environment Canada Average Low Temperatures, Average High Temperatures and Total Precipitation from May to October: London Weather Station, 1992 to 1996

Average Monthly Low Temperatures *(degrees Celsius)*	**1992**	**1993**	**1994**	**1995**	**1996**
May	*6.4*	*6.1*	*4.9*	*7.5*	*6.3*
June	*9.6*	*11.5*	*12.3*	*13.8*	*13.6*
July	*13.2*	*15.7*	*15.5*	*16.1*	*13.8*
August	*12*	*14.3*	*12.7*	*16*	*13.4*
September	*9.2*	*8*	*9.3*	*7.3*	*10.4*
October	*2.4*	*2.8*	*4.8*	*5.9*	*4.7*
Average Monthly High Temperatures *(degrees Celsius)*	**1992**	**1993**	**1994**	**1995**	**1996**
May	*19.3*	*18.8*	*16.9*	*18.4*	*17.4*
June	*21.1*	*22.1*	*23.6*	*25.1*	*22.7*
July	*22.9*	*26.1*	*25.7*	*26.4*	*24.5*
August	*22.4*	*26.5*	*23.4*	*27.3*	*25.9*
September	*19.7*	*17.4*	*20.5*	*20*	*19.9*
October	*12.4*	*13.1*	*15.2*	*15.2*	*14*
Total Monthly Precipitation *(mm)*	**1992**	**1993**	**1994**	**1995**	**1996**
May	*53.2*	*33.0*	*79.6*	*98.6*	*116.8*
June	*65.8*	*102.1*	*112.2*	*99.3*	*103.0*
July	*203.6*	*73.6*	*90.6*	*18.2*	*86.2*
August	*136.4*	*36.2*	*70.2*	*63.2*	*38.1*
September	*149.2*	*127.2*	*37.0*	*34.2*	*295.2*
October	*75.8*	*64.3*	*25.8*	*110.4*	*85.6*

(ClimateSource 1997)

Crop Insurance Commission weather reports. However the recollection of weather conditions for 1992 by the study group does not share this similarity. While some of the respondents in the study group did identify 1992 as a cold and wet season overall, a greater number of farmers surveyed identified 1996 and 1997 as comparatively worse years. Yet the weather conditions as described by the Crop Insurance Commission for 1992 are comparatively worse than those for 1996 and 1997. This suggests that the recollection of weather conditions by farmers in the study group may not be adequate.

When comparing the weather data in Table 5.2 to the recollection of the survey participants, it is important to realize that it is impossible to specify an exact "recipe" for ideal climatic conditions for soybean production. The success of a crop is more dependent upon the combination of climatic conditions which occur and the sequence in which they occur. In this sense a crop may survive a dry spell if the soil was able to store adequate moisture from earlier in the season and therefore may not have been perceived as a risk to production. A comparison of weather conditions is therefore somewhat limited.

5.3 Response to Weather Related Risks

In order to identify responses to weather-related risks, farmers were asked how they managed each of the previously identified weather risks in both the short and long terms. These responses are displayed in Table 5.3 ,where short term refers to response during the specific growing season *(tactical)* and long term refers to response in subsequent growing seasons *(strategic)*.

Responses to weather risks varied depending upon the nature of the risk. However in the short term most farmers chose to not respond and wait out the associated risk and its consequences. This may be attributed to the fact that not every weather risk has a potential immediate response other than to do nothing and wait. Response in the short term is also somewhat limited to production related strategies. No marketing or financial management strategies, for example crop insurance claims, were identified by the study group. Assuming that some farmers did have crop insurance claims throughout the study period, it would suggest that claims may not be consciously considered a direct response to weather-related risks during a particular growing season.

Table 5.3
Farm Level Responses to Weather-Related Risks for 1992 to 1997 (*inclusive*)

Tactical Responses (*same growing season*)					
late plant *n = 100*	**late or no germination** *n = 3*	**late or no maturity** *n = 15*	**late or no harvest** *n = 11*	**white mold** *n = 31*	**Phytophthora root rot** *n = 9*
replant (10 farmers)	replant (2 farmers)	no response reported	no response reported	wait (26 farmers)	no response reported
				plough down (3 farmers)	
				spray (2 farmers)	
Strategic Responses (*subsequent growing seasons*)					
late plant	**late or no germination**	**late or no maturity**	**late or no harvest**	**white mold**	**Phytophthora root rot**
change variety (12 farmers)	no response reported	change variety (3 farmers)	change variety (1 farmer)	change variety (14 farmers)	change variety (6 farmers)
change crop (2 farmers)				change rotation (6 farmers)	change rotation (7 farmers)
change planting schedule (1 farmer)				change to no till (2 farmers)	
				change plant density (11 farmers)	

n = number of farmers reporting each weather-related risk

The long term responses to weather risks were more diverse than short term responses. Farmers surveyed indicated production related strategies such as changing variety or crop rotation in subsequent years to avoid risks associated with weather. A small number of farmers surveyed indicated that they changed their choice of crop. All of the responses indicated by participants were aimed at the production aspect of farming. While farmers were asked to identify all types of response *(production, financial etc.)*, none of the farmers surveyed identified the use of crop insurance as a long term response to weather risks.

5.4 Crop Insurance

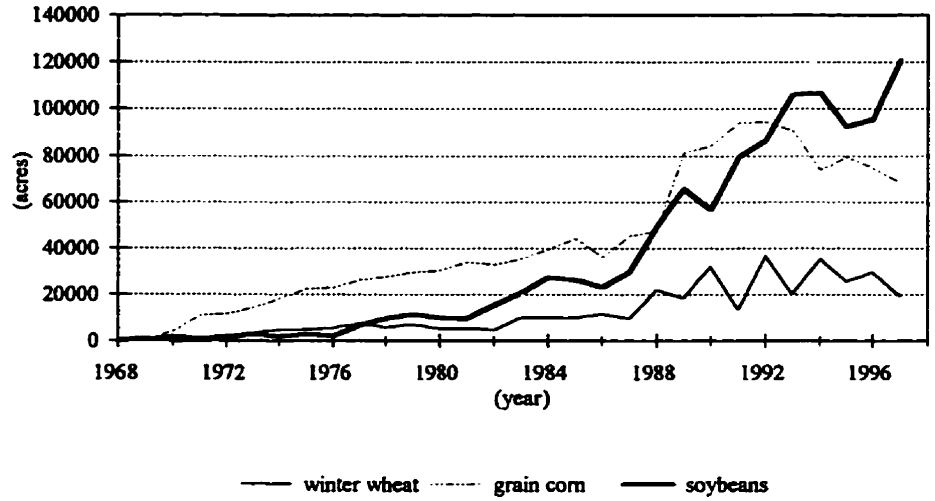
In order to understand how crop insurance is used to manage weather risks to soybean production, farmers were asked about their participation, choice of coverage levels, and claim history between 1992 and 1997.

5.4.1 Participation

The data for Middlesex County show that participation in the crop insurance program by soybean farmers has increased steadily over time with notable variation and patterns of decline in recent years (Figure 5.4 and 5.6). This is also true of grain corn and winter wheat which also show decline. However the overall participation rate in crop insurance for Middlesex County is highest among soybean farmers (Figure 5.5). This is true in terms of both the number of farmers purchasing crop insurance and the total acreage insured (Figures 5.6 and 5.7). These patterns of participation in the crop insurance program in Middlesex County are similar to those observed at a provincial level.

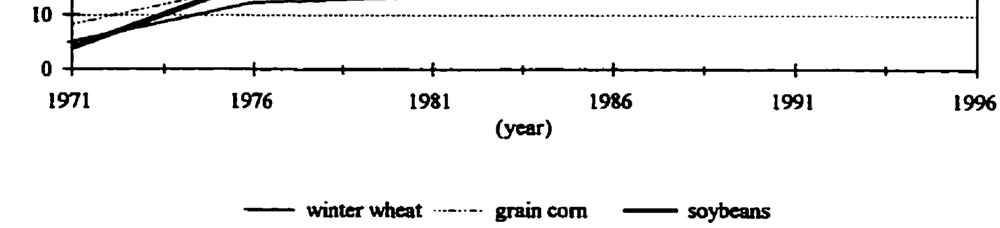
Within the 1992 to 1997 period there is little annual variation in terms of the number of farmers in the study group who purchased crop insurance. The overall participation rate in the sample group shows some variation from 69% in 1992 to 63% by 1997 (Figure 5.8).

Figure 5.4
Middlesex County Acres Insured: Soybeans, Grain Corn and Winter Wheat, 1968 to 1997



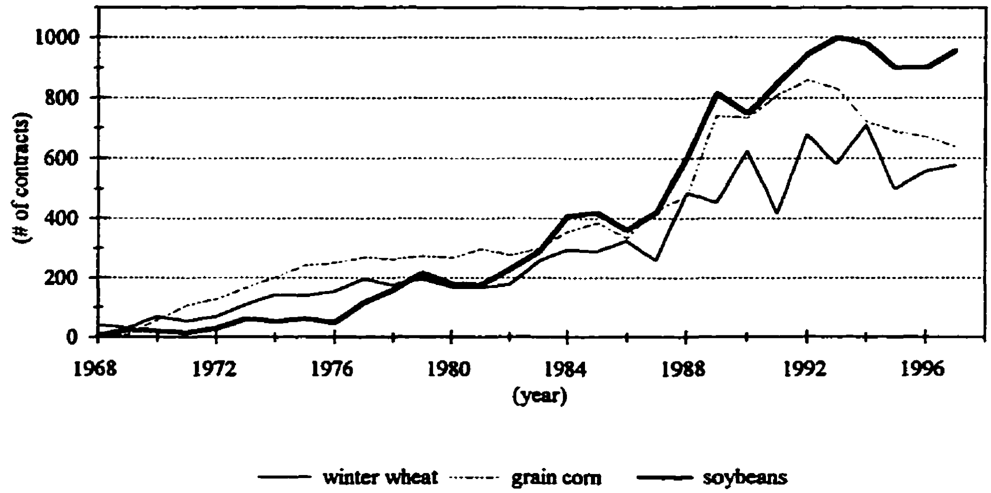
(AGRICORP 1998)

Figure 5.5
Middlesex County Acres Insured as a Percentage of Acres Harvested: Soybeans, Grain Corn and Winter Wheat, Census Years 1971 to 1996



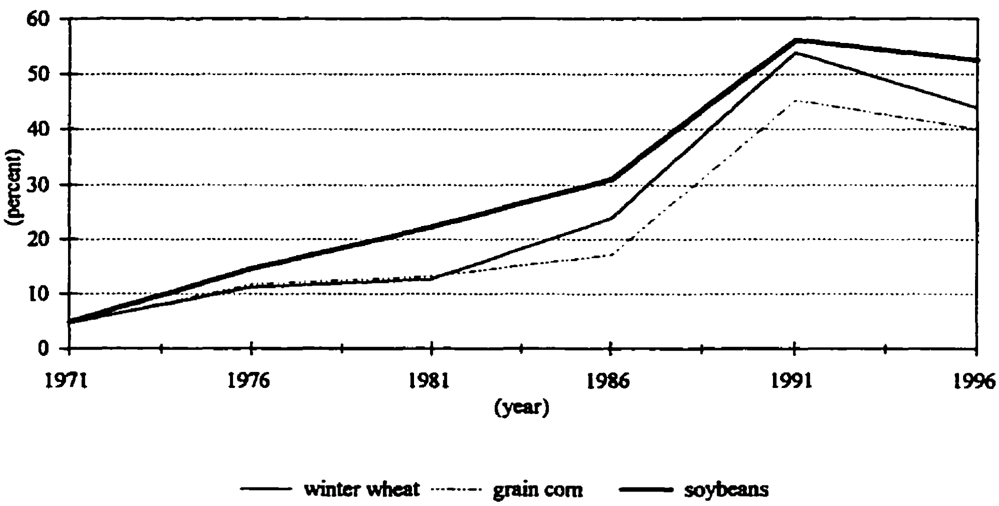
(Dominion Bureau of Statistics 1953-1968; Statistics Canada 1973-1997, AGRICORP 1998)

Figure 5.6
Middlesex County Crop Insurance Contracts Purchased: Soybeans, Grain Corn and Winter Wheat, 1968 to 1997



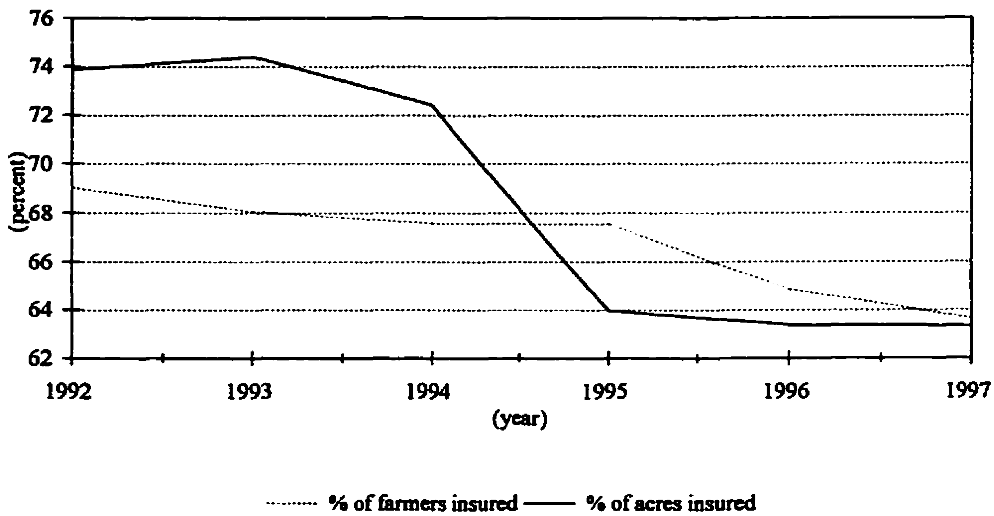
(AGRICORP 1998)

Figure 5.7
Middlesex County Crop Insurance Contracts Purchased as a Percentage of Farmers Reporting Soybeans, Grain Corn and Winter Wheat, Census Years 1971 to 1996.



(Dominion Bureau of Statistics 1953-1968; Statistics Canada 1973-1997, AGRICORP 1998)

Figure 5.8
Participation Rate (*Number of Insured Farmers vs. Acres Insured*) Among Survey Respondents, 1992 to 1997



There appears to be a greater decline over time in terms of the total acres insured as a percentage of acres reported by the sample group. The rate of acres insured peaks at just over 74% in 1993 and drops to just under 64% by 1997.

Farmers who participated in crop insurance were asked what level of coverage they purchased in 1997. Due to the variation over time in the available coverage levels for soybeans, farmers were asked to identify whether or not they had purchased the minimum coverage level (75%), maximum coverage level (90%), or a coverage level in between the two (80 - 85%). Of those participating in crop insurance, approximately 3% chose the minimum coverage, 60% chose a mid range coverage option, and 37% chose the maximum level. While these totals varied slightly year to year, many farmers stated that they felt that a mid range coverage provided adequate coverage if they needed to claim without having to pay the highest premium. Some of the farmers purchasing the 90% coverage option commented that they felt the risk to be great enough to warrant the highest possible coverage. Others commented that the difference in premiums was so small that it really did not cost all that much more to purchase the highest coverage option. Of those farmers purchasing the lowest coverage option, some commented that it was due to the cost of premiums.

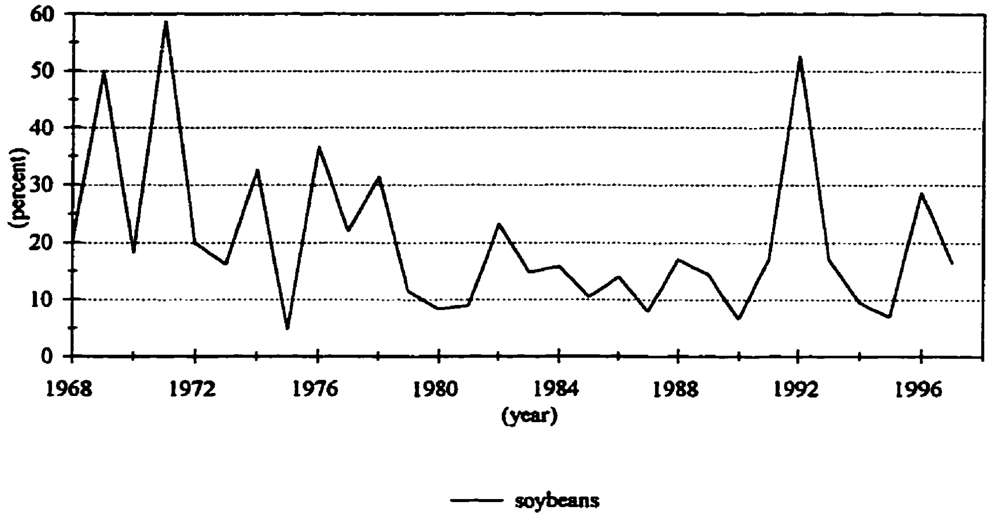
Among the survey respondents, those farmers who participated in the program had generally always participated, and those who did not stated that they had little interest in the program. Over the 1992 to 1997 period, six farmers decided to stop insuring their soybeans, while only two decided to start insuring. Those farmers who switched out of the crop insurance program did so because they felt that the level of risk did not justify the cost of insurance, or that they could take on the associated weather risk through other management strategies. The two farmers that switched into the program did so because they increased their soybean acreage and depended upon the crop as a major source of income and felt the level of risk justified the cost of premiums.

5.4.2 Claims

The number of claims by soybean farmers for all of Middlesex County has varied considerably over time. Figure 5.9 displays the total number of claims as a percentage of the contracts purchased from 1968 to 1997 for Middlesex County. The number of soybean claims as a percentage of contracts purchased appears to be comparatively higher in the early years of the program. However after 1980 the number of claims seems to taper off with some extreme variability in selected years.

Farmers with a history of crop insurance use in the study group were asked to recall

Figure 5.9
Middlesex County Claims as a Percentage of Contracts Purchased: Soybeans, 1968 to 1997



(AGRICORP 1998)

from memory their prior claims between 1992 and 1996. Claims were grouped as yield related claims or replant claims (when a farmer is compensated for the cost associated with replanting a crop during the same growing season). In this sense, an insured party may file a claim to replant, as well as a yield claim within the same growing season if the yield falls below the threshold imposed by the crop insurance program. Once it was determined if a replant or yield claim had been filed, farmers were asked if the claim was approved and for what peril it was filed. Farmers were then asked to recount the growing season conditions for each claim identified. Table 5.4 categorizes crop insurance claims in the sample group between 1992 and 1996 according to the associated weather conditions.

Reasons for crop insurance claims varied throughout the study period, although claims due to late or no maturity were most common. Claims due to late planting and reseeding were also prominent, and to a much lesser extent claims due to white mold, late or no germination and late harvest. The highest number of claims (23) during the study period occurred in 1996. A majority of the claims for this year were attributed to cold and wet conditions which resulted in late planting and replanting. However both wet and dry conditions were cited as the associated conditions which resulted in late or no maturation.

Table 5.4
Crop insurance Claims and Associated Perils*: 1992 to 1996

replant:	*conditions*	*1992*	*1993*	*1994*	*1995*	*1996*	*total # of claims*
	wet/cold	*2*	*1*	*0*	*0*	*8*	*11*
yield claims:	*conditions*	*1992*	*1993*	*1994*	*1995*	*1996*	*total # of claims*
late plant	*wet/cold*	*0*	*0*	*0*	*0*	*5*	*7*
	wet only	*1*	*0*	*0*	*0*	*0*	
	cold only	*0*	*0*	*0*	*0*	*1*	
late/no germination	*wet*	*0*	*0*	*1*	*1*	*0*	*2*
late/no maturity	*wet/cold*	*5*	*0*	*0*	*0*	*1*	*13*
	cold	*1*	*0*	*0*	*0*	*3*	
	dry	*0*	*0*	*0*	*0*	*3*	
late harvest	*wet*	*1*	*0*	*0*	*0*	*0*	*1*
white mold		*0*	*0*	*1*	*1*	*2*	*4*
Total # of claims:		*10*	*1*	*2*	*2*	*23*	*38*
# of insured farmers		*49*	*49*	*47*	*49*	*48*	

** Farmers may specify more than one weather condition associated with a particular claim.*

The high number of claims reported by the study group in 1996 is also observed in the county level data, although the 1992 county level data exhibit a much higher rate of claims (Figure 5.9). Yet among the survey respondents, only 10 claims were reported for 1992. This again suggests that farmers may not possess accurate recall of weather risks and may even have forgotten about past claims. However, a comparison of Table 5.4 to Table 5.2 shows that both the farm level data and the Environment Canada climatological data characterize 1992 as a year which experienced cold and wet conditions during the maturity stage of soybean growth (July and August), and 1996 as a year that experienced cold and wet conditions during planting (May and early June). Hence the recall of farmers does appear to at least reflect the nature of weather risks over time.

While none of the farmers surveyed indicated that they used crop insurance to manage the risk associated with weather, Table 5.4 shows conflicting evidence. The presence of crop insurance claims indicates that soybeans are indeed sensitive to weather, and that farmers are using crop insurance to compensate for losses associated with weather.

5.5 Explanations for crop insurance use

One approach to understanding crop insurance use is to identify those attributes which distinguish crop insurance users from non-users. Of all of the farmers surveyed, 77 respondents grew soybeans in 1997. This group was divided into two groups based upon participation in crop insurance in 1997. These groups were then compared according to various production, financial and marketing attributes of the farm operation collected in the survey. A continuity adjusted chi square test (at .05 and .1 significance levels) is used where applicable in order to identify significant relationships between crop insurance use and attributes of the farm operations of farmers participating in the survey.

5.5.1 Production Attributes

The production attributes of a farm have a significant effect on how weather risk is perceived and managed by an individual farm operator. As proposed by the conceptual model in chapter 2, farm attributes such as the choice of outputs, the spatial diversification of crop land, and practices such as crop rotation all have the potential to reduce the risk associated with weather. These types of production attributes of a farm play a role in the management of weather related risks by either complementing or facilitating the need for other management strategies such as crop insurance. This section tests for differences between insured farmers and non-insured farmers based upon the production attributes of *farm size, geographical distribution of land in soybeans, percentage of total crop land in soybeans, crop rotation* and *choice of soybean end market*.

i) Scale of Soybean Operation

As farmers with comparatively more acres in soybeans may be considered to have more to lose than smaller operations, it is hypothesized that farmers with higher soybean acres will tend to insure more.

In order to test this hypothesis, farm operators were categorized into two groups in terms of soybean acreage; those reporting less than the average soybean acreage of the entire study group, and those reporting greater than the average soybean acreage (331 acres) based upon the acres of soybeans reported by respondents for 1997.

Table 5.5
Scale of Soybean Operation and Crop Insurance Use

Soybean Acreage	*>than average (331.78)*	*<than average (331.78)*	*total:*
# of insured farmers	14 (29%)	35 (71%)	49 (100%)
# of not insured farmers	20 (71%)	8 (29%)	28 (100%)

chi square = 15.067
critical value at .05 significance level = 3.84 *critical value at .1 significance level = 2.71*

Farmers reporting a less than the average soybean acreage had a higher tendency to purchase crop insurance, whereas farmers reporting greater than the average soybean acreage tended not to insure (Table 5.5). This relationship proves to be statistically significant at a .05 significance level using a chi square test. This relationship between the scale of a farm operation and crop insurance is consistent with earlier studies of the size of farm operations and crop insurance use (Just and Calvin 1994; Blank and McDonald 1996). These studies concluded that no only do large farm operations tend to have the resources and capital to absorb risk better than smaller operations; they may also tend to have many parcels of land spread out over a greater area. As weather related events may be isolated to certain areas, one parcel of land may experience adverse conditions while others do not. The risk associated with weather is therefore spread out over a greater area.

ii) Geographical Distribution of Soybean Crop Land

As discussed in the previous section relating to the scale of soybean operations, the geographical distribution of crop land may also affect the perception of weather risks by farm operators. It is believed that by spreading out crop land, farmers are able to essentially spread the risk associated with weather (Castle, *et al.* 1972). It is therefore hypothesized that farmers reporting crop land over a spatially extended area will be less likely to purchase crop insurance.

In order to differentiate between farm operations with spatially diverse soybean crop land and those with spatially concentrated soybean crop land, farmers were categorized into two groups: those whose soybean production was within an area with a radius of 10km, and those whose soybean production extended over a greater area.

Table 5.6
Geographical Distribution of Crop Land in Soybeans and Crop Insurance Use

Land Distribution	*farmed land >10km*	*farmed land <10km*	*total*
# of insured farmers	**13 (27%)**	**36 (73%)**	**49 (100%)**
# of not insured farmers	**9 (32%)**	**19 (68%)**	**28 (100%)**

***chi square* = .618**
critical value at .05 significance level = 3.84 *critical value at .1 significance level = 2.71*

The relationship between the geographical distribution of farmed land and crop insurance does not prove to be statistically significant using a chi square test. In fact, a greater proportion of both the insured and not insured farmers reported that their farmed land was confined within a 10km radius (Table 5.6). These findings are inconsistent with previous studies of crop insurance use and the distribution of farmed land (McCloskey 1976; Just and Calvin 1994; Blank and McDonald 1996), and suggest that geographical distribution of farmed land does not function as an alternative risk management strategy to crop insurance for soybean producers.

iii) Percentage of Total Crop Land in Soybeans.

It is hypothesized that farmers who rely on soybeans as their primary production will be more inclined to purchase crop insurance. This hypothesis is best understood in terms of the theories embedded in the natural hazards literature discussed in chapter 2, where the perception of a risk is related to the magnitude of the expected loss (Burton, *et al.* 1993; Palm 1990). In this sense, a farmer who perceives a greater loss as a result of relying more heavily on soybeans will be more likely to purchase crop insurance.

In order to determine the relative importance of a soybean crop to a farm operation, the percentage of each participant's total crop land in soybeans as identified by the survey was calculated. Farmers were then categorized as having either less than or greater than 50% of their total reported crop land in soybeans. Although the 50% figure is somewhat arbitrary, farmers with greater than 50% of their total crop land in soybeans are assumed to have a significant dependence on the crop.

Table 5.7
Percent of Total Crop Land in Soybeans and Crop Insurance Use

Percentage of Soybeans	*>50%*	*<50%*	*total*
# of insured farmers	**24 (49%)**	**25 (51%)**	**49 (100%)**
# of not insured farmers	**7 (25%)**	**21 (75%)**	**28 (100%)**

chi square = 3.32
critical value at .05 significance level = 3.84 *critical value at .1 significance level = 2.71*

The results show that among the insured farmers there is no difference between those farmers who reported less than 50% of their crop land in soybeans and those farmers who reported greater than 50% of their crop land in soybeans (Table 5.7). Yet among the non-insured farmers 75% reported that soybeans accounted for less than 50% of their total crop land. This relationship proves to be statistically significant at a .1 significance level using a chi square test. This suggests the proportion of soybeans relative to other crops grown by farmers may affect their decision to take out crop insurance. If soybeans are the main crop grown by a farmer, it is possible that they may also be a prime source of income. The magnitude of a weather-related loss would as a result be greater then the loss experienced by a farmer with a comparatively smaller soybean crop.

iv) Rotation

The literature pertaining to soybean production recommends that soybeans are grown on a 2 to 3 year rotation to avoid annual disease and insect problems which are often associated with weather (OMAFRA 1997). It may then be hypothesized that farmers who do not rotate their soybeans are more likely to experience certain weather related risks(*for example white mold*) and therefore will be more likely to insure. This relationship is consistent with the research pertaining to moral hazard and adverse selection as discussed in relation to the conceptual model proposed in chapter 2 (Quiggin 1994).

To test this hypothesis, farmers were asked to identify what rotation they used with their soybean crop. Some farmers followed a strict rotation, while others varied over time. For the purpose of this research, the shortest rotation (or no rotation) identified by each farmer is used as the basis for analysis. To clarify, no rotation involves planting soybeans year after year on the same ground, where as a two year rotation involves planting soybeans every second year alternating with a different crop, and so on. For the purposes of this analysis, farmers were categorized as either employing no rotation, a two year rotation, or a three year or greater rotation.

Table 5.8
Rotation and Crop Insurance Use

Rotation	*no rotation*	*2 year rotation*	*3 or >3 year rotation*	*total:*
# of insured farmers	**5 (10%)**	**13 (27%)**	**31 (63%)**	**49 (100%)**
# of not insured farmers	**3 (11%)**	**3 (11%)**	**22 (78%)**	**28 (100%)**

chi square test not applicable

These results suggest that there is little difference between insured and non-insured farmers with respect to rotation (Table 5.8). A majority of the farmers surveyed (both insured and not insured) reported at 3 year or greater rotation. These results are inconsistent with the expected relationship based upon theories of moral hazard which suggest that farmers who purchase crop insurance will be less likely to employ alternative management strategies such as crop rotation.

v) Soybean Market Destination

Two classifications of soybeans grown within Middlesex County are crusher beans and specialty beans. Crusher soybeans are considered the lowest quality and are used for a variety of purposes while specialty beans are used for high quality products such as tofu, and possess a higher market value. It is hypothesized that farmers who grow even a small proportion of specialty beans will be more likely to insure their soybean crop due to the magnitude of the perceived loss (Burton, *et al.* 1993; Palm 1990).

Farmers were asked to identify the end market of their soybean crop. For this analysis, farmers were placed into 2 categories based upon end market destination; those who reported no specialty beans, and those who reported specialty beans regardless of the acreage.

Table 5.9
Soybean Market Destination And Crop Insurance Use

Soybean Market	*no specialty beans*	*specialty beans*	*Total:*
# of insured farmers	39 (80%)	10 (20%)	49 (100%)
# of not insured farmers	26 (93%)	2 (7%)	28 (100%)

chi square = 3.498
critical value at .05 significance level = 3.84 *critical value at .1 significance level = 2.71*

The results indicate that a greater proportion of the insured farmers reported specialty beans (Table 5.9). This relationship between specialty soybeans and crop insurance use proves to be statistically significant at a .1 significance level using a chi square test. These results support the hypothesis that farmers who grow specialty beans perceive there to be a higher degree of weather-related risk to soybean production and as a result would be more likely to purchase crop insurance.

This section has examined crop insurance use in relation to various production attributes of the farm. The results suggest that farmers who reported comparatively smaller acres of soybeans tended to purchase crop insurance more frequently. These results are consistent with earlier studies of crop insurance use as it relates to farm size (Just and Calvin 1994; Blank and McDonald 1996). A significant relationship was also found to exist between crop insurance use and those farmers who reported that soybeans accounted for at least 50% of their total crop land. These findings are consistent with the expected relationship based upon theories within the natural hazards research which suggest that a greater reliance on soybeans would perpetuate an increased perception of risk due to an increased associated loss (Burton, *et al.* 1983). Finally these results have concluded that among those farmers who grew higher priced specialty beans, a significant proportion tended to purchase crop insurance. Once again, these results are consistent with theories within the natural hazards research pertaining to the perception of risk as it relates to the magnitude of the associated loss (Burton, *et al.* 1983).

Yet these results have also shown there was no significant difference between insured and non-insured farmers with regard to the geographical distribution of farmed land. This is inconsistent with earlier studies by McCloskey (1976), Just and Calvin (1994), and Blank and McDonald (1996). These results have further shown that there was no difference between insured and non-insured farmers with regard to rotation. This has proved to be inconsistent with theories within the literature pertaining to moral hazard which suggest that farmers who purchase crop insurance would be less likely to practice other weather risk management strategies such as crop rotation (Quiggin 1994).

As alluded to in this section, there are a number of alternative weather risk management strategies which farmers may employ, either instead of, or in conjunction, with crop insurance. While some of the production based strategies have been discussed here, there also exist a number of financial and marketing strategies available to farmers to manage the risk associated with weather.

5.5.2 Financial and Market Attributes

Marketing management strategies may be distinguished from financial management strategies in that they are designed to alleviate the risk associated with market conditions. As discussed in chapter 2, this may be achieved through initiatives such as forward contracting and government price support schemes. Financial management strategies attempt to alleviate the risk associated with a loss of income due to any number of reasons. Examples of financial management strategies include off-farm employment, investments and crop insurance. This section aims to identify differences between insured and non-insured farmers with respect to the presence of alternate financial or marketing management strategies. This includes an examination of whether or not survey respondents derive added income from off-farm employment, or participate in GRIP and NISA.

i) Off-farm income

It is hypothesized that farmers with greater off-farm incomes will be less likely to purchase crop insurance to manage weather-related risks as the added income would provide an improved sense of security. This relationship is consistent with a study by Blank and McDonald (1996) which concluded that farmers in California with relatively low off-farm income levels tend to purchase crop insurance more frequently. In order to test this hypothesis, farmers were asked to approximate the percentage of the farm household's total net income which is derived from off-farm employment. For this analysis, off-farm income is broken down into three groups as percentages of total net income: no significant off-farm income, less than 50% of net income, and greater than 50% of net farm income.

An examination of the results reveals that while a greater proportion of the uninsured farmers reported no off farm income at all, a greater proportion of insured farmers reported

Table 5.10
Off-farm Income and Crop Insurance Use

Off-farm Income (OFI)	*none*	*OFI <50%*	*OFI >50%*	*total:*
# of insured farmers	27 (55%)	15 (31%)	7 (14%)	49 (100%)
# of not insured farmers	17 (61%)	5 (18%)	6 (21%)	28 (100%)

chi square = 7.56
critical value at .05 significance level = 5.99 *critical value at .1 significance level = 4.6*

less than 50% of their net income to be derived employment off the farm (Table 5.10). It is speculated that the comparatively higher proportion of uninsured farmers reporting off-farm incomes which account for greater than 50% of their total net income may be substituting the financial security of this added income for crop insurance use. This is consistent with earlier studies of the relationship between the financial attributes of the farm and crop insurance, where farmers with less financial security tend to purchase crop insurance more frequently (Leathers 1994; Blank and McDonald 1996).

ii) Participation in other policy initiatives: Market Revenue and NISA

As discussed in chapter 4, there are currently three policy initiatives within Ontario to reduce the risk associated with the production, financial and marketing aspects of agriculture. Crop insurance compensates for production losses related to weather, market revenue stabilizes the risk associated with fluctuating markets, and NISA provides income protection by establishing a minimum threshold annual income regardless of the source of income fluctuations. As the Market Revenue program does not directly alleviate the risk associated with weather, it is hypothesized that many of the farmers who purchase crop insurance also purchase Market Revenue as a complementary risk management strategy. On the other hand, it is hypothesized that the NISA program will tend to be employed as a substitute for crop insurance.

In order to test this hypothesis, farmers were asked what programs they currently participate in. For this analysis, insured and non-insured farmers were categorized into 4 groups: those who participated in NISA only, those who participated in Market Revenue only, those who participated in both NISA and Market Revenue, and those who participated in neither program.

Table 5.11
Participation in Financial and Marketing Policy Initiatives and Crop Insurance Use

Other Policy Initiatives	*Market Revenue only*	*NISA only*	*both programs*	*neither program*	*total:*
# of insured farmers	7 (14%)	0 (0%)	42 (86%)	0 (0%)	49 (100%)
# of not insured farmers	0 (0%)	4 (14%)	23 (82%)	1 (4%)	28 (100%)

chi square test not applicable

A majority of the farmers in the study group participated in both Market Revenue and NISA regardless of crop insurance use (Table 5.11). Yet the number of farmers participating in NISA (whether alone or along with Market Revenue) is higher among the non-insured farmers. In fact 96% of the non-insured farmers participated in NISA as opposed to 86% of the insured farmers. These results are consistent with an earlier study by Leathers (1994) which concluded that farmers substitute income protection strategies for crop insurance to manage the risk associated with weather.

This section has examined the relationship between crop insurance use, off-farm employment and participation in NISA and Market Revenue. Consistent with earlier studies by Leathers (1994) and Blank and McDonald (1996), a significant relationship was observed between off-farm employment and crop insurance use. This suggests that farmers in this study may consider income derived off-farm to provide adequate security against loss due to weather-related risks. While a chi square test for significance could not be applied to the data on participation in other policy initiatives, some interesting relationships can still be observed. The results suggest that those farmers who did not purchase crop insurance may be substituting income protection in the form of the NISA program to manage the risk associated with weather. This type of relationship is consistent with an earlier study of crop insurance use as it related to other income protection strategies (Leathers 1994).

5.6 Summary of Results

The objective of this chapter was to identify the role of crop insurance in the farm level management of weather- related risks. This was achieved primarily through the documentation of information provided by the study group relating to soybean production, weather related risks, response to these risks, and crop insurance participation and claims. The documentation of available information at the county level was also included to provide an improved understanding of the representativeness of the study group. This section will discuss the results of the survey used to identify the role of crop insurance in the farm level management of weather-related risks.

While this chapter has shown that soybean production within both Middlesex County and the study group has experienced considerable increase since 1992, there are undoubtedly a number of market and weather-related risks inherent to soybean production. The greatest weather-related risks to soybean production identified by the study group were cold and wet conditions during planting and white mold, with a majority of the identified risks occurring in recent years. A comparison of the weather risks reported by the study group to weather data obtained from Environment Canada and the Annual Crop Insurance Report suggests that farmers may possess poor recollection. While the recollection of farmers in the study group does reflect the nature of weather risks over time, it does not appear to adequately reflect the magnitude of the risks and their consequences in terms of crop insurance claims.

The nature of the weather risks that were identified by the study group were mirrored by the weather risks associated with crop insurance claims reported by the study group. Here, the claims associated with weather conditions during planting and reseeding together outnumbered all others. Even though a majority of the claims were attributed to adverse conditions related to planting, some farmers in the study group did file claims for loss due to other weather-related risks including late or no germination, late or no maturity, late or no harvest, and white mold. Similar to the identification of weather risks, the greatest number of claims were reported in recent years. Once again, a comparison with the crop insurance claims data at a county level suggests that some of the farmers in the study group may not possess adequate recall of crop insurance claims that may have occurred earlier in the study period (specifically 1992).

While the rate of participation in crop insurance did not vary greatly in the study group between 1992 and 1997, the total acreage insured appears to be decreasing. Yet soybean production in Middlesex County continues to rise. As variability in weather continues to exist, it would suggest that participation in crop insurance in terms of either the number of producers or acres insured would reflect the increase in soybean production. However this is not the case. This relationship may be a result of dissatisfaction with the current crop insurance program. This observation is re-enforced by the fact that when uninsured farmers were asked if they would consider purchasing crop insurance if the premium were lowered by 50%, only 18% said yes. This implies that the affordability of premiums may not always be a deciding factor in whether or not to purchase crop insurance.

In order to address the question of why some farmers purchased insurance and others did not, the production attributes of the participant's farm operations were examined (Table 5.12). With regard to production attributes of the farm, statistical analysis revealed that farmers were more likely to insure if they possessed a relatively smaller soybean acreage. It is speculated that small farm operators would lack the diversification and capital that might be present in larger farm operations, which in turn might help to absorb some of the risk associated with weather. Statistical analysis also revealed that farmers who grew a greater proportion of soybeans also tend to purchase crop insurance. If soybeans are the main crop grown, they may account for a major source of income. Finally, farmers who grew specialty beans with a higher market value also tended to insure more. In all three cases the relationship between the perceived loss associated with a risk and the impetus for response is consistent with other studies of crop insurance use (Gardner, *et al.* 1994; Just and Calvin 1994; Blank and McDonald 1996) and theories embedded in the natural hazards research (Burton, *et al.* 1983; Palm 1990).

Table 5.12
Explanations for Crop Insurance Use
(shading denotes statistical significance)

Soybean Acreage *	*>than average (331.78)*	*<than average (331.78)*
# of insured farmers	14 (29%)	35 (71%)
# of not insured farmers	20 (71%)	8 (29%)

Land Distribution	*farmed land >10km*	*farmed land <10km*
# of insured farmers	13 (27%)	36 (73%)
# of not insured farmers	9 (32%)	19 (68%)

Percentage of Soybeans **	*>50%*	*<50%*
# of insured farmers	24 (49%)	25 (51%)
# of not insured farmers	7 (25%)	21 (75%)

Soybean Market **	*no specialty beans*	*specialty beans*
# of insured farmers	39 (80%)	10 (20%)
# of not insured farmers	26 (93%)	2 (7%)

Rotation ***	*no rotation*	*2 year rotation*	*3 or >3 year rotation*
# of insured farmers	5 (10%)	13 (27%)	31 (63%)
# of not insured farmers	3 (11%)	3 (11%)	22 (78%)

Off-farm Income (OFI) *	*none*	*OFI <50%*	*OFI >50%*
# of insured farmers	27 (55%)	15 (31%)	7 (14%)
# of not insured farmers	17 (61%)	5 (18%)	6 (21%)

Other Policy Initiatives ***	*Market Revenue only*	*NISA only*	*both programs*	*neither program*
# of insured farmers	7 (14%)	0 (0%)	42 (86%)	0 (0%)
# of not insured farmers	0 (0%)	4 (14%)	23 (82%)	1 (4%)

**** .05 significance level   ** .1 significance level   *** chi square test not applicable***

With regard to the financial attributes of the farm operation, statistical analysis revealed that farmers with a comparatively higher off-farm incomes which account for greater than 50% of their total net income may be substituting the financial security for crop insurance use. This is consistent with earlier studies of the relationship between the financial attributes of the farm and crop insurance (Leathers 1994; Blank and McDonald 1996).

Yet another explanation for crop insurance use within the literature pertains to the theory of moral hazard (Schmitz, *et al.* 1994; Quiggin 1994). As discussed in chapter 2, moral hazard is defined as the change which results in an insured person's optimal decision as a result of purchasing crop insurance. In this sense, an insured farmer would be less likely to implement other weather risk management strategies knowing that crop insurance will ultimately compensate for any loss. An examination of farm level response to weather risks by the study group concludes that this is not true. In fact, insured farmers tended to implement other production related risk management strategies (ie. changes in variety rotation and planting schedule) with more frequency than uninsured farmers.

Responses to weather risks by the study group were generally production oriented strategies, such as changes in variety and rotation in subsequent planting seasons. Although none of the farmers surveyed identified the use of either crop insurance or any other financial strategies to alleviate the risk associated with weather, an examination of the financial and marketing attributes of the farm operations in the survey group suggests otherwise.

The fact that more than half of the study group participated in crop insurance shows that it is indeed being employed as a weather risk management strategy. Among those farmers who do not insure, the comparatively higher participation in NISA suggests that these farmers may be substituting income protection to alleviate the risk associated with weather. The fact that a majority of the study group participated in all three programs simultaneously suggests that many farmers are employing a suite of strategies to manage agricultural risk (including weather-related risks).

However none of the farmers surveyed directly identified crop insurance as a response to weather-related risks. As a result, this researcher speculates that crop insurance is purchased by many farmers as a means to compensate for the loss which results when all other management strategies fail. In this sense, crop insurance may be viewed by farmers as a means of compensation, rather than a management strategy.

6.0 CONCLUSIONS

This thesis examined the role of crop insurance in the farm management of weather-related risks. The aggregate analysis provided an improved understanding of increases in soybean production, variation in weather, and patterns of crop insurance use in Ontario. The survey analysis provided an opportunity to examine patterns of crop insurance use at the farm level without making bold assumptions about decision making. The combination of the two methodologies aided in the identification of some substantive findings relating to soybean production, weather, and crop insurance.

Before discussing the major findings of this thesis, the limitations and contributions of this research must be addressed. One limitation of this research may be understood in terms of the timing of interviews. As farmers were interviewed over a two month period, the perception of specific weather risks may have changed. Depending upon the prevailing weather conditions, each farmer's perception may have been subject to bias. Another limitation of this research is the lack of accurate recall which was demonstrated in chapter 5. As the recall of the study group appears to have decreased over time, it is impossible to say how accurate some of the information in this thesis may be.

Regardless of these limitations, this thesis provides an improved understanding of the weather-related risks to soybean production and crop insurance. By identifying the attributes of the farmers who purchase crop insurance, this thesis may aid policy makers and planners with the modification of the existing program or formulation of future policies.

The weather-related risks to soybean production identified in this research are predominantly those which interfere with the planting schedule and those that discourage germination. Among the survey respondents, the associated weather conditions were generally identified as cold and wet. Survey respondents also identified with some frequency risks to the maturity of the soybean plant as a result of dry conditions, disease risks of white mold and Phytophthora root rot (generally associated with wet conditions), and risks to harvest as a result of cold and wet conditions. However a comparison of the weather risks and crop insurance claims identified by the study group to Environment Canada and Annual Crop Insurance Report data suggests that recall among the survey respondents is not entirely accurate in terms of the magnitude of weather risks and associated claims (specifically for 1992).

Although the response strategies available to farmers to manage these risks may be characterized as production, financial, and market oriented: the farmers surveyed identified only production related responses, which generally involved changes in subsequent growing seasons. As the greatest weather risks identified by the survey group involved cool and wet conditions, it is speculated that there may be few management options available to farmers to reduce the associated risk during the affected growing season. In this sense, long term management strategies may be the only viable choice. Even so, none of the farmers surveyed identified using crop insurance as a long term management strategy despite the fact that more than half of the study group purchased insurance for their soybeans. This may be a result of farmers using crop insurance to compensate for loss should all other strategies fail. In this sense crop insurance exists as something farmers hope they will never have to use.

Participation in crop insurance has been variable in the past, exhibiting a recent tapering off in participation and decline in acres insured. However crop insurance claims do not reflect this decline and have remained highly variable. This relationship suggests that the recent decline in levels of participation is not a result of fewer claims. Perhaps farmers are employing alternate strategies to manage the risk associated with weather.

One possibility is that farmers are substituting income protection in the form of NISA for crop insurance. This is quite possible as NISA provides farmers with more control over their investment than the crop insurance program. For example, if a farmer never has a crop insurance claim he will never receive a return on his premiums. The NISA allows farmers to control the amount of money they put into the program knowing that they are guaranteed a return.

While the NISA program appears to be a more flexible alternative to crop insurance, the nature of the program is such that it takes time to build up an account. As a result, new farmers with less capital may not receive the same security from the program as a farmer who has greater capital and a longer history in the program. For this reason, many farmers may continue to purchase crop insurance.

One reason why some farmers in the study group purchase crop insurance may be related to the size of their soybean operations. A comparison of insured and non-insured farmers revealed that insured farmers tend to operate smaller farm operations in terms of soybean acreage. This may result from the fact that smaller farm operators may not have the available capital to survive the loss due to severe weather risks. Another reason for crop insurance use among the survey respondents appears to be the relative proportion of soybeans grown. Farmers who reported that soybeans accounted for more than 50% of their total crop land tended to purchase crop insurance. This may be a result of the fact that soybeans exist as a prime source of income. Similarly, there appears to be a relationship between farmers who grow specialty beans and crop insurance use. The higher market value associated with specialty beans may increase the perception of weather-risk as a result of the potential loss. In all of these situations, crop insurance may therefore exist as a necessity rather than an alternative.

This type of behaviour is consistent with theories embedded in the natural hazards research which recognize that risk response is related to the magnitude of the risk itself. Smaller farmers with little capital and more to lose may be more willing to pay a higher price (*or purchase crop insurance*) to avoid the associated loss. It may be that the crop insurance program survives on the premiums paid by farmers who are in situations where the potential loss associated with weather variability outweighs the risk of non-participation.

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Appendix 1

Crop Insurance, Weather-Related Risks and Soybean Production in Middlesex County: The Experience of Farmers

Name: ____________________
Address: ____________________
Date: ____________________
Administered by: ____________________

1. Attributes of Farm

a) Size of your operation

Area Farmed: *owned:* ______
rented: ______

Planted in Crops(total): ______
soybeans(acres): ______ *type/purpose/market:* ______________
corn(acres): ______
winter wheat(acres): ______
other: ______

Livestock (main type and numbers)
beef cattle: ______
dairy cattle: ______
sows: ______
weaners: ______
chickens: ______
other(specify): ______

b) What main rotation of crops do you generally follow?______________________________

c) Is your farmed land in one block or is it a number of blocks spread out over a larger area? *(If spread out, how far apart?)*______________________________

d) Does off-farm employment contribute significantly to your farm household income? Y/N
*if yes, approximately what percent?*______________

e) Has your farm operation changed significantly over the past 5 years? Y/N

*if yes, how?*____

2. Weather -Related Risks

a) How sensitive are soybeans to climate and weather-related risks compared to other field crops in your actual experience?*(specify other crops in comparison)*

More Sensitive than:

Same as:

Less Sensitive than:

b) What are the main weather-related risks you have experienced in soybean production since 1990?

c) When did you experience these risks (since 1990), why did they occur, how did you deal with them and how did they effect your farm operation?

i) Examples to prompt response if necessary:

Weather related risk and when	Why it occurred	What was done about it that season	Consequences of short term response	What was done in subsequent years
what is the specific weather risk: *-diseases* *-pests* *-delayed planting or harvesting*	*what weather conditions caused this risk* *-are there other associated problems*	*-inputs* *-change in production strategy* *-replant*	*impact on:* *-time* *-income* *-yield* *-quality* *-other aspects of farm operation* *-quality of life*	*-how did it effect your farm operation in following years in terms of:* *-type of crop* *-diversification* *-type of inputs* *financial and market planning*

ii) Actual Response

Weather related risk and when	Why it occurred	What was done about it that season	Consequences of short term response	What was done in subsequent years

4. Crop insurance: Actual Experience over last 6 years

Growing Season	Area of Soybeans (ACRES)	Bin Run or Certified Seed	Crop Insurance	Level of Coverage and Why	Growing Season Conditions	Claim	Reason	Claim Granted	Effect on Subsequent Management Decisions	NISA	Market Revenue or GRIP
1997			Y/N							Y/N	Y/N
1996			Y/N			Y/N		Y/N		Y/N	Y/N
1995			Y/N			Y/N		Y/N		Y/N	Y/N
1994			Y/N			Y/N		Y/N		Y/N	Y/N
1993			Y/N			Y/N		Y/N		Y/N	Y/N
1992			Y/N			Y/N		Y/N		Y/N	Y/N

5. Crop Insurance

a)What do you see as the strengths and weaknesses of the current crop insurance program?

*Strengths:*____

*Weaknesses:*____

b) Would you continue/begin to purchase crop insurance in the future if premiums were:

1) twice as much as they are presently? Y/N

*why/why not?*____

2) half as much as they are presently? Y/N

why/why not?____

c) Would you continue/begin to purchase crop insurance if it were administered by a private rather than government organization? Y/N

*why/why not?*____

d) any other comments/ideas:____

Appendix 2

June , 1997

Dear

I am a graduate student at the University of Guelph researching the role of crop insurance in the management of climate-related risks in soybean farming in southern Ontario.

While some of my research relies on published data, I wish to learn from the actual experiences of soybean farms in order to understand how crop insurance is used by farmers and what influences the decision to purchase crop insurance or not. I have been in contact with the Ontario Soybean Growers Marketing Board, who have expressed an interest in my results.

My study focuses specifically on Middlesex County, and depends on information supplied by farmers like yourself. I wish to identify the management strategies employed by farmers to deal with climate-related risks, and how and why crop insurance has been used. I am also interested in any changes you would like to see made to the current crop insurance program.

I will be contacting you by phone over the next few weeks to see if you would be willing to meet with me at a time of your convenience. I am aware that this is a busy time of year and would greatly appreciated your help. It is my hope that the results of the research, which will be reported through the Ontario Ministry of Agriculture, Food and Rural Affairs program at Guelph, will prove beneficial by documenting the strengths and weaknesses of the current crop insurance program as it applies to soybean producers.

Sincerely,

Cindy Smithers

local address: Cindy Smithers
320 Wharncliffe Rd. North
London, Ontario
N6G 1E3
(519) 672-6371

University of Guelph contact: Dr. Barry Smit
(519) 824-4120 ext. 3279

IMAGE EVALUATION TEST TARGET (QA-3)

150mm

6"

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