FACTORS AFFECTING THE USE OF FORAGE INSURANCE

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A Thesis submitted to the Faculty of Graduate Studies of

The University of Manitoba

in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Department of Agribusiness and Agriculture Economics

University of Manitoba

Winnipeg, Manitoba

January 2018

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ABSTRACT

The objective of this study is to examine factors affecting the use of three government administered risk management programs: forage index insurance, crop insurance, and AgriStability. Survey data is from 87 beef and forage producers in Saskatchewan and Alberta, and probit regression models are used for the analysis. Results indicate that producers' who use more forage index insurance are younger, maintain less forage inventory, have greater perceived weather risk, and have higher levels of insurance knowledge. Results suggest that producers who use more crop insurance have a higher proportion of rented farmland, a smaller share of off-farm household income, and higher levels of insurance knowledge. Lastly, producers that use the AgriStability program more have larger farms, smaller households, have experienced a large previous farm loss, and have purchased forage insurance regularly in the past. This analysis should provide policy makers with useful information regarding forage producers' risk management decisions.

Keywords: Forage Insurance, Index Insurance, Crop Insurance, AgriStability, Willingness to Pay, Probit Model, Survey

ACKNOWLEDGEMENTS

I would like to thank my co-advisors Professor Milton Boyd and Professor Lysa Porth for their valuable advice, and support. Additionally, I would like to thank my committee members, Professors Barry Coyle and Brock Porth, for their useful insights throughout the thesis process. I would also like to acknowledge the Kraft Fellowship for generous support throughout my M.Sc. studies. Lastly, I would like to thank my wife Katerina, as well as my family for their encouragement.

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CHAPTER 1

INTRODUCTION AND FORAGE BACKGROUND

Introduction

Forage production is very important in the beef and dairy industry, and forage makes up the largest proportion of farm and ranchland in Canada (McCartney, 2011). The largest concentration of beef and forage producers in Canada are in the provinces of Alberta and Saskatchewan. Agricultural producers face significant risk and therefore must make important risk management decisions regarding avoiding, reducing, retaining, or transferring risks (Hoag, 2009). Producers face two main types of risk, production risk and price risk.

Production risk in Alberta and Saskatchewan is often due to droughts that are prevalent in both provinces. Extended droughts can decimate crops and are not uncommon (Maybank et al., 1995). In addition to production risk, producers face considerable price risk. Also, the Canadian domestic market for beef is too small to absorb Canadian production, and therefore the beef industry is heavily dependent on exports (Kimura, Antón, & Martini, 2011). A catastrophic event such as a prolonged drought or a trade export ban can cause large farm losses. Canadian farmers experienced a decade-long drought in the 1930's and more recently a beef trade export ban in response to disease concerns.

In the past, large losses have been covered by ad hoc disaster payments. In 2002, after a severe drought limited feed availability for beef and dairy producers in Alberta and Saskatchewan, the Canadian government paid $355 million in disaster payments. Soon after that, a price shock occurred in the market when a case of BSE was discovered in 2003, causing a ban for typical beef exports until late 2006. Disaster payments of approximately $2.2 billion were made to cattle producers (Klein & Le Roy, 2010). A more efficient and cost-effective way of handling these calamities may be through risk management and a well-functioning insurance program. In general, participation rates for grains and oilseed producers are relatively high, around 70-80%. However, agriculture insurance participation among forage producers is much more limited. Because of this, forage producers may not be as well prepared as other producers to endure a catastrophic event or large losses.

Therefore, this research seeks to provide policy makers with information regarding the factors that affect the use of three risk management programs: forage index insurance, crop insurance, and AgriStability. This information may help policy makers increase participation in agriculture insurance programs and reduce reliance on ad hoc disaster payments. The primary focus of this research is to examine the factors that affect forage producers' risk management decisions, including socio-demographics and many other factors. Producers in Canada have a variety of government programs to manage risk. Producers have forage index insurance to manage feed production risk, crop insurance to manage production risk for other crops, and AgriStability to manage profit margins. To understand the factors that affect the three risk management programs, this research is segmented into two parts including "Forage Index Insurance," and "Other Risk Management Programs." The objectives in each of these two parts are outlined in more detail below.

Objectives, Data, and Methodology

In the first part of this study, "Forage Insurance," the objective is to examine the factors affecting the use of forage index insurance and examine the factors related to the willingness to pay for forage insurance. A survey of forage producers in Alberta and Saskatchewan is conducted. A binomial probit model is used to examine the factors affecting the use of forage index insurance, and an ordered probit model is used to examine the factors related to willingness to pay for forage insurance.

In the second part of this study, "Other Risk Management Programs," the objective is to examine factors affecting the use of two other risk management programs available to forage producers in Canada, crop insurance and AgriStability. Crop insurance is a production insurance program available for most crops, while AgriStability is a margin insurance program. Based on the same survey data as in the first part, an ordered probit model is used to examine factors affecting crop insurance and AgriStability use among forage producers.

Background and Contribution

Forage production covers 44% of Canada's farmland and ranchland with the majority of this production situated in Western Canada. Alberta and Saskatchewan account for 29% and 24% of Canada's forage production, respectively. Approximately 76% of Canada's forage land is dedicated to native and improved pasture for grazing (McCartney, 2011). Forage index insurance is available to provide forage producers risk management. However, use of this index insurance is relatively low. This study is believed to be one of the first risk management studies regarding the use of forage index insurance among forage producers in Alberta and

Saskatchewan. Also, this study may provide valuable insights on how forage producers manage risk and use risk management programs. These insights may be valuable to policy makers who are interested in increasing program participation rates among forage producers. Producers in Alberta and Saskatchewan can be exposed to catastrophic risks such as prolonged drought, and risk management may be an effective means to cover these risks.

Structure of the Study

The remainder of this thesis is organized as follows. Chapter one provides a background on forage production and a brief overview of how forage producers manage risk, through risk reduction and insurance. Some of the challenges associated with forage insurance and the currently available forage insurance programs for Alberta and Saskatchewan are also discussed. Chapter two covers analysis of forage insurance, and Chapter three covers analysis of crop insurance and AgriStability. Lastly, Chapter four provides a summary of the thesis, including a brief overview of results.

Forage Background

Alberta and Saskatchewan Forage Sector

World demand for beef and dairy products has been rising steadily over the past few decades, and as global incomes rise, beef demand will likely increase (Bruinsma & FAO, 2003). The beef sector in both Alberta and Saskatchewan represents a large portion of Canada's beef cattle and livestock production. These two provinces represent approximately 80% of Canada's beef producers. One of the main reasons for this concentration of Canada's beef production is the availability of land for forage production. Forage production is a primary concern for Alberta and Saskatchewan beef producers. According to the 2016 Canadian census, approximately two thirds of Canada's 9 million forage hay acres are in Alberta and Saskatchewan (Statistics Canada, 2017). For beef and dairy producers in Canada, approximately 90% of forage is produced for on-farm use (McCartney, 2011).

Forage Types

Forage in Canada can be divided into two plant types: annual plants and perennial plants. Some popular annual plants used for feed are fodder corn, rye, and oats. The most common perennial plant, alfalfa, is used for hay and grasslands. Other perennial plants used for forage production include ryegrass, alfalfa seed mixtures, and trefoil (AFSC, 2017c; McCartney, 2011).

Forage Management Styles

Different management types such as green feed, hay, native pasture, and improved pasture can further segment forage production. Green feed or silage is produced from annual plants such as fodder corn harvested for feed. Hay is produced from perennial plants or perennial plant mixtures, and it is harvested for multiple cuts each year and overwintered. Native pasture and improved pasture are grassland types, which are used for grazing. Improved pastures are planted with alfalfa or other perennial plants, and native pastures are merely wild grassland.

On-Farm Risk Reduction

Forage production can be risky as producers manage pasture health in adverse weather conditions to preserve adequate feed stores for their cattle herds. There are many risk reducing activities producers can use including crop diversification, savings, feed storage, price risk management, off-farm income, and various other mechanisms. These management methods may not be enough to limit agriculture production risk, due to the relatively high weather risk faced by producers. However, some weather risks such as drought may be reduced by investment in risk reduction systems, though, the cost may be high (Harwood, Heifner, Coble, Perry, & Somwaru, 1999).

Agriculture Insurance

Crop insurance is used by producers to significantly reduce the risk of farm loss, due to adverse weather conditions. In the 2016 crop year, the Alberta crop insurance program insured approximately 77% of eligible acres. Despite the high participation rates of agriculture insurance for Canadian producers overall, forage insurance continues to have low participation rates relative to the overall crop insurance program. Alberta perennial forage insurance had a 29% participation rate for the 2016 crop year (AFSC, 2017b).

Forage Insurance Challenges

Forage may be a particularly difficult crop to insure for five main reasons. First, cattle are continuously grazing on native and improved pastures. Continuous grazing makes the measurement of loss difficult. Likewise, hay production involves multiple cuts, which complicates loss measurement. Second, low feed quality can be of concern, in addition to low yield quantity (yield loss). Low-quality feed must be mixed with grains or high-quality feed to meet livestock needs. Third, most forage is grown for on-farm use, which means there are few or no records of yield or price. Fourth, insurance can cause adverse effects such as moral hazard and adverse selection. Moral hazard in the case of forage production may present itself by altered management practices that increase the likelihood of a claim. An example of a moral hazard practice among forage producers could be to keep cattle grazing late in the season to lower feed costs, while causing more winterkill. Adverse selection occurs when the producer has more information about their own risk than does the insurance provider. This information asymmetry can lead to a mispricing of premiums, in which the lowest risk producers subsidize the highest risk producers. Fifth, administering forage insurance could be very costly, namely because of the previous reasons outlined (Dismukes, Zepp, & Smith, 1995).

Types of Forage Insurance

Forage Insurance for Hay and Green Feed

Forage insurance for hay in Alberta is available in two types, 1) Hay Insurance and 2) Export Timothy Hay Insurance. Hay Insurance starts as an area yield program and progresses to an individual yield based program once enough historical yields can replace the use of the area index. Export Timothy Hay Insurance provides coverage in the same way as Hay Insurance (AFSC, 2017c). For green-feed crops Alberta offers two insurance types, 1) Barley Proxy Coverage, and 2) Lack of Moisture Coverage. Barley Proxy Coverage insures green-feed silage at 80% of the coverage level of barley crops covered under the crop insurance program. Barley crops grown in the immediate area are used to proxy the insurance coverage. Lack of Moisture Coverage Insurance compensates producers when precipitation is below 80% of the historical average. The insurance is index-based and producers choose weather stations that they believe are most similar to their on-farm precipitation (AFSC, 2017d). In Saskatchewan, individual yield loss forage insurance is available for hay and green feed (SCIC, 2018).

Forage Index-Based Insurance for Native Pasture and Improved Pasture

Forage index-based insurance is available in both provinces for the two grassland forage types: native pasture, and improved pasture. Alberta offers two variations of forage index insurance, 1) weather index insurance called Moisture Deficiency Insurance, and 2) satellite index insurance called Satellite Yield Insurance. Saskatchewan offers a weather index insurance called Forage Rainfall Insurance. The benefit of these programs is they seek to overcome some of the challenges previously outlined with forage insurance. First, forage index insurance overcomes some of the challenges associated with the measurement of forage yield loss. It overcomes some of these challenges because indemnities are index-based and do not require loss measurement. Also, index insurance is believed to have less adverse selection problems and be less subject to moral hazard than traditional insurance. Additionally, index insurance is relatively inexpensive to administer, as yield loss measurement is not required (Hazell & Hess, 2010). However, the major drawback of index-based insurance is basis risk (Clarke, Mahul, Rao, & Verma, 2012; Elabed, Bellemare, Carter, & Guirkinger, 2013; Woodard & Garcia, 2008). Basis risk is the risk that the index differs from on-farm yield. Basis risk in the worst scenario for a producer could result in a large on-farm loss that is not observed by the index.

AgriStability and AgriInvest

Margin insurance such as AgriStability can help protect producers from production risk, and also output/input price risk. AgriStability seeks to protect producers from large margin decreases. The beef industry, for example, may be vulnerable to risks such as disease outbreaks that could cause export bans or severe droughts that could limit feed availability. The AgriStability program attempts to protect producers from larger margin declines and directs government assistance to farms that experience margin declines greater than 30% of producer net revenue (AFSC, 2017a). Another program, AgriInvest is a self-managed producer-government savings account that matches producers' contributions. The intended objective of the program is to provide producers with savings to deal with income declines. The respective provincial and federal government provide the matching savings account contribution (Agriculture and Agri-Food Canada, 2011).

CHAPTER 2

FORAGE INSURANCE

Forage Insurance Literature

Index Insurance for Forage

Index insurance was first proposed for North American use in 1949 and was seen as a viable way to combat adverse selection (Halcrow, 1949). The proposed insurance was yield based and yield measurement was based on an area yield instead of on an individual farm yield. Weather index insurance uses an underlying index based on weather conditions rather than yield. Index insurance reduces measurement costs and allows the insurance of crops in situations where yield based crop insurance is not feasible, such as forage grasslands. The problem with index-based insurance is that it has basis risk. Basis risk is the risk that the index does not precisely match the on-farm yield.

Several developments have made index-based insurance more viable and useful for producers. The main priority for increasing index-based insurance effectiveness is the reduction of basis risk (Carter, de Janvry, Sadoulet, & Sarris, 2014). Developing improved indices is central to minimizing basis risk. The information used to construct the index should fulfill four criteria. First, the information used to compose the index must be verifiable and trustworthy. Second, the information must highly correlate with what it intends to insure. Third, the information must be reliable, meaning the stream of information cannot stop at any time during the insurance contract. Last, historical information must be available to underwrite the risk and price the premiums (Vrieling et al., 2014).

Recent developments in index information have used remote sensing technologies to attempt to fulfill the criteria above. The normalized difference vegetation index (NDVI) attempts to measure forage growth (yield) (Goward, Tucker, & Dye, 1985), and is used for Alberta's satellite forage insurance. More recently, a forage production index has been developed using the fraction of green vegetation cover, and this remote sensing technology also attempts to measure forage yield (Roumiguie et al., 2015). Improvements in remote sensing technologies may decrease basis risk and make forage index insurance more attractive to agriculture producers.

Eliciting Insurance Program Use and Willingness to Pay for Forage Insurance

In an attempt to examine which factors affect insurance and stabilization program participation, it is useful to adopt two model frameworks. First, a framework can be developed in which producers' state that they either enroll or do not enroll in an insurance program. This is a common method in many econometric studies using farm-level data for determining the use of crop insurance (Coble, 1996; Smith & Baquet, 1996). Second, in markets where information is incomplete, it is often useful to adopt a willingness to pay framework. Forage insurance exists in an incomplete market where a payout can occur in multiple states. Willingness to pay can be accepted as a test of whether producers will purchase insurance, and how much they are willing to pay (Shaik, Coble, Hudson, et al., 2008). There are different methods to elicit use of agriculture insurance. Two common research methodologies are often adopted. The first method examines observed crop insurance purchases, while the second method analyzes producer survey responses (Knight & Coble, 1997; Shaik, Coble, Knight, Baquet, & Patrick, 2008; Smith & Goodwin, 1996). This study analyzes survey responses to elicit the use of risk management programs and the willingness to pay for forage insurance.

Factors Affecting Use of Index Insurance

The decision to purchase index insurance often begins with the self-assessment of risk and self-determination of the probability of loss. When purchasing weather index insurance, weather risk assessment is important for the decision. Hill et al. (2011) found that farmers in Ethiopia had a greater willingness to purchase index-based insurance if they had a higher perceived chance of experiencing loss. Basis risk was also found to have a negative effect on producers' willingness to purchase index insurance. Additionally, producers who had higher education and wealth were more likely to purchase index insurance. Forage producers may use more forage index insurance if they have higher perceived weather risk. Index insurance use is normally thought of as negatively correlated with price, because if the price of the insurance falls or it is subsidized, more producers are likely to use the insurance. Cole et al. (2013) in an empirical study conducted in India confirmed that willingness to purchase index insurance is negatively affected by increasing prices. Producers' wealth position may also affect the use of index insurance. In Malawi, wealth position has been linked to increased desire to purchase index insurance (Giné & Yang, 2009). Additionally, high levels of insurance knowledge and more positive attitudes toward insurance are found to be very important factors affecting the use of index insurance (Cole et al., 2013; Lin et al., 2015). In the case of forage production in France, producers with larger feed storage capacity and low average stocking rates were found to have less incentive to purchase forage index insurance (Mosnier, 2015).

Factors Affecting Willingness to Pay for Agriculture Insurance

Higher insurance knowledge levels are found to affect willingness to pay for index insurance, and higher trust in the insurance is found to also be an important factor (Cole et al., 2013). Kong et al. (2011) Observed that index insurance use was negatively related to insurance price. In addition to the impact of price, they found that crop producers had a higher willingness to pay than livestock producers. Another interesting result was that increases in both yield risk and price risk increased willingness to pay for weather index insurance. Shaik et al. (2008) conducted a willingness to pay analysis on index-based insurance for commercial trout producers, and found that wealth and farm size increased the willingness to pay for index insurance.

Data and Methodology

Data

Risk Management and Insurance Survey for Forage Producers

A questionnaire was administered in conjunction with the Alberta Beef Producers and the Saskatchewan Cattleman Association, and 47 responses were collected from Saskatchewan, and 40 responses were collected from Alberta. Survey respondents were forage and livestock producers and almost exclusively raised beef cattle. The questionnaire was designed to collect primary data to aid in developing and improving risk management tools for forage producers. The survey questions were broken into four sections: 1) risk management and insurance, 2) general farm practices and specific farm operations, 3) demographic characteristics, and 4) forage insurance. The first section risk management and insurance asked producers about their on-farm risk reduction, their knowledge and attitude towards agriculture insurance, their risk assessment, and their past weather disasters. Section two, general farm practices and specific farm operations, elicited information regarding producers' farm size and risk level, management practices, crop and livestock mix, and government risk management program use. Section 3, demographics, asked questions about producer socio-demographics such as age, gender, province, household size, and income, etc. The final section, forage insurance, was composed of questions relating to the use of forage index insurance, including the willingness to pay for forage insurance, basis risk concerns, index insurance policy preferences, and producer specific management questions. The questionnaire was conducted both online and in person. A total of 87 completed responses were compiled, and 30 of these responses were collected in person. The majority of questions were designed on a 1 to 5 Likert scale with a few exceptions. One question was on a 1 to 4 Likert scale, and some questions were binary (1,0).

Methodology

Binomial Probit Model

Given a binary dependent variable, it is useful to use a discrete choice model (Greene, 2010). In the most basic form, a linear probability model can be used to predict the probability of observing an outcome with a binomial choice, for instance, the use of crop insurance (Yes=1 and No=0). As seen in equation [1.1] a latent variable y* is an unobserved index variable representing the propensity for the event to occur. When this latent variable is greater than 0 an event y=1 is observed and if this latent variable is less than or equal to 0 then the event did not occur, and y=0 is observed. A latent regression determines this outcome. The outcome of the binary choice model is determined from the value of the unobserved latent variable and this is displayed in equation [1.2].

$$y^* = \gamma' x_i + \varepsilon_i, \qquad [1.1]$$

$$y = \begin{cases} 1 \text{ if } y^* > 0 \\ 0 \text{ otherwise} \end{cases} \qquad [1.2]$$

Error Term Probability Distribution

The model assigns a probability distribution specification to the error term. For the model to be theoretically correct, the probability must be constrained between 0 and 1.

$$\mathrm{Prob}(y_i = 1|x_i) = \mathrm{Prob}(y_i^* > 0|x_i) \qquad [1.3]$$

$$= \mathrm{Prob}(\gamma' x_i + \varepsilon_i > 0)$$

$$= \mathrm{Prob}(\varepsilon_i > -\gamma' x_i)$$

Linear Probability Model

It is common to assign the linear probability model as displayed in equation [1.4]. However, there are several flaws associated with linear probability models in this situation. First and most importantly, the probability is not required to be between 0 and 1. Second, the linear probability model can lead to heteroskedasticity issues. While the linear model is sometimes useful for preliminary results, there are superior link functions available, such as probit.

$$\mathrm{Prob}(y_i = 1|x_i) = \gamma' x_i \qquad [1.4]$$

Probit Model

The literature supports using a probit link function (Liao, 1994), and when a probit link is adopted, the model is referred to as a probit model. The probit link distribution is based on a cumulative normal distribution Φ and is displayed in equation [1.5]. To use the probit link function, $y_i|x_i$ is assumed to be a Bernoulli random variable as displayed in equation [1.6].

Where F in equation [1.6] denotes the cumulative distribution function for ε_i, which in the case of probit is replaced by the cumulative normal distribution Φ.

Probit Link

$$f(\varepsilon_i) = \frac{\exp\,(-\varepsilon_i^2/2)}{\sqrt{2\pi}} \qquad [1.5]$$

$$\begin{aligned} \mathrm{Prob}(y_i = 1|x_i) &= \mathrm{Prob}(y_i^* > 0|x_i) \qquad [1.6] \\ &= \mathrm{Prob}(\varepsilon_i > -\gamma' x_i) \\ &= \int_{-\gamma' x_i}^{\infty} f(\varepsilon_i)d\varepsilon_i \\ &= 1 - F(-\gamma' x_i) \end{aligned}$$

Probit Model Standard Notation

Following from equation [1.6] the probit link distribution has the special characteristic that $1 - F(-\gamma' x_i) = F(\gamma' x_i)$. From this characteristic, equation [1.7] can be outlined. Replacing F with the standard normal distribution the probit standard notation can be adopted in equation [1.8] and equation [1.9] The probability of the event occurring can be seen in equation [1.8] and the probability of the event not occurring is displayed in equation [1.9].

$$\mathrm{Prob}(y_i = 1|x_i) = 1 - F(-\gamma' x_i) = F(\gamma' x_i) \qquad [1.7]$$

$$\mathrm{Prob}(y_i = 1|x_i) = \Phi(\gamma' x_i) \qquad [1.8]$$

$$\mathrm{Prob}(y_i = 0|x_i) = 1 - \Phi(\gamma' x_i) \qquad [1.9]$$

Probit Model Advantages

The Probit model does not have the same weaknesses as the linear probability model. The most important differences are the probability distribution is constrained between 0 and 1, and probit also reduces heteroskedasticity.

Marginal Effects

Probit coefficients magnitudes are not commonly interpreted. Instead, marginal effects are interpreted. Marginal effects are more useful than the probit coefficients because similar model results can be directly compared. For instance, another common link function is the logit link. Using marginal effects, logit results and probit results can be directly compared. The marginal effects for continuous variables are computed holding all other independent variables constant at their means as shown in equation [1.10]. Marginal effects for binary variables are computed using a stepwise approach outlined in equation [1.11] where $\bar{x}_d$ represents the remaining independent variables held at their means.

Marginal Effects Continuous Variables

$$\frac{\partial \mathrm{Prob}(\mathrm{y}=1)}{\partial \mathrm{x_i}} = \Phi(\gamma' \mathrm{x_i})\gamma \qquad [1.10]$$

Marginal Effects Binary Variables

$$[\mathrm{Prob}(\mathrm{y_i}=1|\bar{\mathrm{x}}_\mathrm{d}, \mathrm{d_i}=1)] - [\mathrm{Prob}(\mathrm{y_i}=0|\bar{\mathrm{x}}_\mathrm{d}, \mathrm{d_i}=0)] \qquad [1.11]$$

Ordered Probit Model

An unobserved latent variable y^* is determined by a latent regression as seen in equation [1.12]. It is assumed that the error term ε_i follows a specific distribution with a mean of zero. A set number of outcomes such as 1 to 5 or 1 to 4 are observed. The unobserved latent variable is assigned to these categories based on estimated thresholds. The latent variable may not exactly correspond to any of the underlying categories, but because of the estimated thresholds, the respondent's unique y* is assigned to the closest available category (the first threshold is assumed to be 0). This process is outlined in equation [1.13].

$$y^* = \gamma' x_i + \varepsilon_i \qquad [1.12]$$

$$y = \begin{cases} 1 \text{ if } y^* \leq \mu_1 (= 0), \\ 2 \text{ if } \mu_1 < y^* \leq \mu_2, \\ 3 \text{ if } \mu_2 < y^* \leq \mu_3, \\ . \\ . \\ . \\ j \text{ if } \mu_{j-1} < y^*, \end{cases} \qquad [1.13]$$

$$0 < \mu_2 < \mu_3 < \cdots < \mu_{j-1}$$

Standard Notation

The standard notation for the ordered probit follows from the same process as the binomial probit model and is presented in equation [1.14] and the expanded form of the standard notation is in equation [1.15].

$$\text{Prob}(y = j) = \Phi(\mu_j - \gamma' x_i) - \Phi(\mu_{j-1} - \gamma' x_i) \qquad [1.14]$$

Or

$$\text{Prob}(y = 1) = \Phi(-\gamma' x_i), \qquad [1.15]$$

$$\text{Prob}(y = 2) = \Phi(\mu_2 - \gamma' x_i) - \Phi(-\gamma' x_i),$$

$$\text{Prob}(y = 3) = \Phi(\mu_3 - \gamma' x_i) - \Phi(\mu_2 - \gamma' x_i),$$

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$$\text{Prob}(y = J) = 1 - \Phi(\mu_{j-1} - \gamma' x_i)$$

Marginal Effects

The independent variables are computed at their means in equation [1.16] and in the case of binomial variables a step-wise procedure similar to the one outlined in equation [1.11] is applied.

Marginal Effects Continuous Variables

$$\frac{\partial \text{Prob}(y = j)}{\partial x_i} = [\Phi(\mu_{j-1} - \gamma' x_i) - \Phi(\mu_j - \gamma' x_i)]\gamma_i \qquad [1.16]$$

Forage Insurance Selected Results

Descriptive Results: Socio-Demographic Characteristics of Sample Respondents by Province

A descriptive analysis of survey respondents' socio-demographic characteristics may be useful for examining the socio-demographic profile of forage producers. A contingency table segmented by province and selected socio-demographic variables can be found in Table 2.1.

The most common response regarding farm size representing 29.89% of producers in the sample is 1001 to 2000 acres. There are large concentrations of producers with farms 1000 or less acres and producers greater than 5000 acres, representing 20.69% and 21.84% of the sample respectively. The majority of the sample is producers between the ages of 56 to 70 years. No respondents in the sample are age 25 or younger. This sample is relatively representative of the average farm operator age in these provinces, as according to the recent 2016 Canadian census of agriculture, the average farm operator is 55 years old in Alberta and Saskatchewan (Statistics Canada, 2016) and Canada has relatively few young farmers (Agriculture and Agri-Food Canada, 2014). The most common household size among Alberta and Saskatchewan producers is two, while the second most common household size is three to four people. These household size results closely correspond to the general population household size in both provinces (Statistics Canada, 2016). Farm operators in the survey are predominately male representing 87.36% of the sample. The median household income for forage producers in the sample is $95,000 to $124,000.

Contingency Table Results: Use of Forage Index Insurance and Selected Socio-Demographics

Additionally, it may be useful to examine how use of forage index insurance and willingness to pay for forage insurance relates to the socio-demographic characteristics of the sample. A contingency table with socio-demographic variables and the use of forage index insurance can be found in Table 2.2. Also, in Table 2.3 socio-demographics are compared with the willingness to pay for forage insurance.

Farm Size (Acres)

Larger farms seem to use forage index insurance slightly more often than smaller farms. Except for farms with 1000 or less acres of land, larger farms use forage insurance more often. For example, of the producers with a farm size of 2001 to 3000 acres, 35.71% of those use forage index insurance. While of the producers who have farms in the range 2001 to 3000 acres, 50% of those use forage index insurance.

Age (Years)

Younger producers use forage index insurance more often than older farmers. As observed in contingency Table 2.2, 41.18% of producers aged 26-40 and 45.16% of producers aged 41-55 use forage index insurance. This is compared to the category age 71 and older where 0% of respondents use forage index insurance.

Household Size

The majority of the sample has a household size of three to four people or smaller, these categories represent 83.91% of the sample. The contingency table results suggest that the households of five or more use forage index insurance less often than other household sizes.

Education Level

The effect of education is unclear in the sample. The most common education level among producers is some college. The second most common response was high school graduate. Comparing the two education levels regarding forage index insurance use, results show that use of forage index insurance is relatively equal among education levels at 28.64% for some college, and 27.27% for high school graduates. Producers with a bachelors' degree seem to use forage index insurance more often at 66.67% of the sample. Despite the spike in use for those with a bachelors' degree, producers with a postgraduate or professional degree have a lower use at 33.33%.

Gender

Males in the sample seem to be slightly more interested in purchasing forage index insurance than females. Of the male producers, 43.42% are interested in using forage index insurance, while for the female producers, only 9.09 percent use forage index insurance.

Part Time/ Full Time Employment

Producers who have full-time off-farm income are considered part-time producers, while producers who do not have full-time off-farm income are considered full-time producers. Full-time producers use forage index insurance more than part-time producers. As seen in Table 2.2, 44.44% of full-time producers use forage index insurance, while only 25% of part-time producers use forage index insurance.

Household Income

The effect of income on the use of forage index insurance remains unclear from the contingency table results. The two extreme Likert scale options "less than $50,000" and "$125,000 and above" yield similar results. About 50% of producers with an annual household income of "less than $50,000" use forage index insurance, and 45.24% of producers with an annual household income of "$125,000 and above" use forage index insurance.

Contingency Table Results: Willingness to Pay for Forage Insurance and Selected Socio-Demographics

Farm Size (Acres)

Willingness to pay for forage insurance when segmented by producers' farm size appears to show relatively constant usage rates among groups. Each farm size category has approximately 50% of producers willing to pay "<$5" per acre for forage insurance. However, producers with smaller farm size seem to be willing to pay more per acre relative to larger farmers.

Age (Years)

Examining Table 2.3, younger producers seem to have slightly less willingness to pay for forage insurance. However, the results remain unclear. Of the producers in the youngest observed group, 64.71% are willing to pay less than $5 per acre, and of the producers in the eldest group, 100% are willing to pay less than $5 per acre.

Household Size

The effect of household size on the willingness to pay for forage insurance is unclear from the contingency table results. Of the respondents with households of three to four people or smaller, approximately 50% of them have a willingness to pay of less than $5 per acre. The larger households have comparatively less willingness to pay. However, the number of respondents in these larger household groups is quite low.

Education Level

Education seems to have an impact on the extreme observations for willingness to pay for forage insurance. For instance, producers who are in the education category "Some high school," 100% have the lowest level of willingness to pay less than $5 per acre. While of the producers in the education category "Post-Graduate/Professional," only 33.33% of respondents are in the lowest category of willingness to pay. As for the majority of respondents that don't correspond to these extremity categories, willingness to pay is relatively equal.

Gender

Males seem to have a higher willingness to pay for forage insurance. However, the sample size of females is quite low. Only 48.68% of males selected the lowest willingness to pay, while 81.82% of females chose less than $5, the lowest category.

Part-Time/ Full-Time Employment

Producers who have full-time off-farm income are considered part-time, and producers who do not have full-time off-farm income is labeled full-time. As expected, and following from Table 2.3, part-time producers' willingness to pay for forage insurance is much lower than the willingness to pay among full-time forage producers. Among full-time producers, only 47.62% selected the lowest willingness to pay. Compared to the full-time producers', willingness to pay by part-time producers' is much lower, with 66.67% of part-time producers selecting the lowest willingness to pay.

Household Income

Results from contingency Table 2.3 regarding household incomes are unclear. Willingness to pay among producers in the lower categories and highest categories are similar, with approximately 50% of producers selecting the lowest tier of willingness to pay. In contrast, willingness to pay among producers in the middle tier with a household income of $75,000 to $94,000 sharply declines with 75% of these producers indicating the lowest possible selection of willingness to pay. Conversely, the group with the highest respective willingness to pay is producers with a household income of $95,000 to $124,999. Of these producers, only 33.33% of them selected the lowest tier of willingness to pay.

Forage Insurance Probit Model Regression Results

Binomial Probit Results: Use of Forage Index Insurance

Dependent Variable

Table 2.4 describes the variables used in the "Use of Forage Index Insurance" probit regression analysis. Additionally, the scale and mean of each variable are displayed. Survey results indicate that 39% of producers are willing to purchasing forage index insurance. Figure 2.1 displays the survey response frequency results for the binary dependent variable "Do you plan to purchase index insurance this year or in the future?"

Independent Variables and Binary Probit Model Goodness of Fit

The binary probit regression model, "Use of Forage Index Insurance" is estimated with a total of 11 independent variables categorized into five groups, and Table 2.5 displays the results. The five groups are producer attitudes and price importance, weather risk perceived by the producer, use of risk management programs, risk reduction, and socio-demographics. The model has a goodness of fit measure of 0.4493 for the McFadden R^2. Additionally, the percent predicted correct goodness of fit measurement is 81.61%. Of the 11 variables, 6 of 11 are significant at the 10% level or better. As indicated by the goodness of fit measures, the model has an acceptable fit. Additionally, marginal effects are shown in Table 2.6 for interpretation.

Producer Attitudes and Importance of Price

This group is composed of three independent variables: knowledge of forage insurance, attitude towards forage insurance, and forage insurance price importance by the producer (Table 2.5). Two of three variables are significant at the 5% significance level or better. Knowledge of forage insurance, as well as attitude towards forage insurance, are both positively related to the willingness to purchase forage index insurance. These results are shown in Table 2.5 as knowledge of forage insurance has a positive coefficient (0.511) significant at the 5% level, and attitude towards forage insurance has a positive sign (0.534) significant at the 1% level. These results are similar to findings in India by Clarke et al. (2013), as well as in China by Lin et al. (2015). The importance of price has a negative relationship with the use of forage index insurance as shown by the negative coefficient (-0.234). However, the importance of price was not found to be significant.

Weather Risk Perceived by Producer

Two independent variables are in this group, and both of these variables are found to be significant at the 1% level or better (Table 2.5). Producer perceived weather risk is found to positively impact the use of forage index insurance. Producers use more forage index insurance as their self-assessed weather risk increases. This relationship is shown by the positive coefficient (1.109) that is significant at the 1% level. Perceived importance of drought risk is also found to positively affect the use of forage index insurance. The coefficient (0.888) is positive and significant at the 1% level. These results are supported by other studies such as Hill et al. (2011) in which producers perceived likelihood of loss is found to positively affect the use of index insurance.

Use of Risk Management Programs

This group has two independent variables, and neither is found to be significant at the 10% level or better. Though neither variables are significant in impacting forage index insurance use, Agristability has a negative coefficient (-0.173) and AgriInvest has a positive coefficient (0.143).

Risk Reduction

The risk reduction category is composed of two independent variables, maintain inventory and off-farm income. The degree in which producers maintain inventory (-0.173) is found to be significant at the 10% level. Producers seem to use forage inventory reserves as a substitute for forage index insurance. This result is consistent with findings from Mosnier (2015). Off-farm income was not found to be significant at the 10% level. However, the coefficient is negative. Further analysis is needed to determine off-farm incomes effect on the use of forage index insurance. Both empirical studies and theoretical research have indicated that risk reduction negatively affects the use of index insurance (Clarke, 2016; Mosnier, 2015).

Socio-Demographics

Age and gender make up the two independent variables in the group socio-demographics. Age is found to be significant at the 10% level, or better and education was not found to be significant. As indicated by the sign (-0.512) age is negatively related to the use of forage index insurance, as age increases forage index insurance use decreases. Education showed a positive coefficient (0.196), but it was not significant.

Ordered Probit Results: Willingness to Pay for Forage Insurance

Dependent Variable

Table 2.7 shows the description of variables as well as the scale of each variable in the "Willingness to Pay for Forage Insurance" ordered probit regression model. A frequency distribution can be seen in Figure 2.2 outlining producers' survey response to the dependent variable "What would be an affordable forage insurance premium for you?" The mean survey response was 1.55 out of 4 indicating that willingness to pay for forage insurance is toward the lower end of Likert scale.

Independent Variables and Ordered Probit Model Goodness of Fit

The ordered probit regression model is composed of 10 independent variables in which five are found to be significant at or better than the 10% level. The independent variables are categorized into four groups: knowledge and attitude, producer profile, perceived drought risk by producer, and socio-demographics. The goodness of fit of the ordered probit regression model is considered adequate with a McFadden $R^2$of 0.2110. A McFadden $R^2$of 0.2 to 0.4 is considered an adequate fit. Results are available in Table 2.8. Additionally, marginal effects are computed and shown in Table 2.9.

Knowledge and Attitude

This group has three variables in which two are found to be significant at the 10% level or better (Table 2.8). Knowledge level regarding forage insurance is found to have a positive effect on the willingness to pay for forage insurance. This finding is evident in the coefficient sign (0.264) that is significant at the 10% level. Attitude towards forage insurance is also found to positively affect willingness to pay for forage insurance as displayed by the coefficient (0.432) that is significant at the 1% level. This result is consistent with previous studies such as (Cole et al., 2013). Basis risk was found to be negative with a coefficient of (-0.168), however, it is not found to be statistically significant at the 10% level.

Producer Profile

A producers' cost of operation relative to their peers is found to have a positive relationship with the willingness to pay for forage insurance, and has a 10% level of significance. As displayed by the coefficient (0.341) in Table 2.8, producers with a higher relative cost of operation are willing to pay more for forage insurance. This finding is consistent with previous literature in which producers with higher risk perceive they have a higher likelihood of loss, and therefore are willing to pay more for insurance (Clarke, 2016; Hill, Hoddinott, & Kumar, 2013). Producers who indicate that their main source of livestock feed is improved pasture (0.668) have a higher willingness to pay for forage insurance at a 5% level of significance. Additionally, using native pasture as the primary source of feed has a negative coefficient (-0.190) and is insignificant.

Perceived Drought Risk by Producer

Drought risk is a primary concern of producers, however, it is not found to have a significant impact on the willingness to pay for forage insurance (Table 2.8). The coefficient is positive (0.178), and it is not significant at the 10% level or better.

Socio-Demographics

Three variables are included in the socio-demographic group. Of these variables, one is found to be statistically significant at the 10% level. Having full-time off-farm income is found to negatively affect the willingness to pay for forage insurance. Following from Table 2.8 the coefficient of off-farm income (-0.626) is negative and significant at the 10% level or better. Past studies support this finding that off-farm income reduces the willingness to purchase and willingness to pay for insurance coverage (Harwood et al., 1999; Knight & Coble, 1997). Farm size (-0.122) has a negative effect on willingness to pay for forage insurance. However, it is not found to be significant. Lastly, the effect of education on the willingness to pay for forage insurance is positive but insignificant. As seen by the coefficient of education (0.204) in Table 2.8, education is positively related to willingness to pay, but this result is not statistically significant. Hill et al. (2011) also found that producers who were more educated used more weather index insurance.

Summary

Use of Forage Index Insurance

In the estimated binomial probit model "Use of Forage Index Insurance" 6 of 11 variables are found to be significant at the 10% level or better. Forage producers with higher levels of knowledge and a more positive attitude toward forage insurance were found to use forage index insurance more often than other producers. Further, producers who rate drought as being of greater importance and perceive that their overall weather risk as being higher are more likely to use forage index insurance. Also, producers who maintained higher inventory levels of forage were found to use less forage index insurance. Lastly, age is found to be an important factor in determining forage index insurance use, and younger producers are found to use forage index insurance more often than older producers.

Willingness to Pay for Forage Insurance

The ordered probit model "Willingness to Pay for Forage Insurance" has 5 of 10 independent variables significant at the 10% level or better. Similar to the findings in the" Use of Forage Index Insurance" analysis, the variables knowledge level regarding forage insurance and attitude towards forage insurance are both found to be positively related to the willingness to pay for forage insurance. Additionally, producers who have higher operating costs relative to their peers are found to have a higher willingness to pay for forage insurance. Further, forage producers whose main source of livestock feed is improved pasture have a higher willingness to pay for forage insurance. Lastly, producers who have full time off farm income have a lower willingness to pay for forage insurance.

Figure 2.1 Response Frequency: Use of Forage Index Insurance (N=87)

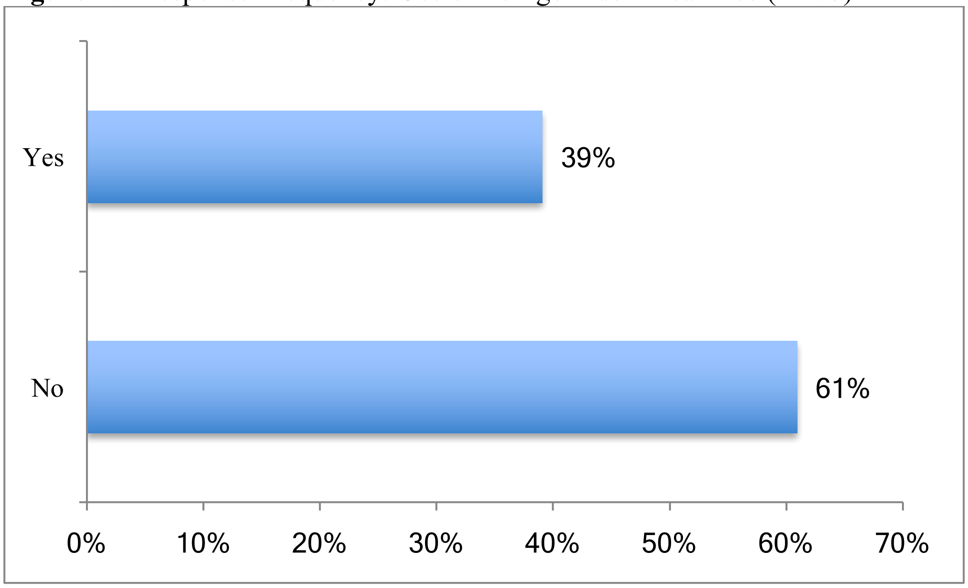

Figure 2.2 Response Frequency: Willingness to Pay for Forage Insurance (N=87)

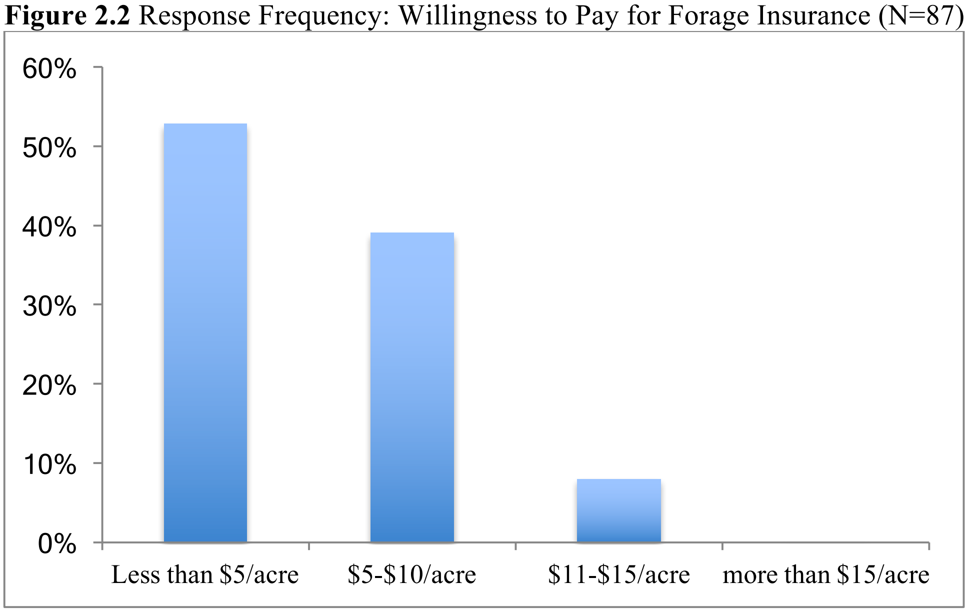

Table 2.1 Contingency Table: Socio-Demographic Characteristics of Sample Respondents by Province (N=87)

	Saskatchewan		Alberta		Total	
	N	%	N	%	N	%
Farm Size (Acres)						
1000 or less	7	14.89[a]	11	27.50	18	20.69
1001 to 2000	18	38.30	8	20.00	26	29.89
2001 to 3000	7	14.89	7	17.50	14	16.09
3001 to 5000	4	8.51	6	15.00	10	11.49
Greater than 5000	11	23.40	8	20.00	19	21.84
Age (Years)						
Under 25	0	0	0	0	0	0
26-40	11	23.40	6	15.00	17	19.54
41-55	15	31.92	16	40.00	31	35.63
56-70	19	40.43	18	45.00	37	42.53
71 and older	2	4.26	0	0.00	2	2.30
Household Size						
One	4	8.51	2	5.00	6	6.90
Two	18	38.30	19	47.50	37	42.53
Three to Four	15	31.92	15	37.50	30	34.48
Five to Six	9	19.15	4	10.00	13	14.94
Seven or More	1	2.13	0	0.00	1	1.15
Education Level						
Some high school	2	4.26	1	2.50	3	3.45
High school graduate	16	34.04	6	15.00	22	25.29
Some college	22	46.81	22	55.00	44	50.58
Bachelors' degree	6	12.77	9	22.50	15	17.24
Post- Graduate/ Professional	1	2.13	2	5.00	3	3.45
Gender						
Male	41	87.23	35	87.50	76	87.36
Female	6	12.77	5	12.50	11	12.64
Part Time/ Full Time						
Full Time	32	68.09	31	77.50	63	72.41
Part Time	15	31.92	9	22.50	24	27.59
Household Income						
Less than $50,000	4	8.51	6	15.00	10	11.49
$50,000-$74,999	8	17.02	4	10.00	12	13.79
$75,000-$94,999	5	10.64	3	7.50	8	9.20
$95,000-$124,999	7	14.89	8	20.00	15	17.24
$125,000 and above	23	48.94	19	47.50	42	48.28
Total	47[b]		40		87	

[a] Interpretation as follows: 14.89% of producers from Saskatchewan have a farm size of 1000 acres or less

[b] Interpretation as follows: 47 of 87 producers are from Saskatchewan

Table 2.2 Contingency Table: Use of Forage Index Insurance and Selected Socio-Demographics (N=87)

	No		**Yes**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**
Farm Size (Acres)						
1000 or less	12	22.64[a]	6	17.65	18	20.69
1001 to 2000	18	33.96	8	23.53	26	29.89
2001 to 3000	9	16.98	5	14.71	14	16.09
3001 to 5000	5	9.43	5	14.71	10	11.49
Greater than 5000	9	16.98	10	29.41	19	21.84
Age (Years)						
+Under 25	0	0	0	0	0	0
26-40	10	18.87	7	20.59	17	19.54
41-55	17	32.08	14	41.18	31	35.63
56-70	24	45.28	13	38.24	37	42.53
71 and older	2	3.77	0	0.00	2	2.30
Household Size						
One	5	9.43	1	2.94	6	6.90
Two	23	43.40	14	41.18	37	42.53
Three to Four	14	26.42	16	47.06	30	34.48
Five to Six	10	18.87	3	8.82	13	14.94
Seven or More	1	1.89	0	0.00	1	1.15
Education Level						
Some high school	3	5.66	0	0.00	3	3.45
High school graduate	16	30.19	6	17.65	22	25.29
Some college	27	50.94	17	50.00	44	50.58
Bachelors' degree	5	9.43	10	29.41	15	17.24
Post- Graduate/ Professional	2	3.77	1	2.94	3	3.45
Gender						
Male	43	81.13	33	97.06	76	87.36
Female	10	18.87	1	2.94	11	12.64
Part Time/ Full Time						
Full Time	35	66.04	28	82.35	63	72.41
Part Time	18	33.96	6	17.65	24	27.59
Household Income						
Less than $50,000	5	9.43	5	14.71	10	11.49
$50,000-$74,999	8	15.09	4	11.77	12	13.79
$75,000-$94,999	7	13.21	1	2.94	8	9.20
$95,000-$124,999	10	18.87	5	14.71	15	17.24
$125,000 and above	23	43.40	19	55.88	42	48.28
Total	53[b]		34		87	

[a] Interpretation as follows: 22.64% of producers who responded "No" have farms of 1000 or less acres

[b] Interpretation as follows: 53 of 87 producers who indicated they do not use forage index insurance

Table 2.3 Contingency Table: Willingness to Pay for Forage Insurance and Selected Socio-Demographics (N=87)

	< $5	**$5 - $10**	**$11 - $15**	**> $15**	**Total**
	%	**%**	**%**	**%**	**%**
Farm Size (Acres)					
1000 or less	50.00[a]	44.44	5.56	0.00	20.69[b]
1001 to 2000	57.69	30.77	11.54	0.00	29.89
2001 to 3000	57.143	28.57	14.29	0.00	16.09
3001 to 5000	50.00	40.00	10.00	0.00	11.49
Greater than 5000	47.37	52.63	0.00	0.00	21.84
Age (Years)					
+Under 25	0.00	0.00	0.00	0.00	0.00
26-40	64.71	23.53	11.77	0.00	19.54
41-55	41.94	58.07	0.00	0.00	35.63
56-70	54.05	32.43	13.51	0.00	42.53
71 and older	100.00	0.00	0.00	0.00	2.30
Household Size					
One	50.00	50.00	0.00	0.00	6.90
Two	51.35	40.54	8.11	0.00	42.53
Three to Four	50.00	40.00	10.00	0.00	34.48
Five to Six	61.54	30.77	7.69	0.00	14.94
Seven or More	100.00	0.00	0.00	0.00	1.15
Education					
Some high school	100.00	0.00	0.00	0.00	3.45
High school graduate	54.55	45.46	0.00	0.00	25.29
Some college	50.00	38.64	11.36	0.00	50.58
Bachelors' degree	53.33	33.33	13.33	0.00	17.24
Post- Graduate/ Professional	33.33	66.67	0.00	0.00	3.45
Gender					
Male	48.68	42.11	9.21	0.00	87.36
Female	81.82	18.18	0.00	0.00	12.64
Part Time/ Full Time					
Full Time	47.62	44.44	7.94	0.00	72.41
Part Time	66.67	25.00	8.33	0.00	27.59
Household Income					
Less than $50,000	50.00	40.00	10.00	0.00	11.49
$50,000-$74,999	50.00	50.00	0.00	0.00	13.79
$75,000-$94,999	75.00	25.00	0.00	0.00	9.20
$95,000-$124,999	33.33	46.67	20.00	0.00	17.24
$125,000 and above	57.14	35.71	7.14	0.00	48.28
Total	46[c]	34	7	0	87

[a] Interpretation as follows: 50% of producers who have farms of 100 acres or less have a willingness to pay of less than $5.

[b] Interpretation as follows: 20.69% of producers who have farms that are 1000 acres or less

[c] Interpretation as follows: 46 of 87 producers indicated they have a willingness to pay less than $5

Table 2.4 Description of Variables and Survey Response Scores for Use of Forage Index Insurance Binomial Probit Model (N = 87)

Variable Names	Mean Survey Response	Scale of Variables
Dependent Variable		
Do you plan to purchase forage index insurance this year or in the future?	0.39	1= Yes, 0 = No
Independent Variables		
Producer Attitudes and Price Importance		
Knowledge level regarding forage insurance	2.79	1= Very low,.., 5 = Very high
Attitude towards forage insurance	3.03	1= Very negative,.., 5 = Very positive
Forage insurance price importance	4.24	1= Not important,..,5 =Very important
Weather Risk Perceived by Producer		
Producer perceived weather risk	3.17	1= Much lower,.., 5 = Much higher
Perceived importance of drought risk by producer	4.24	1= Not important,..,5 =Very important
Use of Risk Management Programs		
AgriStability use	3.02	1= Never,…, 5 = Very often
AgriInvest use	3.91	1= Never,…, 5 = Very often
Risk Reduction		
Maintain inventory	3.63	1= Never,.., 5 = Very often
Off farm income	0.28	1= Yes, 0 = No
Socio- Demographics		
Age	3.28	1= under 25, 2= 26-40, 3= 41-55, 4= 56-70, 5= 71 and older
Education	2.92	1= Some high school, 2= High school graduate, 3= Some college or other education, 4= bachelors' degree, 5= Post- Graduate

Table 2.5 Estimates of the Binomial Probit Model: Use of Forage Index Insurance (N=87)

Parameters	**Estimates**	**S.E.**
Producer Attitudes and Price Importance		
Knowledge level regarding forage insurance	0.511**	0.204
Attitude towards forage insurance	0.534***	0.203
Forage insurance price importance by producer	-0.234	0.203
Weather Risk Perceived by Producer		
Producer perceived weather risk	1.109***	0.337
Perceived importance of drought risk by producer	0.888***	0.293
Use of Risk Management Programs		
AgriStability use	-0.173	0.119
AgriInvest use	0.143	0.128
Risk Reduction		
Maintain inventory	-0.380*	0.222
Off farm income	-0.559	0.464
Socio- Demographics		
Age	-0.459*	0.235
Education	0.196	0.235

Pseudo R-Square
McFadden R^2 0.4493
Percent predicted correct: 81.61% Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Note: Dependent variable "Do you plan to purchase forage index insurance this year or in the future?"
Note: Forage index insurance includes coverage for improved pasture and native pasture grasslands

Table 2.6 Marginal Effects for the Binomial Probit Model: Use of Forage Index Insurance (N=87)

	dF/dx	S.E.
Producer Attitudes and Price Importance		
Knowledge level regarding forage insurance [a,b]	0.1622*	0.0634
Attitude towards forage insurance	0.1698**	0.0647
Forage Insurance Price Importance by Producer	-0.0743	0.0799
Weather Risk Perceived by Producer		
Producer perceived weather risk	0.3522***	0.1034
Perceived importance of drought risk by producer	0.2822***	0.0840
Use of Risk Management Programs		
AgriStability use	-0.0548	0.0373
AgriInvest use	0.0454	0.0407
Risk Reduction		
Maintain Inventory	-0.1206*	0.0708
Off farm income	-0.1612	0.1186
Socio- Demographics		
Age	-0.1460*	0.0787
Education	0.0623	0.0757
Note:	*p<0.1; **p<0.05; ***p<0.01	

[a] Interpretation: A one unit increase in Knowledge level regarding forage insurance results in a 16.22% greater chance of using forage index insurance

[b] Marginal effects are computed at the variable means

Table 2.7 Description of Variables and Survey Response Scores for Willingness to Pay for Forage Insurance Ordered Probit Model (N = 87)

Variable Names	Mean Survey Response	Scale of Variables
Dependent Variable		
What would be an affordable forage insurance premium for you?	1.55	1= less than $5/acre, 2 = $5-$10/acre, 3= $11-$15/acre, 4= more than $15/acre
Independent Variables		
Knowledge and Attitude		
Knowledge of forage insurance	2.79	1= Very low,…, 5 = Very high
Attitude towards forage insurance	3.03	1= Very negative,…, 5 = Very positive
Concern for basis risk	3.43	1= No concern for basis risk,…,5 =large concern for basis risk
Producer Profile		
Cost of operation relative to peers with same farm size	2.67	1= Much lower,…, 5 = Much higher
Main source of feed: improved pasture	0.06	1= Yes, 0 = No
Main source of feed: native pasture	0.85	1= Yes, 0 = No
Perceived Importance of Drought Risk by Producer		
Drought risk importance	4.24	1= Not important,…,5= Very important
Socio- Demographics		
Off farm income	3.91	1= Yes, 0 = No
Farm size (acres)	2.44	1= 1000 or less, 2= 1001 to 2000, 3= 2001- 3000, 4= 3001- 5000, 5= 5000>
Education	0.28	1= Some high school, 2= High school graduate, 3= Some college or other education, 4= Bachelors' degree, 5= Post- Graduate/ Professional degree

Table 2.8 Estimates for the Ordered Probit Model: Willingness to Pay for Forage Insurance (N=87)

Parameters	Estimates	S.E.
Knowledge and Attitude		
Knowledge level regarding forage insurance	0.264*	0.140
Attitude towards forage insurance	0.432***	0.145
Concern for basis risk	-0.168	0.155
Producer Profile		
Cost of operation relative to peers with same farm size	0.341*	0.181
Main source of feed: improved pasture	0.663**	0.333
Main source of feed: native pasture	-0.190	0.410
Perceived Importance of Drought Risk by Producer		
Drought risk importance	0.178	0.180
Socio- Demographics		
Off farm income	-0.626*	0.334
Farm size (acres)	-0.122	0.334
Education	0.204	0.176

Pseudo R-Square
McFadden R^2 0.2110 Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Note: Dependent variable is "What would be an affordable forage insurance premium for you?" 1= less than $5/acre, 2 = $5-$10/acre, 3= $11-$15/acre, 4= more than $15/acre
Note: Forage insurance includes insurance coverage for hay, improved pasture, and native pasture

Table 2.9 Marginal Effects for the Ordered Probit Model: Willingness to Pay for Forage Insurance (N=87)

Parameters	Effect 1	Effect 2	Effect 3
Knowledge and Attitude			
Knowledge level regarding forage insurance	-0.105*	0.086*	0.019
Attitude towards forage insurance [a,b]	-0.171***	0.140***	0.031**
Concern for basis risk	0.066	-0.054	-0.012
Producer Profile			
Cost of operation relative to peers with same farm size	-0.135*	0.111*	0.025
Main source of feed: improved pasture	-0.259**	0.192**	0.067
Main source of feed: native pasture	0.074	-0.062	-0.012
Perceived Drought Risk by Producer			
Drought risk	-0.071	0.058	0.013
Socio- Demographics			
Off farm income	0.238**	-0.202*	-0.036*
Farm size (acres)	0.048	-0.039	-0.009
Age	-0.081	0.066	0.015
Note:	$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$		

[a] Interpretation: A one unit increase in attitude level towards forage insurance results in the producer being 17.1% less likely to have a willingness to pay less than $5 per acre (effect 1), 14.0% greater likelihood of a willingness to pay of $5-$10 per acre (effect 2), a 3.1% greater chance of having a willingness to pay of $11-$15 per acre.

[b] Marginal effects are computed at variable means and marginal effects sum to a net effect of zero

CHAPTER 3

OTHER RISK MANAGEMENT PROGRAMS

Crop Insurance, and Margin Insurance Literature

Factors Affecting the Use of Crop Insurance

The decision to purchase crop insurance has been studied with both farm level data and survey response data. In a two-stage process, in which producers first decide to purchase crop insurance then chose a coverage level Smith and Baquet (1996) found that producers who use more crop insurance have higher education levels, higher debt levels, and had a disaster relief payment in the past five years. Sherrick et al. (2004) using survey data and a multinomial logit approach found that participants of crop insurance are older, less tenured (rent a higher proportion of farmland), use more leverage, and have higher perceived yield risks. Enjolras et al. (2012) found that crop insurance use was positively related to the size of the farm and the number of cultivated crop types. Moral hazard is a concern for crop insurance, and evidence of moral hazard has been found in several empirical studies such as (Goodwin & Kastens, 1993; Smith & Goodwin, 1996). In both studies, fertilizer use and chemical use were found to decrease with crop insurance coverage. Since these findings, co-payment measures in addition to other measures have been taken to reduce moral hazard (Smith & Glauber, 2012).

Factors Affecting the Use of Margin Insurance

AgriStability is a margin insurance program that uses producers tax information. Relatively few studies have examined factors that affect the use of AgriStability, with the exception of Poon (2013).The analysis concluded that producers' who use the AgriStability program typically have larger farms in terms of land size. Several studies have examined the factors related to the use of revenue insurance, and Coble et al. (2000) found that producers who use revenue insurance tend to use slightly less forward contracting. Sherrick et al. (2004) found that producers who prefer revenue insurance to crop insurance have larger farms, are less wealthy, and are highly leveraged. This finding builds upon earlier work by Makki and Somwaru (2001) who found that higher risk farmers are more likely to choose revenue insurance. Additionally, work by Mirshra and Goodwin (2006) found that producers who purchase less revenue insurance, are instead reducing their risk with savings, off-farm income, and forward contracts.

Data and Methodology

The same survey data and ordered probit methodology as in Chapter 2 are used in this section. Please see Chapter 2 data and methodology section for more information.

Other Risk Management Selected Results

Risk Management Survey Results: On-Farm Risk Management and Perceived Weather Risks

To outline producers risk management decisions and to underscore the risks most important to them, producers were asked a series of risk management questions. These questions were segmented into three categories: 1) on-farm risk reduction, 2) Selected production risk management practices and 3) the importance of specific weather risks.

On-Farm Risk Reduction

Figure 3.1 "Use of on Farm Risk Reduction" presents the mean score of each risk reduction activity. The most widely used on farm risk reduction strategies are maintain inventory, produce crops and livestock, and grow different crops.

Selected Production Risk Management Practices

Figure 3.2 "Use of Selected Production Risk Management Practices" outlines the mean scores of popular production risk management strategies. These include insect management, disease management, weed management, fertilizer use, use of soil testing, no-till production, and use of risk management software. Among these options, weed management and fertilizer use are the most popular. The use of risk management software remains unpopular among producers with a mean score of 1.8 out of 5.

Importance of Specific Weather Risks

Figure 3.3 "Importance of Weather Risk for Forage Production" showed that producers in the sample overwhelmingly perceived drought risk to be the most important weather risk for forage production, with a mean score of 4.2 out of 5. The second most important weather risk as identified by producers is too much rainfall during planned cutting. Winterkill risk and wind damage risk are less important to producers. However, these risks still pose considerable threats. Also, it may be useful to examine the relationship between socio-demographic characteristics and the use of the crop insurance and AgriStability. Table 3.1 and Table 3.2 present the socio-demographic response variables with the use of crop insurance and the use of AgriStability.

Contingency Table Results: Use of Crop Insurance and Selected Socio-Demographics

Farm Size (acres)

From Table 3.1 there seems to be no clear relationship between farm size and use of crop insurance. If both the "Often" and "Very often" categories are analyzed in conjunction, crop insurance use among farm size tiers appear to be very similar.

Age (Years)

The effect of age on use of crop insurance is unclear. The "Very often" column shows crop insurance use increasing with age, while the "Often" column does not. Examining the columns together shows that usage among the age groups is rather uniform at 50% of producers using crop insurance either often or very often.

Household Size

Crop insurance use is negatively related to household size according to Table 3.1. Observing the column "Very often" the pattern is evident, 50% of producers with a household size of one use crop insurance "Very often," while only 23.08% of producers with a household size of "Five to Six" use crop insurance "Very often." Crop insurance use declines uniformly with household size.

Education

According to Table 3.1, producer education level appears to have a positive relationship with the use of crop insurance. This link is best illustrated by the responses in the "Very often" column and the "Some high school" and "Post- Graduate/ Professional" rows. Of producers who indicated that they had an education level of "Some high school" 0% used crop insurance "Very often," while of the producers in the group "Post- Graduate/Professional" 66.67% indicated crop insurance use "Very often." These examples are representative of the overall pattern displayed in Table 3.1.

Gender

Crop insurance use among each gender was rather uniform. However, females are more likely than males never to use crop insurance.

Part Time/ Full Time Employment

Regular off-farm income (employment) has a negative impact on crop insurance use. Part-time producers are more likely to use crop insurance "Never" at 50%, while only 22.22% of full-time producers indicated using crop insurance "Never." Part-time producers are also less likely to use crop insurance "Very often." Of the part-time producers, 20.83% indicated using crop insurance "Very often," compared to that of full-time producers at 44.44%.

Household Income

The relationship between household income and crop insurance use is not evident in Table 3.1. Further analysis would be necessary for determining whether crop insurance use is affected by household income.

Contingency Table Results: Use of AgriStability and Selected Socio-Demographics

Farm Size (acres)

AgriStability use appears to be positively related to farm size. In Table 3.2 this is best observed by examining the highest use tier "Very Often" for AgriStability. Producers in the farm size "3001 to 5000" acres and "Greater than 5000" acres both use AgriStability "Very often" 50.00% and 57.90% respectively. The percentage of large producers using AgriStability very often is much higher than the percentage of smaller producers using AgriStability very often. The "Very often" column results suggest that the use of AgriStability increases as farms get larger and the use of AgriStability decreases as farms get smaller. According to these contingency table results, AgriStability use appears to be positively related to farm size.

Age (Years)

According to the contingency table results, a clear relationship between age and AgriStability use is not evident, and results seem to be rather evenly dispersed.

Household Size

The effect of household size on AgriStability use appears to be negative, as larger households appear to use less AgriStability. This result is illustrated by examining the results of the "Very often" column in Table 3.2, and AgriStability use declines as household size increases.

Education

According to Table 3.2, there may be a positive relationship between education levels and the use of AgriStability. However, the extremity choices "Some high school" and "Post

Graduate/Professional" have low observations. Agricultural producers with some high school use very high amounts of AgriStability. Eliminating these two categories with small sample sizes and focusing on the three most common categories, "High school graduate," "Some college," and "Bachelors' degree," education seems to be positively related to the use of AgriStability.

Gender

AgriStability use and gender do not appear to have a strong relationship. AgriStability use is closely related between genders and is slightly different at higher AgriStability use levels.

Part Time/ Full Time Employment

Off-farm income (employment) seems to have a limited effect on AgriStability use, however, the contingency table results suggest that part-time producers are more likely to never use the AgriStability program. Among part-time producers who use AgriStability, usage levels look very similar to the full-time producers using AgriStability.

Household Income

The contingency table results indicate that annual household income is negatively related to the use of AgriStability. This relation is best illustrated by examining the "Very often" AgriStability use column in Table 3.2. Among producers with an annual income of less than \$50,000, 50% of these producers use AgriStability "Very often." Producers in the household income tier of \$75,000 to \$94,999 use AgriStability less often than the "less than \$50,000" tier at 41.67% of producers. This decline in AgriStability use continues with the next household income class of producers with annual incomes of “$75,000 to $94,000.” Of these producers, 25% use AgriStability very often. Among the subsequent income classes, AgriStability usage remains relatively constant with approximately 25% of producers indicating using AgriStability very often.

Other Risk Management Probit Regression Model Results

Ordered Probit Results: Use of Crop Insurance

Dependent Variable

Displayed in Table 3.3 is the description and measurement of the dependent variable as well as the independent variables. Figure 3.4 illustrates the frequency of response for the dependent variable “To what extent do you use crop insurance?” The most common response among producers is “Very often” representing 38% of the sample. Similar to the response of AgriStability use, the second most common response is “Never.”

Independent Variables and Ordered Probit Model Goodness of Fit

The ordered probit model “, Use of Crop Insurance,” has a total of 15 variables of which 8 of 15 are found to be statistically significant at the 10% level or better (Table 3.4). The independent variables are categorized into five groups: 1) risk aversion and price importance, 2) knowledge and attitude, 3) government risk management programs, 4) use of selected production risk management practices, and 5) socio-demographics. The McFadden R^2 of 0.3048 suggests an adequate goodness of fit.

Risk Aversion and Importance of Price

This group is composed of two variables, willingness to take risk, and importance of price (Table 3.4). Willingness to take risk (-0.490) is statistically significant at the 5% level. The negative coefficient indicates that the more risk the producer is willing to take, the less they use crop insurance. This result corresponds to the theoretical research as well as empirical findings (Knight & Coble, 1997). The variable importance of price (-0.160) is negative and statistically insignificant. The price variable may not have been significant because crop insurance is highly subsidized in Canada this may affect the price sensitivity among producers (Clarke, 2016).

Knowledge and Attitude

Two variables are included in this category, knowledge level regarding forage production insurance, and attitude towards crop insurance (Table 3.4). The variable knowledge level regarding forage production insurance (0.600) has a positive coefficient and is statistically significant at the 5% level. This finding is consistent with studies from Cole et al. (2013) and Lin et al. (2015). Attitude towards forage crop insurance (0.072) is found to be positive, however, it is statistically insignificant.

Government Risk Management Programs

The group government risk programs is composed of the independent variables AgriInvest use, AgriStability use, and the use of crop insurance for crops other than forage (Table 3.4). AgriInvest (0.241) is significant at the 5% level, and the coefficient has a positive sign. Therefore, AgriInvest use is a complement to the use of crop insurance. Next, AgriStability (0.117), has a positive coefficient and is statistically insignificant. Lastly, crop insurance use for crops other than forage (0.884) is statistically significant at the 1% level. As forage producers diversify into other crop production, they appear to use more crop insurance.

Use of Selected Production Risk Management Practices

Selected production risk management practices is made up of four variables (Table 3.4): fertilizer use (0.423), weed management (0.120), disease management (0.096), and insect management (-0.511). One of the drawbacks of crop insurance is that it is susceptible to moral hazard. Subsequent strides have been made to limit the effects of moral hazard in agriculture insurance markets. One way to examine moral hazard is by analyzing producer's production risk management decisions. If producers use less selected production risk management and use more crop insurance, there may be moral hazard in the crop insurance market. First, fertilizer use (0.423) is positive and significant at the 5% level and this is contrary to moral hazard behavior. Second, weed management (0.120) is positive and insignificant. Third, disease management (0.096) is positive and insignificant. Last, insect management (-0.511) is negative and significant at the 5% level. The overall effect does not suggest evidence of moral hazard.

Socio-Demographics

Four variables are included in socio-demographics, two of which are found to be statistically significant at the 10% level or better (Table 3.4). The proportion of land rented (0.207) is significant at the 10% level, and the coefficient is positive. This finding indicates that producers who operate with higher proportions of rented land use more crop insurance. This result aligns with past literature that states that proportion of land rented is a risk-enhancing variable (Sherrick, Barry, Ellinger, & Schnitkey, 2004). The household size (-0.232) variable is negative, however it is insignificant. Percentage of household income earned off farm (-0.271) is negative and significant at the 5% level. Households that have more income generated from off-farm activities use less crop insurance. This finding agrees with empirical results (Sherrick et al., 2004) in which off-farm income is found to be a common way for producers to reduce risk and subsequently reduce crop insurance use. Lastly, the independent variable education (0.120) appears to be positively related to the use of crop insurance, however, it is insignificant at the 10% level. Table 3.5 shows the marginal effects for the ordered probit model.

Ordered Probit Results: Use of AgriStability

Dependent Variable

Table 3.6 shows the scale of the variables as well as a description of the variables included in the ordered probit analysis. Figure 3.5 displays AgriStability use among producers, 57% of producers indicated they used AgriStability sometimes or more. The most common AgriStability use levels are “Very often” at 32% and “Never” at 30%.

Independent Variable and Ordered Probit Model Goodness of Fit

A total of 12 variables are used in this analysis, and 9 of 12 are found to be statistically significant at or better than the 10% level (Table 3.7). Independent variables are categorized into four groups: 1) producer risk profile, 2) use of risk management programs, 3) risk reduction, and 5) socio-demographics. The pseudo R^2 used as a goodness of fit measurement for this analysis is the Mcfadden R^2, an adequate fit of 0.2062 is measured. Probit model results can be found in Table 3.7, and marginal effects can be seen in Table 3.8.

Producer Risk Profile

This group is composed of 4 independent variables, in which all of them are statistically significant at or better than the 10% level. The first variable, individual responsibility for severe farm losses (-0.784) is found to have a statistically significant negative relationship with the use of AgriStability. Therefore, farmers that believe the federal government should take responsibility for farm loss, use more AgriStability. This result is similar to Goodwin and Kastens (1993) in their study of crop insurance use. The second variable, the previous weather disaster extent of loss (0.564) has a significant positive effect on AgriStability use. Both these variables are found to be significant at better than the 1% significance level. The third variable, perceived inability for forage index insurance to cover losses (0.667) has a positive effect on the use of AgriStability. This variable is found to be significant at the 10% level, indicating forage producers may also desire AgriStability instead of only forage index insurance. The fourth variable, enrollment in forage insurance for all years (0.951) is significant at the 1% level. This variable indicates that producers who have used forage insurance regularly in the past use more AgriStability.

Use of Risk Management Programs

This group is composed of three independent variables AgriInvest use, crop insurance use, and forage index insurance use (Table 3.7). First, the coefficient for AgriInvest (0.172) is positive and statistically significant at the 10% level, indicating it is positively related to AgriStability use. AgriStability and AgriInvest are related programs and together provide stabilization for producers. Second, the coefficient for crop insurance use (0.064) is positive and insignificant. Lastly, forage index insurance use (-0.593) is negative and statistically significant at the 10%

level. From these results, it appears that forage index insurance use may be a substitute for AgriStability use.

Risk Reduction and Socio-Demographics

Four variables are included in the group risk reduction and socio-demographics (Table 3.7), to explain AgriStability use. Crop diversification, is a common risk reduction strategy among forage producers. Crop diversification (-0.190) is found to be statistically insignificant, and crop diversification may lower the use of AgriStability. The second variable, household size (-0.436) is significant at the 5% level, and the coefficient is negative. Therefore, AgriStability use is negatively affected by household size. The third variable, farm size (0.345) is statistically significant at the 1% level, and this result suggests that AgriStability use is positively affected by larger farm size. This finding corresponds with previous literature such as (Sherrick et al., 2004). The fourth variable, education (0.122) is positively related to AgriStability but is not statistically significant. Lastly, the province variable (0.505) is statistically significant at the 10% level, indicating that producers in Saskatchewan use AgriStability more often than producers in Alberta.

Summary

Use of Crop Insurance

For the ordered probit regression model "Use of Crop Insurance," 8 of 14 independent variables are found to have a statistically significant effect on the use of crop insurance. Forage producers who take more risks in their farming operations were found to use more crop insurance. This result follows that producers who use crop insurance are more risk-averse than producers who do not use crop insurance. Furthermore, the use of crop insurance was found to be significantly affected by the producers' knowledge level regarding forage insurance. Also, the results suggest that crop insurance use is positively related to the use of AgriInvest. Similarly, producers who use more crop insurance grow additional crop types and purchase crop insurance for these crops. Evidence of moral hazard is not observed in the ordered probit model results. Fertilizer use is positively related to crop insurance use, while insect management use is negatively related to crop insurance use. Additionally, the use of crop insurance is found to be positively affected by the proportion of farmland rented. Lastly, producers who use less crop insurance have households that generate a larger proportion of their income from off-farm sources.

Use of AgriStability

For the ordered probit regression model explaining "Use of AgriStability," the results indicate that 9 of 12 independent variables are statistically significant. Producers who use AgriStability more often indicate that they believe the government should take greater levels of responsibility for serve farm losses. Also, the magnitude of the producer's most recent previous farm loss has a significant positive effect on the use of AgriStability. The results indicate that producers who use AgriStability more often believe forage index insurance does not sufficiently cover farm losses. Additionally, producers who use AgriStability more often indicate that they enroll in forage insurance for all years rather than enrolling only in years they believe they have greater risk exposure. Next, the use of AgriStability is positively affected by the use of AgriInvest. In contrast, the use of AgriStability is negatively affected by forage index insurance use, indicating these risk management tools may be substitutes. The results indicate that producers who use AgriStability more often have smaller household sizes, meaning producers with larger households use the program less often. Further results suggest that larger farms use AgriStability more often than smaller farms. Lastly, producers in Saskatchewan use AgriStability comparatively more often than producers in Alberta.

Figure 3.1 Use of Farm Risk Reduction (N=87)

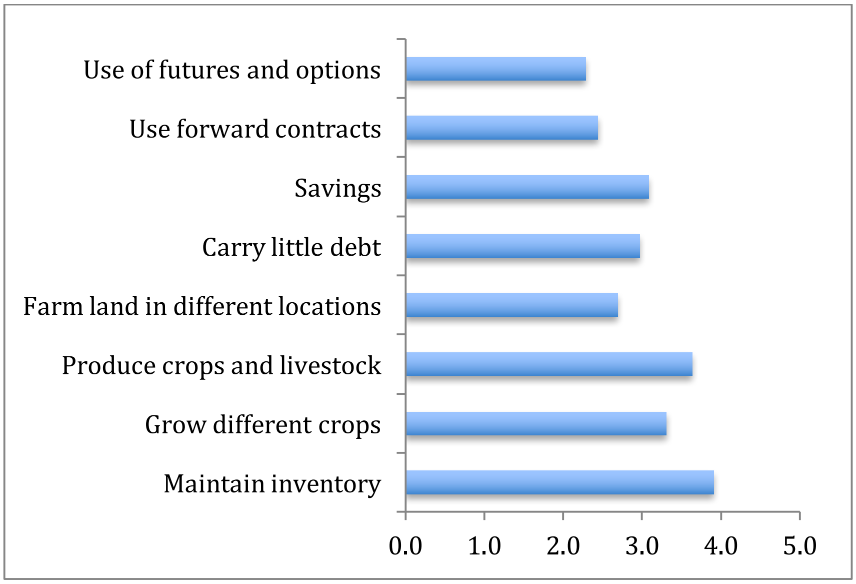

Figure 3.2 Selected Production Risk Management Practices (N=87)

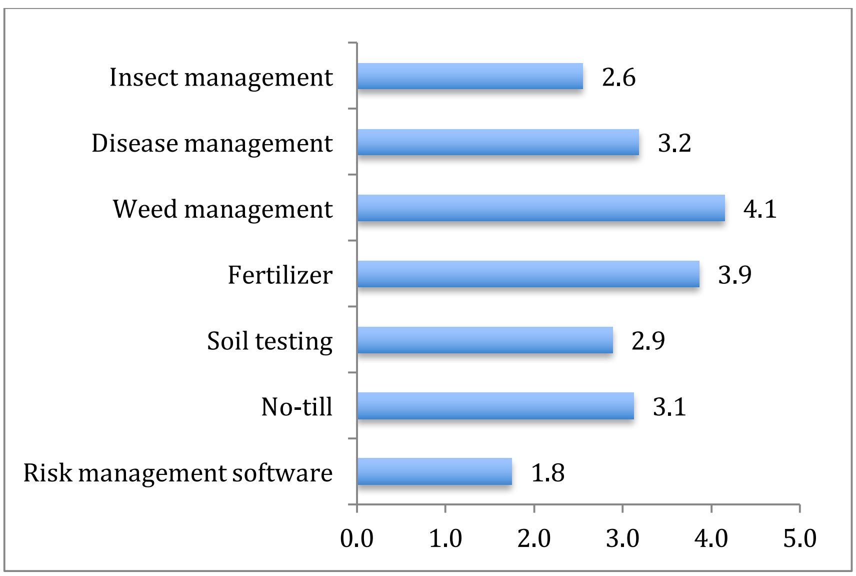

Figure 3.3 Importance of Weather Risk for Forage Production (N=87)

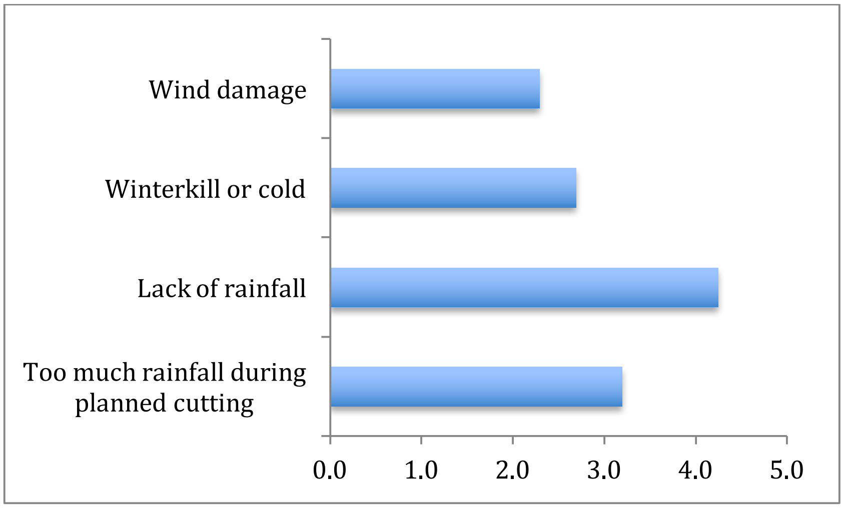

Figure 3.4 Response Frequency: Use of Crop Insurance (N=87)

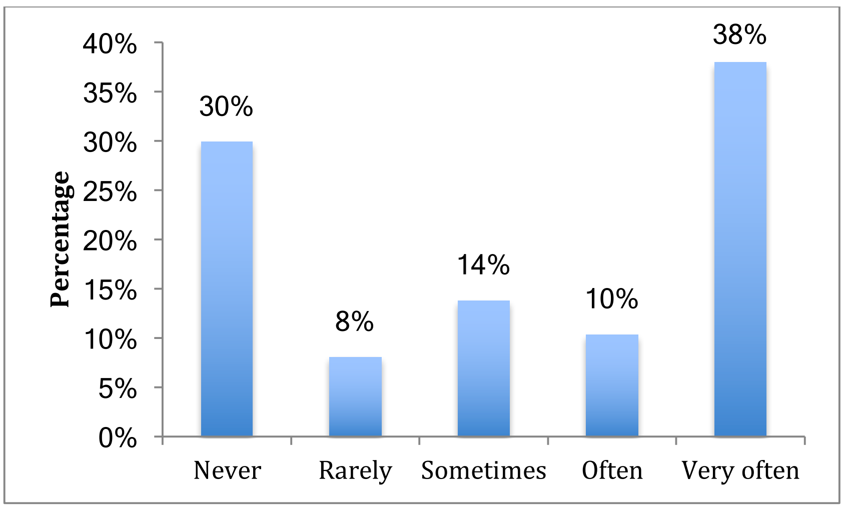

Figure 3.5 Response Frequency: Use of AgriStability (N=87)

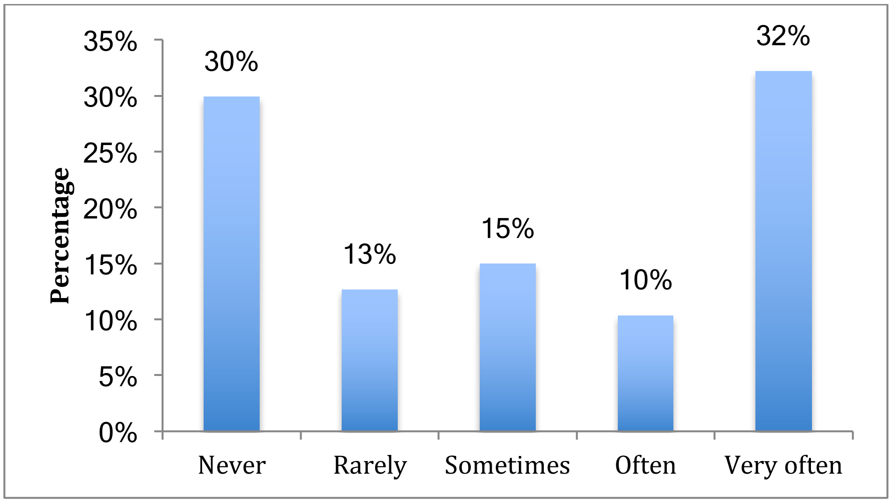

Table 3.1 Contingency Table: Use of Crop Insurance and Selected Socio-Demographics (N=87)

	Never	Rarely	Sometimes	Often	Very often	Total
	%	%	%	%	%	%
Farm Size (Acres)						
1000 or less	44.44	0.00	11.11	33.33	20.69[a]	20.69[b]
1001 to 2000	23.08	7.69	15.39	23.08	30.78	29.89
2001 to 3000	35.71	14.29	0.00	0.00	50.00	16.09
3001 to 5000	30.00	0.00	20.00	0.00	50.00	11.49
Greater than 5000	21.05	15.79	21.05	5.26	36.84	21.84
Age (Years)						
+Under 25	0.00	0.00	0.00	0.00	0.00	0.00
26-40	35.29	5.88	17.65	11.77	29.41	19.54
41-55	22.58	12.90	19.36	12.90	32.26	35.63
56-70	35.14	5.41	5.41	5.41	48.65	42.53
71 and older	0.00	0.00	50.00	50.00	0.00	2.30
Household Size						
One	33.33	0.00	16.67	0.00	50.00	6.90
Two	27.03	5.41	8.11	10.81	48.65	42.53
Three to Four	26.67	13.33	16.67	13.33	30.00	34.48
Five to Six	46.15	7.69	15.39	7.69	23.08	14.94
Seven or More	0.00	0.00	100.00	0.00	0.00	1.15
Education						
Some high school	33.33	33.33	0.00	33.33	0.00	3.45
High school graduate	27.27	13.64	13.64	13.64	31.82	25.29
Some college	31.82	4.55	11.36	9.09	43.18	50.58
Bachelors' degree	26.67	6.67	26.67	6.67	33.33	17.24
Post- Graduate/ Professional	33.33	0.00	0.00	0.00	66.67	3.45
Gender						
Male	26.32	9.21	14.47	10.53	39.47	87.36
Female	54.55	0.00	9.09	9.09	27.27	12.64
Part Time/ Full Time						
Full Time	22.22	11.11	9.52	12.70	44.44	72.41
Part Time	50.00	0.00	25.00	4.17	20.83	27.59
Household Income						
Less than $50,000	20.00	0.00	10.00	10.00	60.00	11.49
$50,000-$74,999	25.00	8.33	25.00	16.67	25.00	13.79
$75,000-$94,999	50.00	12.50	12.50	12.50	12.50	9.20
$95,000-$124,999	33.33	6.67	13.33	6.67	40.00	17.24
$125,000 and above	28.57	9.52	11.91	9.52	40.48	48.28
Total # of Respondents	26	7	12	9	33	87
Column Total % N	29.89	8.05	13.79	10.35	37.93	100.00

[a] Interpretation as follows: 20.69% of producers who have a farm size of 1000 acres or less use crop insurance "Very often"

[b] Interpretation as follows: 20.69% of producers who have a farm size of 1000 acres or less

Table 3.2 Contingency Table: Use of AgriStability and Selected Socio-Demographics (N=87)

	Never	Rarely	Sometimes	Often	Very often	Total
	%	%	%	%	%	%
Farm Size (Acres)						
1000 or less	44.44[a]	11.11	16.67	11.11	16.67	20.69[b]
1001 to 2000	38.46	15.39	11.54	15.39	19.23	29.89
2001 to 3000	28.57	14.29	21.43	7.14	28.57	16.09
3001 to 5000	30.00	20.00	0.00	0.00	50.00	11.49
Greater than 5000	5.26	5.26	21.05	10.53	57.90	21.84
Age (Years)						
+Under 25	0.00	0.00	0.00	0.00	0.00	0.00
26-40	17.65	11.77	35.29	5.88	29.41	19.54
41-55	35.26	12.90	12.90	3.23	38.71	35.63
56-70	32.43	10.81	8.11	18.92	29.73	42.53
71 and older	50.00	50.00	0.00	0.00	0.00	2.30
Household Size						
One	50.00	0.00	0.00	0.00	50.00	6.90
Two	21.62	18.92	16.22	10.81	32.43	42.53
Three to Four	30.00	6.67	16.67	16.67	30.00	34.48
Five to Six	38.46	15.39	15.39	0.00	30.77	14.94
Seven or More	100.00	0.00	0.00	0.00	0.00	1.15
Education						
Some high school	0.00	0.00	0.00	33.33	66.67	3.45
High school graduate	40.91	18.18	9.09	9.09	22.73	25.29
Some college	34.09	15.91	15.91	9.09	25.00	50.58
Bachelors' degree	13.33	0.00	26.67	6.67	53.33	17.24
Post- Graduate/ Professional	0.00	0.00	0.00	33.33	66.67	3.45
Gender						
Male	30.26	13.16	13.16	9.21	34.21	87.36
Female	27.27	9.09	27.27	18.18	18.18	12.64
Part Time/ Full Time						
Full Time	25.40	17.46	11.11	12.70	33.33	72.41
Part Time	41.67	0.00	25.00	4.17	29.17	27.59
Household Income						
Less than $50,000	30.00	10.00	0.00	10.00	50.00	11.49
$50,000-$74,999	25.00	16.67	8.33	8.33	41.67	13.79
$75,000-$94,999	50.00	0.00	12.50	12.50	25.00	9.20
$95,000-$124,999	26.67	26.67	13.33	6.67	26.67	17.24
$125,000 and above	28.57	9.52	21.43	11.91	28.57	48.28
Total # of Respondents	26	11	13	9	28	87
Column Total % N	29.89	12.64	14.94	10.35	32.18	100.00

[a] Interpretation as follows: 44.44% of the producers who have a farm size of 1000 or less acres use AgriStability "Never"

[b] Interpretation as follows: 20.69% of producers who have a farm size of 1000 acres or less

Table 3.3 Description of Variables and Survey Response Scores for Use of Crop Insurance Ordered Probit Model (N = 87)

Variable Names	Mean Survey Response	Description of Variables
Dependent Variable		
To what extent do you currently participate in the crop insurance program?[a]	3.18	1 = Never,.., 5= Very often
Independent Variables		
Risk Aversion and Price Importance		
Willingness to take risk	3.23	1= Much lower,…, 5= Much higher
Importance of price	4.16	1= Not important,…,5= Very important
Knowledge and Attitude		
Knowledge level regarding forage insurance	2.79	1= Very low,…, 5 = Very high
Attitude towards forage insurance	3.03	1= Very negative,…, 5 = Very positive
Use of Risk Management Programs		
AgriInvest use	3.91	1= Never,…, 5 = Very often
AgriStability use	3.02	1= Never,…, 5 = Very often
Crop Insurance use for crops other than forage	0.51	1= Yes, 0= No
Use of Selected Production Risk Management Practices		
Fertilizer use	3.86	1= Not important,…,5= Very important
Weed management (herbicide use)	4.15	1= Not important,…,5= Very important
Disease management (fungicide use)	3.18	1= Not important,…,5= Very important
Insect management (pesticide use)	2.55	1= Not important,…,5= Very important
Socio Demographics		
% Of total farmed acres rented	2.24	1= less than 10%, 2= 10% to 25%, 3= 25% to 40%, 4= 40% to 65%, 5= 65% and over
Household size	2.66	1= Much lower,…, 5= Much higher

[a] The crop insurance program includes forage insurance as well as production insurance for crops other than forage

Table 3.4 Estimates of the Ordered Probit Model: Use of Crop Insurance (N=87)

Parameters	Estimates	S.E.
Risk Aversion and Price Importance		
Willingness to take risk	-0.509**	0.208
Importance of price	-0.111	0.213
Knowledge and Attitude		
Knowledge level regarding forage insurance	0.614***	0.160
Attitude towards forage insurance	0.202	0.138
Government Risk Management Programs		
AgriInvest use	0.246**	0.099
AgriStability use	0.145	0.096
Crop Insurance use for crops other than forage	0.960***	0.320
Use of Selected Production Risk Management Practices		
Fertilizer use	0.423**	0.186
Weed management (herbicide use)	0.163	0.188
Disease management (fungicide use)	0.051	0.167
Insect management (pesticide use)	-0.473***	0.182
Socio- Demographics		
Proportion of farmland rented	0.207*	0.120
Household size	-0.218	0.169
% Of household income made off farm	-0.277**	0.120

Pseudo R-Square

McFadden R^2 0.3048 — Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Note: Dependent variable, “To what extent do you currently participate in the crop insurance program?”

Table 3.5 Marginal Effects for the Ordered Probit Model: Use of Crop Insurance (N=87)

Parameters	Effect 1	Effect 2	Effect 3	Effect 4	Effect 5
Risk Aversion and Price Importance					
Willingness to take risk	0.133**	0.050*	0.016	-0.032	-0.168**
Importance of price	0.029	0.011	0.003	-0.007	-0.036
Knowledge and Attitude					
Knowledge level regarding forage insurance [a,b]	-0.160***	-0.061**	-0.019	0.038*	0.202***
Attitude towards forage insurance	-0.053	-0.020	-0.006	0.013	0.067
Government Risk Management Programs					
AgriInvest use	-0.064**	-0.024*	-0.008	0.015	0.081**
AgriStability use	-0.038	-0.014	-0.005	0.009	0.048
Crop Insurance use for crops other than forage	-0.250***	-0.086**	-0.026	0.055*	0.308***
Use of Selected Production Risk Management Practices					
Fertilizer use	-0.111**	-0.042	-0.013	0.026	0.139**
Weed management (herbicide use)	-0.042	-0.016	-0.005	0.010	0.054
Disease management (fungicide use)	-0.013	-0.005	-0.002	0.003	0.017
Insect management (pesticide use)	0.123**	0.047*	0.015	-0.030	-0.156**
Socio Demographics					
Proportion of farmland rented	-0.054*	-0.021	-0.007	0.013	0.068*
Household size	0.057	0.022	0.007	-0.014	-0.072
% Of household income made off farm	0.072**	0.027*	0.009	-0.017	-0.091**

Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

[a] Interpretation: A one unit increase in knowledge level regarding forage results in the producer being 16.0% less likely to never use crop insurance (effect 1), 6.1% less likely to rarely use crop insurance (effect 2), 1.9% less likely to use crop insurance an average extent (effect 3, insignificant), 3.8% more likely to use crop insurance often (effect 4), and 20.2% more likely to use crop insurance very often (effect 5)

[b] Marginal effects are computed at variable means and marginal effects sum to a net effect of zero

Table 3.6 Description of Variables and Survey Response Scores for Use of AgriStability Ordered Probit Model (N = 87)

Variable Names	Mean Survey Response	Description of Variables
Dependent Variable		
To what extent do you currently use the AgriStability program?	3.02	1 = Never,.., 5= Very often
Independent Variables		
Producer Risk Profile		
Individual responsibility for severe farm losses	1.95	1= Government Programs, 2= Government crop and livestock insurance, 3= Individual Risk Management
Previous weather disaster extent of loss	3.29	1= Very negative,…, 5 = Very positive
Perceived inability for forage index insurance to cover losses	0.24	1= Yes, 0= No
Enrollment in forage insurance for all years	0.36	All years=1 Only years when perceived risk is greater =0
Use of Risk Management Programs		
AgriInvest use	3.91	1= Never,…, 5 = Very often
Crop Insurance use	3.18	1= Never,…, 5 = Very often
Forage Index Insurance use	0.39	1= Yes, 0= No
Risk Reduction		
Crop diversification	3.31	1= Never,…, 5 = Very often
Socio Demographics		
Household size	2.61	1=one, 2= two, 3= three to four, 4= five to six, 5= seven or more
Farm size (acres)	2.84	1= 1000 or less, 2= 1001 to 2000, 3= 2001 to 3000, 4= 3001 to 5000, 5= greater than 5000
Age	3.28	1= under 25, 2= 26 to 40, 3= 41 to 55, 4= 56 to 70, 5= 71 and older
Province: Saskatchewan=1 Alberta=0	0.46	1= Saskatchewan, 0 = Alberta

Table 3.7 Estimates for the Ordered Probit Model: Use of AgriStability (N=87)

Parameters	**Estimates**	**S.E.**
Producer Risk Profile		
Individual responsibility for severe farm losses	-0.784***	0.209
Previous weather disaster extent of loss	0.564***	0.179
Perceived inability for forage index insurance to cover losses	0.667*	0.342
Enrollment in forage insurance for all years	0.951***	0.327
Use of Risk Management Programs		
AgriInvest use	0.172*	0.097
Crop insurance use	0.064	0.099
Forage index insurance use	-0.593*	0.337
Risk Reduction		
Crop diversification	-0.190	0.123
Socio- Demographics		
Household size	-0.436**	0.171
Farm size (acres)	0.345***	0.101
Education	0.122	0.174
Province: Saskatchewan = 1 Alberta = 0	0.505*	0.294

Pseudo R-Square

McFadden R^2 0.2062 Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Note: Dependent variable, “To what extent do you currently use the AgriStability program?”

Table 3.8 Marginal Effects for the Ordered Probit Model: Use of AgriStability (N=87)

Parameters	**Effect 1**	**Effect 2**	**Effect 3**	**Effect 4**	**Effect 5**
Producer Risk Profile					
Individual responsibility for severe farm losses	0.238***	0.067**	-0.007	-0.056**	-0.242***
Previous weather disaster extent of loss	-0.171***	-0.048*	0.005	0.040*	0.173***
Perceived inability for forage index insurance to cover losses	-0.175**	-0.067	-0.017	0.033*	0.226*
Enrollment in forage insurance for all years	-0.256***	-0.087**	-0.016	0.048*	0.312***
Use of Risk Management Programs					
AgriInvest use	-0.052*	-0.015	0.002	0.012	0.053*
Crop insurance use	-0.020	-0.005	0.001	0.005	0.020
Forage index insurance use	0.180*	0.050	-0.006	-0.043	-0.182*
Risk Reduction					
Crop diversification	0.058	0.016	-0.002	-0.014	-0.058
Socio Demographics					
Household size	0.133**	0.037*	-0.004	-0.031*	-0.134**
Farm size (acres) [a,b]	-0.105***	-0.029**	0.003	0.025*	0.106***
Education	-0.037	-0.010	0.001	0.009	0.038
Province: Saskatchewan =1 Alberta =0	-0.150*	-0.043	0.003	0.034	0.157*
Note:					$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

[a] Interpretation: A one unit increase in farm size results in the producer being 10.50% less likely to never use AgriStability (effect 1), 3.7% more likely to rarely use AgriStability (effect 2), 0.4% less likely to use AgriStability an average extent (effect 3, insignificant), 3.1% less likely to use AgriStability often (effect 4), and 10.6% more likely to use AgriStability very often (effect 5)

[b] Marginal effects are computed at variable means and marginal effects sum to a net effect of zero

CHAPTER 4
SUMMARY

Problem and Importance

Forage insurance participation rates in Canada are low relative to that of crop insurance for non-forage crops. Forage producers face risks in both production and prices, and while many of these risks can be reduced on-farm, catastrophic risks are difficult to reduce without forage insurance and other risk management approaches. Catastrophic events such as prolonged droughts and disease outbreaks can be costly to cover on an ad hoc basis. An effective means to deal with these catastrophic risks may involve producers reducing risk by participating in available insurance programs such as forage index insurance, crop insurance, and AgriStability.

Objective

The objective of this study is to examine factors affecting the use of risk management programs among forage producers in Alberta and Saskatchewan including: forage index insurance, crop insurance, and AgriStability. This analysis is an effort to provide policy makers with information regarding forage producers' risk management decisions. This study is segmented into two parts. The first part of the thesis examines factors related to the use of forage index insurance. Also, factors related to the willingness to pay for forage insurance are examined. The second part of the thesis examines factors related to the use of crop insurance and the use of AgriStability.

Data and Methodology

A survey was administered with cooperation from the Alberta Beef Producers and the Saskatchewan Cattleman's Association. A questionnaire was conducted both online and in person, and a total of 87 responses were used for this analysis, and 47 responses were collected from Saskatchewan producers and 40 from Alberta producers. The responses were primarily from beef cattle and forage producers, except for a small number of dairy producers. Ordered probit models and binomial probit models are used for the analysis.

Results

In the first part of the thesis, two models were examined. The first model explained factors affecting the use of forage index insurance, and the second model explained factors affecting the willingness to pay for forage insurance. Results show that Producers who used forage index insurance more often maintained less forage inventory, were younger, had greater perceived weather risk, and had higher knowledge and more positive attitude levels towards forage insurance. Producers who had a greater willingness to pay for forage insurance had higher operating costs, no off-farm income, and higher knowledge and more positive attitude levels toward forage insurance.

In the second part of the thesis, factors affecting the use of crop insurance and AgriStability were examined. Producers who used crop insurance more often had a higher proportion of rented farmland, a smaller share of off-farm household income, and higher levels of knowledge and more positive attitude levels toward forage insurance. Additionally, producers who use AgriStability more often had larger farms, had smaller households, had a recent large production loss, and enrolled in forage insurance regularly. This information may be useful to policy makers who are interested in increasing participation rates among forage producers for forage index insurance, crop insurance, and AgriStability.

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