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- A survey among Swedish farmers

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Abstract

Farmers are constantly facing changes, and the exposure to risk requires monitoring these changes. Financial risks, institutional risks, market risks and production risks are the different risk categories that the farmers face. Production risks stems from factors the farmer cannot affect or is beyond his control. The crop's output is the basis for the primary income of agricultural operations, which is why it is important for farmer to manage their production risk.

A tool to reduce the consequences of production risks is crop insurance. In a global perspective, governments manage production risk in many different ways. Some countries provide compensation for yield loss and some subsidized crop insurance programs. Some countries, including Sweden, have submitted the responsibility to the private sector which provides the agricultural sector with crop insurances.

Swedish farmers have faced a larger variation in yield levels which indicate a higher risk exposure. This may depend on changes in the climate. The range of crop insurance in Sweden is limited to reseeding and hail insurance provided by private companies. Since the Swedish farmer is constantly exposed to risk, an incentive for them is provided to use crop insurance can be observed. Hence the he purpose of this study is to identify the factors that are associated with the Swedish farmers' choice of crop insurance.

To evaluate the Swedish farmers' decision to use crop insurance the expected utility theory is used. A model is developed to evaluate the factors that may affect the choice to purchase or not. The factors affecting crop insurance use have in this study been divided into three different categories; social factors, business related factors and preferences and perceptions. A survey was conducted of Swedish farmers to identify factors that were analyzed with the logit method.

The results show that the statistical significance level differs greatly between different attributes with each category. The business related factors indicate that larger farms and farms with grain production as primary crop to a greater extent use insurance. Farmers with high level of diversification do not use crop insurance to the same extent as less diversified. This indicates that farmers with high risk expose are more likely to acquire insurance. The design of the insurance product is also found to be important for the insurance decision.

Farmers that use insurance perceive that their yield level is higher than the average for their region. They also perceive a higher level of yield risk compared to uninsured farmers. The social factors, age, education and years of farming as well the farmers' risk preferences do not indicate any statistically significance for the crop insurance decision.

Sammanfatting

Lantbrukare påverkas ständigt av förändringar och exponeringen av eventuella risker kräver att dessa förändringar övervakas. Finansiella risker, institutionella risker, marknadsrisker och produktionsrisker är olika kategorier av risker som lantbrukare kan ställas inför. Produktionsrisker uppstår av faktorer som lantbrukarna inte kan påverka själva eller som är utanför deras kontroll. Produktionen från grödorna är basen för den primära inkomsten för jordbruksverksamheten. Därför är det viktigt för lantbrukare att kunna hantera eventuella produktionsrisker.

Ett verktyg för att reducera konsekvenserna av produktionsrisker är grödaförsäkring. Från ett globalt perspektiv, hanterar regeringar produktionsrisker på olika sätt. En del länder tillhandahåller kompensation för skördeförlust medan andra länder subventionerar grödaförsäkringsprogram. Vissa länder, inklusive Sverige, har lämnat ansvaret till den privata sektorn som tillhandahåller jordbruket med grödaförsäkring.

Svenska lantbrukare har mer och mer upplevt större variationer i skördekvantitet, vilket indikerar en högre utsatthet för risk. Detta kan exempelvis bero på förändringar i klimatet. Utbudet av grödaförsäkringar i Sverige är begränsat till omsåddsförsäkring och hagelförsäkring från privata företag. Eftersom svenska lantbrukare konstant är utsatta för risk, har det uppstått behov för dem att använda grödaförsäkring. Därför är syftet med denna studie att identifiera de faktorer som associeras med svenska lantbrukares beslut om grödaförsäkring.

För att undersöka svenska lantbrukares beslut att använda grödaförsäkring används förväntad nyttoteori. En modell upprättades för att undersöka vilka faktorer som kan påverka beslutet att teckna försäkring eller inte. Faktorerna som påverkar användningen av försäkringar är i den här studien indelade i tre kategorier; sociala faktorer, företagsrelaterade faktorer samt preferenser och uppfattningar. En enkät skickades ut till svenska lantbrukare för att identifiera faktorerna. Dessa analyserades sedan med logit modellen.

Resultaten visar att den statistiska betydelsen av olika faktorer skiljer sig åt. De företagsrelaterade faktorerna indikerar att användningen av grödaförsäkring är mest frekvent på större gårdar med spannmålsproduktion. Lantbrukare med hög grad av diversifiering använder inte försäkringar i samma utsträckning som de mindre diversifierade lantbrukarna. Detta indikerar att lantbrukare med högre utsatthet för risk är mer villiga att teckna försäkring. Det visar sig också att utformingen av försäkringsprodukten är viktig för beslutet att teckna försäkring. Lantbrukare vill ha möjlighet att få ett omfattande försäkringsskydd.

Denna studie visar att lantbrukare som använder försäkringar upplever att deras skördenivå är högre än den normala för regionen. De upplever också en högre skörderisk jämfört med oförsäkrade lantbrukare. De sociala faktorerna ålder, utbildning och antalet år som lantbrukare, har ingen statistik betydelse för beslutet att teckna grödaförsäkring. Lantbrukarnas riskpreferenser visar sig heller inte ha någon statistisk betydelse.

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1 Introduction

In this chapter an insight is given about the subject and starts off with a presentation of the problem background, followed by a problem, aim and delimitations. Finally, an outline of the disposition is shown.

1.1 Problem background

The Swedish agricultural sector has been characterized by structural changes. The trend has been that the number of farms has continuously decreased and the average farm size has increased (Johansson, 2011). The farmers act in a world subjected to continuous changes and the farmer as a decision maker faces different risks each day (Boehlje & Eidman, 1984). There are many factors that affect the grain farmer's risk and income, which then affect farmers' choice in different situations that involve risk. It may for example be undesirable rain, decreased prices, machinery problems and political changes (Hardaker *et al.*, 2004).

The bank loans for Swedish farmers have doubled during an eight year period. In 2012 it increased with 6%, which has resulted in a total lending of 259 billion Swedish SEK (LRF konsult, 2014). The cost of inputs for crop farms has also increased in the last few years (SCB 1, 2013). The Swedish Board of Agriculture production price index shows that the price for the total intermediate factor has increased by 32% since 2005 (www, SJV 1, 2014). Variation in harvest for winter wheat since 1990 has also increased (www, SJV 2, 2014). Between 1990 and 2000 the average standard deviation in yield of winter wheat was about 320 kilos per hectare. From the year of 2000 until today the average standard deviation in yield is 520 kg per hectare. Hence the average standard deviation increased with about 200 kg per hectare. The variations in harvests are shown in Figure 1.

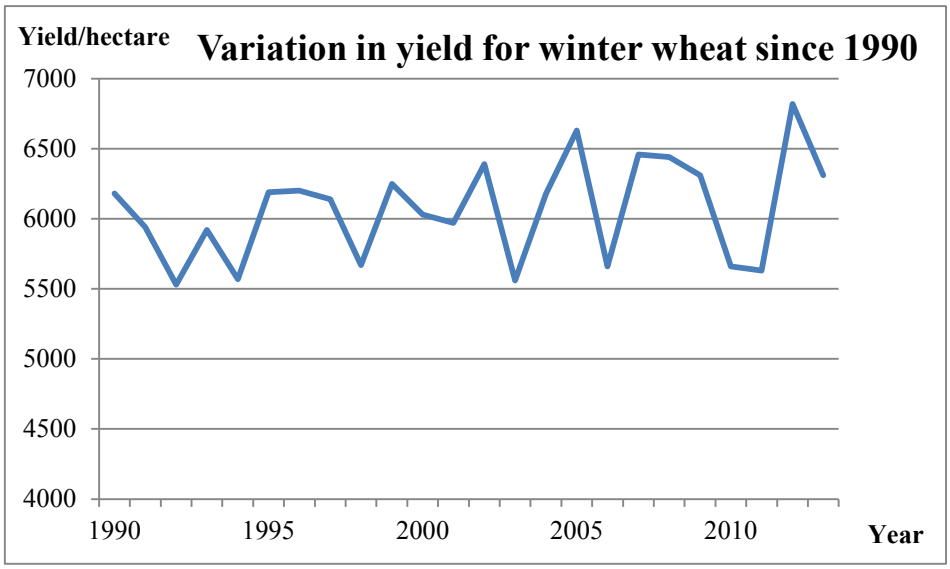

Figure 1. Variation in harvest for winter wheat since 1990 to today, based on average total yield of Sweden (own processing based on www, SJV 2, 2014).

Climate change is expected to result in large variations in the weather, which makes it more difficult for the farmers to plan their business (Albertsson *et al*. 2007). More extreme weather with a higher risk of crop failure and dry periods may be more common, which may result in higher risk exposure to crop disease. Based on the unpredictable conditions, farmers take a risk every time he/she plants a crop (Drollette, 2009). These unpredictable risk conditions can

lower the farmers' production levels significantly. The crop's output is the basis for the primary income of agricultural operations, which is why it is important for farmer to manage their production risk. Farmers try to decrease risk (Hardaker *et al*., 2004) and reducing production risk can be achieved by different management tools (Boehlje *et al.,* 2005). Some of them are available within the household/community and some are supplied by the private sector. In general, farmers normally begin using the tools available at farm level, e.g. crop rotation, plant protection techniques, product diversification or use new technology. To reduce production risk further, crop insurance supplied by the private sector is a common tool. These methods may not necessarily be the factors that maximize profits, but they may decrease the risk for possible losses (Boehlje & Eidman 1984). A skilled farmer thus succeeds in "smoothing out" any peaks and valleys in his performance over the years.

1.2 Crop insurance

Crop insurance has been used for a long time and was developed over 200 years ago (Smith & Glauber, 2012). It started as private insurance funds, which offered protection for livestock and perils, such as hail insurances. Though crop insurance has been available for a long time, it has primarily been used in developed countries. However, during the last 50 years the supply and the design of the insurance products have been subjected to vigorous extensions. A major reason for the change is government intervention in terms of premium subsides and support programs. The US is the largest market for crop insurance and has among all countries the biggest impact of government support. Nowadays, many countries in Europe have similar programs with government support and proposals within EU suggest expanded risk management programs *(ibid)*.

Insurance policies in the agricultural sector are quite similar to any other insurance (Smith & Glauber, 2012). Premiums from the customers have two purposes; cover the cost of losses to the clients and cost of administration. Agricultural firms face several different insurance solutions depending on what they want to assure, where yield and price are the most common insurances. Though yield, price and catastrophic insurances are most common in the EU, other solutions such as revenue, income and re-insurance are available as well but mostly in US *(ibid)*.

Yield insurance is best suited for crops (Smith & Glauber, 2012). In livestock production, it is difficult to measure the level of yield. The yield of crops is often insured for virtual and named threats such as hail. The insurance includes yield guarantee based on individual historical facts or regional average yield.

The insurance provisions in a country are a function based on the state´s willingness to subsidize (Raviv, 1979). A higher level of economic wealth in a country usually provides a higher level of insurance cover than developing countries. The reason for this phenomenon is the range of infrastructure. Developed countries tend to have greater access to data and information which is a requirement in order to offer stable insurance policies.

In developed countries, the range of agricultural policies can be classified into three categories. Specific or named peril products: The insurance, which is common in Western Europe and in Sweden, cover the losses from a specific threat such as hail or fire, and is mainly offered by private companies (Raviv, 1979). The reason why the private sector has been providing this product is that it is a relatively straightforward insurance and simple

product. In some states though, such as the US and France, the government offers subsidized specific peril insurances.

All-risk or multi-peril products provide crop insurance coverage for many types of perils, but there is no specification of perils (Raviv, 1979). Both revenue and yield insurance is often included in this product. The indemnity of revenue is based upon historical observations such as historical yields and market contracts. Compensation for yield insurance is given only if the yield is less than the trigger value levels that were determined when the producer signed up for the insurance. Standard production is a requirement to contract this coverage. Multi-peril is a costly insurance for the companies to administrate. Monitoring problems like moral hazard and adverse selection are economically irreparable (Smith & Glauber, 2012). Studies from US and Spain show that at least 40 % of the fair premium has to be subsidized to obtain 50 % participation levels (Goodwin & Smith, 2010). Hence, the private sector has found it difficult to offer this product.

Index-based products: is a product that the farmers use to protect their crops and the compensation is based on a weather, area or satellite growth index (Smith & Glauber, 2012). Index-based insurance has proven to be less successful. The compensation for loss is hardly ever consistent with the farmer's actual loss. The range of index-based insurance decreases because of the poorly compliant compensations and that subsidized all-risk insurances have been shown to give higher level of insurance coverage with lower premium.

1.3 Agria

Agria is an insurance company, which provides insurance coverage for livestock and crops (www, Agria 1, 2014). The company was founded in the 1890´s as a cattle and horse insurance company in Scandinavia and during the 1900´s pets became an insurance product. In 1992 Agria became a 100 % subsidiary company of Länsförsäkringar AB, which is the hub of the Länsförsäkringar Alliance (www, Lansforsakringar, 2014). Länsförsäkringar Alliance is customer-owned by 23 regional insurance companies with a total of 3,4 million clients. The Alliance offers non-life insurance, life insurance and banking services, real-estate brokerage and other financial solutions for both private and corporate customers. Agria is also Länsförsäkringar AB´s subsidiary, which is specifically oriented toward livestock and crop insurance.

Agria offers insurance within five different areas divided into dogs, cats, other pets, horses and agriculture. Agria Agro insures livestock and crops. Contemporary available insurances for crops as of today are hail and reseeding, e.g. sand drifting, frost and drought (www, Agria 2, 2014). The hail insurance compensates for average rates for production loss, while the reseeding insurance covers the cost of reseeding the original crop.

1.4 Problem

Agriculture is a vulnerable sector, especially in terms of risk (Boehlje *et al.,* 2005). Member states throughout the EU are handling the uncertainty with risk of various ways. Some provide subsidized insurances and others privately funded, e.g. whereas the best tool for handling risk management is probably insurance (Smith & Glauber, 2012). Because the agricultural sector is susceptible to systematic risk, many suffer big losses all at the same time (Drollette, 2009).

In 1928, the Swedish government introduced crop damage protection with the objective to give farm enterprises a financial protection against harvest losses (Statens oficiella utredningar, 1979). After the decision to deregulate Swedish agricultural policy in 1990 the crop damage protection disappeared (SLI Skrift, 2005). Today there is no government crop damage protection. Instead, insurance companies have developed different types of crop insurance (www, Agria, 2014). The provision of agricultural insurances in a country is a function due to the following reasons; the government's willingness to subsidize, infrastructure to provide market insurance, and data and information available, as a requirement to provide insurance. Developed countries are more willing to subsidy agriculture insurance. The reason is that developed states in general have more financial resources and the information is more accurate. Table 1, below, shows which type of insurance policy that the developed countries use. Mpci in the table means multi-peril crop insurance.

Table 1. The extent of agricultural insurance in some developed countries (Own processing based on Mahul & Stutley, 2008).

Country	**Crop-hail/named peril**	**Mpci**	**Revenue**	**Livestock**	**Index-based**
Subsidized					
Austria	X	X		Mortality	
Canada	X	X	X	All risk	Crops
Czech Republic	X				
France	X	X		Mortality	Crops
Israel	X			Mortality	
Italy	X	X		Mortality	
Japan	X	X		All risk	
Portugal	X	X			
Slovenia	X			All risk	
South Korea	X	X		Mortality	
Spain	X	X		Mortality	Crops
Switzerland	X	X		Mortality	
United States	X	X	X	Price/margin	Crops, rangeland
Unsubsidized					
Australia	X			Mortality	
Germany	X	X		All risk	
Greece	X			All risk	
Hungary	X			Mortality	
New Zealand	X			Mortality	Crops
Sweden	X		X	Mortality	
The Netherlands	X			Mortality	

Given this information, Sweden is a unique country in terms of agricultural insurance. A wealthy state where the government interferes in many sectors of the economy (Mahul & Stutley, 2008). However, there is no subsidized insurance program offered for the case of crop insurance. The assistance tool from the government in the agricultural sector is limited to public disaster assistance programs in livestock production. Despite this, the extent of crop insurance in Sweden is extremely high. Three competing private companies provide the insurance. Insurance products available in Sweden are shown in Table 2.

Table 2. Insurance products available in Sweden (own processing based on Mahul & Stutley, 2008).

MPCI'	Crop revenue	Public support	Premium Subsidies	Public cost
No	Yes	No	No	No

There are a few studies concerning what factors affect crop insurance decisions. Barry *et al*. (2004) evaluated factors influencing farmers' crop insurance decisions for crop farmers in Illinois, Iowa, and Indiana. The findings reveal that larger, less tenured, older, more highly leveraged farms and farmer with a higher level of perceived yield risk are more interested in using crop insurance. Similar studies have also been conducted in developing countries, such as India, Ethiopia and Bangladesh, and in some European countries (Shaik *et al*., (2008).

The changes in the agricultural market, climate conditions, financial position, farm size and unpredictable conditions that have affected the production conditions last years have resulted in the Swedish farmers acting in an environment subject to continuous change. It is important for a company that wants to be competitive that the company is aware of its environment and always tries to adapt to it (Johnsson *et al*. 2011). The environment is always subject to changes. Changes include for example technology, regulations, structural change, increasing average farm size, market demand and new competitors. It is therefore important to understand the changes in the company's environment to satisfy the customer's needs.

As mentioned in the introduction average variation in winter wheat yields has increased and the variation in yield between two single years has increased. Hence, the production risk for Swedish farmers has increased (www, SJV 2, 2014). Sweden is one of few countries that do not provide public subsidizes for a crop insurance (Mahul & Stutley, 2008). Swedish farmers' use the private sectors instruments to manage risk, which may have a potential impact to reduce the cost of transferring risk (Boehlje & Lins, 1998). If a farmer purchases an insurance or not has therefore an impact on their business and financial risk (Boehlje *et al.,* 2005). Farmers try to decrease their business risk by choosing a risk management tool (Hardaker *et al.* 2004). The choice of risk management tool is a complex decision for a farmer to make and due to the farm business, it is fundamental for the viability (Hansson & Lagerkvist, 2012). The level of risk in the business may for example have impacts on the lender willingness to lend money, which is why a farmer that uses risk management offers lower risk to the bank (Boehlje *et al.,* 2005).

To find out what factors determine the decision to purchase insurance as a risk management tool is complex. Hence, differences between in farmers' operating conditions may have an impact on their insurance decision (Barry *et al.* 2004). To explain the differences the expected utility theory is often used, which is one of the most common theories describing the farmers decision under risk (Barry, 1984). Theory shows that there is an advantage to purchase insurance, if it is based on a perfect product, but in the real world it may be otherwise. To explain the factors importance is crucial to understand the crop insurance decision, a theoretical model is developed. Previous studies have been able to present a pattern of what factors that are of importance to the decision. Swedish insurance companies offer the same product regardless of location (www, Agria 2, 2014). This may explain why insurance products are absent in the market, due to various factors that affect the decision. Differences could occur between insured and uninsured farmers. An important task is therefore to evaluate which factors affect farmers' choice to purchase crop insurance in a Swedish context.

1.5 Aim

The aim of this study is to examine what underlying factors that are associated with crop insurance decisions among Swedish farmers. Furthermore, the aim is to investigate their perceptions about crop insurance. The objective is to develop an understanding of characteristics of the choice of purchasing insurance. The intension is to evaluate differences between insured and uninsured farmers. If there are any differences, these will provide valuable knowledge about what characteristics that are important for farmers in their decision concerning crop insurance.

The research question is:
Which factors are associated with the farmers' choice to sign up for crop insurance and how do these factors affect the decision?

The novelty of this study is to measure the importance of forest holdings and organic production. The farmers in this study also grow several types of crops than respondents in the American studies, which major crops are corn and soybean.

1.6 Delimitations

This study examines the Swedish farmers' use of a management tool such as insurance. The study does not evaluate the insurance use in the northern regions of Sweden. The major grown crop in that region is forage (SCB 1, 2013) and forage is not possible to insure today (www, Agria 2, 2014). The study is mainly based on studies from US, but also some from EU. Since many countries have subsidies for crop insurance and the major growing crops in US are corn and soybean. This makes the American and Swedish insurance market not fully comparable.

1.7 Outline

The study is structured according to the following. Chapter 1 present the problem background, problem, aim and delimitation, while chapter 2 provides the literature review. The literature review is divided into the areas of risk, risk in agriculture, production risk, risk management, factors affecting the decision to use crop insurance. Finally, a table summarizing all the literature is presented. Chapter 3, include the theoretical framework of the study, and serves as a basis for the questionnaire sent to the respondents. Chapter 4 presents the statistical method used in the study and issues of the course of action is argued. In chapter 5 a background for the empirical study is given. Empirical results from the survey are presented in chapter 6, followed by analysis and discussion in chapter 7. Finally, in chapter 8, conclusions and ideas for future research are presented.

2 Literature review

In chapter two a literature review based on previous research is presented. At first, a presentation about risks and risk management in agriculture introduced and concludes with a review about which factors that affects the decision to use crop insurance.

2.1. Risk

Risk can be defined as "*The potential loss of equity capital. Risk has two components: uncertainty and exposure. If both are not present, then there is no risk. For risk to materialize there should be exposure to the uncertainty"* (Parihar, 2003 pp. 31).

The terms risk and uncertainly are two definitions which are easy to mix up since they are also similar to each other and hard to interpret (Hardaker *et al.,* 2004). According to Newberry and Stiglitz (1981) risk can be divided into systematic, nonsystematic and disastrous risks. *Systematic risk* is related to events that recur over time and with a pattern that can be measured by probabilities. It can be analyzed to get an estimation of the probability of different outcomes that may occur. *Nonsystematic risk* is when the risk is characterized by little knowledge about the events. It is therefore difficult to estimate the probabilities of the event to occur. *Disaster risks* are risks associated with an event that happens with low frequency but has a big impact when it does happen.

2.2 Risk and risk management in Agriculture

Famers are well aware that they are involved in a sector with high extent of risk (Hardaker *et al.,* 2004). Farmers have adapted their production and economic decision to the level and type of risk they are exposed to (Hansson & Lagerkvist, 2012). One reason can be that governments eliminate some sources of risk through programs, both in the EU and USA such support programs exist (Hardaker *et al.,* 2004). However, the World Trade Organization (WTO) has launched trade negations with the purpose to reduce the level of price supports member states providing their producers. This type of liberalization is considered as risk an increasing action. Many farmers will in the future, face a greater exposure to risk because of the forces in a more competitive market.

Risk in the agricultural sector has traditionally been classified into the categories production risk, financial risk, market risk and institutional risk (Boehlje *et al.,* 2005). Another classification that risk and uncertainty can be categorized into is strategic and tactical risk. The tactical risk includes business risk and financial risk, which are the traditional risks perceived by agribusiness firms and farmers. Business risk is defined as "*the inherent uncertainly in the performance of the firm independent of the way it is financed"* (Boehlje *et al.,* 2005, pp. 23). Business risk includes price risk, production risk, and a number of factors influencing the variations. The strategic risk is associated with strategic decisions, ineffective strategy implementation and uncertainties in the firm's business climate. It is easier to manage tactical risk than strategic risk, because there is information available to measure these risks. These risks are also possible to transfer to others through some available risk management instruments, such as futures market and insurance for production risks. Many risks in agriculture are difficult to quantify. Boehlje *et al.,* (2005) states that despite the possibility of measuring risks objectively, it is important not to ignore more subjective risks that facing business even if they are more difficult to quantify.

Individuals have different preferences towards risk (Pindyck *et al.,* 2005). One of the most common risk preference when farmers face risky wealth outcomes is risk aversion. People mostly dislike risk and they are therefore willing to reduce the level of an expected return to be able to reduce their risk. Which actions a farmer chooses depends up explore the farmer's degree of risk aversion. For example, their willingness to purchase a certain insurance will be determined by their choice of a more diversified production system or choice of marketing strategies may reflect their degree of risk aversion.

2.2.1 Production risk

Production risk originates from factors the farmer cannot affect or are beyond his control (Hardaker *et al.,* 2004). Farmers have made an effort to make their business less risky in many ways, e.g. by improved production control (Hardaker *et al.,* 2004). One of the production risks that are common to reduce by insurance is weather risks, since this risk is difficult for farmers to influence (The World Bank, 2011).

Weather risk is one type of production risk affecting agriculture (The World Bank 2011). The effects of the weather are difficult to generalize because of the complexities in the global climate. The climate has an important effect on the yield and crop growth at the field level (Selvaraju, 2010). Specific agricultural systems and local conditions influence the impact of the weather, for example kind of crop and soil, water balance and risk management tools (Selvaraju, 2010, The World Bank, 2011). Poor infrastructure like poor drainage, access to irrigation, and mismanagement are also factors that influence the effects (Selvaraju, 2010, The World Bank, 2011). The agricultural risk assessment depends on the timing of the loss according to the agricultural calendar (The World Bank, 2011). The reason for this is that the crop vulnerability differs depending on season and growth stage. Many types of weather risks to consider are unforeseeable sudden events like hail, heavy rain, windstorm or frost. Cumulative events caused by variations during a long period can result in floods, winter freeze (winterkill) or scabbing. Another type of production risk is pests and diseases that may occur due to climate change. The risks from the climate can alter other risks, such as financial risk (Selvaraju, 2010).

2.3 Review of factors affecting crop insurance decisions

Several studies concerning factors affecting farmers' decision due to use crop insurance have been conducted. Here follows a presentation of some of studies.

Barry *et al.,* (2004) evaluate the demand for crop insurance in their study "Factors influence farmers' crop insurance decisions" by using expected utility theory. The basis of the theory is that farmers expect a larger utility while having insurance, compared to the utility when not having access to insurance. In the study a survey questionnaire was sent out to farmers in Illinois, Iowa and Indiana with corn and soybean as primary crops. The survey includes questions about demographic, business information, risk attributes, risk management and other similar subjects. Since these demographic and socioeconomic factors like age, education, farm size, debt use, geographic position, yield risk, experiences and tenure can affect the risk preferences these determinants should also be considered at a crop insurance usage. In the study, the Likert scale was used where farmers define their own view of risk and risk management options by choosing an alternative on a scale from 1 to 5. Findings show that business factors and personal factors influence the farmer's risk and willingness to have an insurance. The results show that the likelihood for using crop insurance is higher for older,

less tenured, larger, highly leveraged farms and by farmers that perceive higher level of yield risk. The study also shows that the level of insurance depends on the farmers risk preferences.

The choice to purchase an insurance also depends on the premium level, expected indemnity, risk level and availability of alternative risk management tools (Makki & Somwaru, 2001). A study made by Ginder & Aslihan (2006) shows that the price of the insurance is the most influential factor determining the farmers decision to have insurance or not and what type of insurance product that is chosen.

In a study made by Shaik (2008), the farmers' demand for insurance is analyzed by estimating the price elasticity for demand. The choice to purchase insurance or not is based upon the expected utility theory and the farmers' risk preferences. Even in this study, a survey was sent to a number of farmers and the data that was received were subjective. The findings revealed that the farmers that perceive a greater yield risk are more interested to buy insurance. Farmers who perceive higher expected yields are less likely to insure. Other results stemming the expected utility theory, like wealth and risk aversion, are not found to be statistically significant. The writers' explanation for that these factors not are statistical significant with the choice to insure, is that the highly subsidized reduce the risk preferences roll in the decision.

A study made by Adinolfi *et al*. (2012) evaluates crop insurance in France and Italy, and shows that weather conditions has less influence on the farmers' insurance decisions. They find that business related factors such as farm size, the number of crops grown and the premium levels influence the farmers' insurance decisions. Even in this study, the choice was based upon the expected utility framework. Smith & Baquet (1996) evaluate the demand for multiple peril crop insurance for wheat farm in Montana. By using expected utility theory, they found that the premium levels, high level of debt use, expected yield and perceived yield risk influence the crop insurance decision.

In another study by Barry *et al*., (2003) a two stage process was used, where the first step is the decision to have an insurance or not and the other step is to choose which crop insurance product to use. In the study, the farmers had to choose between eight insurance products with different attributes. The study shows that farmers' preferences for insurance affect the choice to purchase crop insurance or not. Farmers want to be flexible in terms of freedom to select acreage to be covered under the insurance. This would make it easier for farmers to effectively use the insurance to match the acreage of risky areas. Insurance is also preferred by young farmers, farmers with large farms and farmers with geographically dispersed acreage. Another finding is that future work should address the complex relationship between farmers' preferences for crop insurance and the subjective perception of the risks they face. How well their beliefs correspond to actual yield risk could also be an important explanation to the use of crop insurance. The results from earlier studies are summarized in Table 3.

Table 3. Presentation of previous studies results, theories and methods (own processing).

	Barry *et al.,* 2004	Shaik *et al.,* 2008	Smith& Baque, 1996	Makki & Somwaru, 2001	Adinolfi *et al*. 2012	Barry *et al*., 2003
Farm size	**X**				**X**	**X**
Debt use	**X**		**X**			
Tenure land	**X**					
Geographic position	**X**					
Perceived yield risk	**X**	**X**		**X**		
Age	**X**					**X**
Education	**X**					
Experiences	**X**					
Diversification					**X**	
Risk attitude	**X**		**X**			
Expected yield		**X**	**X**			**X**
Premium levels			**X**	**X**	**X**	
Insurance perceptions						**X**
Theory	Expected utility theory	Demand elasticity Expected utility theory	Expected utility theory	Artificial neural network (ANN) models	Expected utility theory	Considered known
Method of data collection	Mail survey	Mail survey	Mail Survey	Historical data from U.S Department of Agriculture	Mail survey	Mail survey

Here follows a presentation of factors influencing the farmers' crop insurance decisions according to the literature.

- **Age, education and experiences**

Older farmers with a higher level of experience and education a more positive to insurance and sophisticated methods to risk management (Barry *et al*,. 2004). This can lead to better precision in risky situation and changes in risk preferences for an improved risk carrying capacity. This group of policyholders has more experience and use more sophisticated methods to calculate risk and possible outcomes. A high level of education and experience indicate more sophisticated risk management tools.

- **Farm size**

Farmers who have larger average acres have higher risk exposure and tend to use crop insurance more often (Adinolfi *et al*., 2012). Greater managing capacity and utilize economies of scale can be reasons for that (Barry *et al*., 2004). Farmers with more hectares have a greater yield requirement and future debt load. These are reasons why they need to reduce the risk. Large farms has also in general taken large investments that increase the rate of return in order to pay offs and rates, since the risk exposure may increase.

- **Debt use**

Farmers with a high debt ratio use insurance more frequently (Barry *et al*. 2004). The reason is the exposure to financial risk that requires a higher level lowest of yield to secure the ability to pay financial costs.

- **Tenure land**

Farmers with a high level of ownership of land tend to have a greater stability in access to land (Barry *et al*., 2004). They have a higher wealth level and therefore less likely to be exposed to financial risk and therefore have less incentive to carry insurance. Farmers with a lower share of tenured land have a greater need for insurance.

- **Geographic position and local conditions**

The geographic position affects what kind of climate the crops are exposed to (The World Bank, 2011). The local conditions for example what type of soil and need for water influence the crop insurance decisions (Barry *et al*., 2004).

- **Off-farm income**

Off-farm income can be expected to stabilize the overall income from the livestock and crop production (Barry *et al.,* 2004). Off-farm income can be viewed as a diversification tool in the agricultural sector. Barry et al., (2004) found that off-farm income did not have any positive impact with the decision to insure.

- **Expected yield**

The expected yield may be assessed by asking the farmers about their subjective perception about the yield level (Shaik *et al.,* 2008). Shaik *et al.,* (2008) find that farmers that perceive a high level of expected yield are less willing to purchase crop insurance. The differences in expected yield may indicate variations in soil quality and management skills (Barry *et al.,* 2004). Farmers with high expected yield also have a higher expected income. Differences in these factors may indicate differences in yield risk, which may affect insurance use.

- **Perceived yield risk**

The farmers have a greater risk to be subjected of negative weather, pests or deceases (The World Bank, 2011 and Selvaraju, 2010). Farmers that perceived a higher level of yield risk are also more willing to purchase crop insurance (Shaik *et al.,* 2008*)*. In this case, it is also interesting to examine which factors/risks that affect production risk the most (The World Bank, 2011)

- **Diversification**

There are other ways then purchasing insurance to manage production risk (Boehlje *et al.,* 2005). Farmers may diversify their business in many ways for example by off-farm income, number of crops grown, hedging and increase the number of enterprises on the farm.

Diversification is one way to decrease risk exposure. Adinolfi *et al.,* (2012) show that a high degree of diversification is associated with a low degree of insurance use.

- **Risk preferences**

Risk preferences affect the choice to purchase insurance (Barry *et al.,* 2004). According to the expected utility theory, the utility function depends on risk preferences (Pindyck and Rubenfield, 2005). Farmers are normally risk averse and such an individual strive to reduce risk (Hardaker *et al.,* 2004).

- **Insurance perceptions**

The properties of the insurance have an impact on if the farmer purchases crop insurance (Barry *et al.,* 2003). Farmers may desire crop insurance that offers a greater flexibility in the choice of insurance. In addition, the cost of the insurance is important. Adinolfi *et al*., (2012) as well as Smiths and Baque (1996) have also found that the premium rate of the insurance is one important factor for the farmers choice of crop insurance. There is critical to has low cost of production to be comparative in a commodity industry. So in the study, several questions about the framers crop insurance perspective were asked.

3. Theoretical framework

The following chapter summarizes the theoretical framework used in the study, which also serve as a basis for the questionnaire sent to the respondents. The chapter ends with a model that is used to define the factors affecting a farmer's decision to use crop insurance.

3.1 Expected utility theory

Expected utility theory is a common-used theory describing decision making under risk (Barry, 1984). It is a common theory describing the complexity about insurance (Pindyck and Rubinfeld, 2005). The theory assumes the decision maker as a rational person who chooses actions that maximize his/her expected utility in a specific situation. The different actions, in this case purchasing an insurance, are based upon the decision makers' individuals preferences. The utility function is used to describe the decision makers' preferences towards additional income. The decision makers' amount of uncertainty is based upon his or her expectations and this is expressed as probability density functions, which serve as a basis in the objective or subjective concepts of probability.

The theory is based on assumptions about that i) the decision maker is aware of his/her goals, aims and values, ii) that these are clear and stable over time and that iii) the decision maker has a fix number of alternatives for which the consequences and the risks are known (Hardaker *et al.,* 2004).

The preferences towards income/wealth vary between decision makers (Varian, 2006). The preferences are described based on the decision makers risk preferences and are divided in risk aversion, risk neutrality and risk preferring attitude (Barry, 1984), see Figure 2.

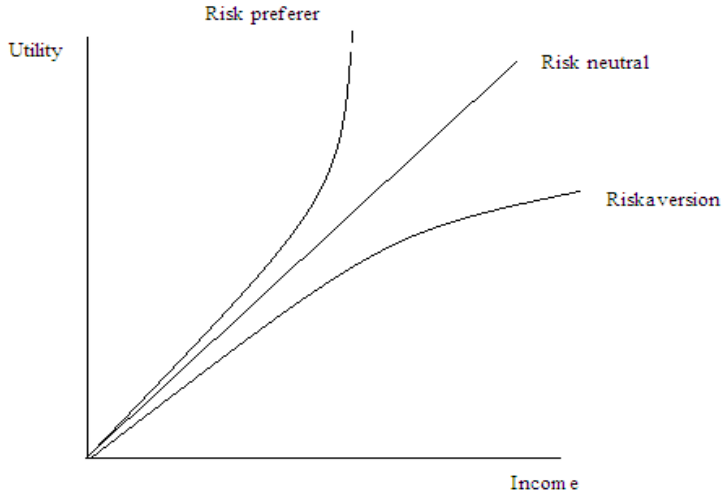

Figure 2. The utility function for different preferences concerning risk (own processing based on Barry, 1984).

The figure shows the decision maker's preferences towards risk (Barry, 1984). A concave function describes a risk averse person, who is trying to avoid risk. The individual is identified as a careful person who prefers less risky income sources (Boehlje and Eidman, 1984). A risk averse individual is also characterized by sacrificing some of the expected income and instead reduce the risk for low income and losses of adverse income. A risk

averse individual will choose a certain alternative before an uncertain, if the expected utility is the same for the two alternatives (Barry, 1984). A linear utility function shows a risk neutral individual. Individual is indifferent between different kinds of outcomes in terms of risk exposure (Barry, 1984). A risk neutral person chooses the alternative that gives the highest expected value irrespective of what kind of uncertainty affects the alternative (Boehlje and Eidman, 1984). The convex function shows a risk preferring attitude where risk increases with income (Barry, 1984). The risk lover prefers in a situation with similar expected value, the alternative with the highest probability of a higher value. This also implies that there is a substantial probability to receive a low value (Boehlje and Eidman, 1984).

The literature shows that farmers are often risk averse, but it is important to add that the attitude towards risk is different between individuals (Hardaker *et al*., 2004). Risk preferences differ between individuals and depend on social factors like age, experiences, and education, see figure 6 in section 3.3. Farmers' preferences to risk also depend on the individuals' goal and financial position (Boehlje and Eidman, 1984).

The farmers' risk preferences affect the farmers' decision about insurance (Pindyck & Rubinfeld, 2005). Since demographic and socioeconomic factors such as age, education, farm size, debt use, geographic position, yield risk, experiences and tenure may affect the risk preferences, these determinants should also be considered to affect crop insurance decision (Barry *et al.,* 2004). The decision to purchase an insurance or not vary for every farmer and depends upon their unique financial risk, business risk and risk aversion (Barry *et al.,* 2004). The effects of crop insurance are also specific for each producer according to the farmers' system and yield history.

The choice to purchase insurance is described by Figure 3. The producer has an expected wealth income, $\overline{X}$ which vary between X_1 and X_2, which is the variation between the maximum and minimum income (Varian, 2006). The values of X_1 and X_2 are affected by business related factors such as farm size, geographic position, diversification e.g. since this business related factors affect the yield levels. These factors are presented in Figure 5 in section 3.3 (Barry *el al.,* 2003). If the gap between X_1 and X_2 increases then the willingness to buy insurance increases.

The premium of the insurance is μH for a specific acreage H hectares, which is illustrated as the difference between X and X_{ce}, see figure 3. The difference between $\overline{X}$ and X_{ce} is affected by the factors' preferences and perception, see Figure 5. This preferences and perceptions are influenced by the social factors (Pindyck & Rubinfeld, 2005).

The loss, L, is given by $\overline{X} - X_1$. The probability for a loss to occur is π and the loss is affected by the production risk (Varian, 2006). When a loss occurs, the insurance is expected to give a return, R, which is the distance between X_1 and X_{ce} and this return depends upon the specifics of the insurance product. This means that the wealth, S, in the situation with no loss is $S_1 = \overline{X} - \mu H$. The wealth in the situation with a loss is $S_2 = \overline{X} - L + R - \mu H$. The wealth is mainly affected by the premium of the insurance as well as the yield level.

The optimal choice of insurance for the producer is described by Varian (2006) and his reasoning is presented below. The choice is determined by the marginal rate of substitution (MRS) condition between the S_1 and S_2 and is equal with the price ratio for the insurance product.

$$MRS = \frac{\pi \Delta u(s_2)/\Delta s_2}{(1-\pi)\Delta u(s_1)/\Delta s_1} = \frac{\mu}{1-\mu} \qquad \text{(equation 1)}$$

If simplifying equation the condition for the optimal insurance;

$$\frac{\Delta u(s_1)}{\Delta s_1} = \frac{\Delta u(s_2)}{\Delta s_2} \qquad \text{(equation 2)}$$

Varian (2006) pp. 227 describes this equation as *"the marginal utility of an extra dollar of income if the loss occurs should be equal to the marginal utility of an extra dollar of income if the loss doesn't occur"*. This explains the difference between a risk averse person and a risk lover. If a risk averse person's marginal utility of wealth is declining, the amount of wealth has to increase. If $S_1 = S_2$ and the individual is risk neutral the marginal utilities of the income are equal and the premium for the insurance is fair. The choice to purchase insurance or not depends on the producers preferences towards risk. A risk averse producer should choose to insure due to utility maximization. A risk averse decision maker maximizes expected utility, and if he/she is offered a fair insurance against a loss he/she will optimally choose to insure. Finally, a number of factors may affect wealth and the insurance decision *(ibid)*. The factors in Figure 5 affect the variables that are presented in Figure 3 which is the utility function curvature, values of X_1, X_2, X_{ce} and $\overline{X}$ s well as the premium level and the return from a loss.

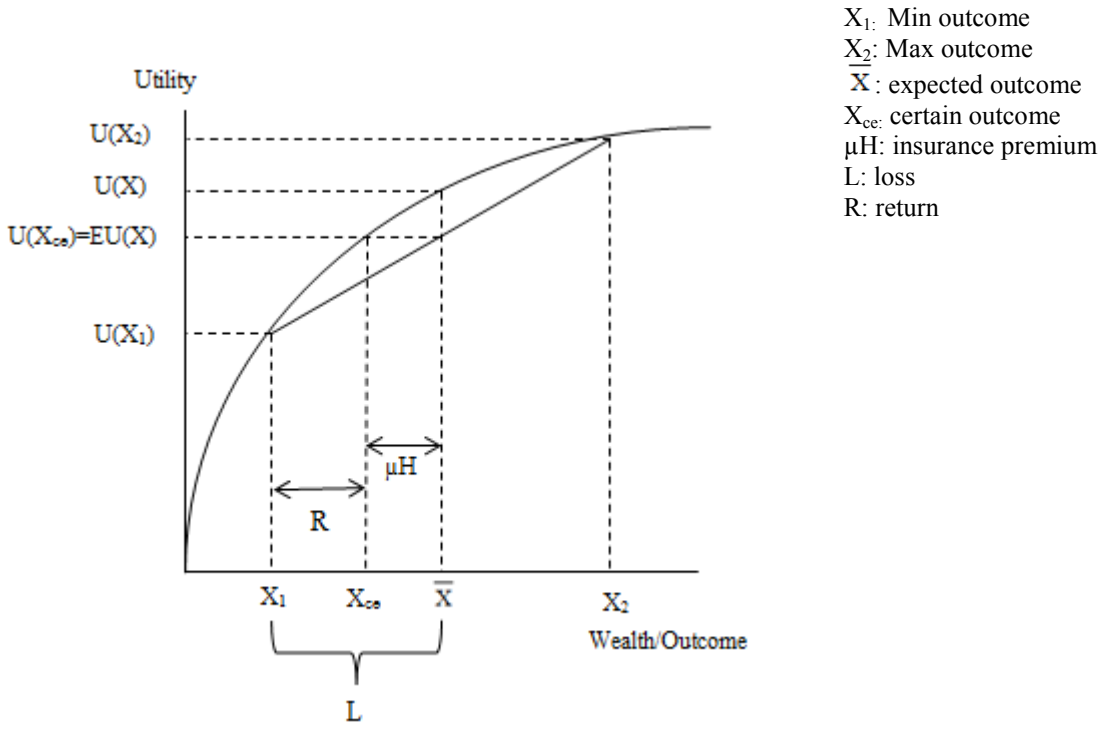

Figure 3. Decision to purchase an insurance (own processing of Pindyck and Rubinfeld, 2005).

The probability of a risk to occur can be estimated from either subjective or objective sources (Barry, 1984). Objective probabilities are computed from historical data and observations. When using historical value subjective views are ignored. Subjective probabilities are elicited from the decision maker and vary among persons and across time for a specific person as a response to new knowledge and experiences. The decision maker may use historical or

subjective probabilities to formulate their expectations. In this study the farmers' subjective probabilities will be analyzed since the personal variation is important factors.

The expected utility theory has been criticized. Individuals cannot make an optimal decision because people are limitedly rational (Pennings, 1998). Thaler (2000) argue that the psychological literature provides explanations for the fact that humans have limited capacity to understand and adapt to the complex world they are living in. This should depend on the human brains inabilities to process all information. A number of alternative theories have been developed to replace the expected utility. Edwards (1992) discuss a number of alternative models to expected utility theory like rank dependent utility, lottery-dependent utility, weighted utility and prospect theory. The result of the discussion is that there is no perfect theory that covers all the issues that have been identified with the expected utility theory.

3.2 To measure risk- a psychometric aspect

Psychometrical measures have their basis in the psychometrical discipline and decision theories (Hansson & Lagerkvist, 2012). The difference from the expected utility theory where the risk preferences are considered as personal, the risk preferences are here considered as context-specific (Pennings, 1998). A basic assumption of the psychometric view of risk is that risk is subjective and defined by individuals who are affected by physical, social, institutional and cultural factors (Hansson & Lagerkvist, 2012). To define the factors, psychometric scaling can be used successfully. A common method to use in this kind of research is Likert statements (Pennings & Smtih, 2000). The method measurers risk preferences by allowing the respondent to answer a number of statements and mark on a scale how well they agree with the statement. In the study, they also evaluate the validity to measure risk attitudes based on expected utility theory and the psychological discipline. Two interesting conclusions can be made from the study. The psychosomatic measurement of risk preferences review a good compliance with how the individuals perceive themselves (risk averse or risk lover) but do not show any connection with the real behavior. Measurements based on the utility theory show the opposite result. The risk attitude correlates well with the real behavior result.

3.3 Decision making models

In risk management, decision analysis is a concept (Hardaker *et. al* 2004). The method is constantly being developed, with purpose to make choices that are more rational and assist to improve decisions in the presence uncertainty. The decision can be described as a choice between alternatives where the best alternative is chosen (Öhlmer *et. al* 2000). If a decision is easy or more difficult to make depends on the number of options and what the nature of those are (Hardaker et al., 2004). In a risky world, it will be impossible to forecast what will be a bad or good decision. A decision that may seem good, will not always lead to a guaranteed good outcome. This is why analysis of a risky decision will always be based upon the preferences of a decision-making person's perception of what a good decision is.

A standard decision process in farm management texts is often listed with five to eight steps (Öhlmér *et al.,* 1998). Decision making is often described by a linear process including following steps; values and goals, problem detection, problem definition, observation, analysis, development of intention and implementation, Based on these steps Ölmér (1998) has develop a revised version of the linear steps into a conceptual matrix including four phases which are useful to identify in the decision making process. Those are problem

detection, problem definition, analysis & choice and implementation. The phases consist of four sub-process and these are searching & playing attention, planning & forecasting, evaluation & choosing and bearing responsibility. The decision to purchase an insurance is analyzed in the function analysis and choice in the model. The focus of the model is how a farmer takes a decision, for example crop insurance. This model gives the farmer control and a view of the problem and options. Whether it is an analytic or intuitive person who makes a decision, Öhlmérs model is useful, the difference is how each phase is processed. The model is presented in Table 4 below.

Table 4. Matrix illustrate a farmers decision making process (own prcessing basedon Öhlmér *et al.*, 1998).

	Subprocess			
Function	**Searching & paying attention**	**Planning & forecasting**	**Evaluating & choosing**	**Bearing responsibility**
Problem detection	Information Scanning; paying attention	Forecasting consequences	Consequence evaluation; problem?	Checking the choice
Problem definition	Information search; finding options	Forecasting consequences	Consequence evaluation; choice of option to study	Checking the choice
Analysis & choice	Information search	Planning & forecasting consequences	Consequence evaluation; choice of option	Checking the choice
Implemen-tation or action	Information search; clues to outcomes	Forecasting outcomes and consequences	Consequence evaluation; choice of corrective actions	Bearing responsibility for final outcome; feed forward information

Pennings & Leuthold (1999) have developed a similar model to understand the choice of a risk management tool such as hedging, see Figure 4. Pennings & Leuthold(1999) model is divided into two sub models. Model 1 focuses on the design, technicalities and administration of the risk management tool. Model 2 illustrate the relation between factors that affect the choice and the decision to hedge or not. Farmers may not be expected to be a homogenous group. Instead they have to be divided into various segments. When the segments are identified, it is reasonable to assume that the choice will be similar between farmers in the same segment, but will vary across segments. The relationship between attributes and choice are described in model 2.

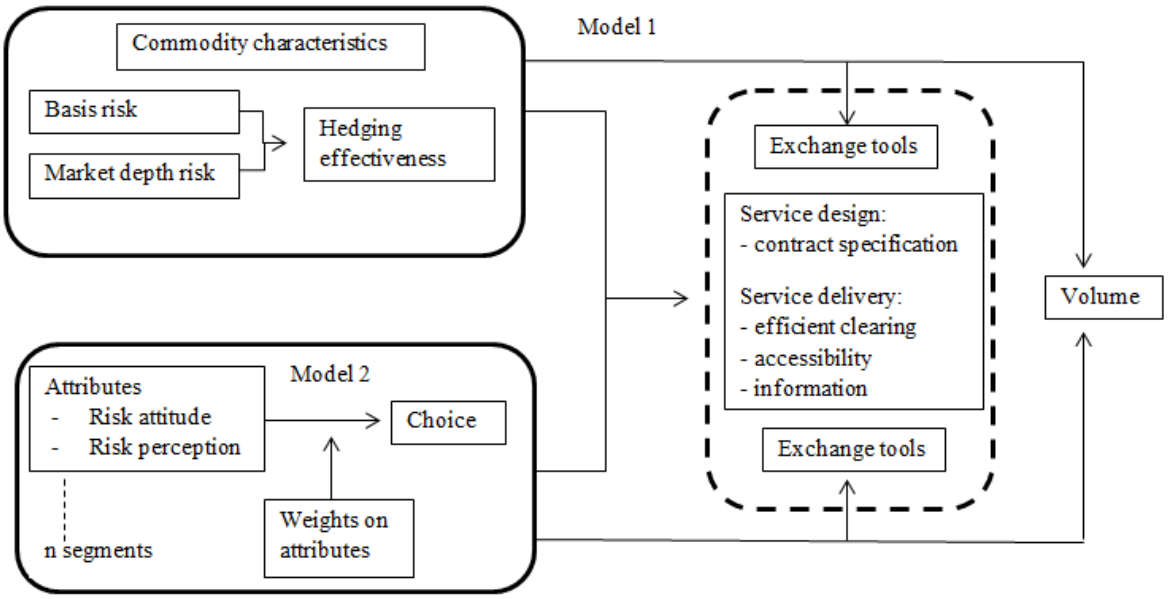

Figure 4. Modell over attributes affecting a decision under risk (own processing based on Pennings and Leuthold, 1999.)

Hedging and crop insurance are two common risk management tools that reduce business risks (Boehlje and Eidman, 1984). Hedging is a tool to minimize the price/market risk and crop insurance to minimize the adverse effects of production risks (Pennings *et al.,* 2008).

3.4 Selected Model

Öhlmérs (1998) model, Table 4, is developed to analyze the decision-making process and factors affecting the process. Pennings & Leuthold (1999) model 2 is used to define factors affecting the use of a risk management tool, see Figure 4. In this study, the choice is to revise Pennings & Leuthold (1999) model to analyze factors that affect a farmer's crop insurance decision. How factors affect the crop insurance decision is described in the model we have chosen. It is based on earlier studies and can be seen as future development of Pennings & Leuthold (1999) model 2, which describes the relationship between attributes and choice to use crop insurance.

From earlier studies concerning insurance factors that affect a farmer's choice to purchase insurance are identified. In the study we compare differences between farmers that choose to purchase crop insurance and them who do not i.e. ability choice. The model presented in Figure 5 therefore provides an opportunity to identify the factors that affect a crop insurance decision. The understanding of the choice to purchase crop insurance or not, is in the model based on the expected utility theory. These factors are based on results from earlier studies and the theoretical framework. These factors are divided into three different sections *social factors, business related factors and preferences and perceptions*. These factors in Figure 5 may affect the variables in Figure 3. Social factors affect the farmers' preferences and perceptions (Hardaker *et al.,* 2004). Risk preferences explain the curvature of the utility function and are fundamental for decision making. The yield perceptions affect the expected yield, $\overline{X}$, which vary between X_1 and X_2, and also the perceived yield risk which affect the farmers perceived probability for a loss to occur. The insurance perceptions and the properties of the insurance product have an influence on X_{ce}. This affect the rate of the insurance premium and the level of the return, R, from the insurance if a loss occur. Business related factors affect the yield variables X_1, X_2 and $\overline{X}$ and thereby also the insurance decision.

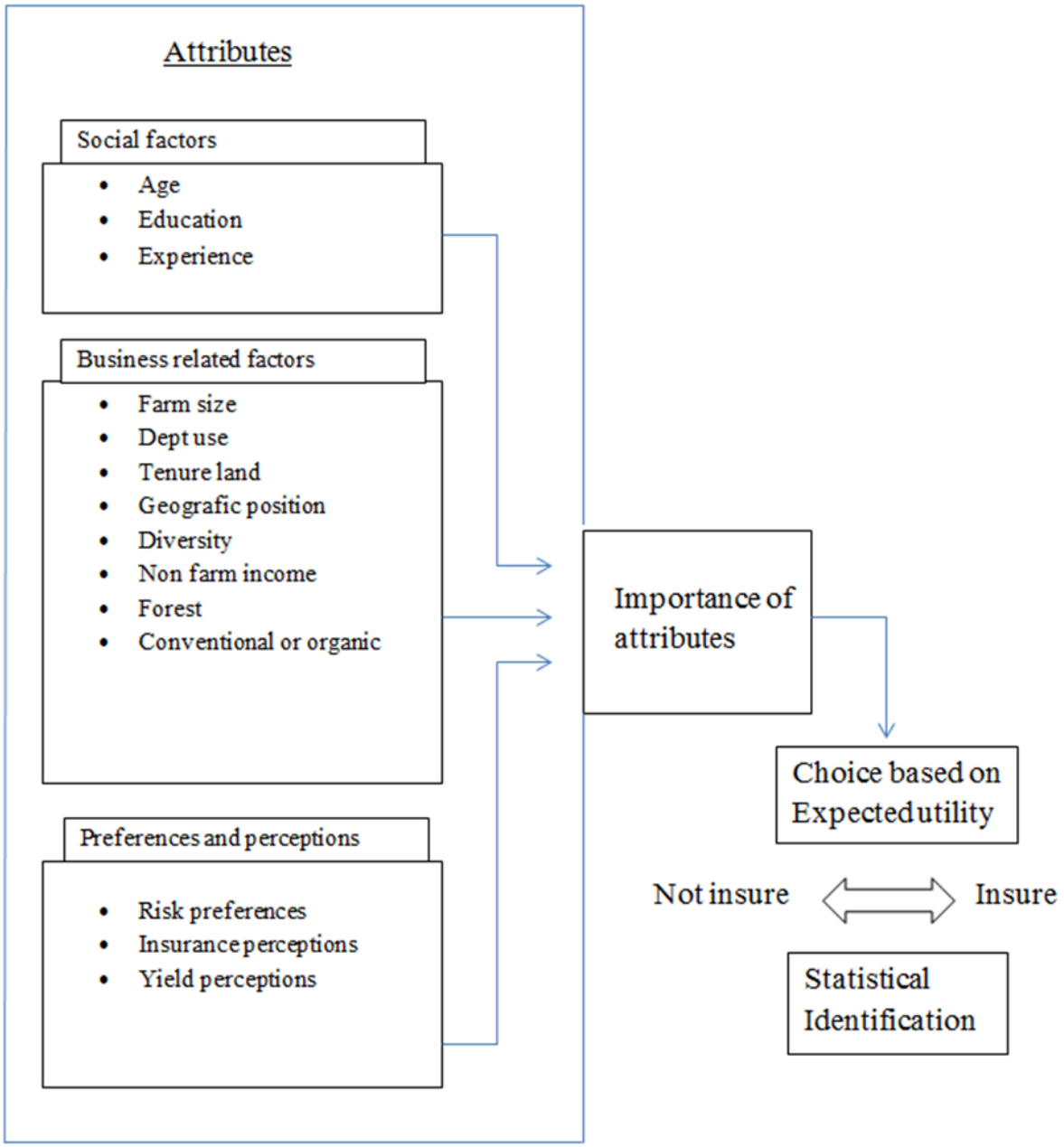

Figure 5. Modell over factors that affect the choice to purchase insurance (own processing based on Pennings & Leuthold, 1999).

4 Method

In this chapter a description of the approach of the study is presented. The method the study is based on is a literature study and a quantitative method by a survey directed to Swedish farmers.

4.1 Literature review

Before collecting the empirical data, a literature review has been conducted. There are numerous of reasons to begin with a literature review before the approach of the interesting aim of the study (Robson, 2011). This was done in order to get a deeper understanding and to obtain knowledge about earlier studies of the subject, but also to examine theories that have been used when analyzing decision making under risk. The literature is collected from databases available at SLU library Primo, Epsilon, Libris. To widen the research has also Google scholar been used. The literature consists of articles from academic journals but also books about risk and risk management.

4.2 Applied theoretical framework

To analyses the choice of crop insurance the expected utility theory is use. The choice of theory depends on the characteristic of problem. Edvards (1992) claim that there is no perfect theory that covers all the issues that have been identified with the expected utility theory Gollier (2001) defend expected utility theory because due to the fact: otherwise are not individual decisions consistent over time and that the model is relatively easy to deal within more complex theory.

Our reasons to use the expected utility theory are:

- It is a common theory describing the decision under risk.
- It is a conventional theory used in the theoretical literature describing the complexities of insurances.
- It is a conventional theory used in a lot of earlier studies about a crop insurance decision to examine why the decision is taken. Examples on earlier studies using expected utility theory are shown in Table 3.

Pennings & Leuthold, (1999) developed a model to understand the factors effecting a decision under risk. This model has been use in studies by Pennings & Leuthold (1999) to evaluate factors affecting the decision to use the risk management tool hedging. In this study this model is revised in order to analyze factors affecting a crop insurance decision which is aimed to reduce the adverse effects of production risk. Hence, hedging is a tool to reduce price/market risk and crop insurance a tool to reduce production risk (Pennings *et al.,* 2008). Since crop insurance and hedging are to different risk management tools and but both used to reduce business risks are their aim similarity. Hence, Pennings *et al.,* (2008) have find that the factors affecting a hedging decision are similar to the factors affecting a crop insurance decision. According to this, the model can be used to define factors affecting a crop insurance decision.

4.3 Choice of method

The aim of this study is to examine which underlying factors affecting farmers' crop insurance decisions and what production risks the farmer wants to insure. In the study the farmers risk preferences are examined and, the degree of risk aversion that affects farmers decision to purchase insurance (Pinduck & Rubinfeld 2005). Farmers have individual risk preferences (Hardaker *et al*., 2004). Earlier studies have also found that factors like farm size, age and education, expected yield, diversification, tenure, geographic position and debt use affect the farmers' crop insurance decision.

There are two main research methods, quantitative and qualitative methods (Robson 2011). The research question, the researchers' role and the study underlining intension are the main aspects to consider when choosing a method. The qualitative research method intends to provide understanding at an individual level. The individual characteristics and experiences are described by the interview subject. This method aims is to generalize, but the aim is to primary create a description and understanding from the perspective of the interviewee.

A quantitative method is based upon quantifiable numerical measures and the aim is to make generalized understandings of common relationship and tendencies that are investigate at an aggregate level (Robson, 2011). The findings from quantitative research are based from the characteristics of a group instead of at the individual level. A quantitative method gives a greater width, can be generalized and usually provides more reliable results. It is also possible to conduct statistical analysis and the significance and validity of the results is higher (Denscombe, 2003). A quantitative study can be made by a survey i.e. sent by post or email, telephone interview or face-to-face interviews.

4.4 Method of collecting data

In this study a quantitative method is chosen based on a survey through an online questionnaire sent by email. A quantitative study by a survey online questionnaire can be made through a large selection of respondents compared to other survey formats in many perspectives (Ejlertsson, 2005).

The response rate is affected of several factors but primarily the facility to answer and return the questionnaire (Robsson, 2011). Web-based questionnaires haves some advantages compared to postal. It is possible to consolidate the answers automatically by a program. This saves time and it also results on a higher quality since the risk that the data can be lost or wrongly used is decreased. Studies have also found that web-based surveys have a similar response rate as surveys sent by post (Denscombe, 2003). Sending an online based questionnaire is the most cost-effective survey. Face to face and a telephone interviews are more expensive in general than online based and paper formats. The cost of the paper survey depends on the number of respondents and the size of the survey. Other advantages of a survey are that data are standardized and collected from a relative large number of persons which are representative of a known population (Robsson, 2011). A survey can also be made to cover a larger geographical area which is the case in this study. A research method by a questionnaire also results in no interviewer effects arise, which often may arise by the interviewer way to ask questions.

The questionnaire is sent to the respondents e-mail address and then a link directs them to the questions. The respondent can only answer the questionnaire once and all questions need to

be answered. The respondents can answer the questionnaire in their smartphone. One risk that may occur with a web-based questionnaire is that the farmers do not open their email during the period. Another risk is that the farmers suspect the email is a spam and don't open it. This will be counteracted by that the email is sent from one of the writers university email address. A summary of the quantitative methods are shown in Table 5.

Table 5. Differences between quantitative methods (own processing based on Czaja & Blair J, 2005).

Quantitative methods	Respond rate	Cost	Geographic distribution	Processing answers	Open/closed question	Confidential answers	Possible interview bias
Web	Low	Low	Wide	Easy	Closed	Yes	No
Postal	Low	Medium	Wide	Medium	Closed	Yes	No
Telephone	Medium	Medium	Wide	Difficult	Open	No	Yes
Face-to-face	High	High	Narrow	Difficult	Open	No	Yes

4.5 Questionnaire

It is recommended to initiate the questionnaire with an introduction letter to clearly inform the participants about the purpose of the study (Robson, 2011). In the letter the aim of the study and the researcher of this study are presented. The introduction letter is presented in appindex 1.

The questions or statements in the questionnaire are both formulated by the researchers and based on previous studies. Before the final questionnaire was determined, two pilot surveys were sent out. In the first round people in our acquaintance were selected and in the second fifteen randomly selected farmers were chosen to answer questionnaire. The statements and questions were evaluated by the test versions and used as a basis for establishing the final version. The statements are based on the statements from earlier studies. It is important that the respondents receive clear instructions about how the questionnaire should be answered. Information is given both in the introduction letter and in the beginning of the questionnaire.

The questionnaire consists of 31 questions divided into social factors, business related factors and preferences and values. The first questions include social- and business related factors with questions about the farm and the farmer like age, education, farm size and geographic position etc. It is common to ask these types of questions to get information about the characters of the population but also to start the survey with simple questions (Jaworski & Kohli, 1993). The next questions are about the farmers' crop insurance perceptions, risk attitude and risk perceptions. These factors are shown in our model, see Figure 5. The questionnaire with the questions and statements is presented in appendix 2.

Questions formed as statements are answered by the Likert scale. The Likert scale is a common method to measure attitudes (Ejlertsson, 2005). The scale consists of some statements within the same topic. The respondent has to agree or disagrees with the statements by answering a five-point or seven-point scale. The extremes are specified by strongly disagree and strongly agree. The scale is assumed to be linear and the preferences can therefore be measured. In this study we use the Likert scale to define the farmers' crop insurance and their risk preferences. Hence, consequently most of the questions and statements in the survey were formulated as a Likert-type with a five point scale.

4.6 Selecting participants

The farmers contacted in this study are farmer customers at Länsförsäkringar AB. These farmers have some kind of agricultural insurance at Länsförsäkringar, but it is not certain that they have a crop insurance from Agria Djurförsäkring since Agria Djurförsäkring is a subsidiary company of Länsförsäkringar AB. The prerequisites to be able to participate in the study is that the respondent has an e-mail address registered at Länsförsäkringar, that the farm is located in Götaland or Svealand and that the farm represents more than 30 hectares of tillable land. Länsförsäkringar AB has 3980 agricultural customers which have their e-mail registered and also comply with the two other conditions. These are therefore chosen to answer the survey.

4.7 Statistical analysis

In this section the statistical methods that is use to analyze the data is presented.

4.7.1 T-test

In the aim of this study is to evaluate differences between insured farmers and farmers that are insured. According to our model, see Figure 5, statistical tests are required. Firstly a T-test is conducted to evaluate if there are any statistically significant differences in every single attribute. This test is aimed to give a descriptive overview of the statistical variables to analyze. The basic hypothesis is that the variances differ and that two independent samples exist where the observations are normally distributed (Newbold, 1991). The number of observations is large and more than 30.

The population variances σ_x^2 and σ_y^2 is estimated by the sampling variance S_x^2 and S_y^2

The population mean value μ_x and μ_y is estimated by the sample mean values of X and Y. The significant level is α and $D_0 = 0$

The null hypothesis is that H_0: $\mu_x - \mu_y = 0$ which is tested against the alternative hypothesis H_1: $\mu_x - \mu_y \neq 0$
The decision rule is:

Reject H_0 if $\dfrac{\overline{X} - \overline{Y} - D_0}{\sqrt{\dfrac{S_x^2}{n_x} + \dfrac{S_y^2}{n_y}}} < -Z_{\alpha/2}$ or $\dfrac{\overline{X} - \overline{Y} - D_0}{\sqrt{\dfrac{S_x^2}{n_x} + \dfrac{S_y^2}{n_y}}} > -Z_{\alpha/2}$ (equation 4)

n_x and n_y relate to the sampling size for X and Y: $Z_{\alpha/2}$ relate to a value from the normal distribution table where the probability for the outcome is $\frac{\alpha}{2}$ (Newbold, 1991). This statistical test compare the mean value for a observed factor between farmers with insurance, X, and without insurance, Y.

4.7.2 Logit method

To be able to analyze how the entire set of the attributes according to the model in Figure 5 affect the decision to purchase an insurance or not, logistic regression is used. The method estimates the probability for a yes or no outcome (Greene, 1993). The variable is binary and

has been given a value Y = 1 for having an insurance and Y = 0 for not having an insurance. Several independent variables X, according to the model in Figure 5, affect the outcome of Y. Hence, the variation in the X variable affects the probability of the outcome of Y, see equation 5. The logit method is also used, in the failure to respond analysis in 6.1, to analyze differences between farmers who answer the survey and those who do not. Hence, given the estimated model we are able to analyze how a single variable affect the decision to purchases insurance given that all other explanatory variables remain unchanged.

$P(Y=1) = F(\beta' X)$ (equation 5)

where

P = the probability
Y = the dependent variable, insurance or not.
β = factors, (β_1..... β_n)
X = a vector of observed variables (x_1…….x_n). That consist of for example farm size, production, age and risk preference.

The probability for Y = 0 is according to (6)

$P(Y=0) = 1 - F(\beta' X)$ (equation 6)

When the cumulative distribution factor f ($\beta' x$) to be logistic equation (7) (Greene, 1993)

$$P(Y=1) = \frac{e^{\beta' x}}{(1+e^{\beta' x})}$$ (equation 7)

Where P(Y =1) is the related probability to Y = 1

4.7.3 Factor analysis

Factor analysis is conducted to examine the reliability for the questions regarding preferences and perceptions (Johnson & Wichern, 2002). The purpose of factor analysis is, that given a set of variables, find underlying dimensions that could explain the pattern correlation between the variables (Johnson & Wichern, 2002). The reliability is given by the Cronbach alpha values which are given by an item analysis (pers., med, Andersson Franko, 2014). Cronbach's alpha is a function of the average correlation between each question and the number of questions (Cronbach, 1951). If alpha is higher than 0,7 the psychometric scale can be interpreted as reliable and a mean value for the following questions can be use in the estimiation of the logit model.

Suppose p variables X1, X2, ..., Xp with mean vector μ and variance matrix $\sum$.
What is interested to examine is the covariance structure of the variables and therefore can μ=0. Further suppose that $\sum$ is of full rank.

$X_j = \lambda_{j1} f_{1+} \lambda_{j2} f_2 + \ldots + \lambda_{jm} f_{m+} e_j$ j=1,…..,m (equation 8)

Where
f_1, $f_{2...}f_m$ is the different factors (m<p)
λ_{jk} = factor loadings
e_j = a specific random number for the variable j.

Cronbach alpha value is calculated as following:

$$\alpha = \frac{n}{n-1}\left(1 - \frac{\sum \sigma_i^2}{\sigma_r^2}\right) \qquad \text{(equation 9)}$$

Where
n = number of item (questions)
σ_r = standard deviation for the total value
σ_i = standard deviation for each item

4.8 Ethics in the research

In any study it is important to ensure the participants well-being, dignity and rights. (Oliver, 2003*)*. Ethics should be considered from the beginning of the survey. The design of the survey is influenced by how information about the respondents and the data is handled. The number of ethical issues of an survey differs depending on what kind of survey is being conducted (Robson, 2010). For example respondents to qualitative face-to-face surveys are more exposed than respondents who answer web-based survey anonymously. The ethic aspect towards the respondent starts when they are nominated to participate in the survey. It is important to demonstrate integrity towards the respondents. A letter with the purpose of the study and the authors is the first information the selected participants receive. They are also informed about the integrity matter and the option not to participate. The choice of a web-based questionnaire makes it easier to handle ethic issues ant to protect the respondents' integrity. The questionnaire contains parts that the respondents may perceive sensitive and personal, since many questions are based on the willingness to disclose personal data. Hence, the survey is designed to give the participants anonymity, and instead of a name or e-mail address the respondents are identified by codes. The results of the questionnaire are processed through a statistical process connecting answers to each other by these codes.

5 Background for the empirical study

In this chapter a brief introduction to the background of the empirical settings, been is presented.

5.1 The Swedish agricultural market

Sweden is divided into different production areas. These areas have been formed after the natural conditions, which affect agriculture, such as bedrock, type of soil, the landscape topography and the climate. This study only focuses on the areas; plain districts in southern Götaland, central districts in Götaland, plain districts in northern Götaland, forest districts in Götaland, plain districts in Svealand and forest districts in central Sweden. These are shown in appendix 3 (SCB 2. 2013). The focus areas are located in the south and middle part of Sweden, where almost 95 % of the grain production year 2013 was located (SCB 1, 2013). In the regions north of this area the major crop is forage (SCB 1, 2013). Forage is not possible to insure (www, Agria 2, 2014).

In the study area there are 19 195 farms with more than 30 hectares of cropland (SCB 3, 2013). In Figure 6, the number of farms with more than 30 hectares of cropland in each county is presented. In the study area there are totally 2 307 184 hectare of cropland (SCB 1, 2013). In Sweden there are about 71 000 farm companies and 54 000 have income from off-farm employment (www, SJV 3, 2014). In our study, we also evaluate how forest affects the choice to sign up for crop insurance. Swedish farmers in the geographic study area also own totally about 2,5 million hectares of forest land (SJV JO 34 SM 1101, 2011). The total hectares of forest land in this area is about 10,2 million hectares. In Sweden 15,7 % of the tillable land 2012 is organically grown (SJV 4, 2013). In the study area, 26 % of the farmers have grain production, 30 % livestock production, 8 % are mixed farms and the last 36 % are smallholders (SJV 1, 2013). The proportion of rented land in the research area is about 41 % (SCB 1, 2013).

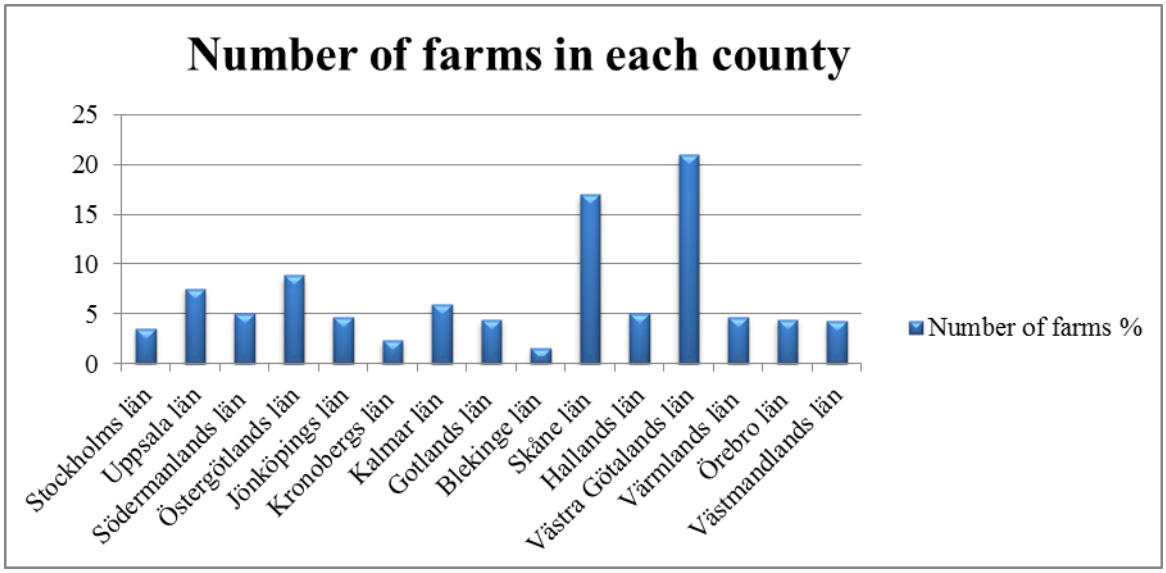

Figure 6. The number of farms in Swedish counties (own processing based on SCB 1, 2104).

6 Empirical results

In the following chapter, the results from the survey are presented. The survey was sent out Monday the 14 of April 2014 and was available for the respondents during a two weeks period until Monday the 28 of April 2014. A reminder was sent out after one week. The survey was sent to 3980 farmers in the selected study area. Out of the sent out e-mails, 409 bounced back due to incorrect addresses. Given this background, 3571 farmers had the opportunity to answer the questionnaire. The number of received answers ended up at 816 which gives a response rate of 22,9 %.

6.1 Failure analysis

A responds rate at 22,9 % may be perceived as low, but there are a number of underlying factors that affect the outcome. The choice of using a web-based survey was found to have a positive effect in order to get feedback to why respondents did not respond the questionnaire. We received well over 200 emails with different reasons. The most frequent answers were that the selected participants no longer had active farms. Other answers were automatic emails with the announcement such that the person is on vacation. A few indicated that they refuse to answer the questionnaire without compensation or due to principle reasons. The most common reasons for not responding are listed below:

- The tillable land is rented out.
- The company is liquidated.
- The receiver does not consider his/her answers as useful.
- The responder is not assessable e.g. vacation.
- No compensation.
- Principle reasons.

The choice of time when the questionnaire was sent out was during Easter weekend. The effects of this fact are hard to measure. It is a holiday weekend but also a busy time for farmers due to spring tillage. We experienced that the ability to answer the questionnaire on their smartphones had a good effect because of lot of feedback e-mails were sent from these.

Partial failure analysis

To compare the farmers who answer the survey and those who not answer the survey, a partial failure analysis by estimating a logit model is conducted. Of the 3571 farmers who had been eligible respondents, we have data on age and number of hectares for 1283 farmers. Out of those 1283 farmers we have 247 that answer the survey. This yields a response rate at 19,3 %. Among these farmers, the average age is 51,7 years for farmers that answer the survey and 52,0 for farmers that do not answer. The average number of hectares is 100 for farmers that answer and 88 for farmers that do not answer the survey. This difference is analyzed by a logit test, which is described in section 4,7. In equation 7 Y is the dependent variable, answer the survey or not. X is the independent variable, age and hectares. If any factor is of statistical significance the P-value needs to be lower than 0,05. The results do not show any statistical significance of any factor that could affect the choice to answer the survey. Furthermore, there are no statistical differences, in age and number of hectares between the farmers that choose to answer and those who not do answer the survey.

Table 6. Result from the logit estimation of farmers that answer the survey and those who not answer (own processing).

Factor	Coefficient	P-value
Age	0,0026559	0.680
Hectares	0,0005965	0,136

6.2 Survey results

In this section the results from the survey are presented. First a descriptive analysis presents the basis factors, followed by statistical analysis where differences between users and non-users are presented. In the end, a statistical test by the logit method is presented, where the test shows if any statistically significance difference exist between those who buy and choose not to buy insurance. The tests are intended to determine which of the factors in Figure 5 that affect the farmers' decision about crop insurance.

6.2.1 Descriptive analysis

The average age of farmers with crop insurance is 50,5 years and those without is 51,4 years. Average time for being a farmer differs barely, it is 23,9 years for insured and 24,4 for not insured. The average hectares of cropland among the respondents are 149 hectares for insured and 100 hectares for not insured. The forest ownership is 61 hectares for insured and 85,4 for not insured In this category the variation is notable, 300 out of the 816 respondents hold 0-10 hectares of forest. The distribution between conventional and organic production is 80/20 %. Figure 7 present the farmer's education, the results show that about 14 % attended elementary school, 46 % attended high school and 40 % attended a university. The distribution of the two segments is shown in the Figure 7.

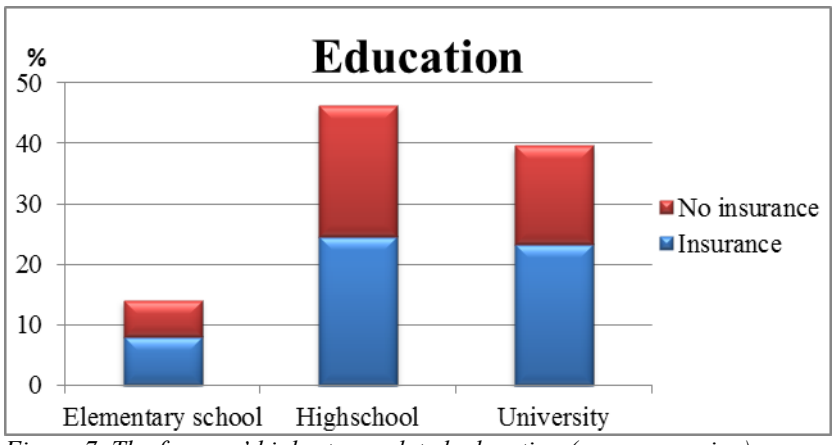

Figure 7. The farmers' highest completed education (own processing).

The production areas are presented in Figure 8. Over 50 % of the respondents are from either Skåne län, Östergötlands län or Västragötlands län. The cause of this phenomenon is that those three counties are distinctive farm areas. The proportion farmers with crop insurance are also higher in those areas. According to the statistics from SCB presented in Figure 6, the response rate from each county is well reflected to the number of farmers in each county. Remarkable is that Skåne län has higher response rate than Västragötalands län since Västra götalands län has more farmers. The difference may depend on Länsförsäkringar's different market shares in different regions. It may also indicate that crop insurance is of higher importance for farmers in Skåne län. Another reason why Skåne län has high response rate may depend on variation in timing of spring tillage between different regions.

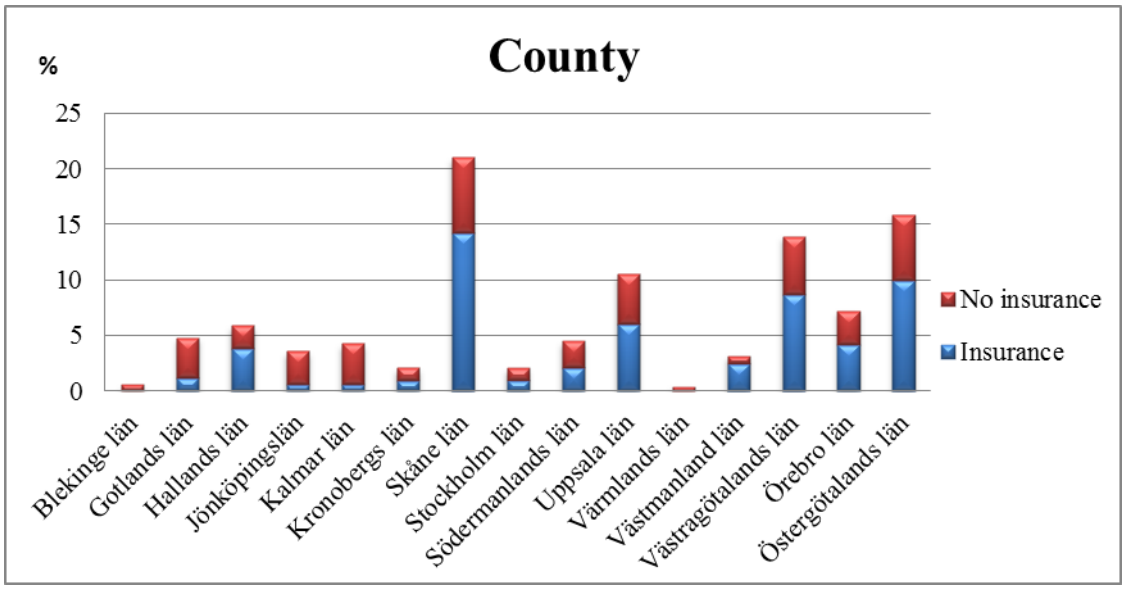

Figure 8. The counties where the farmers' production is located (own processing).

Out of the respondents in the study 45 % have grain production, 25 % crop and livestock production, 17 % livestock production, 8 % other crop production, 3 % outsource services and 2 % other. It is obvious that the insurance rate is highest among specialized grain producers. The type of enterprise is displayed in Figure 9. Grain producers are well represented in this study according to the statistics from SCB. 26 % of the respondents in the area are grain producers (SCB 1, 2013). In the study 18% is livestock producers compared to 30 % in the statistics.

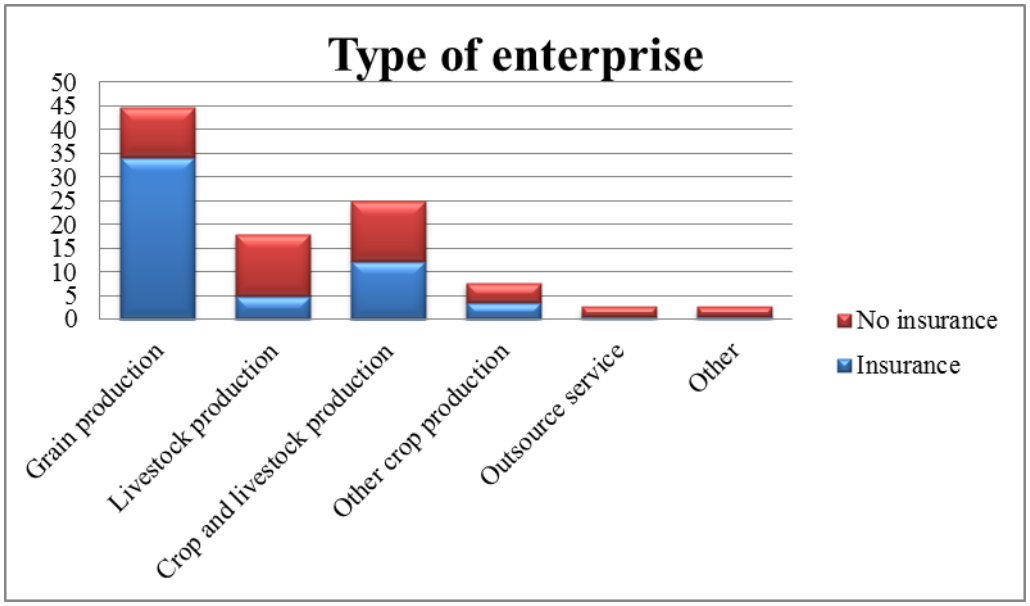

Figure 9. The farmers' type of enterprise (own processing).

In the survey, the farmers revealed their subjective perception concerning what major type production risk that causes a reduced yield. The production risks are presented in Figure 10. 45 % of the respondents perceived drought, 22 % winter freeze and 19 % rain. These three production risks were the most common among the farmers. The answers show that the perceptions of risks are equally shared between users and non-users in all risk besides scrubbing and hail.

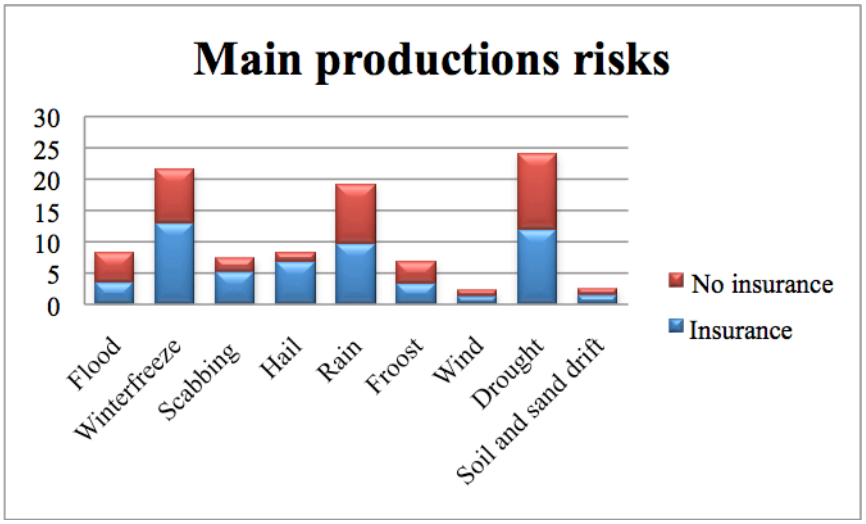

Figure 10. The farmers' subjective perception about production risks (own processing).

In Figure 11, the farmers perception about which crops that are in most need for insurance is presented. The answer shows that 19 % consider winter rapeseed as the crop with highest need for insurance coverage, 16 % perceived winter wheat and 13 % perceived spring rapeseed. No remarkable differences are observed between insured farmers' perceptions and those without insurance.

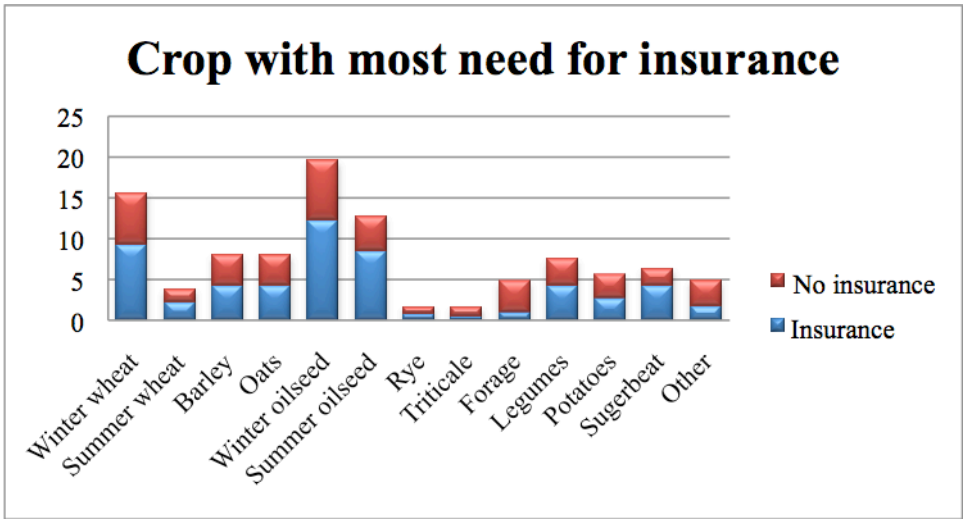

Figure 11. The farmers subjective perception about different crops need for insurance coverage (own processing).

In Figure 12, the proportion of debt in relation to the estimated value of assets is presented. The figure shows that 22 % of the respondents have less than 10 % debt, 18 % of the respondents have more than 50 % debt and 82 % have 50 % or less in debt.

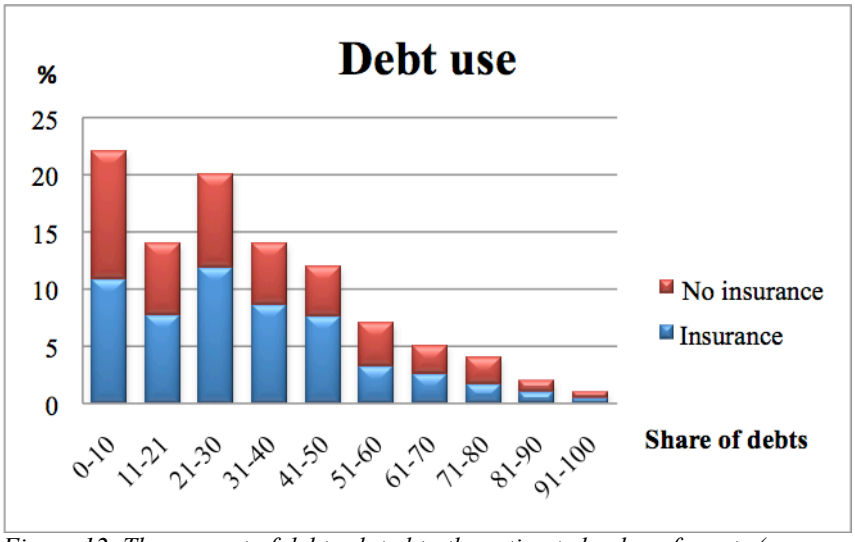

Figure 12. The amount of debt related to the estimated value of assets (own processing).

In Figure 13, the proportion of owned operated land is shown. The answers show that 33 % of the respondents own all or more than 91 % of their land. The alternatives between 81-90 % to 0-10 % owned operated land have each a response rate between 3 % and 10 %. According to SCB 1 (2013) the proportion of rented land is about 41 % in these regions.

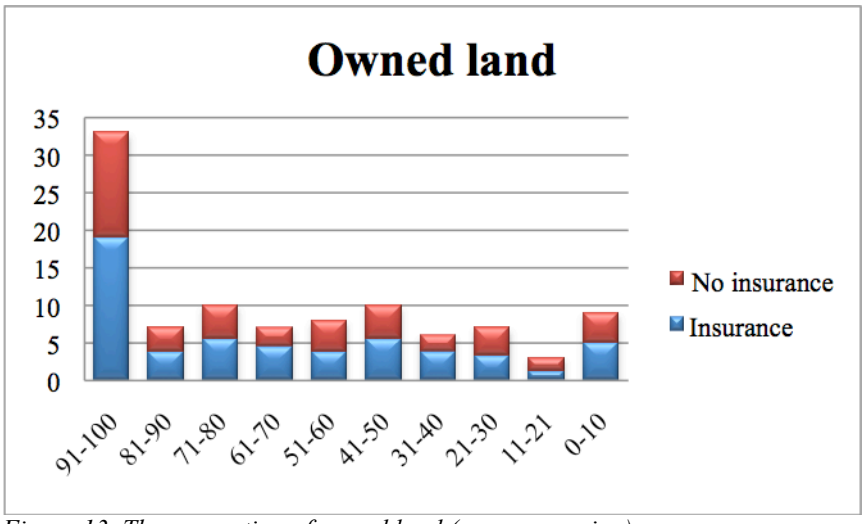

Figure 13. The proportion of owned land (own processing).

The number of years that the farmers perceive a yield loss to occur causing more than a 10 % decline in yield relative to the average yield the last 10 years is displayed in Figure 14. The result is that 59 % perceive that such of losses occur 0 to 1 years, 35 % perceive losses occurs 2 to 3 years, 5 % perceive loss in 4 - 5 years and 0,5 % perceive losses 6 to 10 years.

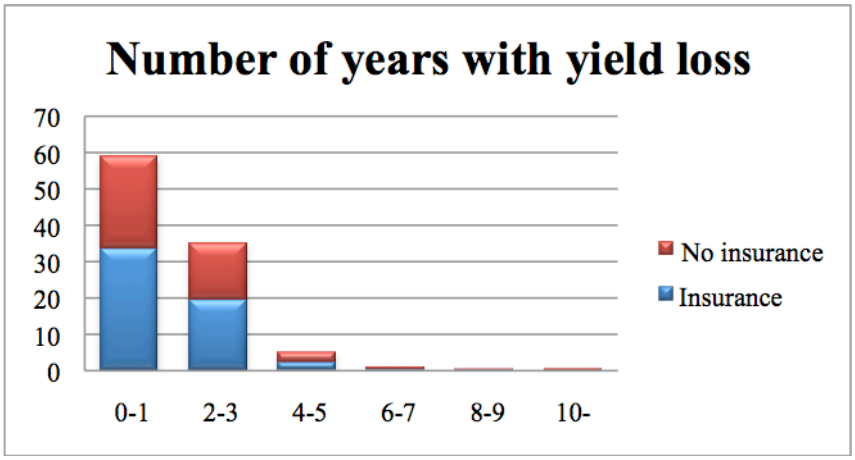

Figure 14. The number of years with a perceived yield loss with more than 10 % of average yield (own processing).

In Figure 15, the farmers' perceptions concerning their yields relative to the average yield for the region are presented. 52 % of the farmers perceive that their average yield is the same as the average yield for the region.

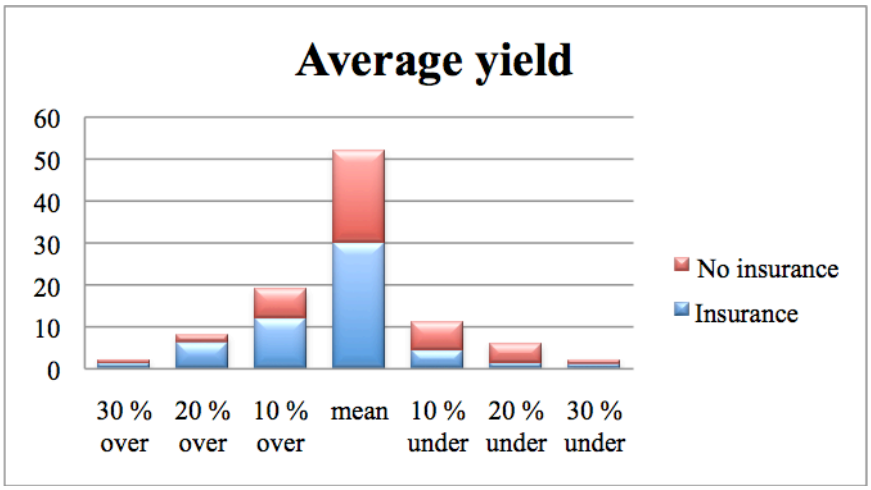

Figure 15. The average yield related to the average yield for the region (own processing).

In Figure 16, the use of insurance is presented. 55,8 % of the farmers have a crop insurance and 44,2 % have not.

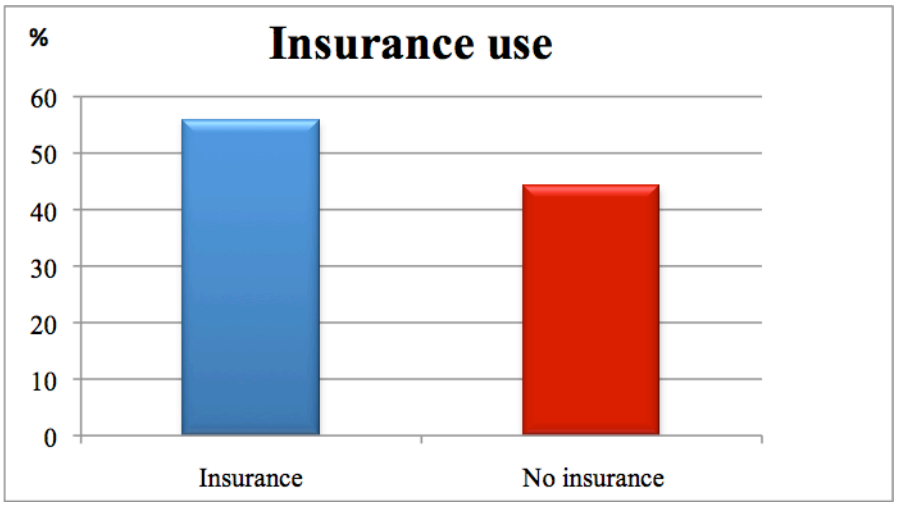

Figure 16. The farmers' use of crop insurance from the survey (own processing).

In figure 17, the farmers' income from other business is displayed. The figure shows that off-farm income is relatively equal across the span of alternatives.

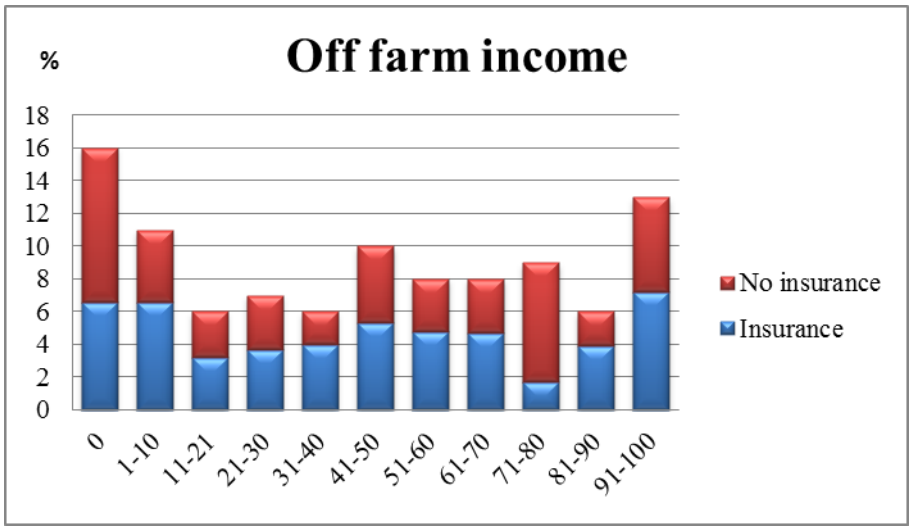

Figure 17. The farmers' off farm income from the survey (own processing).

6.2.2 Statistical analysis

The statistical analysis is based upon a T-test where each single variable impact on the crop insurance decision is evaluated. The statistical significance level is illustrated by # with a P-value < 0.05 and ## < with a P-value < 0.01. No statistical significance is illustrated by e. The impact from other factors is not evaluated in this test. Among the social variables, the result differs from previous studies. Age has in previous studies been correlated with the use of crop insurance. In our test, age indicates no statistical significant difference. Between users and non-users of crop insurance, education and experience are both variables mentioned in the literature as significant but even these prove to be non-significant. The social factors are shown in Table 7.

Table 7. Differences in social factors between farmers with and without insurance (own processing).

Social variables	Mean value farmers with insurance	Mean value farmers with no insurance	Significance level
Age	50,5	51,4	e
Education	2,3	2,2	e
Years of farmer	23,9	24,4	e

The business related variables indicate a higher degree of statistical significance than the social variables. Farm size and off-farm employment are all significant and consistent with the literature. The variables organic farming and forest also show a correlation with crop insurance. However, rented land and debt use does not affect the choice to buy crop insurance. The impact of business factors are presented in Table 8.

Table 8. Differences in business related factors between farmers with and without insurance (own processing).

Business related variables	Mean value farmers with insurance	Mean value farmers with no insurance	Significance level
Hectare of cropland	149	101	##
Organic	1,2	1,3	##
Rented land	4,1	4,3	e
Debt use	1,8	1,8	e
Non-farm income	2,4	2,2	##
Hectare of forest	61	85,4	#

Preferences and perceptions

Preferences and perceptions include three different attributes that measure risk preferences.
Risk preferences in Table 9, are based on farmers response to statements about risk preferences. The answers are based on the Likert scale from 1-5 where 1 is strongly disagree and 5 is strongly agree with the statement. The respondents who have crop insurance agree to a higher extent than respondents with no crop insurance. It is noticeable that insured farmers have a higher average response to the statement “In my business I am willing to take a higher risk to get a higher economic results” than farmers without. It is contradictory to the statement. It is also remarkable that farmers with insurance prefer risk in their business to a higher extent than those who are not insured. However, the aggregated answers to the statements are not statistically significant.

Table 9. Differences in risk preferences between farmers with and without insurance (own processing).

Statement	Mean value farmers with insurance	Mean value farmers with no insurance	Significance level
I like having my business exposed to risk	2,6	2,5	e
I am willing to expose myself to greater risk in order to increase the yield of my crops	3,0	2,7	##
I prefer to be safe than sorry in my business	3,3	3,1	##
I strongly prefer to acquire sustainable gains than avoiding losses in my business	2,6	2,5	e
I am willing to take higher risks in order to achieve a higher payoff	3,1	3,0	#
Crop insurance is important because of debt and rent payment obligations	2,4	1,8	##
Hedging strategies is an important tool when I sell my grain	3,0	2,1	##

The questions 12-14 in the questionnaire aim to evaluate farmers risk perceptions, which are presented in Table 10. The results indicate that farmers who perceive that their yield level is less than normal for their region and farmers that perceive their production of crop as relatively risky are more likely to buy insurance. However the number of years with a substantial yield loss does not show any correlation with the decision to sign up to crop insurance.

Table 10. Differences in percived yield risk between farmers with and without insurance (own processing).

Factor	Mean value farmers with insurance	Mean value farmers with no insurance	Significance level
How do you perceive average yield in relation to average yield in your farm area	2,1	1,8	##
How many years of the last 10 have you perceived yield loss to cause more than a 10 % decline in yield relative to the average yield for your region the last 10 years?	1,4	1,5	e
I perceive that my production of crops is risky.	2.6	2,1	##

Insurance perceptions

Table 11 displays the differences between farmers with and without insurance. The perceptions of the insurance product have an impact on the farmers' choice to buy insurance. There are significant differences in the most of the statements. However, premium per hectare does not show any significance in this test. All other statements indicate a high level of significance.

Table 11. Differences in insurance perceptions between farmers with and without insurance (own processing).

Statement	Mean value farmers with insurance	Mean value farmers with no insurance	Significance level
I am well aware of the crop insurance provisions	3,4	2,2	##
Crop insurance is an important risk management tool in my production	3,1	1,6	##
Per-hectare premium costs are very important to my crop insurance decision	3,2	3,2	e
Availability of high coverage levels is important to me	3,3	2,1	##
The ability to insure different acreages separately is important	3,4	3,0	##
Crop insurance is not important for me because my yield per hectare already is low.	1,8	2,8	##
Crop insurance provides good protection to my yield	3,2	2,2	##

6.2.3 Factor analysis

Factor analysis is conducted to examine if a mean value for the questions in the tree parts within preferences and perceptions can be used. First an item analysis is conducted, the result show that Cronbach's alpha for the tree parts risk preference, perceive yield risk and insurance perceptions. The result, which is presented in Table 12, show that the alfa value is lower than 0,7 in each area, this means that a mean value for the questions not can be used. After discussion with Andersson Franko (2014) the questions within the risk preferences and insurance perceptions will be divide on two factors in the factor analysis, since the value is near 0,7. In the logit model a mean value for Factor 1 and a mean value for Factor 2 can be used. In the factor analysis loadings for factor 1 and 2 is presented for every question. The loadings indicate the question importance for each factor, higher value higher importance. The result of the factor analysis is presented in Table 13 and 14, the results tagged in blue shows with factor the question is associated with. Among the seven statements about risk preferences four shows importance with Factor 1 and three with Factor 2. Among the seven questions about insurance perceptions six shows importance with Factor 1 and only one with Factor 2. Perceived yield risk consists of three questions, since the Cronbach's alpha is 0,2075 all three questions will be used in the estimation of logit model.

Table 12. Cronbach alpha based on the item analysis, own processing.

Area	Cronbach alfa
Risk preferences	0.57
Percived yield risk	0,21
Insurance perceptions	0.61

Table 13. Result for the factor analysis for risk preferences, own processing.

Statement	Factor 1	Factor 2
1) I like having my business exposed to risk	0,314	-0,140
2) I am willing to expose myself to greater risk in order to increase the yield of my crops	0,322	0,013
3) I prefer to be safe than sorry in my business	-0,166	0,496
4) I strongly prefer to acquire sustainable gains than avoiding losses in my business	0,183	0,156
5) I am willing to take higher risks in order to achieve a higher payoff	0,309	-0,027
6) Crop insurance is important because of debt and rent payment obligations	0,069	0,538
7) Hedging strategies is an important tool when I sell my grain	0,165	0,393

Table 14. Result from the factor analysis for insurance preceptions, own processing.

Statement	Factor 1	Factor 2
1) I am well aware of the crop insurance provisions	0,537	0,360
2) Crop insurance is an important risk management tool in my production	0,851	0,172
3) Per-hectare premium costs are very important to my crop insurance decision	0,378	0,732
4) Availability of high coverage levels is important to me	0,853	0,037
5) The ability to insure different acreages separately is important	0,578	0,557
6) Crop insurance is not important for me because my yield per hectare already is low.	0,463	0,0442
7) Crop insurance provides good protection to my yield	0,768	0,112

6.2.4 Estimation of Logit model

The statistical analysis is based upon the logit-method. The method is used to evaluate to which extent different independent variables affect the crop insurance decision (Greene, 1993). The dependent variable 1 for having insurance and 0 for not having insurance which is obtained from question 14 in the questionair. The choice of the independent variables is based on earlier studies, the theory and values from pilot tests.

The test shows that some of the in the literature mentioned variables do not prove to be significant in our test. When the test is conducted by the logit-method, twelve variables were selected. Six of those turned out to be statistically significant. Table 15 displays the parameter values and significance level for the independent variables. Variable in the red colored cells do not show any statistical significance and the results from the blue colored cells indicate that they are statistically significant. Factors with a p-value below 0,05 are statistically significant. A negative coefficient reveals that there is a negative correlation between the factor and the probability of buying insurance. Hence, a positive coefficient indicates a positive correlation.

The logit-test with thirteen different variables indicates that there is a statistically significance by six variables. Some of the variables mentioned in the literature as significant do not show significance in this study. In the model we can notice that farm size has a positive effect on buying crop insurance. Farm size is measured in hectares and has a significance level of 0,001. Age, education and off farm income have no significant with the insurance decision. The hectares of forest land have no statistical significance effect on use of insurance.

In the test the enterprise structure shows significance of 0,000. The test examines if there are differences between grain production and any other types of production. The test shows that farmers with grain production have a higher probability of acquiring insurance. All other

types of production systems have a lower probability of having insurance. Question seven, eight and nine, in the Table 15, concerns the farmers yield perception and statement seven and nine have a statistically significant effect upon insurance use.

The yield perception is statistically significant with a p-value of 0,016. The test examines if there are differences between farmers that perceive to have a higher yield than normal and farmers with normal or lower yield than normal. The results show that the probability is higher that a farmer that has high yield actually selects insurance. The statement "I perceived that my production of crops are risky" indicates significance. Farmers that agree with the statement have a higher probability of having insurance. The statement about number of years with yield loss does not indicate any statistically significance with insurance use.

The estimated model includes two factors concerning insurance perceptions. The factor 1 consist of the mean value from 6 statements which is presented in Table 14. The mean value reflects the farmers insurance perceptions. The result indicate that farmers insurance have impact on the faremer's use of insurance. Factor 2 consist of the statement "Per-hectare premium costs are very important to my crop insurance decision" and indicate that farmers that perceive that the premium per hectare is very important actually are less likely to select crop insurance.

Risk preferences, according to statement twelv and thirteen, indicate no statistically significant effect upon crop insurance use. Hence, risk preferences according to this study do not appear to have any statistically significant impact of the insurance decision.

To determine how well the model fits the data a goodness-of-fit test is conducted. Hosmer-Lemeshows test compare the predicted values in groups with the observed values (Holsmer & Lemeshow, 1989). If the p-value in Hosmer-Lemeshows test is lower than 0,05 indicate that the model does not fits the data. In our model Holsmer – Lemeshow value is 0,411 which indicate that the model fits the data well. The concordant value indicates the number of observations in pairs that is consistent with the model (Lawrence, 1989). The value in our test is 87,2 % and should be considered as high because the maximum value is 100 %. This also provides support for that the model is good.

Table 15. Result from the logit method test, factors associated with farmers choice to have insurance (own processing).

Factor	Coefficient	P-value
1) Age		0,507
2) Type of enterprise		0,000
Grain	0	
Livestock production	-1,56114	
Crop and livestock production	00,763423	
Other grain production	-1,19326	
Outsource service	-2,51599	
Other	-2,19365	
3) Hectare of crop land	0,0029293	0,001
4) Hectare of forest	-0,000401	0,719
5) Off farm income		0159
6) Education		0,496
7) How many years of the last 10 have you perceived yield loss to cause more than a 10 % decline in yield relative to the average yield for your region the last 10 years?		0,811
8) I perceived that my production of crop is risky.	0,206272	0,048
9) Yield perceptions		0,016
Over norm level for my region	0	
Normal yield level for my region	-0,055384	
Under normal level for my region	-0,637811	
10) Mean value for factor 1, Insurance perceptions	1.96708	0,000
11) Factor 2, insurance perceptions. Per-hectare premium costs are very important to my crop insurance decision	-0,361955	0,000
12) Mean value for factor 1 risk preferences	-0,200667	0,160
13) Mean value for factor 2 risk preferences.	-0,065526	0,680

7 Analysis and discussion

This chapter analyses the results from the survey and statistical test in relation to the theoretical framework and literature review. The factors are presented in our model and the headings are based on the model in Figure 5.

7.1 Social factors

The theoretical framework determine that social factors such as age, education and experience, may have an impact on the crop insurance, see the model in Figure 5. These factors affect farmers' preferences and the utility function, which differs between individuals (Hardaker *et al*., 2004). These social factors are embedded in the expected utility theory where the curvature is a function of the individuals' preferences. The hypothesis from the theoretical framework is that farmers are risk averse and risk averse farmers are more willing to select crop insurance (Barry, 1984).

The statistical results show no significant statistically effect for the social factors. Barry *et al.,* (2004) find that a farmer with a higher age, level of education and experience is more positive toward using sophisticated risk management tools such as crop insurance since they are more likely to calculate risk levels. These social factors affect the degree of risk aversion. However, the results in this study indicate that there is no relation between these factors and crop insurance coverage. Hence, our results are in this context not consistent with Barrys *et al.,* (2004) result and the founding's in the expected utility theory.

The level of risk aversion depends on social factors, but does not show any connection with the insurance purchase. This may be logical since the social factors in this study show no connection with crop insurance. One reason that the results of this study show no significant effect of social factors may be due to that there is often two generations that are active in managing the farms. Decisions may be taken in consultation with each other, which could mitigate the impact of the social factors and risk preferences if these vary across generations.

7.2 Business related factors

The literature reveals that business related factors strongly affect the crop insurance decision (Barry *et al.,* 2004) and can be observed in Figure 5. These business related factors have an impact on yield levels and affect the values of X_1, X_2 and $\overline{X}$ in Figure 3. Equation 7 includes four of those related factors; farm size in hectares, type of production, hectares forest and off farm employment. According to the literature, these factors have proven to be significant with the choice to either have or not have crop insurance (Barry *et al.,* 2004). The business related factors are attached to the farmer, and explain the management of the business.

The choice of enterprises is statistically significant with insurance coverage according to our results. Farmers who are specialized grain producers have a higher probability of choosing crop insurance than farmers with more diversified production. Specialized grain producers are the ones that consider themselves to be in most need for crop insurance but also the category that chooses crop insurance to the greatest extent. The lowest level of crop insurance is found among livestock producers. The reason for that may be that these producers have a higher level of diversification and that quality and quantity of grain yields is not that important.

Diversification is a common risk management tool (Adinolfi *et al.,* 2012). Low diversity implies a greater risk exposure, which is a likely explanation why insurance coverage is more commonly used by grain producers. Diversification may affect the curvature of the utility function, since farmers' perceived risk may be changing with a higher number of income sources. According to the Figure 3, in the theory, farmers with low level of diversification tend to increase the variations between $\overline{X}$ and X_{ce}, which indicate higher demand of insurance. The results from this study indicate consistency with the theory as well as the literature. Figure 11, shows that, winter wheat, winter rape seed and summer rape seed, are the crops perceived to be in most need of insurance. These crops are not common feed grains and mostly cultivated by specialized grain producers. This may be a cause of the higher insurance level by the grain producers.

Off-farm income is another kind of diversification. The income reduces the volatility of the farm-households cash flow. The result in this study shows that a high level of off-farm income increases the demand for crop insurance although the effect is not highly significant. Some of the literature claims that a high level of off-farm income is a form of diversification and therefore provides an incentive not to choose crop insurance. Hence, our results differ from earlier studies. Barry *et al.,* (2004) did not find any statistically significant effect between the level of off-farm income and crop insurance coverage. However, off-farm income may indicate a higher level of education, since neither off-farm income nor education show a statistically significant impact on the results.

Hectares of forest show no significance with the use of insurance. The hypothesis is that farmers with forest have a higher level of diversification and therefore are less likely to select crop insurance. The result may depend on that we believe that forest holdings often are used as future retirement savings and as a tool for intergenerational transfer.

The aforementioned diversification methods are different ways of risk management. A high level of diversification decreases production risk, while off-farm income and forest holdings decrease the financial risk and stabilizes the income stream which makes the farmer less risk exposed.

Our results indicate that larger farms use crop insurance to a greater extent as a risk management tools than small farms. According to Barry *et al.,* (2004), large farms are more risk exposed than small farms. The levels of the financial turnover ratio and debt use are positively correlated with farm size and therefore the level of risky consequences increase (Adinolfi *et al.,* 2004). Larger farms may also have larger variations in yield since it is more difficult to conduct all field operations at the right time such as chemical control and fertilizer doses. The increasing risk exposure in relation to size may also depend on that farmers with few hectares often have off-farm income. This makes them less vulnerable to production risk and the subsequent economic consequences. Larger size farms are in general more geographically dispersed and exposed to different local conditions, which makes the farm vulnerable for different types of production risks. The result agrees with the theoretical review, that the use of crop insurance is higher for large farms. The result is consistent with result from earlier studies, both Adinolfi *et al*., (2012) and Barry *et al.,* (2004) find a positive correlation with insurance use and farm size.

The results from the T-test show that there are no statistically significant differences in debt use between insured and uninsured farmers. This contradicts earlier studies since the assumption that a farmer with a higher level of debt faces a greater financial risk and should therefore be in more need of a safe harvest (Barry *et al.,* 2004, Selvaraju, 2010).

The results from the T-tests do not indicate any statistically significant effect of ownership or rented land. Farmers with large ownership are according to the literature in need for less sophistically risk management tools such as crop insurance (Barry et al., 2004). Barry *et al.,* (2004) found that farmers with a higher share of rented land are more willing to sign up for crop insurance. The literature mentions that one reason can be that these farmers have less incentive to choose insurance due to their lower level of financial risk. Our results do not indicate any significance. We believe that the tenant policies in Sweden to some extent may equalize the differences between ownership and leasing right.

Results from the T-test also show that there are no statistically significant differences between users and nonusers in terms of organic/non organic. The insurance products available today on the Swedish market cover hail losses and compensation for reseeding costs. The probability of yield loss due to e.g. hail is equal whether the farmer is conventional or organic. This is a possible reason that any differences do not exist.

7.3 Preferences and perceptions

Preferences and perceptions are devided in three groups; risk preferences, perception of crop insurance product and perceptions of yield. These are analyzed and discussed in the following section.

Risk preferences

According to expected utility theory, a risk averse individual prefers a certain alternative before an uncertain, if the expected utility is the same for the both alternatives (Barry, 1984). The theory can be applied on crop insurance. Risk preferences should therefore have an impact on the choice to insure and a high level of risk aversion is expected to be positive correlated with the choice to insure (Varian, 2006). In the expected utility theory, the risk preferences are reflected by the curvature of the utility function, which is of importance for the insurance decision. In this study, the tests of risk preferences do not reveal any significance. In the logit model, the factors 12 and 13 are used to obtain a perception of the risk preferences. The factors consist of mean values from questions concerning the farmers risk preferences. Which question that belongs to the specific factor is presented in Table 13. We can not see any differences between questions associated with factor 1 or factor 2. One explanation can be the formulation of the questions in the questionnaire. Another explanation can be lacks of focus from the respondents because of the questions are in the end of the questionnaire. The results show no significant effect of risk preferences upon crop insurance coverage. According to Varian (2006) risk preferences are affected by social factors such as age, experience and education. Older and more experienced farmers are more risk averse and tend to use insurance to a greater extent than younger and less experienced farmers (Barry *et al.,* 2004). Neither farmers' social factors or risk preferences show any significance. That may reflect that the farmers risk preferences do not have any significant effect in this study.

The questionnaire has seven questions with the aim to investigate farmers risk preferences. The result from the T-test show that five out of seven questions reveal significant differences between users and non-users. Hence, due to this fact, farmers risk preferences reveal a significant impact on the decision to have an insurance or not. The T-tests indicate that farmers that have insurance are more risk preferring than farmers that do not have insurance. This result contradicts the theoretical basis. Nevertheless as previously mentioned the aggregated impact given the effect of other factors does not show any significance in the logit

model. Hence, risk preferences therefore appear to have no impact on the decision to purchase insurance.

Risk preferences in this study are evaluated by the method psychometric scaling. The method work as the respondent answer how well they agree with a statement by highlight on a 1 to 5 scale how well they agree with the statement (Pennings & Smidt, 2000). Pennings and Smidts (2000) find that the results from psychometric scaling show good agreement with how framers perceive themselves but no correlation with real behaviour. From the T-test we can see that farmers with insurance perceive that hedging is an important tool when they market their gain. This may indicate that farmers with insurance are more willing to decrease their price risk. This also conforms with the results from Pennings and Smiths study (2000) that farmers' risk preferences do not agree with the real behaviour.

Perception of crop insurance products

Farmer's perceptions of crop insurance products have impact on the insurance coverage (Barry *et al.,* 2003). The questionnaire contains seven questions about insurance perceptions. The questions are based on earlier studies where they had a significant impact on the crop insurance decision. The results of the questions in the T-tests indicate that six out of seven statements are highly significant. Remarkably is that the premium per hectare is not significant according to the T-test.

In the logit model, two factors about insurance perception are evaluated. Factor 1 consist of the mean value for questions 1,2,4,5,6,7 in Table 14. Factor 2 only consist of one statement, which is statement 3 in Table 14. We can not see any differences between the questions associated with factor 1 or factor 2. One explanation can be the formulation of the questions in the questionnaire. Another explanation can be lack of focus from the respondents cause of the questions is in the end of the questionnaire.

Factor 1 indicate statistically significance with insurance use. Thereby have also the insurance perceptions impact of the insurance use. The insurance perceptions in Figure 3 are described by R, which indicate the return from the insurance. This can been seen logical since a high return from the insurance gives farmers higher incitament to use crop insurance in their business.

The second Factor 2, which consists of the statement "premium per hectare is very important to my crop insurance decision" indicates that farmers who perceived that the premium per hectare is very important actually are less likely to select crop insurance. However, Smiths and Baque (1996) found that the premium rate of the insurance is one important factor in the farmers' choice of crop insurance. According to the theory, the premium level affects the insurance decision. This describes by Figure 3 where the premium rate is the distance between X_{ce} and $\overline{X}$. Our result is remarkable and not consistent with the theory or earlier studies, since a high premium increase the production cost. A reason that the result differs from other studies may be that farmers' not using insurance has less knowledge about the rate of insurance premium, compared to farmers with insurance. This is substantiated by statement "I am well aware of the crop insurance provisions", which indicates in the T-test that farmers with insurance are more aware of the crop insurance provisions. Hence, farmers without insurance have a difficulty to assess the premium and the benefit of insurance. The answer may indicate that insured farmers are less price sensitive then uninsured farmers.

The results from the T-test show that all statement out off "premium per hectare is very important to my crop insurance decision" indicates statistical significance. The result from statement "availability of high coverage levels is important to me" shows that the possibility of having high insurance coverage is positively correlated with selecting insurance. A higher insurance coverage may result in a higher insurance premium. This is explained by the theory described in Figure 3. If the insurance coverage is higher e.g. R increase in Figure 3 and X_{ce} moves to the left, may explain why the premium level increases with a higher insurance coverage. This also explains that the insurance product has an impact on the decision concerning insurance. The demand for a higher insurance coverage may also correlate with the fact that insurance users do not perceive premium per hectare as important. Since a higher insurance coverage results in a higher premium it seems that farmers with insurance are willing to pay for a higher insurance coverage.

According to the literature, production risk stems from factors the farmer cannot control or are beyond his control (Hardaker *et al.,* 2004). These factors are typically weather risks that can affect the yield negativity.

Figure 10 presents the risk farmers perceive to cause substantial yield losses. Drought, winter freeze and rain are the three highest ranked risks. Today there is only insurance available to compensate reseeding cost caused by draught, scabbing, frost and soil and sand drift. Yield loss is not compensated by any insurance due to the risks mentioned by the respondent farmers. This may be explained by the farmers demand for a higher level of insurance coverage. Of the un-insurable risks, flood has a higher frequency among the farmers' answers. This may indicate that these farmers are requesting disaster insurance.

Perception of yield

The logit model contains three questions 7, 8 and 9 that evaluate the farmers perceived yield, yield risk and number of yera. According to Shaik *et al.,* (2008) farmers who face a high yield risk are more willing to purchase crop insurance.

Statement 7 "how many years of the last 10 have you perceived yield loss to cause more than a 10 % decline in yield relative to the average yield for your region the last 10 years". The statement indicates no statistically significant with the use of insurance.

Statement 8 evaluates the yield risk in this study. The result indicate that farmers with a high level of perceived yield risk have a higher probability to purchase insurance. The result is consistent with the literature. This is also consistent with the theory since the yields risk is reflected by the probability for a loss to occur (Varian, 2006). Farmers with a higher probability for a loss are more willing to have insurance. The probability for a loss is also reflected by the premium level in a perfect insurance product. According to the expected utility theory, it is logical that farmers who perceive a high yield risk have a higher demand for crop insurance.

Results from statement 9 show that farmers who have a subjectively perceived higher yield level than normal for the region are more likely to purchase insurance. This result is not consistent with the findings from Shaik *et al.,* (2008), who find that farmers with a high yield level are less likely to insure their crops, since they perceive less risk. Barry *et al.,* (2004) argue in contrast that farmers with a high expected yield are more willing to insure and that could reflect the local soil conditions and the farmers' management skills. A higher expected

yield may also according to Barry *et al.,* (2004) reflect a higher perceived yield risk. The theory claims that the insurance decision affects the expected yield. If the expected yield increase the farmers' utility of insurance will increase. This is described by the model in Figure 3 where $\overline{X}$ moves to the right. The statement "Crop insurance is not important for me because my yield per hectare already is low" indicates, according to the T-test, to be significant with the choice to not select insurance. This proves the result above. Farmers with a higher expected yield, experiencing significant economic losses when they are exposed to yield loss. We believe that farmers with another enterprise than grain production consider their yield as normal or lower compared to the average yield in the region. This statement is consistent with our results showing that diversified producers have a lower insurance rate.

Crop insurance is one of the most commonly used risk management tools for farmers against production risk (Boehlje et al., 2005). Due to a number of reasons, the demand for crop insurance may increase. Production risks are expected to increase due to weather variation, less diversified farms and deregulation of subsidies and national support. Farms are getting larger and the debt use increases. These factors may affect the choice of crop insurance.
Hence, the results of this study differ only slightly from results in earlier studies, primarily implemented on farms in the United States but also in some Central European countries. Today there are only insurance available to compensate reseeding cost caused by draught, scabbing, frost and soil and sand drift. Yield loss is not compensated by any insurance due to the risks mentioned by the respondent farmers. This may be explained by the farmers demand for a higher level of insurance coverage. Of the un-insurable risks, flood has a higher frequency among the farmers' answers. This may indicate that these farmers are requesting disaster insurance.

8 Concluding comments

The aim with this study is to investigate attributes which are associated with the farmers' choice to have crop insurance. From the study some conclusion can be made.

Farmers risk preferences show no significant difference between farmers with or without insurance. According to expected utility theory risk averse individuals prefer a safe action before an uncertain if the expected monetary outcome is the same for both alternatives. Farmers that choose to purchase insurance have a guarantee that the insurance cover losses if damage occurs on the harvest. Theory implies that farmers with insurance ought to be more risk averse than other farmers.

Farmer with high risk exposure is more likely to acquire insurance. Farmers with large hectares are more prone to select the insurance option. The reason may be that of these farmers exposed to risk in a higher level than others. The turnover ratio directly depends on the hectares of cropland. Farmers that diversify their business try to decrease their risk. From the literature review the inclination is that farmers that diversify their business by off-farm income, several enterprises in the business and the use of hedging are less willing to purchase insurance. Diversification is a management tool to distribute the risk in the business. This study reveals that farmers who that are grain producers are more likely to choose insurance, since they are less diversified. One conclusion is that farmers who are exposed to a higher level of risk are more willing to insure.

Farmers that subjectively perceive a higher level of yield risk but also believe that they have a higher average yield compare to the region have a higher probability to acquire insurance. The fact that farmers with higher yield risk buy insurance is consistent with the literature. The explanation is that most individuals dislike risk and they are therefore willing to give up an expected return to be able to reduce their risk (Pindyck *et al.,* 2005). Farmers with differences in expected yield may indicate that there are differences in local conditions. According to Barry *et al.,* (2004) can that indicate a higher risk since they have a higher expected income from the yield.

Perceptions about the insurance product are of importance for the insurance decision. Farmers without insurance perceived that premium per hectare are important. The price of insurance has according to theory impact on the farmer's choice to purchase insurance. If a risk averse farmer is offered a fair insurance premium he/she would choose to insure (Varian, 2006). The result shows that farmers without insurance indicate insurance premium as important. Hence, the risk preferences indicate to have statistical impact for farmers without insurance. This may be interpreted that they perceived the insurance premium as high or that they do not have information about the price of insurance.

8.1 Further research

The range of crop insurance products in Swedish is limited to reseeding compensation and hail insurance provided by private companies with no subsidies. It will be interesting to follow the development of crop insurance and how farmers' will use insurance in the future. With increasing perceptions of risk, particularly weather risks, the demand for new products may emerge, especially insurance coverage in the case of disasters such as flooding. It would be interesting to examine the Swedish farmers demand for these products and the problem with the absence in the market. This study has not examined the effects of information on the farmers' choice of crop insurance. Another focus could be to analyse if there are differences

in viability between farmers with and without insurance. There could also be of interest to evaluate how subsidies would affect crop insurance use in Sweden, since we have some subsidies related to livestock insurance in case of disasters.

Other areas in need of further research are methods to estimate yield, in order to make fair compensations. In the United States, satellites are used to estimate both yield and losses for more realistic reimbursement rates for the individual farmer, which could be applicable for Swedish insurance companies. Methodologies and models to predict when and the extent of disasters are also in need of further research.

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Personal messengers

Andersson Franko, Mikael. Assistant professor, Department of economiscs and statistics, Swedish University of Agricultural Sciences. Telephone meating 2014-07-21.

Appendix

Appendix1: Introduction letter

Dear farmer

We are two agribusiness students at the Swedish University of Agriculture Sciences in Uppsala. This survey is a part of our master thesis and carried out in collaboration with Agria Djurförsäkring.

You have through a random process been chosen to respond this questionnaire about crop insurance as a risk management tools in agriculture.

The agricultural sector is constantly facing new obstacles, such as the climate change. Due to this, new production risks within the agriculture occur. The aim of this survey is to investigate farmers' primary production risks, which crops are considered as most risky to cultivate and underlying factors and preferences that affecting the choice regarding crop insurance.

Your answers will provide important information about crop insurance to Swedish farmers, and hopefully increase your awareness about crop insurance.

The questionnaire is expected to take five minutes to answer. To achieve most reliable and good results, it is essential for the survey that you answer and submit the questions. Last day of response is 28th of April 2014. Your answers will be anonymous and the questions will not be possible to be connected to you. To find the questionnaire, please press the link below.

If you have any questions or other speculation, you are welcome to contact us!

Thank you in advance!

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Appendix 2 – Questionnaire

Questionnaire
Thank you for choosing to participate in this survey. Some questions are statements were the answer options are a numerical scale from 1-5 as fallow

1-Strongly disagree, 2-agrees to a small extent, 3-neutral, 4-agree, 5-totally agree.

1: Age __
number of years

2: What is you highest graduation?
- ☐ Elementary school
- ☐ High school
- ☐ University

3: For how many years have you been running your farm? _____(years)

4: In which county do you farm?
- ☐ Blekinge län
- ☐ Gotlands län
- ☐ Hallands län
- ☐ Jönköpings län
- ☐ Kalmar län
- ☐ Kronobergs län
- ☐ Skåne län
- ☐ Stockholms län
- ☐ Södermanlands län
- ☐ Uppsala län
- ☐ Värmlands län
- ☐ Västmanlands län
- ☐ Västra Göralands län
- ☐ Örebro län
- ☐ Östergötlands län

5: How many hectares do you farm?_____

6: What is your primary enterprise?
- ☐ Grain production
- ☐ Livestock production
- ☐ Grain and livestock production
- ☐ Specialized crop production
- ☐ Contract service
- ☐ Other

7: How do you operate your farm conventional or organic?

- ☐ Conventional
- ☐ Organic

8: What is the proportion of ownership of the land your company cultivate?

- ☐ Owns 91 – 100 %
- ☐ Owns 81 – 90 %
- ☐ Owns 71 – 80 %
- ☐ Owns 61 – 70 %
- ☐ Owns 51 – 60 %
- ☐ Owns 41 – 50 %
- ☐ Owns 31 – 40 %
- ☐ Owns 21 – 30 %
- ☐ Owns 11 – 20 %
- ☐ Owns 0 – 10 %

9: What is your company's debt use in relation to estimated market value of assets?

- ☐ 0 – 10 %
- ☐ 11 – 20 %
- ☐ 21 – 30 %
- ☐ 31 – 40 %
- ☐ 41 – 50 %
- ☐ 51 – 60 %
- ☐ 61 – 70 %
- ☐ 71 – 80 %
- ☐ 81 – 90 %
- ☐ 91 – 100 %

10: Do the farm household have off-farm income?

State the share of revenue

- ☐ 0 – 10 %
- ☐ 11 – 20 %
- ☐ 21 – 30 %
- ☐ 31 – 40 %
- ☐ 41 – 50 %
- ☐ 51 – 60 %
- ☐ 61 – 70 %
- ☐ 71 – 80 %
- ☐ 81 – 90 %
- ☐ 91 – 100 %

11: How many hectares of forest do you own?_____

12: How do you perceived average yield in relation to average yield in your farm area?

- ☐ 30 % above
- ☐ 20 % above
- ☐ 10 % above
- ☐ Average
- ☐ 10 % less
- ☐ 20 % less
- ☐ 30 % less

13: How many years of the last 10 have you perceived yield loss to causing more than a 10% decline in yield relative to the average yield for your region the last 10 years?

- ☐ 4-5 years
- ☐ 6-7 years
- ☐ 8-9 years
- ☐ 10 years

14: I perceive my crop production expose to great risk

Strongly disagree				Totally agree
1	2	3	4	5
☐	☐	☐	☐	☐

15: Do you have crop insurance?

- ☐ Yes
- ☐ No

16: Which of the following risks do you consider to be the main cause of yield loss?

- ☐ Flood
- ☐ Winter freeze
- ☐ Crust
- ☐ Hail
- ☐ Rain
- ☐ Frost
- ☐ Wind
- ☐ Drought
- ☐ Soil and sand drift

17: Which crop do you consider to be in most need of insurance cover?

- ☐ Winter wheat
- ☐ Summer wheat
- ☐ Barley
- ☐ Oats
- ☐ Winter oilseed
- ☐ Summer oilseed

- ☐ Rye
- ☐ Triticale
- ☐ Forage
- ☐ Legumes
- ☐ Potatoes
- ☐ Sugar bait
- ☐ Other

18: I am well aware of the crop insurance provision

Strongly disagree				Totally agree
1	2	3	4	5
☐	☐	☐	☐	☐

19: Crop insurance is an important risk management tool in my production

Strongly disagree				Totally agree
1	2	3	4	5
☐	☐	☐	☐	☐

20: Per-hectare premium costs are very important to my crop insurance decision

Strongly disagree				Totally agree
1	2	3	4	5
☐	☐	☐	☐	☐

21: Availability of high coverage levels is important to me

Strongly disagree				Totally agree
1	2	3	4	5
☐	☐	☐	☐	☐

22: The ability to insure different acreages separately is important

Strongly disagree				Totally agree
1	2	3	4	5
☐	☐	☐	☐	☐

23: I consider hedging strategies to be an important tool when I sell my grain

Strongly disagree				Totally agree
1	2	3	4	5
☐	☐	☐	☐	☐

24: Crop insurance is important because of debt and rent payment obligations.

Strongly disagree				Totally agree
1	2	3	4	5
☐	☐	☐	☐	☐

25: Crop insurance is not relevant due to low yield

Strongly disagree				Totally agree
1	2	3	4	5
☐	☐	☐	☐	☐

26: Crop insurance provides good protection to my yield

Strongly disagree				Totally agree
1	2	3	4	5
☐	☐	☐	☐	☐

27: I am willing to take a higher risk in order to achieve a higher payout

Strongly disagree				Totally agree
1	2	3	4	5
☐	☐	☐	☐	☐

28: I strongly prefer to acquiring gains than avoiding losses in my business

Strongly disagree				Totally agree
1	2	3	4	5
☐	☐	☐	☐	☐

29: I prefer to be safe than sorry in my business

Strongly disagree				Totally agree
1	2	3	4	5
☐	☐	☐	☐	☐

30: I am willing to expose myself to greater risk to increase the yield of my crops

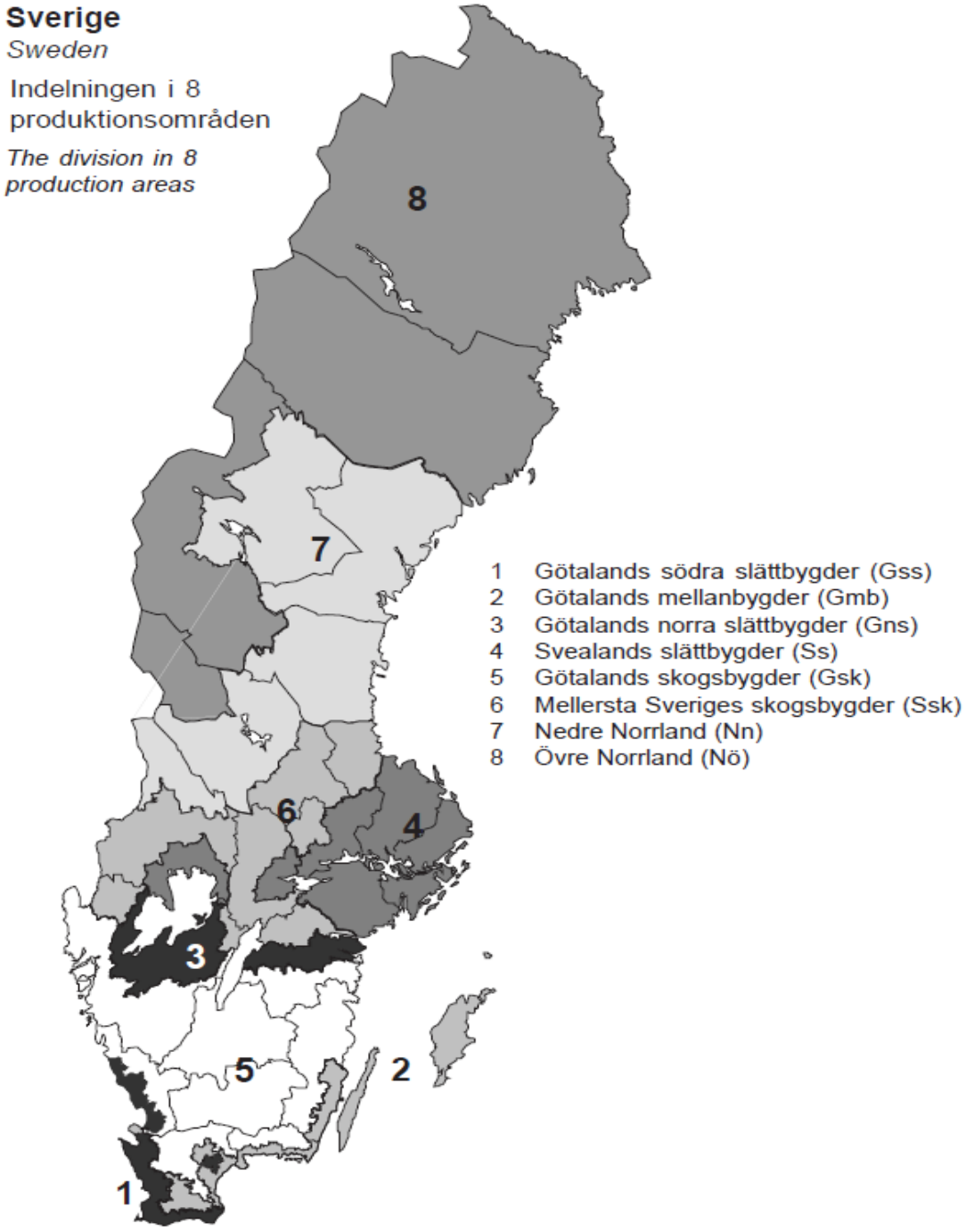
Strongly disagree				Totally agree
1	2	3	4	5
☐	☐	☐	☐	☐

31: I like having my business at risk

Strongly disagree				Totally agree
1	2	3	4	5
☐	☐	☐	☐	☐

Thank you for your commitment and dedication!

Appendix 3. Dividing's of production areas in Sweden



Source: SCB 2, 2013