The determinants of risk-sharing strategies of farmers : A study on Dutch farms

(MSc Thesis report)

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Abstract

Farmers have access to various well-honed agricultural risk management strategies to manage the throbbing in agriculture. Risk-sharing is one of the influential instrument among risk management strategies. It comprises a negotiation of risk allocation between at least two agents to reduce risk and to increase expected utility. The objective of the thesis is to identify the factors that affect to the risk-sharing strategies on Dutch farms. In this regard, this study explains risk sharing instruments from three perspectives: risk reduction; risk mitigation; and risk coping strategies. Farmers combine these risk sharing strategies according to their preference. This study also links the theoretical understanding of the existing off-farm risk sharing strategies with the empirical model. For quantitative analysis, the primary data of thirty one variables of 631 farmers are randomly collected from 12 provinces in the Netherlands. This study uses multinomial logistic regression model to identify the significant factors of selection and combination of risk reduction, risk mitigation and risk coping strategies. The results of this study infer that agricultural specialization, legal form of farm, total land size, number of hired labour, handling probabilities, relative degree of risk loving attitude at financial risk, expectation for succession and agricultural education influence on the combination of risk sharing instruments. There are another four factors (i.e., total number of livestock; negative risk at long term; relative degree of risk loving attitude at marketing and price; relative degree of risk loving attitude at innovation) that have effect on 'not to use any risk sharing strategies' by farmers. The result also shows that the selection of any risk sharing strategies is not mutually exclusive. This study covers only off-farm risk sharing instruments of farming. Consequently, this result is irrespective to on-farm risk management strategies and their combination.

Keywords : Risk reduction, risk mitigation, risk coping, Farms' and farmers' characteristics.

Contents

Chapter 01: Introduction

1.1 Background:

To manage the throbbing in agriculture, farmers have access to various well-honed agricultural risk management strategies (Walker & Jodha, 1986). For example; risk-sharing strategy, risk avoidance, risk reduction and risk acceptance strategy. The main aim of all strategies is to avoid losses and to ensure desired profitability. Risk-sharing comprises in a contract where risk is shared between actors. It is a negotiation of risk allocation between at least two agents where they employ state-contingent reducing risk and increase the expected utility. Risk-sharing is a win-win situation where stability is increased by all parties of farms. The agricultural environment is changing and stakeholders encourage to find private solution managing agricultural risk. As a private solution risk-sharing is perceived advantageous for individual farmers and society as a whole (Meuwissen et al., 2001). The common risk-sharing strategies are insurance, future and option contract, subcontracting, hedging, value chain collaboration, shared equity arrangement and group production agreement. Informal quasi-credit is also a risk-sharing strategy in the third world counties which solves enforcement problem and ensures income pooling arrangement of actors (Marcle, 1999). Stiglitz (1974) explained the concept of sharecropping by incentives and risk-sharing. In sharecropping, worker maximize their utility through contract arrangements which simultaneously maximize the utility of the landlord or capitalist. Eventually it maximizes value of the company. However, the frequency of the risk and the impact of the risk are main determinants of selecting an appropriate risk management strategy. In this regards, risk-sharing strategy is used whenever the frequency of risk is low but the impact of risk is large. Risk-sharing strategies are used at any stages of the farming for example, risk-sharing in production, pricing and financing. Whatever the time of risk-sharing, the main basis is the pooling and spreading risk to other stakeholders. In fact, farmers use many risk-sharing strategies during the transition of farming and trading. Whenever risks influence to production, equity capital and net income of the farm then risk-sharing is needed as a part of business planning and risk management. Even more farmers arrange a portfolio of risk-sharing strategies in the whole business period for example, one risk-sharing strategy (e.g. insurance) might be used to manage production risk simultaneously another risk-sharing strategy (e.g. hedging) might be used to manage marketing and pricing risk. Hence, it is a matter of combination of different risk-sharing schemes.

1.2 State of the art:

Risk is an inherent characteristics of any business. Agriculture is more prone to risk due to natural hazards. Chavas, (2004) focused mainly three reasons behind this risk and uncertainty- a) Inability to control and/or measure causal factors of events b) Limited ability to process information c) Monetary cost of decision. To manage various risk, famer usually use on-farm and off-farm risk management instruments. The most common risk management tool is insurance. A part from insurance, hedging has been used by farmer since before 1980. It appears as a better solution compared to risk reduction benefits for farmers (Harwood et al., 1999). There are various types of agricultural insurance. In some extent, farmer use crop insurance to reduce yield risk simultaneously hedging allows to reduce price risk. In this regard, off-farm income, education, forward contract in sales and networking positively affect to use hedging (Mishra & El-Osta, 2002). Moreover, weather based hedging is potentially an economical and sustainable risk management tool in managing the volume-related weather risk in agriculture (Sharma & Vashishtha, 2007). In the context of developing countries, uninsured weather risks is a major hurdle in investment and capitalization of resources and responsible for rising poverty (Dercon & Christiaensen 2011). For financial security small agro-farm of developing countries also rely on reciprocal financial exchange, kinship ties and community self-help by joining informal risk-hedging schemes, member of micro-finance institution, cooperatives based on reciprocal social relationships (Cox & Fafchamps, 2006). In the market perspective, penetration of agricultural insurance remains small in developing and developed countries due to unwillingness of farmers (Mahul & Stutley, 2010). Holly, Zhang & Wu (2011) explained the factors of contract farming

are related to risk attitudes of farmers. It is not always right that, risk averse farmers use contract and risk seeking farmers do not use contract. Basically, Chinese farmers use contract not only to mitigate price risk rather better offer to reduce marketing and transaction cost (Holly, Zhang & Wu, 2011). The religious castes as a demographic factor also play role in risk-sharing strategies of Indian farmers (Munshi & Rosenzweig, 2006). A part from demography, Murgai et al. (2002) focuses on the role of transaction cost in using local risk-sharing strategies. There are many factors that affect risk management strategy for example, age, educational status of farmer, ownership structure of farm and land size of farmer. Velandia et al. (2009) explained about the risk-sharing strategy more specifically on adaptation of crops insurance, forward contracting and spread sales. They identified proportion of land ownership, off-farm income, education, age, and level of business risks significantly affect to the adoption of the risk management tools. Moreover, Slovakian farmers perceive the price risk, production risk and income risk as most important risk factors. The land size of farmer is associated with price risk, legal form of business is associated with production risk and income risk (Nadezda, Dusan & Stefania, 2017). Drought and input-output price variability are the primary risk factors with potential to affect income of US beef producing farm (Hall et al., 2003). Market linkages and farm structure; access to finance and availability of pro-poor options for beneficial conservation are also critical factors in stimulating risk management strategy and investment (Shiferaw, Okello & Reddy, 2007). Furthermore, technological innovation in market structure, the nature and duration of public policy intervention also affect the risk management strategies of farmers (Feder & Umali, 1993). Because improved technological innovation reduces the down side risk by protecting production in bad years (Emerick et al., 2016). On the other hand, risk attitudes related to cognitive frame of farmers. The risk attitude provide into insight why two farmers behave differently with an identical situation. One farmer prefers to explore the opportunity another does not. Palich & Bagby (1995) studied the decision making process of investor and they categorised the process into entrepreneurs and non-entrepreneurs when confronted with identical information. Barbieri & Mahoney (2009) explained about the entrepreneurial aspiration and pursuits towards risk-sharing strategies. In fact, all these factors potentially influence the intended decision of risk-sharing strategies of Dutch farmers. The more literatures of the factors that affect to specific risk sharing instruments are grossly classified into main four domain (i.e., personal characteristics of farmers, farms' characteristics, subjective risk perception and absolute and relative risk attitudes) in chapter two (Methodology) of this study.

1.3 Problem statement

: There are 12 million farmers produce agricultural products for the 500 million consumers of European Union (Mottershead & Schweitzer, 2018). Particularly in the Netherlands, agricultural industry has big contribution in GDP and plays pivotal role in employment generation. One out of six people is working in agricultural industry. In 2018 the Netherlands gained €90.3 billion by exporting agricultural goods which is second largest agro-food exporting figures after USA. In 2018, there were 53,906 farms in the Netherlands (CBS, 2019). However, each of 53,906 farms is prone to risk and uncertainty. To manage the risk and uncertainty a farmer uses on-farm strategies and off-farm (risk-sharing) strategies. This study is about risk-sharing strategies only. There are plenty of literatures on specific risk-sharing instruments. For example agricultural insurance is the most common risk-sharing strategy (Harwood et al., 1999). Agricultural insurance plays an important role in protecting the income of each farmer though it has maladaptive outcomes due to non-adjustment in coping with climate risk and ecological consequences of land utilization and production (Pocuca, Petrovic & Mrksic, 2018). Insurance can be a careful instrument to manage a comprehensive risks from local, social, economic and ecological context (Muller, Johnson & Kreuer, 2017). Moreover, many research were done on other risk-sharing instruments (e.g. hedging, value chain collaboration and marketing contract). In fact, a farmer uses different risk-sharing strategies (i.e. risk reduction, risk mitigation, risk coping and their combination) to optimize various risk utilities. Farmers don't rely on only agricultural insurance as a whole risk management solution. They arrange a set of portfolio of risk management instruments including risk-sharing tools. However, there are limited literatures regarding the factors affecting risk-sharing strategies on Dutch farm. Meraner et al., (2015) studied about the

determinants of diversification as on-farm strategies. No studies has done yet about the factors affecting the combination of different risk-sharing instruments. This is the main addressing research gap of this study. The personal characteristics of farmers, farm characteristics, risk perception and risk attitudes may affect to consider risk-sharing instruments and their combination. Furthermore, the risk-sharing strategies are associated with the willingness to take risk by farmers. Many farmers also perceive that they take more risk in production, marketing and pricing, financing, innovation or overall farming compared to other farmers. By considering all these factors, this study is going to assess the determinants of risk-sharing strategies and their combination. To what extent these four domain of factors (i.e., personal characteristics, farm characteristics, risk perception and risk attitudes) play role in selection and combination of risk-sharing strategies will be assessed by this study.

1.4 Objectives of the study**:** The main objective of the study is to identify the factors that affect to the risk-sharing strategies on Dutch farms.

To accomplish the main objective, the following sub-objectives will be analysed, i.e. to

1. review the factors that affect to the specific risk-sharing strategies on Dutch farms;
2. assess the factors that affect to the combination of different risk-sharing strategies; and
3. assess the factors that affect not to use of risk-sharing strategies among Dutch farms.

1.5 Outline of the study: This study is organised by four chapters where chapter two shows conceptual frameworks, data operationalization, research methods, empirical model and methodology. Chapter three compiles the results and discussion. Finally, chapter four represents conclusions, recommendation and limitation from results.

Chapter 02: Methodology of the study

2.1 Conceptual Model: The theoretical framework of this study exposes to how farmers characteristics, subjective risk perceptions, risk attitudes and farm's characteristics matter on selecting and combining risk-sharing strategies. Risk-sharing involve to the selection of methods for countering all risks in order to meet the farmer's risk-averting goal. To get insight into the risk-sharing, all possible risk-sharing strategies are clustered into three forms: risk reduction; risk mitigation and risk adaptation or coping. In the model, Risk reduction denoted by R_r and $R_r = 1$ whenever farmer uses any instrument of risk reduction otherwise 0. Risk mitigation is denoted by R_m and $R_m = 1$ whenever farmer uses any instrument of risk mitigation otherwise 0. Finally, Risk coping is also denoted by R_c and $R_c = 1$ whenever farmer uses any instruments of risk coping otherwise 0.

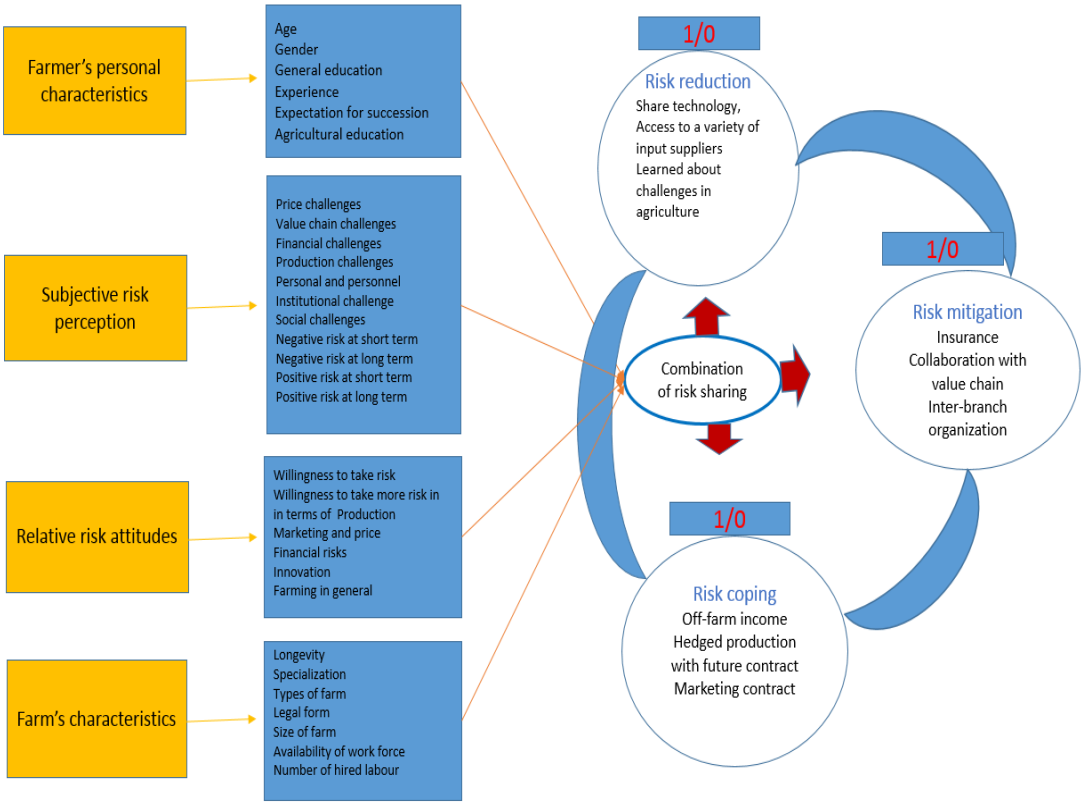

Figure 1: Theoretical framework of the study

2.2 Assumptions of the model: This study presumes that farmers use various risk-sharing strategies simultaneously and combine different risk-sharing strategies considering their risk in harvesting, cultivation or trading. This study checks whether selected four factors (i.e. farmer's personal characteristics; subjective risk perception; risk attitudes and relative risk attitudes; and farm's characteristics) do matter in the combination of risk reduction, risk mitigation and risk coping strategies. The dependent variables (the risk-sharing strategies) are at nominal level. This study has adequate independent variables that are continuous, ordinal or nominal (including dichotomous variables). Independence of observations (each farmers are free to able and take any risk-sharing instruments) and the categorised dependent variable should have mutually exclusive and exhaustive categories. There is no multi-collinearity among the selected independent variables. There is a linear relationship between continuous independent variables and the logit transformation of the dependent variable. Finally, there is no outliers, high leverage values or highly influential points.

2.3 Factor affecting the combination of risk-sharing strategies

2.3.1 Farmer's personal characteristics: This study checks whether farmers personal characteristics have a direct (not mediated) effect on the risk-sharing strategies and their combination. For instance, farmer's personal characteristics include age (Finocchio & Esposti, 2008), gender (Larson et al., 2015), farm succession (Meraner & Finger, 2019), past experience (Saqib et al., 2016) and education (Velandia et al., 2009) have effect on agricultural risk management. These characteristics significantly affect to the adoption of the risk management tools. However, all these studies explained the effect of farmer's personal characteristics on single risk management tool (e.g. uptake of contracts, agricultural credit and insurance) or overall risk management in agriculture. No studies has been done yet about the effect of these personal characteristics of farmers on the choice and combination of risk-sharing strategies. Hence, this study proposes the following hypothesis based on the above mentioned literatures of agricultural risk management.

H1: Farmer's personal characteristics explain the choice and combination of risk-sharing strategies

Table 1: The hypothesized effect of farmer's personal characteristics on risk-sharing strategies

Notation	Effect on risk-sharing strategies/ risk management strategies	Literatures
H.1.1	Farmer's age	(Finocchio & Esposti, 2008)
H.1.2	Gender of the farmer	(Larson et al., 2015)
H.1.3	Farmer's general education	(Velandia et al., 2009)
H.1.4	Experiences	(Saqib et al., 2016)
H.1.5	Expectation for succession	(Meraner & Finger, 2019)
H.1.6	Agricultural education	Not available

2.3.2 Subjective risk perception: Risk perception of each farmer might be different due to subjective judgement of each farmer towards the objective risk. For example a farmer may concern on price risk and another may concern on production risk. A farmer might go for insurance to manage production risk whereas another farmer choose hedging or future contract to manage price risk. They also combine different risk-sharing instruments during their business life. For example, the price risk, production risk and income risk (Nadezda, Dusan & Stefania, 2017; Meuwissen, Huirne & Hardaker, 2001), drought risk (Hall et al., 2003), and categorized weather related risk perception (Ullah, Shivakoti & Ali, 2015) have influence on risk management strategies of farmers. Though they explained the effect of risk perception on only selecting risk management instrument not on the combination of various risk-sharing strategies. Therefore, based on the above literatures this study expects that farmer with a not less perceived risk, the intention to use risk-sharing strategies is also not less. Hence it is proposed that-

H2: Farmer's risk perception positively influences on the choice and combination of risk-sharing strategies of a farmer.

Table 2: The hypothesized effect of farmer's perceived risk on risk-sharing strategies

Notation	Effect on risk-sharing strategies/ risk management strategies	Literatures
H.2.1	Price challenges	Meuwissen, Huirne & Hardaker (2001)
H.2.2	Value chain challenges	Not available
H.2.3	Financial challenges	Barry & Robison (2001), (Binswanger, Khandker & Rosenzweig, 1993)
H.2.4	Production challenges	Nadezda, Dusan & Stefania, (2017)
H.2.5	Personal and personnel challenges	Not available
H.2.6	Institutional challenges	Nick (2004), Duke & Malcolm (2003)
H.2.7	Social challenges	Holzmann & Jørgensen (2001)
H.2.8	Handling probabilities	Zikmund-Fisher et al., (2007)
H.2.8	Negative risk (Bad year) in short term	Not available
H.2.9	Negative risk (Bad year) in long term	Not available
H.2.10	Positive risk (Good year) at short term	Not available
H.2.11	Positive risk (Good year) at Long term	Not available

2.3.3 Risk attitudes and relative risk attitudes**:** Risk attitude has been described in economic literature in the expected utility frameworks (Pennings & Garcia 2001). This study measures risk attitudes of farmers in two forms- a) absolute risk attitude and b) relative risk attitudes (to other farmers). It measures absolute risk attitudes as the willingness to take risk or preferences of farmers and uses of risk management tools. Relative risk attitudes are measured as the willingness to take more risk compared to other farmers in terms of different domain (i.e. production, marketing and price, finance, innovation and farm in general). Many farmers take more risk in terms of production, finance or others compared to other farmers which are considered as relative risk attitudes. Though risk attitude is typically regarded as stable over time, it changes stability at different domains and context (Dohmen et al. 2011). A decision maker may be simultaneously risk seeking and risk averse in different domains (Hansson & Lagerkvist 2012; Pennings & Smidts 2000; Starks & Trinidad, 2007). For example, a farmer may show risk loving attitudes in terms of production but may be risk neutral or averse in financing and innovation. As such this study expects that the more willing the farmers are to take risk, i.e. the less risk-averse farmer, the less motivated they are to use and combine any risk-sharing strategies. Hence, this study propose the following hypothesis.

H3: Risk aversion and relative risk aversion (to other farmers) have negative impact on the choice and combination of risk-sharing strategies.

Table 3: The hypothesized effect of farmer's risk attitudes, relative risk attitudes (to other farmers) on risk-sharing strategies.

Notation	Effect on risk-sharing/ risk management strategies	Literature
H.3.1	Risk attitudes (willingness to take risk)	Winsen et al. (2016)
H.3.2	Relative risk attitudes (to other farmers) in terms of production	Meuwissen, Huirne & Hardaker (2001)
H.3.3	Relative risk attitudes (to other farmers) in terms of marketing and prices	Meuwissen, Huirne & Hardaker (2001)
H.3.4	Relative risk attitudes (to other farmers) in terms of financial risk	Meuwissen, Huirne & Hardaker (2001), (Saqib et al., 2016)
H.3.5	Relative risk attitudes (to other farmers) in terms of innovation	Meuwissen, Huirne & Hardaker (2001)
H.3.6	Relative risk attitudes (to other farmers) in terms of farming in general	Meuwissen, Huirne & Hardaker (2001)

2.3.4 Farms' characteristics: This study has separated farm from farmers in respect to their characteristics. Farm size (Lucas & Pabuayon 2011), farm specialization (Benni, Finger & Mann, 2012) ownership proportion (Saqib et al., 2016) and role of family employee (Benjamin & Kimhi, 2006) have effect on risk management strategies of farmers. This study is going to check whether farm's characteristics have a direct (not mediated) effect on risk-sharing strategies. For instance, we could imagine that very large farms easily manage their risk through big financial portfolio though their risk impact is also big. The traditional old farm are less likely to invest in modern risk-sharing strategies. This study are also going to check whether perceived past experience with risk would have a significant effect on risk-sharing strategies. Based on the above literatures the following hypothesis has been used-

H4: Farm's characteristics have a significant impact on the choice and combination of risk-sharing strategies.

Table 4: The hypothesized effect of farm's characteristics on risk-sharing strategies.

Notation	Effect on risk-sharing/ risk management strategies	Literature
H.4.1	Longevity of farm	Not available
H.4.2	Agricultural specialization	(Benni, Finger & Mann, 2012)
H.4.3	Types of farm	Not available
H.4.4	Number of livestock	Not available
H.4.5	Legal form of farm	(Saqib et al., 2016)
H.4.6	Total size of farm	(Lucas & Pabuayon 2011)
H.4.7	Availability of work force along with family members	Benjamin & Kimhi, (2006)
H.4.8	Number of hired labour	Benjamin & Kimhi, (2006)

2.4 Explanatory variables: All the explained variables are grouped into four sections - a) farmer's personal characteristics; b) subjective risk perception; c) Absolute and relative risk attitudes; and d) farm's characteristics. Personal characteristics of farmers cover age of the farmer, gender, expectation for succession, education and agricultural education. Subjective risk perception incorporates price challenges, value chain, production, personal and personnel, weather and others. Risk attitudes and relative risk attitudes compiles with willingness to take risk, more risk in terms of production, marketing and pricing, finance innovation and farm in general. Finally, farm's characteristics are associated with lifetime of farm, agricultural specialization, livestock product, types of farm, legal form of farm, total size of farm, availability of work force along with family members and number of hired labour. The explained variables of this study with their notation are presented in the following table.

Table 5: List of Explanatory variables with associated hypotheses

Variables	Notation	Unit	Question No.	Literatures
Farmer's personal characteristics			13	Bachev (2013) Sherrick et al. (2004), Velandia et al. (2009), Mohammed & Ortmann (2005), Velandia et al. (2009), Finocchio & Esposti, (2008), Larson et al., (2015), Velandia et al., (2009), Saqib et al., (2016) Meraner & Finger, (2019).
Year of birth	Yr_{fp}	Year Range/ 1900-2000	13.a	
Gender	Gr_{fp}	Binary (0 for male, 1 for female)	13.b	
Expectation for succession	Suc_{fp}	Combination of dummy variables D^1_{suc} = { 1 if no expectation; 0 Otherwise } D^2_{suc} = { 1 if take over to family member; 0 otherwise } D^3_{suc} = { 1 if sell property; 0 otherwise } D^4_{suc} = { 1 if give up tenancy; 0 otherwise }	13.c	
Education	Edu_{fp}	Combination of dummy variables D^1_{edu} = { 1 if No education; 0 otherwise } D^2_{edu} = { 1 if primary education; 0 otherwise }	13.4	

		D^3_{edu} = { 1 if secondary education; 0 otherwise } D^4_{edu} = { 1 if undergraduate; 0 otherwise } D^5_{edu} = { 1 if graduate; 0 otherwise }		
Agricultural education or training	$Aged_{fp}$	Binary (Yes= 1, No = 0)	13.5	
Ability to handle probabilities	$Abhp_{fp}$	Scale of 1 (strongly disagree) to 7 (strongly agree)	10	
Subjective risk perception	RP	Scale of 1 (not challenging at all for my farm) to 7 (very challenging for my farm)	5	Mohammed & Ortmann (2005), Velandia et al. (2009), Emerick et al. (2016), Meuwissen, Huirne & Hardaker (2001), Barry & Robison (2001), Binswanger, Khandker & Rosenzweig, (1993), Nadezda, Dusan & Stefania, (2017), Nick (2004), Duke & Malcolm (2003) Holzmann & Jørgensen (2001).
Price challenges	Pr_{rp}	Scale of 1 (not challenging at all for my farm) to 7 (very challenging for my farm)	5.a	
Value chain challenges	VC_{rp}	Scale of 1 (not challenging at all for my farm) to 7 (very challenging for my farm)	5.b	
Financial challenges	Fr_{rp}	Scale of 1 (not challenging at all for my farm) to 7 (very challenging for my farm)	5.c	
Production challenges	Pn_{rp}	Scale of 1 (not challenging at all for my farm) to 7 (very challenging for my farm)	5.d	
Personal and personnel challenges	PP_{rp}	Scale of 1 (not challenging at all for my farm) to 7 (very challenging for my farm)	5.e	
Institutional challenges	Ins_{rp}	Scale of 1 (not challenging at all for my farm) to 7 (very challenging for my farm)	5.f	
Social challenges	Soc_{rp}	Scale of 1 (not challenging at all for my farm) to 7 (very challenging for my farm)	5.g	
Negative risk (Bad year) in short term	$NrBs_{rp}$	A percentage between 0% and 100%. The higher the percentage, the more likely it is that a bad year occurs	11.a	
Negative risk (Bad year) in long term	$NrBl_{rp}$	A percentage between 0% and 100%. The higher the percentage, the more likely it is that a bad year occurs	11.a	

Positive risk (Good year) at short term	$PrGs_{rp}$	A percentage between 0% and 100%. The higher the percentage, the more likely it is that a good year occurs	11.b	
Positive risk (Good year) at Long term	$PrGl_{rp}$	A percentage between 0% and 100%. The higher the percentage, the more likely it is that a good year occurs	11.b	
Risk attitudes and relative risk attitudes (To other farmers)				Meuwissen, Huirne & Hardaker (2001), Winsen et al. (2016), Flaten et al., (2005), Saqib et al., (2016).
Risk attitudes	RA.	A scale of 0 (not at all willing to take risks) to 10 (very willing to take risks)	12.a	
Relative risk attitudes in production	Pn_{rra}	A scale of 1 (strongly disagree) to 7 (strongly agree) to take more risks than other farmers in terms of production	12.b.	
Marketing and prices	Mp_{rra}	A scale of 1 (strongly disagree) to 7 (strongly agree) to take more risks than other farmers in terms of marketing and prices	12.b	
Financial risks	Fn_{rra}	A scale of 1 (strongly disagree) to 7 (strongly agree) to take more risks than other farmers in terms of financial risks	12.b	
Innovation	In_{rra}	A scale of 1 (strongly disagree) to 7 (strongly agree) to take more risks than other farmers in terms of innovation	12.b	
Farming in general	Fg_{rra}	A scale of 1 (strongly disagree) to 7 (strongly agree) to take more risks than other farmers in terms of farming in general	12.b	
Farm's characteristics				Benjamin & Kimhi (2006), Benni, Finger & Mann, (2012), Saqib et al., (2016) Lucas & Pabuayon (2011).
Longevity of farm	Ln_{fc}	Number of years (0-100 years)	1.a	
Agricultural specialization	As_{fc}	Combination of dummies $D^1_{crops} = \begin{cases} 1 \text{ if crops} \\ 0 \text{ otherwise} \end{cases}$ $D^2_{hort} = \begin{cases} 1 \text{ if Horticulture} \\ 0 \text{ otherwise} \end{cases}$ $D^3_{Dair} = \begin{cases} 1 \text{ if Dairy} \\ 0 \text{ otherwise} \end{cases}$ $D^4_{Pigs} = \begin{cases} 1 \text{ if specialist pigs} \\ 0 \text{ otherwise} \end{cases}$	1.b	

		$D^5_{poul} = \begin{cases} 1 \text{ if specialist poultry} \\ 0 \text{ otherwise} \end{cases}$ $D^6_{livestock} = \begin{cases} 1 \text{ if other grazing livestock} \\ 0 \text{ otherwise} \end{cases}$		
Total number of livestock	Lp_{fc}	Units (1....N)	1.c	
Types of farm	Tf_{fc}	Combination of dummies $D^1_{conventional} = \begin{cases} 1 \text{ if conventional farm} \\ 0 \text{ otherwise} \end{cases}$ $D^2_{organic} = \begin{cases} 1 \text{ if farm organic} \\ 0 \text{ otherwise} \end{cases}$ $D^3_{converted} = \begin{cases} 1 \text{ if farm converted} \\ 0 \text{ otherwise} \end{cases}$	1.d	
Legal form of farm	Lf_{fc}	Combination of dummies $D^1_{sole} = \begin{cases} 1 \text{ if sole proprietorship} \\ 0 \text{ otherwise} \end{cases}$ $D^2_{family} = \begin{cases} 1 \text{ if family farm} \\ 0 \text{ otherwise} \end{cases}$ $D^3_{partnership} = \begin{cases} 1 \text{ if partnership farm} \\ 0 \text{ otherwise} \end{cases}$ $D^4_{company} = \begin{cases} 1 \text{ if company farm} \\ 0 \text{ otherwise} \end{cases}$ $D^5_{cooperative} = \begin{cases} 1 \text{ if cooperative farm} \\ 0 \text{ otherwise} \end{cases}$	1.e	
Total size of farm	Ts_{fc}	Hectares	1.f	
Availability of family labours	Awf_{fc}	Labour units	1.g	
Number of hired labour	Hl_{fc}	Labour units	1.h	

2.5 Explanation of dependent variables:

The farmers reported that they access multiple sources of risk-sharing instruments. We thus assume that farmers are using these risk-sharing instruments simultaneously to manage risks. Moreover, the choice of a farmer among risk-sharing strategies are not mutually exclusive since farmers are accessing risk-sharing instruments from more than one instrument in his risk management portfolio. During the survey farmers reported eight different risk-sharing instruments. For the purpose of analysis, these eight instruments are clustered together in three categories based on common characteristics and risk management literature. Categories of risk-sharing instrument and their example are stated in following table.

Table 6**:** Categories of risk-sharing instruments based on risk management literature and their common characteristics

Sl. No.	Category	Types of risk-sharing instrument
1	Risk reduction (R_r)	Risk reduction covers the measure to decrease the probability of adverse event hit the farm. For example, Cooperated with other farmers to secure inputs of production (e.g. buy inputs together, sharing machinery or exchange land), Had access to a variety of input suppliers (e.g. feed, seed, fertiliser, or finance suppliers), and learned about challenges in agriculture (e.g. farmer group, consultant, or agricultural training).
2	Risk mitigation (R_m)	Risk mitigation indicates the strategies that allow the risk to happen, but reduce its impact (Wauters et al., 2014). Likewise risk reduction, it is also employed before the risk occurs. Mitigation strategies reduce the potential impact if the risk were to occur (Holzmann & Jørgensen, 2001). For example, Member of an (inter)branch organization, collaborate with value chain actors such as processors, retailers, and technology providers, bought any types of agricultural insurance, crop insurance, hail, yield, or livestock insurance and member of a producer organization cooperative or credit union.
3	Risk coping (R_c)	Finally, risk coping is related to restoring the whole property or part of the property the damage when it happen. It is essentially the residual strategy if everything else has failed. For example Used production or marketing contracts to sell (part of) my production and hedge (part of) my production with futures contracts.

The above mentioned risk-sharing instruments are not isolated. The specific risk-sharing instruments and their possible combination are the dependent variables of this study. The list of possible combinations are stated in the following tables.

Table 7: Different combinations of risk-sharing strategies

Sl. No.	Possible sources of risk-sharing strategies and their combination
1	Risk reduction (R_r)
2	Risk mitigation (R_m)
3	Risk coping ($R_{c)}$
4	Risk reduction (R_r) and Risk mitigation (R_m)
5	Risk reduction (R_r) and Risk coping (R_c)
6	Risk mitigation(R_m) and Risk coping (R_c)
7	Risk reduction (R_r), Risk mitigation (R_m) and risk coping (R_c)
8	None of the risk reduction (R_r), risk mitigation (R_m) and risk coping (R_c)

2.6 Data Operationalization:

This study is consist of primary data. The respondents are the farmers of the Netherlands. Data are collected through a structured questionnaire. The questionnaire consist of open-ended and closed-ended questions which gathered information on characteristics of farmers, farms, risk perceptions, risk attitudes of farmers and their risk-sharing instrument. The total number of respondents are 924 farmers in the Netherlands. The data are collected during 2018 from 12 provinces in the Netherlands. 924 farmers consist of 49 farmers from Drenthe, 32 farmers from Flevoland, 87 farmers from Friesland, 113 farmers from Gelderland, 50 farmers from Groningen, 57 farmers from Limburg, 166 farmers from Noord-Brabant, 83 farmers from Noord-Holland, 89 farmers from Overijssel, 46 farmers from Utrecht, 57 farmers from Zeeland and 95 farmers from Zuid-Holland province. Thus the data of each province has randomly selected. The representative data sample of the study is stated in the following pie chart according to province.

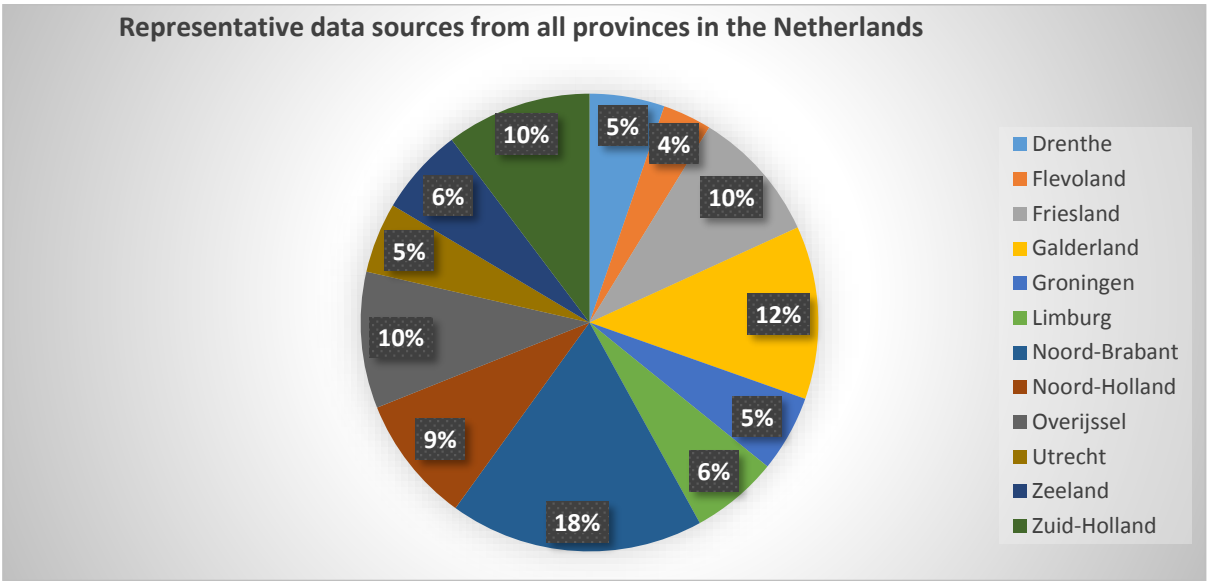

Figure2 : Pie chart of the Data sources according to the respective province

2.6.1 Data management, cleaning and organization:

This **s**tudy uses the dataset of SURE-farm project (A project of Wageningen University and Research). The data set was consist of 145 variables of 924 Dutch farmers. The variables were about demographic aspect of farmers, social, economic, technological, farm itself, risk related, income related and about functional aspect. From these 145 variables we have selected 31 variables as explanatory variables for the research design. The selection of thirty one variables is based on the literature and research design. Moreover these thirty one variables are grouped into four broad domain (i.e., farmers personal characteristics, farms' characteristics, absolute and relative risk attitudes and subjective risk perception). The dataset was formed on survey questionnaires with a random sampling method from mentioned twelve provinces. There are variety of respondents regarding size of farms, types of farms, ownership and their specialization. We reframed this raw dataset according to our research objectives. Firstly we derive few variables from collected data through literature and simple calculation. For example, there are a number of variables regarding livestock. Some of the farmers have cow. Some of the farmers have goats and pigs and so on. As all the respondents are not from any specific industry (e.g. Dairy industry) the unit value of their livestock are not same. To make a common unit of livestock for all types of farmers, we converted their numbers of livestock according to the standard of EU (https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Livestock_unit_(LSU).

2.6.2 Data cleaning, Outlier and Strange observations: Most of the variables of risk perceptions and risk attitudes are measured in terms of seven and ten point Likert scale. The variables of personal characteristics and farm characteristics are measured in simple numerical value and mostly are categorical variables. To identify any strange data, we detect outlier with the help of following statistical formula of outlier and the graphical identification through boxplot of the respective variables.

$$IQ\ (Inter\ Quartile) = 3^{rd}Q - 1^{st}Q$$
$$Upper\ fence = \{3^{rd}Q + (1.5 * IQ)\}$$

Therefore any value greater than "Upper fence" is considered as outlier for this variable. For example, the maximum value of the livestock for a farm-
1^{st}Q = 0.00, 3^{rd}Q = 130.2, Maximum value of livestock = 20,108, Mean = 139.2

$$Inter\ Quartile(IQ) = (130.2 - 0)$$
$$= 130.2$$
$$Upper\ fence = \{130.2 + (1.5 * 130.2)\}$$
$$= 325.5\ units.$$

Theoretically any value greater than 325.5 units would be considered as outlier. However a farmer has 20,108 units of livestock. In reality, this amount of livestock is possible but it has big impact on describing the impact of mean livestock of the whole Dutch farming. Moreover, there might have 'typo error' or the respondents might not understand the question of the interviewer. For example, a farmer respond that the total number of family labour are 750 units. Generally 750 FT of family labour may not be possible. Meanwhile, we detect all the outliers of all explained variables. We filtered the dataset based on the outlier (upper fence X 20) for respective variables. Because there are many farmer specific variables (e.g., age) in this study which are very subjective for the respondents, their surrounding and related to the province. Finally, we get 631 observations (i.e., 68.30% of the main dataset) for analysis.

2.7 Descriptive statistics of factors: The explanatory variables that potentially influence to the farmers risk-sharing strategies are defined as the age, gender, education level, succession and others. The descriptive statistics of farmers characteristics, farm's characteristics and other independent variables of the survey questionnaire is presented in the following table.

Table 8: Descriptive statistics of farmer's and farms' characteristics

Variables	Mean	St. Deviation	Maximum	Minimum
Lifetime of the farm	31	11.45	65	0
Age	52.71	10.22	81	20
Total number of livestock	139.2	135.48	930	0
Total land area	57.43	54.57	500	0
Family labour	1.55	4.06	50	0
Hired Labour	2.42	5.78	60	0
Negative risk Short term	38.22	21.43	100	0
Negative risk Long term	53.49	25.13	100	2
Positive risk short term	50.44	20.82	100	0
Positive risk Long term	60.92	21.51	100	5

Table 9: Frequency distribution of the selected explanatory variables

Variables	Frequency	Percentage
Gender		
Male	588	93.18
Female	43	6.81
Total	631	100
Education		
No Education	1	.15
Primary Education	4	.63
Secondary Education	120	19.01
Undergraduate Education	334	52.93
Graduate Education	172	27.25
Total	631	100
Agricultural Education		
Taken training	539	85.41
No training	92	14.59
Total	631	100
Agricultural Specialization		
Crops	157	24.88
Horticulture	105	16.64
Dairy	257	40.72
Specialist pigs	14	2.21
Specialist poultry	7	1.10
Other grazing livestock	26	4.12
Mixed activities	25	3.96
Others	40	6.33
Total	631	100
Types of farm		
Conventional	597	94.61
Organic	19	3.01
Converting from conventional to organic	11	1.74
Others	4	.63
Total	631	100
Expectation for Succession		
No expectation	222	35.18
Take-over to family	256	40.57
Sell property	94	14.89
Give up tenancy	6	.95
Others	53	8.39
Total	631	100
Legal form of the farms		
Sole proprietorship	136	21.55
Family farm	254	40.25
Partnership farm	183	29.00
Company farm	51	8.08
Co-operative farm	7	1.10
Total	631	100

2.8 Uses of risk-sharing strategies of surveyed farmers:

From the survey questionnaire, it is reported that farmers use various risk-sharing strategies and combine these strategies for common risk hazards. Table 10 represents the proportion of risk-sharing strategies used by 631 Dutch farmers. There are 30.23% farmer uses single risk-sharing strategies in the form of risk reduction, risk mitigation or risk coping. Moreover, 19.6% farmers uses all the possible risk-sharing strategies for managing risk at before and after the risk occurred (i.e. they use risk reduction, risk mitigation and risk coping strategies simultaneously). However, there are almost 5.2% of the farmers are not using any risk-sharing strategies at before and after of risk occurred yet.

Table 10: The Frequency of the risk-sharing categories and their proportionate combination

Dependent variables	Frequency	Percentage
Risk reduction	117	18.52
Risk mitigation	60	9.50
Risk coping	14	2.21
Risk reduction and Risk mitigation	237	37.55
Risk reduction and Risk coping	35	5.54
Risk mitigation and Risk coping	11	1.74
Risk reduction, Risk mitigation and Risk coping	124	19.61
Uses of no risk-sharing strategies	33	5.22
Total	631	100

There are diversities on selecting risk-sharing strategies by farmers across various combinations of risk reductions, risk mitigations and risk coping strategies. There are only 14 observations use risk coping strategies and only 11 observations combine risk mitigation and risk coping strategies. These number of observations (14 and 11) are less than the number of explanatory variables (31 variables). In this regard respective degree of freedom (DoF) for the regression model is < 0. Therefore the model is "under-identified and statistically we always get perfect fit but the solution is not unique. As such we omit these two of risk-sharing sources for further statistical analysis.

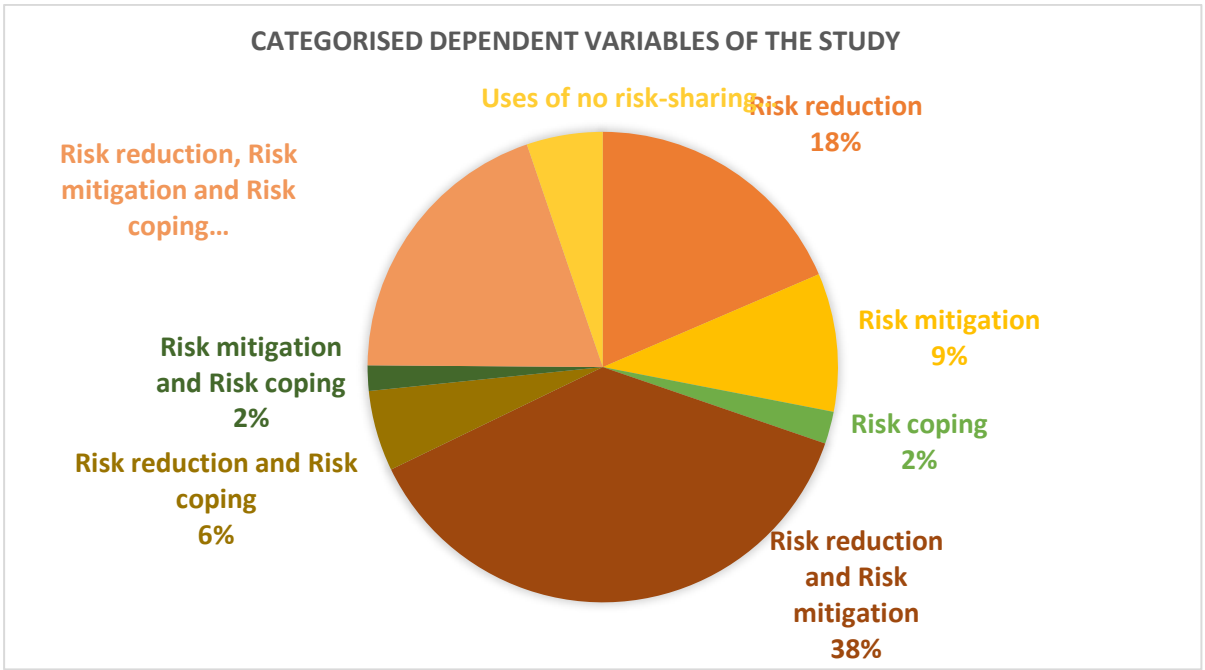

Figure 3: Pie chart of the risk sharing strategies and their possible combinations

2.9 Multi-collinearity test:

Before doing final multinomial logistic regression model by the selected thirty one variables, we check the co-relation coefficient of all these variables. A condition index was used to detect correlation (Belsley, Kuh & Welsch 1980). We could not find any strong positive or negative co-relation among the explanatory variables. The co-relation coefficient matrix of the explanatory variables are within, r = 0.1 to 0.3. Moreover, we also identify the Variation Inflation Factor (VIF) for each explanatory variables of this study. Contrarily by the suggestion of Menapace, Colson & Raffaelli (2013) and van Winsen et al. (2014). We presume that if the value of VIF is > 10 than we decide, there is multi-collinearity among the explanatory variables. In this dataset all the value of VIF is, < 4. The specific VIF of all explained variables are stated in the appendix (Appendix 1).

2.10 Empirical model:

The proposed methodology derive insight on the farmer's personal characteristics, risk perception, risk attitudes and farm's characteristics that lead to the combination of risk-sharing strategies. For the derivation of insight, empirically the model can be specified as follows;

$$\left\{\begin{array}{l} Y_{i1}= X'_{ij1}\beta 1+\varepsilon_{i1} \\ Y_{i2}= X'_{ij2}\beta 2+\varepsilon_{i2} \\ Y_{i3}= X'_{ij3}\beta 3+\varepsilon_{i3} \\ Y_{i6}= X'_{ij6}\beta 3+\varepsilon_{i6} \end{array}\right\} \qquad [1]$$

Where, i = farmer id, Y_{i1} = 1, if farmer use risk reduction strategy (0 otherwise), Y_{i2} = 1, if farmer use risk mitigation strategy (0 otherwise). X'_i = vector of the factors affecting uses of risk-sharing strategies, β_j = vector of unknown parameters (j = 1,2,...6), and ε = is the error term. The hypothesis can be tested by running six different independent multinomial logistic regression models by assuming that the error terms are mutually exclusive. The unknown parameters that to be estimated and ε_{ij} is the unobserved error term. Assuming the error terms across risk-sharing strategies of a farmer are multivariate and are normally distributed with mean vector equal to zero. We estimate the model using in R (version 3.6.1) through *nnet* package. The detailed R code of each analysis is stated in the appendix (Appendix 4). We use 'risk reduction strategy' as reference category for analysis.

Chapter 3: Results and Discussion

3.1 Results of the combination of risk sharing strategies: Table 11 reports estimated marginal effects on the probabilities of each variable. For continuous independent variables, marginal effect measures the change of probability given a one unit change of independent variable, holding all other variables remain constant. The findings of the analysis are presented into four broad domain (i.e. farmer's personal characteristics, farms' characteristics, subjective risk perceptions and relative risk attitudes). Grossly, twelve factors out of thirty one variables show the significant result in the model estimated. Expectation for succession, agricultural education, agricultural specialization, total number of livestock, legal form of farm, total land size, number of hired labour, handling probabilities, negative risk long term, relative degree of risk loving attitude at finance, relative degree of risk loving attitude at marketing and price and relative degree of risk loving attitude at innovation have significant effect on the selection and the combination of risk reduction; risk mitigation; risk coping strategies and not to use of any risk sharing instruments. However there is no significant factors among thirty one predictors that has effect on the selection of specific risk reduction, risk mitigation or risk coping strategy.

3.1.1 The effect of farmer's personal characteristics: As personal characteristics, expectation for succession and agricultural education have significant negative effect on the combination of risk sharing strategies. For example, under, 'expectation for succession', the -0.225 for 'risk reduction, risk mitigation and risk coping' suggests that for one unit increase in 'expectation for succession' score, the multinomial logit coefficient for 'risk reduction, risk mitigation and risk coping' relative to risk reduction (reference category) will decrease by that amount, -0.225. In other words, if expectation for succession increases one unit, the chance of using risk reduction (reference category) are higher compared to using in risk reduction, risk mitigation and risk coping strategies. Our finding shows that expectation for succession is likely to focus on the combination of risk sharing strategies. In other way around, Meraner & Finger (2019) explained anticipation for succession are more likely to focus on on-farm risk management tools and investing on-farm diversification venture. Moreover, Pottrer & Lobley (1996) also explain that anticipation for succession focus on setting up capital to provide a living for the next generation. In case of agricultural education, the hypothesis was higher agricultural educated farmers use the combination of risk sharing strategies. This hypothesis is rejected, but relative to risk reduction (reference category). It explains more agricultural educated farmers have less interest on the combination of risk sharing instrument relative to risk reduction. Because farmers having higher agricultural education might go for on-farm risk management strategies (e.g. diversification) or other risk management instruments. The result of agricultural education and training of this study is align with the finding by Meraner & Finger (2019) and they explained the effect of agricultural training on on-farm risk management strategies.

3.1.2 The effect of farms' characteristics: The general risk sharing model estimates agricultural specialization has a significant negative effect on the probability of using risk sharing instruments. This can be said from the multinomial logit coefficient relative to reference category (risk reduction). For example, under, 'Agricultural specialization', the -0.265 for 'risk reduction and risk coping' suggests that for one unit increase in 'Agricultural specialization' score, the multinomial logit coefficient for 'risk reduction and risk coping' relative to risk reduction (reference category) will decrease by that amount, -0.265. In other words, if agricultural specialization increases one unit, the chance of using risk reduction (reference category) are higher compared to using in risk reduction and risk coping strategies. Hence, agricultural specialization matters on the combination of off-farm risk sharing strategies. This reflects the variety of using risk sharing instruments in horticulture, dairy and others compared to crops industry. However, it has positive effect on only risk mitigation strategy (i.e., Appendix 2). This result of agricultural specialization confirms the findings by Benni, Finger & Mann,

(2012). In our model, total number of livestock has significant effect on 'not to use any risk sharing instruments'. However, Meraner & Finger (2019) found a positive and significant effect on on-farm risk management instrument and off-farm risk sharing strategies. It can be said that, a farm having a large number of livestock is reluctant to use any risk sharing instruments if other things remain constant or they may use other on-farm risk management strategies for their large number of livestock. The divergence of our result may be for considering many agricultural farm without any livestock. Because we consider eight separate agricultural industries whereas Meraner & Finger (2019) focused on only livestock industry. Similarly, legal form of farm also matters on the combination of risk sharing instruments. It has positive and significant effect on the combination of risk sharing strategies. It can be said that, the legal form of ownership of family farm, partnership and company, compared to sole proprietorship, changes the log odds of combination of risk reduction and risk coping strategies by 0.456.This finding are alike as the finding by Saqib et al., (2016). Though they didn't consider the analogous risk management strategies.

A part from that, the relationship between total land size and risk sharing instruments is found to be ambiguous relationship among the various risk sharing strategies. Risk mitigation, risk reduction and risk mitigation and not to use any risk sharing strategies is negatively related with total land size. However, total land size is positively and significantly related to risk reduction and risk coping; and risk reduction, risk mitigation and risk coping strategies. Hired labour and handling probabilities have also positive impact on the combination of risk sharing instruments. This means that under, 'hired labour', the 0.138 for risk reduction and risk coping suggests that for one unit increase in 'hired labour' score, the multinomial logit coefficient for 'risk reduction and risk coping' relative to risk reduction (reference category) will also increase by that amount, 0.138. In other words, if hired labour increases one unit, the chance of using risk reduction are lower compared to using in risk reduction and risk coping strategies. Interestingly hired labour has significant effect on the combination of the risk sharing strategies which is a new finding for risk management literature. Because Meraner, et al., (2015) reports the availability of family labor has a significant negative influence on only on-farm risk sharing instrument (i.e., diversification). The findings of this study is also not align with the findings by Mishra et al. (2004). This new findings may be due to high variation in dataset of hired labor (i.e., mean = 2.16 and standard deviation = 5.748). We find an increasing of total land increases the probability to use the combination of risk sharing instruments compared to individual risk sharing instrument (e.g., risk reduction). Thus the findings of this study is also bring into line with the findings by Velandia et al. (2009) and Mishra & El-Osta (2002). They also claimed that larger land size is associated with greater risk exposure and lower wealth. Consequently in a greater need to combine the risk sharing instruments by off- farm risk sharing strategies.

3.1.3 The effect of subjective risk perceptions

: As subjective risk perception, handling probabilities has significant positive effect on the combination of risk sharing strategies. The hypothesis of the handling probabilities was that the better ability to handling probability of a farmer, the higher use of the combination of risk sharing strategies. The result of the model accept this hypothesis. It explains, under, 'handling probability', the 0.138 for 'risk reduction and risk coping' strategies suggests that for one unit increase in 'handling probabilities' score, the multinomial logit coefficient for 'risk reduction and risk coping' will increase relative to risk reduction (reference category) by that amount, 0.138. In other words, if handling probabilities increases one unit, the chance of using risk reduction (reference category) are lower compared to using in risk reduction and risk coping strategies. This finding are absolutely parallel to the findings by Zikmund-Fisher et al., (2007). They described handling probabilities as handling subjective numeracy score and it was positively correlated with risk compensation. They precisely suggest that a farmer with a better understanding of the probabilities are more likely to take more insurance, commodity future exchange or off-farm investment. In fact, all these strategies are risk sharing instruments. Negative long term risk has positive and significant effect on 'not to take any risk sharing instruments'. It means that a farmer faces one or more bad year(s) in the coming ten years are not used to take any off-farm risk sharing strategies and don't want to

combine risk sharing portfolio. This might be happen whenever a farmer protects one or more bad years by on-farm risk management strategies, give more emphasis on short-term risk management strategies or other risk management tools except risk sharing strategies.

3.1.4 The effect of relative risk attitudes: Relative degree of risk loving attitude at finance has significant negative effect on the combination of risk sharing instruments. For example, under, 'Relative degree of risk loving attitude at finance', the -0.425 for risk reduction and risk coping suggests that for one unit increase in 'Relative degree of risk loving attitude at finance' score, the multinomial logit coefficient for 'risk reduction and risk coping' will decrease relative to risk reduction (reference category) by that amount, -0.425. In other words, if relative degree of risk loving attitude at finance increases one unit, the chance of using risk reduction are higher compared to using in risk reduction and risk coping strategies. Relative degree of risk loving attitude on marketing and price; and innovation have negative effect on 'not to use any risk sharing instruments'. Similarly, under, ' relative degree of risk loving attitude on marketing and price ', the -0.412 for 'not to use any risk sharing instrument' suggests that for one unit increase in 'relative degree of risk loving attitude on marketing and price' score, the multinomial logit coefficient for 'not to use any risk sharing instrument' will decrease relative to risk reduction (reference category) by that amount, -0.412. In other words, if relative degree of risk loving attitude on marketing and price increases one unit, the chance of using risk reduction are higher compared to not using any risk sharing strategies. This is true for innovation as well. It may be due to innovative farms have more probability of facing risk compared to traditional farm or innovative farms give more concentration on on-farm risk sharing strategies. The relative degree of risk loving attitude at marketing and innovation have both negative effect on not to use any risk sharing instruments. This is a new finding in case of risk management literature however both of the factors showed mixed (positive and negative) effect on the combination of risk sharing instruments. This is may be due to the heterogeneity of the respondent in risk attitude at pricing and innovation. In some cases they perceive they are taking more risk compared to their competitors. Furthermore, the relative degree of risk loving attitude at financial risk has negative and significant effect on the selection and the combination of risk sharing strategies. This finding rejects the hypothesis we set before analysis - Risk aversion and relative risk aversion (to other farmers) have negative impact on the choice and combination of risk-sharing strategies. Finally, it is said that more relative degree of risk loving attitude at financial risk of has negative impact on the combination of risk sharing strategies. This finding also confirms findings by Meuwissen, Huirne & Hardaker (2001), Winsen et al. (2016), Flaten et al., (2005), Saqib et al., (2016). They also find a significant influence of risk perception and farms' risk behaviour. The respective estimate and standard error of the significant predictors are stated in the following table 11. The effect of all explained thirty one variables are shown in appendix (Appendix 2).

Table 11 : Estimated marginal effects of the general risk sharing instruments of Dutch Farmers[1*]

Name of the predictors	Risk reduction	Risk mitigation	Risk reduction and risk mitigation	Risk reduction and risk coping	Risk reduction, risk mitigation and risk coping	No risk sharing strategies
Agricultural Specialization	Reference category	0.059	-0.022	-0.265**	-0.334***	-0.084
		(0.082)	(0.061)	(0.128)	(0.091)	(0.124)
Total number of livestock		-0.0004	0.001	-0.001	-0.002	0.003**
		(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Legal form of farm		0.183	0.052	0.456*	0.030	-0.357
		(0.200)	(0.143)	(0.237)	(0.169)	(0.263)
Total land size		-0.0004	-0.0003	0.007*	0.007**	-0.007
		(0.005)	(0.003)	(0.004)	(0.003)	(0.007)
Hired labour		-0.084	0.077	0.138**	0.131**	0.080
		(0.099)	(0.053)	(0.058)	(0.053)	(0.072)
Handling probabilities		0.045	0.147	0.222	0.328**	0.123
		(0.167)	(0.127)	(0.227)	(0.159)	(0.223)
Negative risk long term		0.005	0.008	-0.006	0.003	0.021*
		(0.009)	(0.006)	(0.011)	(0.008)	(0.011)
Relative degree of risk loving attitude at finance		-0.249	-0.148	-0.425**	-0.168	0.004
		(0.165)	(0.116)	(0.205)	(0.141)	(0.210)
Relative degree of risk loving attitude at marketing and price		-0.093	-0.020	0.367	0.070	-0.412*
		(0.186)	(0.125)	(0.234)	(0.155)	(0.224)
Relative degree of risk loving attitude at innovation		0.022	-0.019	0.129	0.031	-0.327*
		(0.158)	(0.112)	(0.210)	(0.141)	(0.190)
Expectation for succession		-0.034	-0.129	0.047	-0.225*	0.172
		(0.148)	(0.104)	(0.173)	(0.132)	(0.180)
Agricultural education		0.344	-0.917**	0.042	-0.760	-0.692
		(0.483)	(0.404)	(0.602)	(0.478)	(0.727)
Constant		0.820	0.421	-0.399	-3.427*	1.683
		(2.271)	(1.411)	(1.259)	(1.785)	(2.731)

*Note: *p<0.1; **p<0.05; ***p<0.01*

1* Risk coping; risk mitigation and risk coping strategies are not in the result because the number of observations are insignificant (i.e., 14 and 11)

3.2 Relative Risk ratio: The measurement level of all independent variables are not in same scale. Therefore the relative impact of independent variables can't be explained by their respective coefficient. To make the explanation more easy, this study allows the relative risk ratio. The relative risk ratio are the exponentiated value of the multinomial logit coefficients. The standardised coefficient of significant factors stated in the following table 12. For example, keeping all other variables constant, if the score of agricultural specialization changes one unit, farmers are 0.767 times more likely to uses risk reduction and risk coping strategies as compared to risk reduction (reference category) and the relative risk ratio or odds is lower by 24%. Conversely, keeping all other variables constant, if the score of hired labour change one unit, farmers are 1.148 times more likely to use risk reduction and risk coping strategies compared to risk reduction strategy (reference category) and the relative risk ratio or odds is higher by 14%. However, both of the coefficients are significant. After all, among all significant variables 'legal form of farm' is the most influential factor (i.e., standardised coefficient score is 1.577) for risk reduction and risk coping and 'agricultural education' is the less influential factor (i.e., standardised coefficient score is 0.40) for 'risk reduction and risk mitigation strategy'. The more detailed of standardised coefficient of all the variables have been attached in appendix (Appendix 3).

Table 12: The standardised coefficients of the significant predictors[1*]

Name of the predictors	Risk reduction	Risk mitigation	Risk reduction and risk mitigation	Risk reduction and risk coping	Risk reduction, risk mitigation and risk coping	No risk sharing strategies
Agricultural Specialization	Reference category	1.061	0.978	0.767**	0.716***	0.919
Total number of livestock		1.000	1.001	0.999	0.998	1.003**
Legal form of farm		1.201	1.054	1.577*	1.031	0.700
Total land size		1.000	1.000	1.007*	1.007**	0.993
Hired labour		0.919	1.080	1.148**	1.139**	1.083
Handling probabilities		1.046	1.159	1.248	1.388**	1.131
Negative risk long term		1.005	1.008	0.994	1.003	1.021*
Relative degree of risk loving attitude at finance		0.780	0.863	0.654**	0.846	1.004
Relative degree of risk loving attitude at marketing and price		0.911	0.980	1.444	1.073	0.662*
Relative degree of risk loving attitude at innovation		1.023	0.981	1.137	1.031	0.721*
Expectation for succession		0.966	0.879	1.048	0.798*	1.188
Agricultural education		1.411	0.400**	1.043	0.468	0.500
Constant		2.271	1.523	0.671	0.033*	5.382

*Note: *p<0.1; **p<0.05; ***p<0.01*

1* Risk coping; risk mitigation and risk coping strategies are not in the result because the number of observations are insignificant (i.e., 14 and 11)

3.3 General Discussion: This study describes off-farm risk sharing strategies in a holistic way because it designates risk sharing strategies not only as a risk management instrument, but also describes features, types, example and relationship of each off-farm risk sharing strategies. The introduction section explains risk sharing strategies from different perspectives. Each of the farmer wants to develop more effective risk sharing instruments for an efficient risk-management strategies. In this regard, personal characteristics, farms' characteristics, risk perceptions and risk attitude are considerable factors for risk management decision. The aim of the discussion has been three-fold: first, aim to find out the factors that matter in selecting risk sharing instruments for Dutch farmers. Second, compare the finding of this study with the findings of previous research of risk sharing and risk management. Third, the novelty, explore the factors that matter in the combination of different risk sharing instruments for Dutch farmers. To accomplish these, this discussion is based on the result of analysis (using multinomial logistic regression model) and data from SURE-farm project of 2018.

With regard to data used, 631 farmers from 53,906 farmers of the Netherlands (CBS, 2019) represent only 1.262% of the farmer's community. To get external validity and to be statistically correct, These data is therefore not representative for the entire population. Though this study collects farm's data from primary sources and from all provinces in the Netherlands. This study considers the mean value of some variables for analysis. The outcomes of this analysis may be different whenever more sample would be considered and more categorical variables would be considered for analysis. The economic claim settlement, how does it matter in selecting different risk sharing strategies are also not incorporated in this study. This study does not suggest any optimal risk sharing strategies for any particular industry or farmer. In fact, the selection or combination of any risk sharing instrument for a farmer depends on his managerial decision and situational consequences. It is to be noted, this study has not taken into account the direct and indirect cost of taking any risk sharing strategies from these three categories. This study also infers that the combination of any risk sharing portfolio is not optimal for all situation of a farm. This combination of risk sharing instrument may be time oriented, yield based, weather dependent and so on.

Finally, if we compare the results broadly into two groups: Using risk sharing strategies and not using any risk sharing strategies, we see only four factors have significant effect on 'not to use any risk sharing strategies'. There are eight factors have significant effect on the combination of risk reduction, risk mitigation and risk coping strategies. Most of the findings of this study justifies the findings of previous studies with a few novelty. However, most of the previous studies stressed on specific risk sharing strategies or on-farm risk sharing instruments. In some cases they combined risk sharing strategies on the basis of different risk criteria; not on the basis of risk sharing classification (i.e., risk reduction, risk mitigation, risk coping and their possible combination). The combination risk sharing strategies in terms of risk reduction, risk mitigation and risk coping is the main novelty of this study.

Chapter 4: Conclusion, Limitation and further Recommendation

4.1 Conclusion:

Risk sharing strategies provide opportunities for a farm to mitigate risk. Risk sharing strategies are also used to improve the commitment of stakeholders of agriculture which distribute risk among multiple parties. Many researcher studied risk management strategies from various perspective (e.g., studied on on-farm risk management strategies, off-farm risk sharing strategies) and enriched risk management literature for agricultural stakeholders and policy makers. Based on previous studies and practical relevance this study studied on off-farm risk sharing strategies on Dutch agriculture. To do this a set of predictors are used and necessary hypothesis are set for analysis to accomplish three specific objectives which drive to accomplish main objective. There are total thirty one predictors have been selected based on previous studies. These predictors have been classified into four broad categories (i.e., famer's personal characteristics, farms' characteristics, subjective risk perceptions and relative degree of risk loving attitude). The analysis is done through multinomial logistic regression model using statistical package 'R'. Final outcome of twelve predictors have significant effect on risk sharing strategies that have discussed into the objectives.

Review the factors that affect to the specific risk-sharing strategies on Dutch farms

The previous literatures and case studies of agricultural farms show a significant effect on specific risk sharing instruments (e.g., insurance, hedging and marketing contract). Most of the study highlighted farmers' personal characteristics, risk perception, risk attitude and farm's characteristics. However, in our analysis we could not find any significant effect of any predictors on the selection of specific risk reduction, risk mitigation or risk coping strategy. Moreover, the evidence from applications of specific risk sharing instrument in Dutch farming is still limited to only these four domain (i.e., personal characteristics, farms' characteristics, risk perception and risk attitudes). No scientific studies has done yet by considering the willingness to take technology as a considerable factor for specific risk sharing instruments.

Assess the factors that affect to the combination of risk reduction, risk mitigation and risk coping strategies.

There are eight factors (i.e., agricultural specialization, legal form of farm, total land size, hired labour, handling probabilities, relative degree of risk loving attitude at finance, expectation for succession and agricultural education) have significant effect on the combination of risk reduction, risk mitigation and risk coping strategies. Moreover, these eight factors were also significant factors for specific risk sharing instruments (e.g., insurance, diversification). Therefore the finding of this study is align with the previous studies.

Assess the factors that affect 'not to use of risk-sharing strategies' among Dutch farms.

There are 33 farmers who don't use any risk sharing strategies. From analysis we have identified four factors (i.e., total number of livestock, negative risk at long term, relative degree of risk loving attitude at marketing and price, and relative degree of risk loving attitude at innovation) have significant effect on 'not to use any risk sharing strategies' by farmers. They might use on-farm risk management instruments (e.g., diversification, financial saving for hard time, invested in technologies) or other risk management tools. Though, from only thirty three respondents it is difficult to draw a conclusion using thirty one predictors.

4.2 Limitation of the study:

The main limitation of the study is time constraint. This study does not cover the factors related to technology, economic claim of risk sharing strategies, ability to cope with financial challenges and comparative innovation of farm. The result would be different and more comprehensive if these factors would be considered. These outcomes prevail whenever followed assumptions exist. There might have different outcomes whenever authors adopt other assumptions.

4.3 Recommendation:

Further research is needed to get more insight into the effect of these and other factors through another dynamic model. For example, the effect of adaptability and the resilience of farmer on the combination of risk sharing strategies through a multinomial Probit model or latent cluster analysis (LCA) might be subject matters of future research. Moreover, should go for single experimental design for specific industry like Dutch dairy industry. Anyone may also go to identify the interaction effect of the selected predictors or doing same analysis by taking another strategies as reference category. Finally, this study describes various risk sharing strategies but does not suggest any specific combination of risk sharing portfolio as the best combination because managerial decision of farmers decide appropriate combination for farming.

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Appendix1:

Variation Inflation Factor of the explanatory variables

Farmer's characteristics	Risk perception	Risk attitudes	Farms' characteristics
Age	Average Price Challenge	Negative Risk short term	Years of Farming
2.74	1.91	1.83	2.71
Education	Average production challenge	Negative Risk long term	Agricultural Specialization
1.27	1.47	1.73	1.14
Gender	Average Value chain challenge	Positive Risk Short term	Types of farm
1.4	1.89	1.93	1.12
Expectation for Succession	Average Financial Challenge	Positive Risk long term	legal form of farm
1.06	1.59	1.96	1.16
Agricultural Education	Average Institutional Challenge	Absolute Risk Attitudes	Total number of livestock
1.35	1.69	1.77	1.15
Handling Probabilities	Average Personal challenge	Relative Risk Attitudes at Production	Total land size
1.17	1.38	2.04	1.13
	Average Societal Challenge	Relative Risk Attitude at Finance	Family labour
	1.46	2.04	1.04
		Relative Risk Attitude at Marketing and Price	Hired labour

	2.27 Relative Risk Attitudes at farming in general 3.3 Relative Risk Attitudes at Innovation 1.98	1.26

Appendix 2:

Marginal effect of all predictors with the identification of significant factors [ab*]

Name of the predictors	Risk mitigation	Risk reduction and risk mitigation	Risk reduction and risk coping	Risk reduction, risk mitigation and risk coping	No risk sharing strategies
Years of Farming	0.016	0.008	-0.024	-0.001	-0.009
	(0.024)	(0.018)	(0.027)	(0.020)	(0.029)
Agricultural Specialization	0.059	-0.022	-0.265**	-0.334***	-0.084
	(0.082)	(0.061)	(0.128)	(0.091)	(0.124)
Total number of livestock	-0.0004	0.001	-0.001	-0.002	0.003**
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Types of farm	-0.072	0.168	-0.089	-0.059	-0.285
	(0.445)	(0.326)	(0.556)	(0.408)	(0.678)
Legal form of farm	0.183	0.052	0.456*	0.030	-0.357
	(0.200)	(0.143)	(0.237)	(0.169)	(0.263)
Total land size	-0.0004	-0.0003	0.007*	0.007**	-0.007
	(0.005)	(0.003)	(0.004)	(0.003)	(0.007)
Family labour	0.038	-0.007	-0.007	0.015	-0.029
	(0.035)	(0.035)	(0.073)	(0.038)	(0.081)
Hired labour	-0.084	0.077	0.138**	0.131**	0.080
	(0.099)	(0.053)	(0.058)	(0.053)	(0.072)
Average Price challenge	0.108	0.120	0.144	0.197	-0.102
	(0.209)	(0.141)	(0.268)	(0.177)	(0.233)
Average value chain challenge	0.226	-0.020	0.121	0.120	0.081
	(0.166)	(0.114)	(0.205)	(0.140)	(0.199)
Average financial challenge	0.053	-0.097	0.231	-0.018	0.212
	(0.142)	(0.100)	(0.174)	(0.121)	(0.185)
Average production challenge	-0.098	0.034	-0.065	0.096	-0.237

	(0.158)	(0.112)	(0.193)	(0.137)	(0.201)
Average personal challenge	0.056	0.047	-0.128	0.131	-0.096
	(0.138)	(0.096)	(0.176)	(0.116)	(0.168)
Average institutional challenge	-0.091	0.135	0.020	0.002	-0.231
	(0.144)	(0.108)	(0.187)	(0.128)	(0.185)
Average societal challenge	-0.072	-0.035	-0.149	-0.070	-0.102
	(0.122)	(0.090)	(0.158)	(0.108)	(0.154)
Handling probabilities	0.045	0.147	0.222	0.328**	0.123
	(0.167)	(0.127)	(0.227)	(0.159)	(0.223)
Negative risk short term	-0.005	-0.012	0.002	-0.005	-0.010
	(0.011)	(0.008)	(0.014)	(0.009)	(0.013)
Negative risk long term	0.005	0.008	-0.006	0.003	0.021*
	(0.009)	(0.006)	(0.011)	(0.008)	(0.011)
Positive risk short term	0.008	-0.007	0.010	0.001	0.009
	(0.012)	(0.008)	(0.015)	(0.010)	(0.014)
Positive risk long term	0.002	0.008	0.005	0.001	-0.0003
	(0.011)	(0.008)	(0.014)	(0.009)	(0.014)
Absolute risk attitude	0.023	0.057	0.086	0.127	0.157
	(0.106)	(0.077)	(0.141)	(0.096)	(0.137)
Relative risk attitude at production	0.034	-0.067	-0.329	-0.169	0.222
	(0.182)	(0.127)	(0.224)	(0.154)	(0.218)
Relative risk attitude at finance	-0.249	-0.148	-0.425**	-0.168	0.004
	(0.165)	(0.116)	(0.205)	(0.141)	(0.210)
Relative risk attitude at marketing and price	-0.093	-0.020	0.367	0.070	-0.412*
	(0.186)	(0.125)	(0.234)	(0.155)	(0.224)
Relative risk attitude at innovation	0.022	-0.019	0.129	0.031	-0.327*
	(0.158)	(0.112)	(0.210)	(0.141)	(0.190)
Relative risk attitude at farming in general	-0.162	-0.001	-0.051	0.106	0.045
	(0.241)	(0.176)	(0.300)	(0.217)	(0.301)
Age	-0.001	-0.021	0.012	0.002	0.024
	(0.028)	(0.019)	(0.030)	(0.022)	(0.033)
Gender	-1.870	0.851	-2.528	0.838	-0.044
	(1.146)	(0.559)	(1.807)	(0.675)	(1.142)
Expectation for succession	-0.034	-0.129	0.047	-0.225*	0.172

	(0.148)	(0.104)	(0.173)	(0.132)	(0.180)
Education	-0.158	0.045	-0.285	0.022	-0.264
	(0.259)	(0.186)	(0.300)	(0.218)	(0.331)
Agricultural education	0.344	-0.917**	0.042	-0.760	-0.692
	(0.483)	(0.404)	(0.602)	(0.478)	(0.727)
Constant	0.820	0.421	-0.399	-3.427*	1.683
	(2.271)	(1.411)	(1.259)	(1.785)	(2.731)
Akaike Information Criteria.	2,237.668	2,237.668	2,237.668	2,237.668	2,237.668
Log likelihood value is -894.833 N= 631. Hit ratio (h) =0.473					

*Note: *p<0.1; **p<0.05; ***p<0.01*

Note2:

a) Risk reduction is reference category of this study

b) Risk coping; risk mitigation and risk coping strategies are not in the result because the number of observations are insignificant (i.e., 14 and 11)

Appendix 3:

Standardised coefficient of all the predictors [ab*]

Name of the predictors	Risk mitigation	Risk reduction and risk mitigation	Risk reduction and risk coping	Risk reduction, risk mitigation and risk coping	No risk sharing strategies
Years of Farming	1.017	1.008	0.976	0.999	0.991
	(0.024)	(0.018)	(0.027)	(0.020)	(0.029)
Agricultural Specialization	1.061	0.978	0.767**	0.716***	0.919
	(0.082)	(0.061)	(0.128)	(0.091)	(0.124)
Total number of livestock	1.000	1.001	0.999	0.998	1.003**
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Types of farm	0.930	1.183	0.915	0.943	0.752
	(0.445)	(0.326)	(0.556)	(0.408)	(0.678)
Legal form of farm	1.201	1.054	1.577*	1.031	0.700
	(0.200)	(0.143)	(0.237)	(0.169)	(0.263)
Total land size	1.000	1.000	1.007*	1.007**	0.993
	(0.005)	(0.003)	(0.004)	(0.003)	(0.007)
Family labour	1.039	0.993	0.993	1.015	0.971
	(0.035)	(0.035)	(0.073)	(0.038)	(0.081)
Hired labour	0.919	1.080	1.148**	1.139**	1.083

	(0.099)	(0.053)	(0.058)	(0.053)	(0.072)
Average Price challenge	1.114	1.127	1.155	1.218	0.903
	(0.209)	(0.141)	(0.268)	(0.177)	(0.233)
Average value chain challenge	1.253	0.980	1.128	1.127	1.084
	(0.166)	(0.114)	(0.205)	(0.140)	(0.199)
Average financial challenge	1.055	0.908	1.260	0.982	1.236
	(0.142)	(0.100)	(0.174)	(0.121)	(0.185)
Average production challenge	0.907	1.035	0.937	1.100	0.789
	(0.158)	(0.112)	(0.193)	(0.137)	(0.201)
Average personal challenge	1.058	1.048	0.880	1.140	0.908
	(0.138)	(0.096)	(0.176)	(0.116)	(0.168)
Average institutional challenge	0.913	1.144	1.020	1.002	0.793
	(0.144)	(0.108)	(0.187)	(0.128)	(0.185)
Average societal challenge	0.931	0.965	0.862	0.932	0.903
	(0.122)	(0.090)	(0.158)	(0.108)	(0.154)
Handling probabilities	1.046	1.159	1.248	1.388**	1.131
	(0.167)	(0.127)	(0.227)	(0.159)	(0.223)
Negative risk short term	0.995	0.989	1.002	0.995	0.990
	(0.011)	(0.008)	(0.014)	(0.009)	(0.013)
Negative risk long term	1.005	1.008	0.994	1.003	1.021*
	(0.009)	(0.006)	(0.011)	(0.008)	(0.011)
Positive risk short term	1.008	0.993	1.010	1.001	1.009
	(0.012)	(0.008)	(0.015)	(0.010)	(0.014)
Positive risk long term	1.002	1.008	1.005	1.001	1.000
	(0.011)	(0.008)	(0.014)	(0.009)	(0.014)
Absolute risk attitude	1.023	1.058	1.090	1.135	1.170
	(0.106)	(0.077)	(0.141)	(0.096)	(0.137)
Relative risk attitude at production	1.035	0.935	0.720	0.845	1.249
	(0.182)	(0.127)	(0.224)	(0.154)	(0.218)
Relative risk attitude at finance	0.780	0.863	0.654**	0.846	1.004
	(0.165)	(0.116)	(0.205)	(0.141)	(0.210)
Relative risk attitude at marketing and price	0.911	0.980	1.444	1.073	0.662*
	(0.186)	(0.125)	(0.234)	(0.155)	(0.224)
Relative risk attitude at innovation	1.023	0.981	1.137	1.031	0.721*
	(0.158)	(0.112)	(0.210)	(0.141)	(0.190)
Relative risk attitude at farming in general	0.851	0.999	0.951	1.112	1.046
	(0.241)	(0.176)	(0.300)	(0.217)	(0.301)
Age	0.999	0.979	1.013	1.002	1.024
	(0.028)	(0.019)	(0.030)	(0.022)	(0.033)
Gender	0.154	2.341	0.080	2.311	0.957

	(1.146)	(0.559)	(1.807)	(0.675)	(1.142)
Expectation for succession	0.966	0.879	1.048	0.798*	1.188
	(0.148)	(0.104)	(0.173)	(0.132)	(0.180)
Education	0.854	1.046	0.752	1.023	0.768
	(0.259)	(0.186)	(0.300)	(0.218)	(0.331)
Agricultural education	1.411	0.400**	1.043	0.468	0.500
	(0.483)	(0.404)	(0.602)	(0.478)	(0.727)
Constant	2.271	1.523	0.671	0.033*	5.382
	(2.271)	(1.411)	(1.259)	(1.785)	(2.731)
Akaike Information Criteria.	2,237.668	2,237.668	2,237.668	2,237.668	2,237.668

Log likelihood value is -894.833
N= 631.
Hit ratio (h) =0.473

*Note: *p<0.1; **p<0.05; ***p<0.01*

Note2:

a) Risk reduction is reference category of this study

Risk coping; risk mitigation and risk coping strategies are not in the result because the number of observations are insignificant (i.e., 14 and 11)

Appendix 4:

R-code for the analysis of the study to find the results

```
### install.packages("excel.link")
library("excel.link")

data_directory <- "C:/Users/sagar/Desktop/Minor thesis data analyis/T.2.1 Data reporting template_NL.xlsx"

#Import data and prepare a datadirectory
# Variables heading###"ID","YearsOfFarming", "AgriculturalSpecialization ", Other", "Nolivestock", "Sows", "Fatteningpigs", "Dairycows", "Fatteningcalves", "Fatteningbulls", "Heifers", "Broilers", "layinghens", "Horses", "Sheep", "Goats", "Otheranimals", "othernumbers", "othersanimal2", "othersanimals3", "othernumbers2", "Othernumber3" "Typesoffarm", "Othertypes", "legalformoffarm", "Otherownership", "Totallandsize", "Arableland", "Paastureland", "Ownland", "Rentland", "Familylabour", "Hiredlabour", "Financialsaving", "Nodebt", "Investedtechnology", "Preventivemeasure", "Hardworker", "Offfarmjob", "Marketinformation", "Diversifiedproduction", "Diversifiedotheractivities", "Costflexibility", "Timeflexibility", "Openfarmdays", "CS1", "CS2", "CS3", "Cooperatiedwithotherfarm", "memberofcooperative", "Interbranceorganization", "Accesstosupplier", "Agriculturallearning", "Agriculturalinsurance", "Marketingcontract", "Hedging", "CSspecific1", "Csspecific2", "Csspecific3", "Futurechallenge1", "Futurechallenge2", "Futurechallenge3", "Strategies1", "Strategies2", "Strategies3", "Delivaryfunction", "Biobasedresources", "Farmincome", "Employment", "Naturalresources", "Biodiversity", "Agrotourism", "Aminalwelfare", "OTherfunctions", "Numberofotherfunction", "Highinputprice", "Inputpricefluction", "Lowmarketprice", "Marketpricefluction", "Lowbargainingpowertoretailer", "lowbargainingpowertosupplailer", "Limitedaccesstobank", "Latepaymentfrombuyers", "Extremeweather", "Pestoutbreak", "lowsoilquality", "Unskilledworkers", "Unabailabilitytowork", "Strictregulation", "EffectofCAP", "Publicdistrust", "Lowsoailacceptance", "CSspchallenge1", "CSspchallenge2", "Csspchallenge3", "Abilitytobounceback", "Quickrecoveryofshocks",
```

"Easytogetback", "Adequateoptions", "Adoptability", "Situationaladoptability", "Agriculturaladoptability", "Environmentaladoptability", "Transformability", "Rerorganisibility", "Abilitytofacechallenge", "Farmtransformibility", "Familiarwithothers", "Interactionwithneighbouring", "Supportfromothers", "Professionalattachment", "Interactionwithprofessional", "Supportfromnetwork", "Farmlevelinnovation", "Technologicalinnovation", "Easytodealwithagriculturalchallenges", "Selfdependencyonfarm", "Selfcontrol", "Abilitytodealchallengeonfarm", "Awarenessoffarmchallenges", "Negativeconsequencesofagriculturalchallenges", "Resilienttoagriculturalchallenges", "Longtermresilienttoagriculture", "Probabilitytoweatherforecast", "Workingwithpercentage", "Handlinginformation", "Handlingnewmarketprice", "Negativeriskshortterm", "Negativerisklongterm", "Positiveriskshortterm", "Positiverisklongterm", "Absoluteriskattitudes", "Relativeriskattitudesproduction", "Relativeriskattitudemarketingandprice", "Relativeriskattitudefinance", "Relativeriskattitudesinnovation", "Relativeriskattitudefarmingingeneral", "Yearofbirth", "Gender", "Expectationforsuccession", "Otherexpectation", "Education", "Agriculturaleducation", "Othernotes", "Province")

col_names <- c("ID","YearsOfFarming", "AgriculturalSpecialization",
"Otherspecialization","Nolivestock",
"Sows","Fatteningpigs","Dairycows","Fatteningcalves","Fatteningbulls","Heifers", "Broilers", "layinghens", "Horses", "Sheep", "Goats", "Others", "othernumbers", "othersanimal2", "othersanimals3", "othernumbers", "Othernumber2",
"Typesoffarm", "Öthertypes", "legalformoffarm", "Otherownership", "Totallandsize", "Arableland", "Paastureland", "Ownland", "Rentland", "Familylabour", "Hiredlabour", "Financialsaving", "Nodebt", "Investedtechnology", "Preventivemeasure", "Hardworker", "Offfarmjob", "Marketinformation", "Diversifiedproduction", "Diversifiedotheractivities", "Costflexibility", "Timeflexibility", "Openfarmdays", "CS1", "CS2", "CS3", "Cooperatiedwithotherfarm", "memberofcooperative", "Interbranceorganization", "Accesstosupplier", "Agriculturallearning", "Agriculturalinsurance", "Marketingcontract", "Hedging", "CSspecific1", "Csspecific2", "Csspecific3", "Futurechallenge1", "Futurechallenge2", "Futurechallenge3", "Strategies1", "Strategies2", "Strategies3", "Delivaryfunction", "Biobasedresources", "Farmincome", "Employment", "Naturalresources", "Biodiversity", "Agrotourism", "Aminalwelfare", "OTherfunctions", "Numberofotherfunction", "Highinputprice", "Inputpricefluction", "Lowmarketprice", "Marketpricefluction", "Lowbargainingpowertoretailer", "lowbargainingpowertosupplailer", "Limitedaccesstobank", "Latepaymentfrombuyers", "Extremeweather", "Pestoutbreak", "lowsoilquality", "Unskilledworkers", "Unabailabilitytowork", "Strictregulation", "EffectofCAP", "Publicdistrust", "Lowsoailacceptance", "CSspchallenge1", "CSspchallenge2", "Csspchallenge3", "Abilitytobounceback", "Quickrecoveryofshocks", "Easytogetback", "Adequateoptions", "Adoptability", "Situationaladoptability", "Agriculturaladoptability", "Environmentaladoptability", "Transformability", "Rerorganisibility", "Abilitytofacechallenge", "Farmtransformibility", "Familiarwithothers", "Interactionwithneighbouring", "Supportfromothers", "Professionalattachment", "Interactionwithprofessional", "Supportfromnetwork", "Farmlevelinnovation", "Technologicalinnovation", "Easytodealwithagriculturalchallenges", "Selfdependencyonfarm", "Selfcontrol", "Abilitytodealchallengeonfarm", "Awarenessoffarmchallenges", "Negativeconsequencesofagriculturalchallenges", "Resilienttoagriculturalchallenges", "Longtermresilienttoagriculture", "Probabilitytoweatherforecast", "Workingwithpercentage", "Handlinginformation", "Handlingnewmarketprice", "Negativeriskshortterm", "Negativerisklongterm", "Positiveriskshortterm", "Positiverisklongterm", "Absoluteriskattitudes", "Relativeriskattitudesproduction", "Relativeriskattitudemarketingandprice", "Relativeriskattitudefinance", "Relativeriskattitudesinnovation", "Relativeriskattitudefarmingingeneral", "Yearofbirth", "Gender", "Expectationforsuccession", "Otherexpectation", "Education", "Agriculturaleducation", "Othernotes", "Province")

```
# Transformation of data to mydata

mydata <- xl.read.file(data_directory, header = FALSE, row.names = FALSE, col.names = FALSE, xl.sheet="Data reporting template", top.left.cell="A5", password="=`5vshGawPT[Cy2/")
colnames(mydata) <- col_names

str(mydata)

# Creation of required variables from collected data i.e.
#conversion of age from year of birth. in some variables it was done through average

mydata$Age <- 2018-mydata$Yearofbirth
mydata$AveragePricechallenge <- (mydata$Highinputprice+mydata$Inputpricefluction+mydata$Lowmarketprice+mydata$Marketpricefluction)/4
mydata$Averagevaluechainchallenge <- (mydata$Lowbargainingpowertoretailer+mydata$lowbargainingpowertosupplailer)/2
mydata$Averagefinancialchallenge <- (mydata$Limitedaccesstobank+mydata$Latepaymentfrombuyers)/2
mydata$Averageproductionchallenge <- (mydata$Extremeweather+mydata$Pestoutbreak+mydata$lowsoilquality)/3
mydata$Averagepersonalchallenge <- (mydata$Unskilledworkers+mydata$Unabailabilitytowork)/2
mydata$Averageinstitutionalchallenge <- (mydata$Strictregulation+mydata$EffectofCAP)/2
mydata$Averagesocietalchallenge <- (mydata$Publicdistrust+mydata$Lowsoailacceptance)/2
mydata$Handlingprobabilities <- (mydata$Probabilitytoweatherforecast+mydata$Workingwithpercentage+mydata$Handlinginformation+mydata$Handlingnewmarketprice)/4

#Calculation of total number of livestock according to the guideline of the EU....EUROSTAT

mydata$Totalnumberoflivestock <- (mydata$Sows*.5+mydata$Fatteningpigs*.3+mydata$Dairycows*1+mydata$Fatteningcalves*.4

+mydata$Fatteningbulls*.4+mydata$Heifers*.8+mydata$Broilers*.007+mydata$layinghens*.014+mydata$Horses*.8

+mydata$Sheep*.1+mydata$Goats*.1+mydata$othernumbers*.02+mydata$Othernumber2*.02+mydata$othersanimals3*.02)


# Determination of Dependent variables and grouping them

mydata[,"Riskreduction"] <- NULL
mydata$Riskreduction
for (i in 1:nrow(mydata)) {mydata[i,"Riskreduction"] <- if (

  # Any of the risk reduction instruments should be 1
  (mydata[i,"Cooperatiedwithotherfarm"]==1 | mydata[i,"Accesstosupplier"]==1 | mydata[i,"Agriculturallearning"]==1) &

  # All of the other risk sharing instruments should be 0
```

```
                        mydata[i,"memberofcooperative"]==0 & mydata[i,"Interbranceorganization"]==0
& mydata[i,"Agriculturalinsurance"]==0 &
                        mydata[i,"Marketingcontract"]==0 & mydata[i,"Hedging"]==0)

 {1} else {0}}
 mydata$Riskreduction

## Delete a column (wrongly done of cooperatied with outher farm)

mydata$Cooperatiedwithotherfar=NULL

# Risk mitigation as dependent variable
# Determination of Dependent variables and grouping them

mydata$Riskmitigation <- NULL
mydata$Riskmitigation

for (i in 1:nrow(mydata)) {mydata[i,"Riskmitigation"] <- if (

 # Any of the risk reduction instruments should be 1
 (mydata[i,"memberofcooperative"]==1 | mydata[i,"Interbranceorganization"]==1 |
mydata[i,"Agriculturalinsurance"]==1) &

 # All of the other risk sharing instruments should be 0
 mydata[i,"Cooperatiedwithotherfarm"]==0 & mydata[i,"Accesstosupplier"]==0 &
mydata[i,"Agriculturallearning"]==0 &
 mydata[i,"Marketingcontract"]==0 & mydata[i,"Hedging"]==0)

 {1} else {0}}

mydata$Riskmitigation


# For Risk coping
# Determination of Dependent variables and grouping them

mydata$Riskcoping <- NULL
mydata$Riskcoping

for (i in 1:nrow(mydata)) {mydata[i,"Riskcoping"] <- if (

 # Any of the risk reduction instruments should be 1
 (mydata[i,"Marketingcontract"]==1 | mydata[i,"Hedging"]==1) &

 # All of the other risk sharing instruments should be 0
 mydata[i,"Cooperatiedwithotherfarm"]==0 & mydata[i,"Accesstosupplier"]==0 &
mydata[i,"Agriculturallearning"]==0 &
 mydata[i,"memberofcooperative"]==0 & mydata[i,"Agriculturalinsurance"]==0 &
mydata[i,"Interbranceorganization"]==0)

{1} else {0}}
```

```
mydata$Riskcoping

## For Risk reduction and risk mitigation
# Determination of Dependent variables and grouping them

mydata$RiskreductionandRiskmitigation <- NULL
mydata$RiskreductionandRiskmitigation

for (i in 1:nrow(mydata)) {mydata[i,"RiskreductionandRiskmitigation"] <- if (

  # Any of the risk reduction instruments should be 1
  (mydata[i,"Cooperatiedwithotherfarm"]==1 | mydata[i,"Accesstosupplier"]==1 |
mydata[i,"Agriculturallearning"]==1) &

  # All of the other risk sharing instruments should be 0
  (mydata[i,"memberofcooperative"]==1 | mydata[i,"Interbranceorganization"]==1 |
mydata[i,"Agriculturalinsurance"]==1) &
  mydata[i,"Hedging"]==0 & mydata[i,"Marketingcontract"]==0)
{1} else {0}}

mydata$RiskreductionandRiskmitigation

# Riskreduction and Risk coping
# Determination of Dependent variables and grouping them

mydata$RiskreductionandRiskcoping <- NULL
mydata$RiskreductionandRiskcoping
for (i in 1:nrow(mydata)) {mydata[i,"RiskreductionandRiskcoping"] <- if (

  # Any of the risk reduction instruments should be 1
  (mydata[i,"Cooperatiedwithotherfarm"]==1 | mydata[i,"Accesstosupplier"]==1 |
mydata[i,"Agriculturallearning"]==1) &

  # All of the other risk sharing instruments should be 0
  (mydata[i,"Marketingcontract"]==1 | mydata[i,"Hedging"]==1) &
  mydata[i,"memberofcooperative"]==0 & mydata[i,"Interbranceorganization"]==0 &
mydata[i,"Agriculturalinsurance"]==0)
{1} else {0}}
mydata$RiskreductionandRiskcoping


## For Risk mitigation and Risk coping
# Determination of Dependent variables and grouping them

mydata$RiskmitigationandRiskcoping <- NULL
mydata$RiskmitigationandRiskcoping

for (i in 1:nrow(mydata)) {mydata[i,"RiskmitigationandRiskcoping"] <- if (

  # Any of the risk reduction instruments should be 1
  (mydata[i,"memberofcooperative"]==1 | mydata[i,"Interbranceorganization"]==1 |
mydata[i,"Agriculturalinsurance"]==1) &
```

```
 # All of the other risk sharing instruments should be 0
 (mydata[i,"Marketingcontract"]==1 | mydata[i,"Hedging"]==1) &
 mydata[i,"Cooperatiedwithotherfarm"]==0 & mydata[i,"Accesstosupplier"]==0 &
mydata[i,"Agriculturallearning"]==0)

{1} else {0}}

mydata$RiskmitigationandRiskcoping


## Uses risk reduction, risk mitigation and risk coping
# Determination of Dependent variables and grouping them

mydata[,"RiskreductionRiskmitigationandRiskcoping"] <- NULL
mydata$RiskreductionRiskmitigationandRiskcoping

for (i in 1:nrow(mydata)) {mydata[i,"RiskreductionRiskmitigationandRiskcoping"] <- if (

 # Any of the risk reduction instruments should be 1
 (mydata[i,"Cooperatiedwithotherfarm"]==1 | mydata[i,"Accesstosupplier"]==1 |
mydata[i,"Agriculturallearning"]==1) &
 (mydata[i,"memberofcooperative"]==1 | mydata[i,"Interbranceorganization"]==1 |
mydata[i,"Agriculturalinsurance"]==1) &
 (mydata[i,"Marketingcontract"]==1 | mydata[i,"Hedging"]==1) &
 # all other risk risk sharing strategies is equal to zero
 mydata[i,"Riskreduction"]==0 & mydata[i,"Riskmitigation"]==0 & mydata[i,"Riskcoping"]==0 &
mydata[i,"RiskreductionandRiskmitigation"]==0 & mydata[i,"RiskmitigationandRiskcoping"]==0 &
mydata[i,"RiskreductionandRiskcoping"]==0)

{1} else {0}}

mydata$RiskreductionRiskmitigationandRiskcoping


# None of the risk sharing strategies uses by farmers # Determination of Dependent variables and
grouping them

mydata[,"NoRisksharingstrategies"] <- NULL
mydata$NoRisksharingstrategies

for (i in 1:nrow(mydata)) {mydata[i,"NoRisksharingstrategies"] <- if (

 # Any of the risk reduction instruments should be 1
 (mydata[i,"Cooperatiedwithotherfarm"]==0 | mydata[i,"Accesstosupplier"]==0 |
mydata[i,"Agriculturallearning"]==0) &
 (mydata[i,"memberofcooperative"]==0 | mydata[i,"Interbranceorganization"]==0 |
mydata[i,"Agriculturalinsurance"]==0) &
 (mydata[i,"Marketingcontract"]==0 | mydata[i,"Hedging"]==0) &
 # all other risk risk sharing strategies is equal to zero
 mydata[i,"Riskreduction"]==0 & mydata[i,"Riskmitigation"]==0 & mydata[i,"Riskcoping"]==0 &
mydata[i,"RiskreductionandRiskmitigation"]==0 & mydata[i,"RiskmitigationandRiskcoping"]==0 &
```

```
mydata[i,"RiskreductionandRiskcoping"]==0 & mydata[i,
"RiskreductionRiskmitigationandRiskcoping"]==0)

{1} else {0}}

mydata$NoRisksharingstrategies

# Determination of Risksharing strategies
### Dependent variables
# number of observation is less than number of selected variables
## Delete risk riduction strategies and riskmitigation and riskcoping strategies


# Determination of dependent variables
## Risk sharing strategies

mydata$Risksharingstrategies<-
(mydata$Riskreduction*1+(mydata$Riskmitigation)*2+(mydata$Riskcoping)*3

+(mydata$RiskreductionandRiskmitigation)*4+(mydata$RiskreductionandRiskcoping)*5

+(mydata$RiskmitigationandRiskcoping)*6+(mydata$RiskreductionRiskmitigationandRiskcoping)*7
        +(mydata$NoRisksharingstrategies)*8)

table(mydata$Risksharingstrategies)

# Data Check
# Determination of outlier and data check before analysis.
# There were 924 observations and 61 are not using any risk sharing strategies
#and There were 6 observations which were in extreem outlier e.g. number of livestock 21084, land
size 22000 hector,
# family labour 750, 700 and others.
# To check N/A value from my dataset

sum(is.na(mydata))
sum(is.na(mydata$Age))
sum(is.na(mydata$Totalnumberoflivestock))
sum(is.na(mydata$Riskreduction))
sum(is.na(mydata$Riskreduction))
sum(is.na(mydata$Riskcoping))
sum(is.na(mydata$Risksharingstrategies))


# Frequency table of the dependent variables

table(mydata$Riskreduction)
table(mydata$Riskmitigation)
table(mydata$Riskcoping)
table(mydata$RiskreductionandRiskmitigation)
table(mydata$RiskreductionandRiskcoping)
table(mydata$RiskmitigationandRiskcoping)
table(mydata$RiskreductionRiskmitigationandRiskcoping)
```

```
table(mydata$NoRisksharingstrategies)
table(mydata$Risksharingstrategies)

# piechart of province with respective percentage

table(mydata$Province)

#install.packages("plotrix")
library(plotrix)

x <- c(49, 132, 87, 113, 50, 57, 166, 83, 89, 46, 57, 95)
labels <- c("Drenthe", "Flevoland", "Friesland", "Gelderland", "Groningen", "Limburg", "Noord-Brabant",
           "Noord-Holland", "Overijssel", "Utrecht", "Zeeland", "Zuid-Holland")
pct <- round(x/sum(x)*100)
lbls <- paste(labels, pct) # add percents to labels
lbls <- paste(lbls,"%",sep="") # ad % to labels
pie(x,labels = lbls, col=rainbow(length(lbls)),main="Pie Chart of the respondents from provinces of the Netherlands")


# To check outlier and other strange variables

boxplot(mydata$Age, mydata$YearsOfFarming, mydata$Totalnumberoflivestock,
      mydata$Totallandsize, mydata$Familylabour, mydata$Hiredlabour, mydata$Negativeriskshortterm,
      mydata$Negativerisklongterm, mydata$Positiveriskshortterm, mydata$Positiverisklongterm)

boxplot(mydata$Age)

# treatment for outlier for Age,
# total land size, total number of livestock, family labour and hired labour

summary(mydata$Age)
IQR_Age= 59-20 # Third quartile - first quartile
Upfen_Age= 59+1.5*IQR_Age
Upfen_Age
sd(mydata2$Totallandsize)

# Total landsize
summary(mydata$Totallandsize)
IQR_Totallandsize= 70-21
Upfen_Totallandsize= 70+1.5*IQR_Totallandsize
Upfen_Totallandsize

# Treatment for outlier for number of livestocks
summary(mydata$Totalnumberoflivestock)
IQR_Totalnumberoflivestock= 130.2-0
Upfen_Totalnumberoflivestock= 130.2+1.5*IQR_Totalnumberoflivestock
Upfen_Totalnumberoflivestock
sd(mydata2$Totalnumberoflivestock)
```

```
# for family labour
summary(mydata$Familylabour)
IQR_Familylabour= 2-0.1 # third quartile- first quartile
Upfen_Familylabour= 2+1.5*IQR_Familylabour
Upfen_Familylabour

# for hired labour
summary(mydata$Hiredlabour)
IQR_Hiredlabour= 2-0.0
Upfen_Hiredlabour= 2+1.5*IQR_Hiredlabour
Upfen_Hiredlabour

# determinaiton of newdataset after deleting outlier
# maximum value has been considered 20 times more than upfens of the respective variables
# not for all variables
# As this study is about cetagorical variables and there are more variety of the farming so and if we consider absolutely the standard
# after outlier the dataset will be too small and the effect of any influential respondent will be noted in discussion part
# Considering the above standard and based on selected variables the following dataset is created

mydata2= subset(mydata, ID<= 924 & YearsOfFarming<= 98 & AgriculturalSpecialization<= 8 & Totalnumberoflivestock<= 1000
        & Typesoffarm<= 4  & legalformoffarm<= 6 & Totallandsize<= 2870 & Familylabour<= 50
        & Hiredlabour<= 200 & AveragePricechallenge<= 7 & Averagevaluechainchallenge<= 7
        & Averagefinancialchallenge<= 7 & Averageproductionchallenge<= 7 & Averagepersonalchallenge<= 7
        & Averageinstitutionalchallenge<= 7 & Averagesocietalchallenge<= 7 & Handlingprobabilities<= 7
        & Negativeriskshortterm<= 100 & Negativerisklongterm<= 100 & Positiveriskshortterm<= 100
        & Positiverisklongterm<= 100 & Absoluteriskattitudes<= 10 & Relativeriskattitudesproduction<= 7
        & Relativeriskattitudemarketingandprice<= 7 & Relativeriskattitudefinance<= 7
        & Relativeriskattitudesinnovation<= 7 & Relativeriskattitudefarmingingeneral<= 7 & Age<= 117
        & Gender<= 2 & Expectationforsuccession<= 5 & Education<= 5 & Agriculturaleducation<= 2)


# Boxplot after deleting outlier
boxplot(mydata2$Age, mydata2$YearsOfFarming, mydata2$Totalnumberoflivestock,
    mydata2$Totallandsize, mydata2$Familylabour, mydata2$Hiredlabour, mydata2$Negativeriskshortterm,
    mydata2$Negativerisklongterm, mydata2$Positiveriskshortterm, mydata2$Positiverisklongterm)

table(mydata2$Riskcoping)
table(mydata2$RiskmitigationandRiskcoping)
table(mydata2$Risksharingstrategies)

# Model stting and uses of refenence value...
mydata2$Risksharingstrategies <- as.numeric(as.factor(mydata2$Risksharingstrategies), ref = "1")
```

```
# Descriptive statistics of the new dataset
summary(mydata2)
table(mydata2$Education)
table(mydata2$Risksharingstrategies)
table(mydata2$AgriculturalSpecialization)
table(mydata2$Typesoffarm)
table(mydata2$legalformoffarm)
table(mydata2$Gender)
table(mydata2$Expectationforsuccession)
table(mydata2$Agriculturaleducation)

#Derivation of multinoamial logistic regression model

library(nnet)
mymodel <-
multinom(Risksharingstrategies~YearsOfFarming+AgriculturalSpecialization+Totalnumberoflivestock
+Typesoffarm+legalformoffarm

+Totallandsize+Familylabour+Hiredlabour+AveragePricechallenge+Averagevaluechainchallenge+Aver
agefinancialchallenge

+Averageproductionchallenge+Averagepersonalchallenge+Averageinstitutionalchallenge+Averageins
titutionalchallenge

+Averagesocietalchallenge+Handlingprobabilities+Negativeriskshortterm+Negativerisklongterm+Posi
tiveriskshortterm

+Positiverisklongterm+Absoluteriskattitudes+Relativeriskattitudesproduction+Relativeriskattitudefin
ance

+Relativeriskattitudemarketingandprice+Relativeriskattitudesinnovation+Relativeriskattitudefarmingi
ngeneral+Age+Gender+Expectationforsuccession
        +Education+Agriculturaleducation, data= mydata2)

summary(mymodel)
coef <- summary(mymodel)$coefficients
AIC(mymodel)

##install.packages("openxlsx")
##library("openxlsx")
## Determination of P value and Standardised "Z value"
#Z <- summary(mymodel)
#p <- summary(mymodel)


# predict and probability

predict(mymodel,mydata2)
predict(mymodel,mydata2,type= "prob" )
predict(mymodel,mydata2[c(5,100,500),],type= "prob")
```

```
# Determinaiton of model fitness and calculation of misclassification error

cm <- table(predict(mymodel),mydata2$Risksharingstrategies)
print(cm)
1-sum(diag(cm))/sum(cm)

# Calculating accuracy of the model
# sum of diagonal elements divided by total observation

1-(1-sum(diag(cm))/sum(cm))
logLik(mymodel)

# Two tailed t test

install.packages("AER")
library("AER")
coeftest(mymodel,df=224)


# for P value and Standardised coefficeint and relative risk ratio

install.packages(stargazer)
library(stargazer)

stargazer(mymodel,type= "html", out= "mymodel.htm")
mymodel.rrr = exp(coef(mymodel))
mymodel.rrr

library(stargazer)
stargazer(mymodel, type= "text", coef= list(mymodel.rrr), p.auto=FALSE, out= "mymodelrrr.htm")

# Two tailed Z test
z<- summary(mymodel)$coefficients /summary(mymodel)$standard.errors
p <- (1-pnorm(abs(z),0,1)) * 2
p
head(round(fitted(mymodel), 2))
exp(coef(mymodel))


# Check for multicolinearity of the predictors
#install.packages("faraway")

library(faraway)
library(car)


# To test VIF

attach(mydata2)
colnames(mydata2)
```

```
Risksharining_reg=
lm(Risksharingstrategies~YearsOfFarming+AgriculturalSpecialization+Totalnumberoflivestock+Typesoffarm+legalformoffarm

+Totallandsize+Familylabour+Hiredlabour+AveragePricechallenge+Averagevaluechainchallenge+Averagefinancialchallenge

+Averageproductionchallenge+Averagepersonalchallenge+Averageinstitutionalchallenge+Averageinstitutionalchallenge

+Averagesocietalchallenge+Handlingprobabilities+Negativeriskshortterm+Negativerisklongterm+Positiveriskshortterm

+Positiverisklongterm+Absoluteriskattitudes+Relativeriskattitudesproduction+Relativeriskattitudefinance

+Relativeriskattitudemarketingandprice+Relativeriskattitudesinnovation+Relativeriskattitudefarmingingeneral+Age+Gender+Expectationforsuccession
        +Education+Agriculturaleducation, data= mydata2)

summary(Risksharining_reg)


## VIF determination
# correlation matrix of predictor and multicolinearity
#install.packages("mctest")
library("mctest")
vif(Risksharining_reg)
tab(vif)
table(mydata2$Risksharingstrategies)
```

.....