

# Risk perception, attitudes towards risk and risk management: evidence and implications

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**Abstract:** The comprehensive risk analysis of a business such as farming entails questions on what is at stake, how important is the risk concern and how to deal with it. We performed a sequential mixed method, with the in-depth interviews in the first stage ( $n = 35$ ), followed by a survey on the Flemish FADN ( $n = 614$ ) in the second, to investigate the farmers' risk perception, the attitudes towards risk and the perceived usefulness of the risk management strategies. We find that, rather than the short-term volatility in prices, the longer term co-evolution of expenses versus receipts is of a major concern to farmers, next to the land availability and the policy risks. Farmers are shown to be only slightly risk averse, rather risk neutral even. Further, our results suggest that farmers do not consider extensively studied risk management strategies such as contracts, futures and insurances, a valid option for their farm, and put more faith in internal strategies such as the debt management, the liquidity management and diversification. Last, risk management is to a substantial degree performed at the household level, rather than at the farm level, with strategies such as cutting the private expenses and the off-farm employment. These results hardly differ according to the farm and farmer characteristics.

**Key words:** FADN, mixed method, perceptions, risk, risk attitudes, risk management

In agriculture, a number of large but gradual changes have led to the increased importance of the financial and economic management, which need a scientifically based understanding of business decisions. First, the agricultural responsibility for achieving a stable farm income rests increasingly by the manager himself, given the reduction of stabilization measures such as quotas, export subsidies and price stabilization. Second, the trade in agricultural commodities is becoming more and more globalized, which ensures that, even though still only a minority of the world output is internationally traded, the prices of output and input are becoming more volatile. Third, the increased scale and mechanization of agricultural production warrant a higher debt repayment capacity than before.

Understanding farmers' decisions under risk and uncertainty can help to steer the policy in the right direction so that the objectives of the policy (safe and adequate food, reasonable and stable standard of living for farmers and sustainable production) are

realized. Additionally, this insight also helps to develop and recommend management strategies. Sound and representative knowledge about what kind of risks farmers perceive, their attitudes towards risk and their perception on the value of the the different risk management strategies can offer valuable insights supporting the design of risk management policies and instruments.

Wilson et al. (1988) surveyed the Arizona dairy farmers about their risk perceptions and management responses. They found that concerns about inputs such as feed, labour and capital were equally important as the fluctuating milk prices and milk production per cow. Their management responses were very consistent with these perceptions, for instance, with dairy farmers engaging in the forward contracting arrangements for feed. In the recent times, risk perceptions and the adoption of risk management strategies has been investigated in the U.S. by, among others, Patrick (1984), Patrick and Musser (1997; 1999), Coble et al. (1999), Mickelsen and Trede (2001),

Musser and Patrick (2002) and Hall et al. (2003) and Harwood et al. (1999) summarized the results of a number of nation-wide surveys on the risk perception and risk management in the U.S, most of which were unpublished. McCarthy and Thompson (2007) report the results of an Australian survey on the risk perception, risk attitudes and risk behaviour. Martin (1996) and Martin and McLeay (1998) investigated the diversity of the New Zealand farmers' risk management strategies.

Similar risk management surveys in the EU are much more scarce, an observation that could partly be explained by the file-drawer and the language problem, referring to the fact that surveys may have been published in the native language, which makes the study hard to find using the common literature search mechanisms. Meuwissen et al. (2001) studied the livestock farmers' risk perceptions and risk management. Price and production risk were found to be the most important risk sources. Insurance schemes were perceived as a relevant risk management strategy, albeit somewhat less by the mixed farmers compared to the specialised dairy and pig farmers. Akcoaz and Ozkan (2005) conducted a risk survey in Turkey aimed at identifying and clustering risk sources and risk management strategies. Policy risks and risks associated with prices and production were considered the most significant risk sources, whereas personal risks were among the least important. With respect to risk management strategies, diversification was identified as the most valid option.

In general, the previous literature confirmed that farmers perceive market risks, production risk and institutional risks to be the most important sources of risk. Further, farmers are shown to be highly risk averse to risk neutral. With respect to the risk management, the results show that farmers often like to apply a variety of risk management strategies, rather than focusing on one strategy. In this respect, it is surprising that not more studies into the farmers' combined risk behaviour have been performed. There is much more research focusing on investigating the determinants of the use of a particular risk management strategy and/or risk management in a single sector. Jackson et al. (2009), for instance, investigated the factors influencing the adoption of price risk management strategies, in the particular futures and forward contracting, by the Australian wool producers. Uematsu and Mishra (2011) studied the adoption of production and marketing contracts. Region-wide surveys remain important, however, in order to inform policy makers, advisers and re-

searchers on the relevant perceptions and intentions about risk and risk management. Most of the surveys mentioned in the literature review have two elements in common. First, the respective surveys are developed from the researcher or expert point of view, meaning that the list of risk sources and/or the potential risk management strategies that the responding farmers are asked to rate/score, has been compiled based on the previous surveys and/or what the experts think the major sources are. Although we do not question the expertise of those involved in the development of these surveys, we do question this methodology, since over the course of time, it may lead to obstinate and persistent misperceptions on the real concerns of farmers and on the strategies that farmers apply or would want to apply. Second, in those surveys, risk management is predominantly seen as an on-farm process, and the off-farm risk management strategies are mainly narrowed down to the off-farm employment. This publication reports results of a survey on the Flemish FADN sample, eliciting the risk perceptions, the attitude towards risk and the perceived usefulness of risk management strategies. Compared to previous surveys, we extend the methodology for such surveys in two valuable ways. First, we apply a sequential mixed methodology, which enables us to first determine in a qualitative way the relevant issues that should be included in the survey. What aspects farmers find the most worrisome for the future of their business? How much control they have over these aspects? What is the general attitude of farmers towards risk? And how do farmers estimate the usefulness of the particular management strategies to ensure viability in uncertain times? Thanks to the qualitative research phase and the use of open questions, we were able to (1) adapt our quantitative survey in several ways and (2) get a better explanation of the more quantitative results of the survey. Second, we include a proxy indicator, measuring the degree with which risk management is being performed off-farm, rather than on-farm.

## MATERIAL AND METHODS

### Conceptual framework

Farmers' risk management strategies are to a large extent guided by their subjective probabilities of adverse events, i.e., the risk perception, and their risk preferences, i.e., the risk attitudes (e.g., Hardaker et

al. 1997). Different models relating risk perception and risk attitude to risk behaviour have been proposed (e.g., van Winsen et al., 2011). According to Bard and Barry (2000), the key components in risk analysis with a view to develop strategies and policies are identifying the sources of risk, evaluating the risk management strategies and tailoring the risk advice to the risk attitudes of individuals.

From a realist perspective, it is assumed that risk can objectively be measured, and that only the individual perceptions about risk differ. Risk perception is often conceptualized as subjective probability (e.g. Sjöberg 2000). Hence, risk perception deals with the subjective likelihood of the adverse events happening. Risk has also been conceptualized as the probability weight by the impact, in which impact refers to the impact of an adverse event when it occurs. Again from a realist perspective, we can distinguish the subjective impact and the objective impact, in which the subjective impact is considered more important in driving people's behaviour. Last, the people's behaviour has been shown to depend on the locus of control, defined as the perceived degree of control over something (e.g., Elkind 2008). In our survey, risk perception was conceptualized as consisting of (1) people's subjective probability regarding a series of events; (2) people's subjective impact regarding this series of events and (3) people's subjective influence on the severity of this series of events. Conceptualizing risk perception using the perception on the probability of the shock happening and the perception of the impact of the shock once it happens is the most common way to measure risk perception (e.g., Smith et al. 2000; Quinn et al. 2003; Hoag 2009). Although our previous research on risk perception showed that such assessment might suffer problems due to, amongst others, the difficulty in considering different risk sources in isolation from other risk sources, the difficulty with (semi-)quantitatively scoring or ranking risk sources (van Winsen et al. 2013), in the context of a survey with closed questions, few alternatives are available. Inspired by the locus of the control literature, we also added subjective influence as an important part of risk perception. We define the subjective influence as the degree to which an individual perceives to have control over the severity of an adverse event, deliberately leaving it an open question whether this occurs through influencing its' probability and/or its' impact.

Risk attitude is the people's willingness to take risks. Regardless of their risk perception, different individuals have different risk attitudes, that attitudes

that may cause them to act differently. There are two major approaches to quantify the risk attitude of people: (1) the expected utility framework and (2) the psychometric method, involving measures derived from responses to scales (e.g. Antle 1987). Since a quantification of risk preferences based on the expected utility framework is near impossible using a postal survey, we used the psychometric method to measure risk perception. We also used a the self-assessment, using a direct measurement scale (e.g., Bard and Barry 2000).

Risk management, finally, is defined as any action with the – partly – deliberate goal to modify the probability and/or impact of adverse events. As such, risk management may be seen as a part of the overall farm management. Farmers' risk management is generally either one of three types: risk reduction, risk mitigation and risk coping (OECD 2009). Risk reduction involves any measure to decrease the probability that adverse events hit the farm, such as the technology choice. Risk mitigation is done by strategies that allow the risk to happen, but reduce its impact, such as internal strategies like diversification or the market based strategies such as insurances. Risk coping, finally, is performed using strategies to restore (part of) the damage when it happens, such as the off-farm income, cutting private expenses or selling assets. In our survey, we are interested, not in the actual risk management strategies, but in the farmers' judgment about risk management strategies. This judgment can be seen as a proxy for the intended risk management behaviour.

Since risk perception, risk attitudes and risk management will likely be context and farmers specific, we also collect information regarding the farmer (e.g., education) and the farm (e.g., farm type and farm size).

## Procedure

We applied a sequential mixed method in this study. Mixed methods are research methodologies where the quantitative and qualitative research is combined (Cameron 2009). Mixed methods are gaining an increasing popularity in agricultural and rural studies, especially when the subject of interest entails personal, social and psychological variables (Phelan and Mulhall 2007), and the examples are plentiful (e.g., Davis et al. 2004; Haque et al. 2010; Wauters and Mathijs 2013). Sequential mixed methods are the methods in which the qualitative

and quantitative parts are different stages in time, often involving the use of qualitative techniques in the first stage, in preparation for the data collection in the second stage.

In our study, the first, qualitative, stage consisted of in-depth interviews with a number of farmers about their conceptions of risk, uncertainty, shocks and risk management. The purpose was to obtain a better insight into the sources of shocks they perceived and the ways in which they deal with these shocks and future uncertainties. In the second stage, we surveyed a large group of farmers, using a postal survey, on their perceptions of shocks, the attitudes towards risk and their perception on the usefulness of a series of risk management strategies.

In a sequential mixed research method, the first stage is normally influencing the data collection in the second stage. In our study, the findings from the in-depth interviews influenced the data collection in the second stage in a number of ways. First, it influenced the shocks related to which we assessed – and did not assess – risk perception. After the interviews, we had a list of shocks that were more or less commonly shared by most farmers. For these shocks, it is safe to assume that the farmers' risk perceptions are readily accessible, meaning that, when including these shocks in a quantitative risk perception survey, leads the farmers to provide a good indication of their risk perception, since this is an aspect that is easily accessible for them. Shocks that are not commonly shared are the shocks that are not readily accessible for all farmers, which in the quantitative assessment, can lead to a forced answer that is not really an indication of how the respondent really perceives this shock. Many of the shocks we included in the quantitative survey are the common shocks that are present in the literature. One noteworthy example of a shock that was included as a direct result of the a-priori in-depth interviews was "suffering a longer period with insufficient receipts compared to expenses". Second, the in-depth interviews were instrumental in the decision to include and the way to design the household risk balancing scale. During the interviews, we found that interaction between household and farm decision are best described as a combination of four aspects: (1) starting to take decision as a family rather than by the manager only; (2) not separating private and business accounts; (3) adjusting private expenses; and (4) adjusting the off-farm income streams. The in-depth interviews were not instrumental for the decision to assess risk attitude, using a direct assess-

ment and a psychometric scale, as this was totally based on the previous literature.

### Data collection and variables

In the first stage of our sequential mixed method, we performed in-depth interviews with farmers to understand their conceptions of risk. In particular, the in-depth interviews were designed to get an exhaustive overview of the sources of risk and the shocks that farmers perceive and the way they deal with these shocks and with future uncertainties. During these interviews, we avoided as much as possible the use of the word "risk", since it has been shown that farmers use the notion of risk in different ways (van Winsen et al. 2013). Instead, we asked the farmer about uncertainties that make the farm management difficult, about shocks and changes that have caused problems to the business and about their worries and uncertainties for the future. In order to gain a better understanding of the different management strategies they applied or did not apply, we asked them how they dealt with the shocks, uncertainties and worries and how they expect to deal with these issues in the future. The advantage of this qualitative stage preceding the actual survey is, first, the fact that we gain a more broad understanding of the farmers' risk perception and risk behaviour and, second, the fact that it prevents us from asking too many researcher-driven questions in the actual survey. The sample for this qualitative data collection ( $n = 35$ ) was obtained via the purposive sampling, a form of non-random sampling in which those individuals are selected from which the researcher expects to obtain the most information (e.g., Guarte et al. 2006; Teddlie and Yu 2007). One approach was contacting different farmers' organisations and asking for contact details of the potential respondents. Another approach was the snowball sampling, in which one respondent was asked to provide contact details of other potential respondents. Last, we contacted several farmers randomly, from several contact databases at our institute. The number of respondents was determined using the concept of the theoretical saturation (e.g., Locke 2001; Goulding 2002; Douglas 2003), which occurs when no new data is harvested from expansion of the sample. The results from this stage were used to calibrate the survey in the second stage. For an elaboration of the findings of this first stage, we refer to van Winsen et al. (2013).

In the second stage, we designed a survey to elicit the farmers' risk perception, their attitudes towards risk, perceptions on the usefulness of different risk management strategies, the items of the household risk balancing scale and a number of farm and farmer characteristics. We recall that risk perception is conceptualized as consisting of the subjective probability, the subjective impact and the subjective influence. The subjective probability is assessed by asking the farmers to score the likelihood of a series of shock, on a scale from 1 (very unlikely) to 5 (very likely). The subjective impact was assessed using the question "If this shock happens, how severe would be the impact for your farm?" which the farmers rated between 1 (very small impact) to 5 (very large impact). The subjective influence was quantified by asking the farmers to score the degree of control they experience about the severity risk, also on a 5-point scale from 1 (no control) to 5 (very much control). The list of shocks to be included in the survey was mainly based on the in-depth interview stage with some validation from the previous literature (e.g., Meuwissen et al. 2001; Knowles 2002; McCarthy and Thompson 2007). For the list of shock that were surveyed, we refer to Tables 2 to 4 in the results section. Finally, through an open-ended question we asked the farmers to list the most important concerns about the future and viability of their business. These three aspects of risk perception – probability, impact and influence – were assessed in a rather generic fashion. We acknowledge that different farmers may relate these shocks to different goals with which the shock may impair. Yet, our goal is to elicit those sources of risk that are most important from the farmers' point of view, and not to elicit those sources of risk that are most important with respect to one common goal, e.g., profit. It is therefore not a problem that different farmers may relate these shocks to different goals, as we elicit those shocks that are most important for their goals. That being said, the qualitative phase of our study showed that the economic viability and financial feasibility of the farm households' activities is for all farmers at least to some extent one of the main and common goals.

Risk attitude was measured in this survey in two ways: direct measurement and psychometric measurement based on a scale. The direct measurement was a question by which the farmers indicate to what extent they are willing to take risks, and it was adapted from the previous literature (e.g., Bard and Barry 2000). The psychometric measurement of risk attitude consisted of a series of items, on which farmers indicate to what extent agree with a series of statement about

risk taking in general on a 5-point Likert-type item from 1 (strongly disagree) to 5 (strongly agree). The questions themselves were adapted from the previous applications and selected from the literature (e.g., Bard and Barry 2000; Pennings and Garcia 2000; McCarthy and Thompson 2007).

Perceptions on the usefulness of risk management strategies were measured by asking the farmers to what extent they consider a number of strategies to deal with risk and uncertainty a valid and likely option on their farm. This was scored on a 5-point scale from 1 (definitely not) to 5 (certainly). The strategies that were surveyed are the strategies most often cited in the preliminary in-depth interviews and in the previous literature. For the complete list of the investigated risk management strategies, we refer to Table 7 in the results section.

A special type of the risk management strategy is the household risk balancing, a strategy described by Wauters et al (2013). The household risk balancing is the strategy to make adjustments in the household activities, such as cutting the household expenses, delaying private purchases, investing in an off-farm business and engaging in the off-farm employment in response to changes in the farm-level risk. It is a form of risk management that allows farmers to manage the on-farm risk by decision that are made off-farm, and hence a strategy that does not entail substantial changes to the farm business itself. Based on the in-depth interviews, we decided to include this as a special type of risk management and developed a number of statements relating to different sub-dimensions of the construct household risk balancing. The farmers were asked to score the agreement on each of these statements on a scale from 1 (totally not) to 5 (totally). The statements were dealing with the degree to which they were cutting their private spending as a response to the adverse business performance, the necessity of the off-farm employment and the liquidity of the reserves for household welfare, the mixing of private and business accounts and whether decision were taken as a household or rather by the farm manager solely.

The survey was sent out in March 2013 to the whole Flemish FADN sample, a total of 759 farmers. This allowed us to obtain a representative sample of the Flemish agricultural sector. After 4–5 weeks, we received 624 surveys. Upon the initial data cleaning, 10 surveys could not be retained for the analysis, due to the unreliable scores and/or more than 25% missing values. Hence, our final sample had 614 respondents, which amounts to a response rate of 81%.

## Data analysis

First, the data was screened initially, in order to check for outliers and deviations to normality. Since the items are all Likert-type items, most parametric techniques are very robust, even in the case of serious deviations to normality (Norman 2010). However, as the goal of this paper is also to provide a representative descriptive picture of risk perception, attitude towards risk and risk behaviour, skewness and kurtosis are important characteristics, since they can reduce the information value of statistics such as the mean. All items were found to satisfy the normality conditions, with the acceptable skewness and kurtosis statistics between  $-1$  and  $+1$ .

Second, the internal reliability of the measurement items of constructs risk attitude and household risk balancing that are measured by a scale consisting of several items, was tested. The psychometric measurement scale for risk attitude was, based on theoretical foundations, considered a reflective measurement scale. This means that the items are manifestations of the underlying construct, and a change in the construct is believed to cause a change in all items of the measurement scale (Edwards and Bagozzi, 2000). Given the availability of measurement items from the previous studies, we used the confirmatory factor analysis, using the maximum likelihood and varimax rotation, to assess the reliability of this scale. Items with a loading smaller than 0.5 were excluded from the scale. As a validation check, the internal reliability of the final psychometric scale for risk attitude was tested with Cronbach alpha. The psychometric measurement scale for household risk balancing was considered a formative scale using a reflective measurement scale for each dimension. In a formative measurement scale, it is assumed that the indicators cause the construct, and a change in the construct is not necessarily associated by an equivalent change in all the indicators of the construct (Podsakoff et al. 2003). Based on the qualitative interviews, the household risk balancing was defined as a behaviour that is characterized by (1) making decision as a family; (2) adjusting private expenses; (3) adjusting off-farm income streams and; (4) mixing the private and business account and. The first three dimensions were measured using two items, the latter using three items. Each of these subscales was considered a reflective measurement scale. The reliability of each separate dimension was assessed with the confirmatory factor analysis using maximum likelihood and varimax rotation and validated

using the Cronbach alpha values. The values of each sub-dimension were calculated as the mean of the individual item scores. The four-dimensionality was tested with principal component analysis. Because each dimension was considered equally important in defining the household risk balancing construct, the composite index was calculated as the mean of all sub-dimensions.

Third, the means and standard deviations were drawn from all variables of interest. Last, we performed a one-way ANOVA to check whether the results differ significantly between the different farm typologies and size classes in the sample. When this test suggested significant differences between at least two of these groups, a post hoc test was performed to examine which groups had significant differences in the mean scores and what the size of this difference was. Since the choice for the best post hoc test depends mainly on the equal variances assumption, an a-priori Levene's test was performed. When this test revealed equal variances, a Tukey post hoc test was used, otherwise, we used the Dunnett's T3. All data analyses were carried out using the SPSS software (IBM 2010).

## RESULTS

### Summary statistics

Table 1 describes the summary statistics of the sample. Most farmers are in the business stages 'established and growing' and 'established and stable'. A small percentage is starting out and around 10% are winding down for retirement. The average age of farmers is 48.54 years, with the large majority between 41 and 60 years of age. Less than 20% is younger than 40. The bulk of farmers received a lower technical or vocational education, a small percentage receiving only the elementary education or the university education. accounted for 14% of the sample. About one third of the sample was assigned to each of the size classes small, medium and large, with slightly more farms in the large class compared to the small category. Last, about 66% of farmers gain attract income from other sources besides agriculture.

### Risk perception

Table 2 shows the average subjective probability of a shock occurring. Based on the subjective probability

Table 1. Summary statistics

Characteristic	Statistic*	Characteristic	Statistic*
<i>Business stage</i>		<i>Age</i>	
Starting out	2.0%	Average age	48.5
Established and growing	28.8%	< 40	17.4%
Established and stable	58.3%	41–50	38.9%
Preparing the take-over	3.6%	51–60	36.7%
Winding down for retirement	7.5%	> 60	7.0%
<i>Income from other sources</i>		<i>Education</i>	
0%	34.0%	Elementary education	1.7%
10%	21.8%	Lower technical or vocational education	81.1%
20%	7.8%	Higher education	14.2%
30%	9.0%	University education	3.1%
40%	5.3%	<i>Size class</i>	
50%	10.4%	Small	27.1%
60%	4.8%	Medium	34.2%
70%	3.2%	Large	38.7%
80%	1.9%		
90%	0.9%		
100%	0.9%		

\*Percentages are corrected to account for non-responses

of a shock, the greatest worries are the limited availability of land and/or high land prices, followed by prices, costs and the ratio of expenses versus receipts. The farmers estimate the probability of personal

problems and production losses caused by diseases as rather moderate. The subjective probability of shock does not differ according to the size classes to which farms are assigned, except for the probability

Table 2. Subjective probability of shocks for all farms, by typology and size class ( $n = 614$ )\*

	Type of shock								
	weather	pests	prices	costs	margin	policy	land	personal	subsidy
<i>All farms</i>	3.06	2.70	3.48	3.59	3.58	3.52	4.00	2.61	3.33
<i>Typology</i>									
Arable farms	3.12	2.60	3.56	3.74	3.26	3.56	4.26	2.64	3.88
Greenhouse growers	2.88	2.82	3.51	3.54	3.51	3.30	3.29	2.42	2.79
Horticulture	3.16	2.63	3.72	3.32	3.59	3.59	3.56	2.81	2.72
Fruit and orchards	3.79	2.52	3.61	3.59	3.44	3.35	3.80	2.81	2.52
Dairy farms	3.05	2.74	3.50	3.54	3.49	3.44	4.19	2.71	3.64
Beef farms	2.92	2.80	2.88	3.41	3.73	3.45	4.49	2.61	3.77
Mixed cattle	3.03	2.78	3.31	3.56	3.67	3.64	4.06	2.67	3.89
Pig farms	2.65	2.84	3.80	3.83	3.85	3.58	4.19	2.53	3.11
Mixed crop-livestock farms	3.28	2.64	3.48	3.56	3.62	3.75	4.19	2.54	3.83
<i>Size class</i>									
Small	3.11	2.68	3.25	3.43	3.53	3.52	4.01	2.64	3.46
Medium	3.15	2.76	3.51	3.68	3.58	3.54	4.03	2.63	3.39
Large	2.95	2.66	3.63	3.62	3.59	3.50	3.96	2.58	3.19

\*Average value on the scale “How likely are the following events to happen on your farm?” from 1 (very unlikely)–5 (very likely).

of exceptionally low prices, which is estimated as significantly lower by small farms.

Looking at the differences between the typologies of farmers regarding their subjective probability of calamities (Table 2); we find that most farm types exhibit the same pattern as the overall sample. A few significant differences are worth mentioning. Most of these differences reflect the actual situation in that sector, both biophysically and economically. Fruit growers estimate the probability of an adverse weather higher than most other farm types, whereas mixed farmers estimate this probability significantly higher than the specialist pig farmers. Fruit growers are more exposed to extreme weather conditions, whereas pig farming is mostly indoor and hence less exposed to changing weather conditions. The probability of having exceptionally low prices was estimated significantly lower by the specialist cattle farmers, compared to most other sectors. The risk of suffering a longer period with insufficient receipts versus expenditures was significantly more likely for the specialist pig farmers compared to most other farm types. Greenhouse growers and horticulture farmers estimate the probability of having difficulties to obtain land significantly smaller than several other farm types. The risk of losing (part of) their subsidies was estimated significantly higher by ar-

able farmers, cattle farmers, dairy farmers and mixed farmers. There are no significant differences for the calamities production loss due to diseases and pests, exceptionally high costs, policy risks and personal risks. The sSize class has no influence on the subjective probability of shocks.

Farmers estimate the impact of most shocks as moderately high to high. Exceptionally low selling prices, excessive cost, and suffering longer periods in which the revenue compared to spending is too low to have the greatest impact (Table 3).

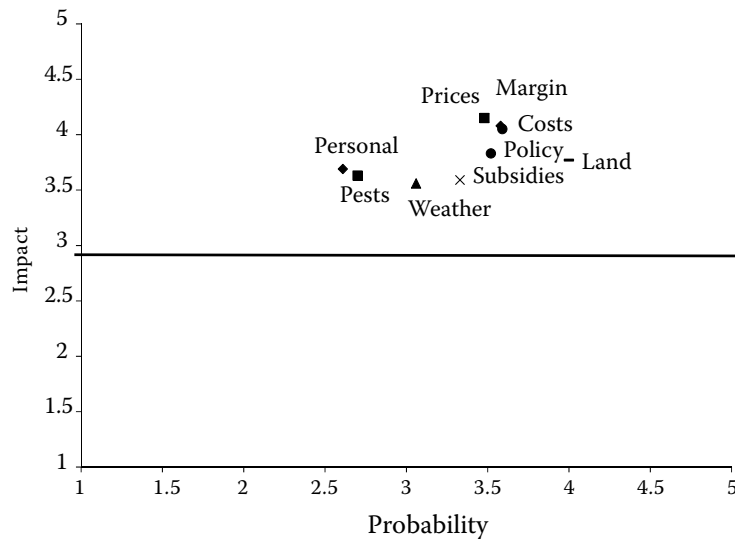
With respect to the impact of calamities, here too most farm types have the same pattern as the aggregate population (Table 3). Specialist pig farmers judge the impact of the adverse weather events smaller than most other farm types, whereas fruit growers judge this impact significantly higher than most farm types. Specialist pig farmers assess the impact of exceptionally high costs significantly higher than most other farm types. The impact of calamities related to land availability is judged significantly higher in arable farms and significant lower by greenhouse growers. The latter judge the impact of the loss of (part of) the subsidies significantly lower than many other farm types, whereas arable farmers, specialist dairy farmers, specialist cattle breeders and mixed farmers evaluate this impact significantly higher. There

Table 3. Subjective impact of shocks for all farms, by typology and size class ( $n = 614$ )\*

	Type of shock								
	weather	pests	prices	costs	margin	policy	land	personal	subsidy
<i>All farms</i>	3.56	3.63	4.15	4.05	4.08	3.83	3.77	3.69	3.59
<i>Typology</i>									
Arable farms	3.79	3.51	4.02	4.05	4.00	3.86	4.07	3.74	3.95
Greenhouse growers	3.58	3.75	4.29	3.88	4.04	3.67	3.18	3.47	3.04
Horticulture	3.78	3.47	4.13	3.84	3.94	3.55	3.41	3.69	2.78
Fruit and orchards	4.31	3.25	4.27	3.88	3.96	3.58	3.37	3.54	2.73
Dairy farms	3.60	3.67	4.08	4.00	4.01	3.76	4.06	3.68	4.00
Beef farms	3.47	3.90	4.13	4.10	4.23	3.92	4.06	3.92	4.22
Mixed cattle	3.43	3.75	4.03	4.17	4.19	3.97	4.06	3.64	4.42
Pig farms	3.04	3.74	4.36	4.39	4.22	3.89	3.88	3.80	3.30
Mixed crop-livestock farms	3.66	3.59	4.11	3.98	4.11	4.03	3.89	3.78	4.05
<i>Size class</i>									
Small	3.52	3.56	4.07	3.95	4.01	3.84	3.71	3.78	3.72
Medium	3.71	3.68	4.19	4.13	4.12	3.84	3.82	3.70	3.68
Large	3.44	3.62	4.18	4.06	4.09	3.84	3.75	3.63	3.41

\*Average value on the scale “How serious is the impact on your farm of the following events when they occur?” from 1 (very small impact) to 5 (very large impact).



Figure 1. Risk map indicating probability and impact of various shocks ( $n = 614$ )

is no difference in the subjective impact of shocks between the size classes.

The combined picture of the subjective probability and the subjective impact can be presented in a risk map, a widely used representation form for risk perception (Smith et al. 2000; Quinn et al. 2003; Hoag 2009). Most shocks are in the upper right quadrant, i.e., high probability – high impact, meaning that they pose the biggest threats. This is due to our mixed-method of surveying, which ensures that only those

shocks that are relevant are included in the survey. Personal risks and problems due to diseases and pests are considered the least important risks. Prices, costs and the longer term margin between expenses and receipts on the hand and land availability on the other are the biggest worries (Figure 1).

The farmers estimate their influence on all shocks as rather low (Table 4). The highest influence, albeit still moderate, is believed to be exerted on production losses due to the diseases and pests. There is almost

Table 4. Perceived influence on the severity of all shock for all farms, by typology and by size class ( $n = 614$ )\*

	Type of shock								
	weather	pests	prices	costs	margin	policy	land	personal	subsidy
<i>All farms</i>	2.23	2.90	2.04	2.16	2.45	2.11	2.20	2.50	2.04
<i>Typology</i>									
Arable farms	2.40	3.07	2.37	2.44	2.86	2.42	2.42	2.79	2.30
Greenhouse growers	2.55	3.04	2.06	2.22	2.52	2.09	2.04	2.41	2.07
Horticulture	2.72	3.13	2.13	2.22	2.34	2.28	2.44	2.66	2.06
Fruit and orchards	2.33	3.02	1.92	2.22	2.65	2.08	2.39	2.51	1.98
Dairy farms	2.24	2.78	2.15	2.24	2.45	2.27	2.42	2.60	2.12
Beef farms	2.08	2.83	2.00	2.15	2.35	2.17	2.13	2.65	2.06
Mixed cattle	2.08	2.58	2.08	2.19	2.31	1.94	2.14	2.56	2.03
Pig farms	1.82	2.97	1.94	2.03	2.34	2.07	2.08	2.41	1.94
Mixed crop-livestock farms	2.07	2.66	1.89	2.06	2.31	1.89	2.01	2.31	1.98
<i>Size class</i>									
Small	2.35	2.79	2.12	2.22	2.45	2.16	2.31	2.57	2.12
Medium	2.20	2.87	1.97	2.10	2.42	2.03	2.08	2.49	2.06
Large	2.17	3.00	2.05	2.18	2.46	2.14	2.23	2.46	1.98

\*Average value on the scale “How much control do you have over the severity of the following events?” from 1 (control) – 5 (very much control).

no difference in the subjective control exerted on the severity of a shock between farm types. Specialist pig farmers believe to have a significantly less control on the severity of the adverse weather effects than the greenhouse growers and horticulture farmers. There is no difference in the perceived influence according to the size class.

Farmers also had the opportunity to indicate by the means of an open question, which aspects they believe to constitute the greatest threat to their business. The response to this was, in contrast to the average response to the open-ended questions in surveys, quite large: 368 of the 614 farmers (60%) have completed this question. The processing and reporting of these results were done in 2 steps. First, all answers were listed, and all answers were given a specific code, referring to the risk issue. Second, a number of codes was aggregated into major themes. These are reported in Table 5, which also shows how often an element that is housed in this theme was mentioned.

The advantage of this open question is that, together with the in-depth interviews in the first stage, it enables us to document the argumentation behind the risk perception results, i.e., why certain shocks and issues are of the concern to farmers. The first interesting finding is the huge link between price, costs and the margin between expenses and receipts on the one hand, and policy changes on the other. The farmers perceive many policy measures to have an immediate impact on costs and/or prices. As such, the concern about the longer term ratio between expenses and receipts is not driven mainly by an increase in the costs of production as such, but by the fact that the policy measures induce additional costs to be incurred. Examples are the policy measures related to manure, land conservation, animal welfare and food safety.

A second noteworthy finding is that the price and costs risk are conceptualized as worries about the longer term margin between prices and costs, rather than as the short-term, in-season volatility of prices. This is shown by the abundance of quotes that could be assigned to either costs, prices or the ratio between expenses and receipts and the low number of quotes that specifically refer to the price volatility. This focus in the agricultural economics literature on the short-run risk versus the potentially more important long-term risk issues has been acknowledged by Just (2003) as an opportunity/challenge for the risk research in agricultural economics. In fact, of the two risks – price risk and production risk –

Table 5. Responses to the open question “What are your biggest concerns”

Codes and sub-codes	Times mentioned
<i>Margin between expenses and receipts</i>	193
Too low prices	75
Too high costs	64
Higher expenses than receipts	54
<i>Policy</i>	133
Too much regulation	37
Too many administration and inspection	21
Policy changes too fast	7
Government has no positive vision for agriculture	6
Permits and expandability	10
Loss of grants and subsidies	34
Unfair competition because of the policies in place	15
Abolition of stabilization policies	3
<i>Land</i>	66
Land prices/availability	66
<i>Production losses</i>	56
By weather	32
By diseases in crops	10
By diseases of cattle	14
<i>Health</i>	41
Health/illness in the family	41
Environmental limitations	35
Environmental constraints	20
Manure policy	15
Financial risk	33
High investments to still get low returns	33
Labour	27
Finding suitable and affordable staff	17
Having to work many hours for a small income	10
Acquisitions	25
Willingness and financial feasibility to take over business	25
Autonomy	18
Control over prices	5
Too little competition in distribution channels	2
No market power compared to large buyers and suppliers	8
Method of price setting	3
Scale	17
Too large scale to carry the shocks in the family	3
Not follow scale enlargement plans of colleagues	8
Orientation of policy and industry towards larger scale and specialization	6
Price volatility	8
Price fluctuations	8

that are most often investigated in the risk research literature, the production volatility, although not the biggest concern, is identified as a concern to farmers, but price volatility is not. This has important consequences for the practical use of much price risk research, in which the price risk is almost invariably conceptualized as the volatility in prices of both input and output. Farmers regard such volatilities more as certain variability. Much more challenging than managing volatilities in prices is safeguarding the longer term margin between expenses and receipts. This worry is induced by the uncertainty about the future evolution of prices versus costs, and also by the farmers' past experience. With regard to the latter, many farmers describe a situation that is known in the literature as Cochrane's treadmill (Cochrane 1958), referring to the necessity to invest in new technology and thereby increasing structural costs, only to see the future prices drop to a level producing a less favourable margin between expenses and receipt than before.

The third and last prominent theme was the land availability and land prices. This is a particularly relevant situation in a densely populated area such as Flanders, whereby many different users put a claim on land, thereby lowering availability and raising prices.

### Risk attitude

Risk attitude, or the willingness to take risks, is seen as an important determinant of risk behaviour, both in positive and normative analyses. Risk attitude in this survey was measured in two ways. The first measurement method was the direct elicitation using a single question. On a scale of 1 (very risk averse) to 5 (very risk taking), the average score is 2.65 suggesting that the Flemish farmers are in average risk-averse, but not very much. The second measurement method is a psychometric scale consisting of 9 items. The

Table 6. Risk attitude results ( $n = 614$ )<sup>1</sup>

	Direct measure	Psychometric scale
All farms	2.65 (1.01)	2.76 (0.58)
Size class small	2.40 (0.94) <sup>***</sup>	2.60 (0.55) <sup>***</sup>
medium	2.60 (0.70) <sup>***</sup>	2.74 (0.58) <sup>***</sup>
large	2.88 (1.04) <sup>***</sup>	2.88 (0.58) <sup>***</sup>

<sup>\*\*\*</sup>, <sup>\*\*</sup>, <sup>\*</sup> denotes significance at 1%, 5% and 10% respectively

<sup>1</sup>Average and standard deviation between brackets on a scale from 1 (very risk averse) to 5 (very risk seeking)

confirmatory factor analysis confirmed that these 9 items were loading on a single construct and all items were retained since all loading exceeded the 0.50 threshold. The internal consistency of this scale (Cronbach alpha = 0.73) is considered good, allowing us to calculate the average of the nine items. The average of this scale is a measure for the latent variable risk attitude and it equals 2.76, which leads to the same conclusion as the direct measurement (Table 6). Both ways to measure the risk attitude have a correlation of 0.48. The correlation is very significant, and it is higher than correlations between different measuring methods we find in the literature (e.g., Pennings and Smidts, 2000; Pennings and Garcia 2001; Maart-Noelck and Musshoff 2013; Nielsen et al. 2013).

The results suggest that farmers are only slightly risk averse, even more on the risk neutral side. This result is contradictory to several previous studies in the European context. Hansson and Lagerkvist (2012), for instance, found that Swedish farmers are risk averse in several domains. In the U.S., Bard and Barry (2000), found that the farmers were just in the risk averse zone of their scale.

The degree of risk aversion is uniform across all production types and it is thus not separately reported here. This result is according to our expectation, since the risk attitude is a personal characteristic, and thus there is no reason why the risk attitude would differ according to the production typology. There is, however, a significant difference in the risk attitude according to the size class of the farms. Larger farms are less risk averse than medium and small farms and medium farms are less risk averse than small farms (Table 6).

### Perception on the usefulness of risk management strategies

Table 7 presents the average usefulness of different risk management strategies. Importantly, several of the most mentioned and investigated risk management strategies, are not considered a valid option by the farmers.

Farmers have a slightly negative intention to implement risk management strategies such as contracts, and with respect to the use of insurances and futures (Figure 2). The most popular measures are actually internal strategies that farmers already apply since long and that are usually much less often considered in the frame of risk management: maintaining a financial buffer, saving on private expenditures,

Table 7. Perceived usefulness of various risk management strategies ( $n = 614$ )\*

Strategy	All	Size class			Status
		small	medium	large	
Maintain financial buffer	4.02	3.95	4.09	4.02	-
Cutting/postponing private consumption	3.76	3.69	3.69	3.84	-
Technological optimization and modernization	3.55	3.35	3.47	3.77	s < m, l
Debt management	3.32	3.61	3.24	3.16	s > m, l
Work hard in difficult times	3.18	3.02	3.19	3.28	-
Diversification within the farm	3.10	3.20	2.99	3.14	-
Scale enlargement	3.00	2.72	3.05	3.14	s < m, l
Contracts	2.76	2.56	2.76	2.91	-
Non-agricultural employment	2.65	3.04	2.63	2.37	s > m, l
Diversifying income sources	2.64	2.93	2.55	2.50	s > m, l
Insurances	2.59	2.59	2.51	2.66	-
Futures	2.24	2.25	2.29	2.20	-
Non-agricultural investments	2.19	2.38	2.13	2.12	s > m, l

\*Average value on the scale “To what extent are the following strategies a valid and useful option on your farm to manage risks?” from 1 (definitely not) – 5 (definitely).

improving technology, avoiding debt and increasing their efforts in difficult times.

We also investigated whether there exist any trade-offs among the willingness to apply different risk management strategies. Several scholars point to the crowding-out effect of one risk management strategy vis-à-vis other risk management strategies (e.g., OECD 2009). We measured the correlation factors between the implementation intention of all risk management strategies. We found modest

correlations, although often significant<sup>1</sup>. However, most correlations are positive, suggesting that a higher willingness to implement a particular risk management strategy is associated with a higher willingness to implement other strategies as well. Hence, the farmers find a mixture of different risk management strategies very beneficial to manage the risk and uncertainty. One noteworthy exception is the most popular strategy, maintaining a financial buffer. Farmers who find this strategy a valid option for their farm are significantly more inclined to dislike strategies such as insurances, futures and investments outside agriculture. This could suggest that for many farmers, avoiding too much debt is the only feasible and valid option to manage the farm risk.

The perceived usefulness of risk management strategies differs very little depending on the production direction, and it is therefore not reported here. There are only two significant differences. First, the off-farm income is considered a less valid option by the greenhouse growers compared to dairy farmers, beef farmers and mixed farmers. Second, extra-legal insurances are considered significantly more an option for the orchard and fruit farmers compared to arable farmers, cattle farmers and pig farmers.

There are some differences according to the size class of the farms. Small farms find the technological optimization and modernization and the scale

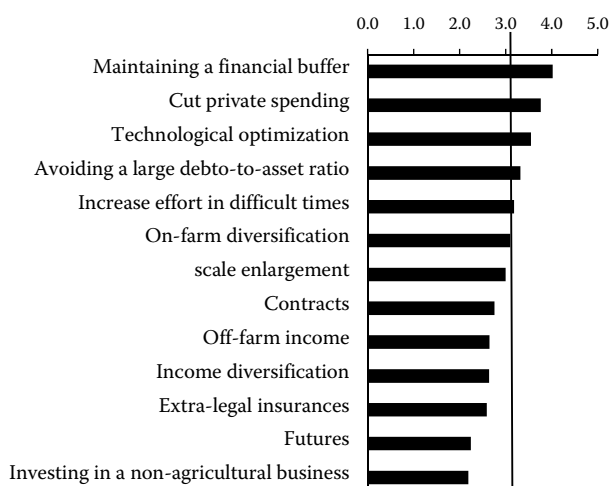


Figure 2. Perception on the usefulness of various risk management strategies

<sup>1</sup>For the sake of brevity, this table is not reported in this paper, but available on request.

enlargement a significantly less valid option compared to the medium and large farms. These small farms, however, regard the off-farm strategies such as the non-agricultural employment, the non-agricultural investment, diversifying income sources as more beneficial for managing risks compared to the medium and large farms.

### Household risk balancing

We developed a measurement scale as a proxy indicator for the household risk balancing behaviour, based on the findings of the in-depth interviews. In total, we developed 9 statements dealing with the various aspects involved in the household risk balancing: making decisions as a family, mixing farm and private accounts and making household-level adjustments in response to changes in the farming environment. First, we examined, using the confirmatory factor analysis, whether the reflective measurement scales for the four sub-dimensions show adequate reliability. The cConfirmatory factor analysis showed that this was the case. Taking decisions as a family, adjusting private expenses and adjusting off-farm income streams had 2 items each, with no items having a lower factor loading than 0.5. Mixing the private and business account had 3 items, all with factor loadings above 0.50. Second, the value of the sub-dimensions were calculated as the mean of all items for each sub-construct. Third, we calculated the composite household risk balancing construct as the average of each of these subconstructsub-constructs. The results are shown in Table 8. The mean value, on a scale from 1 (totally no HRB behaviour) to 5 (very substantial HRB behaviour), over all farmers was

Table 8. Household risk balancing behaviour ( $n = 614$ )\*

(Sub-)Factor	Average (Std. Dev.)
Aggregate construct	3.35 (0.65)
Sub-dimensions	
Decisions in family	3.80 (0.78)
Delay/reduction in private spending	3.77 (0.92)
Mixing farm and private accounts	3.13 (1.17)
Necessity of non-farm income	2.73 (1.24)

\*Average and standard deviation between brackets of the composite household risk balancing index and its four sub-dimensions, on a scale from 1 (very low household risk balancing behaviour) to 5 (very substantial household risk balancing behaviour).

3.35, suggesting a moderately positive household risk balancing behaviour.

There are no significant differences in the aggregate construct according to farm typologies, which suggests that risk management is to an equal degree performed at the household level in all farm types. According to size, there is a significantly smaller tendency of large farms to exhibit the household risk balancing behaviour. The average score for this size class (3.23), however, still suggests that also on large farms, the farm-household interactions are substantial.

### DISCUSSION AND CONCLUSIONS

Farmers perceive several sources of risk and uncertainty that are a worry to them and most of the sources identified in our study relate to the common risk source mentioned in the previous literature. However, a major result of our survey is that, rather than in-season and short-term volatility in prices, the longer term ratio of expenses versus receipts is a bigger worry to farmers. This is not reflected in the abundance of research related to price risk that uses price volatility, often measured on historical data, as a proxy for price risk. It is an empirical confirmation, however, of the statement made by Just (2003) in his position paper on the future of risk research in agriculture: “Data availability constraints can and do bias research away from investigating some of the most important problems.” (Just 2003, p. 153). In the U.S., Michelsen and Trede (2001) obtained a similar result, showing that narrowing margins is what farmers are most concerned about in terms of price and market risks. A much higher importance that is attached by farmers to the longer term evolution of prices and costs and, in particular, to the longer term ratio between expenses and receipts, highlight the importance of collecting panel data and investing more time and effort in the panel data research in the risk framework. The fact that farmers, when prices and costs are a concern, are much more concerned about the co-evolution and shrinking margins also questions equating “risk” with “volatility”, a common approach in the risk analysis and management research (Aven 2010).

We find that production losses to diseases and pests are considered a relatively smaller risk compared to several previous studies. This contrasts the findings of, for instance, Meuwissen et al. (2001), who find that epidemic diseases are among the top worries for farmers. Whereas their sample is limited to live-

stock farmers, in our survey, we find no evidence that livestock farmers attach a higher importance to livestock diseases than the average farmer over all sub-sectors. This result can explain to a certain extent the low uptake of the animal health management technologies. The relatively lower importance of production risks could be explained by several context-specific aspects. First, although the adverse weather events such as summer droughts or late frost do occur, the climate in Belgium may be considered moderate compared to some of the regions in which the previous studies were conducted. Second, farmers in Belgium did not recently suffer a major epidemic crisis, the last crisis being the EHEC-crisis in 2011. We think the results of a survey on risk perception may be biased by recent events, and recent events in Belgium are more dealing with market risks as compared to production risks. Third, during our qualitative pre-survey, we also observed a cultural difference between the perceptions of market risk and production risk. Whereas suffering low output prices and/or high input prices is regarded as a complete matter of good or bad luck, the occurrence of production losses is partly considered as a matter of good or bad management. We think this view of production risks as partly manageable explains to some extent the relatively lower importance that was attached to production risks.

Our risk attitude results differ from some previous studies in the sense that several previous studies identified farmers as more risk averse than we did. Yet, our study is not the first and only to identify farmers as more in the risk neutral spectrum. Some of the difference with those studies that defined farmers as risk averse may have a cultural background, in that farmers in the Flemish region of Belgium are generally regarded as a bit more entrepreneurial than in many other countries. However, this is just a word of mouth statement and clear comparative evidence does not exist. Given the inherent riskiness of the farm business, we consider our results very plausible, however, and question a bit the widespread assumption that farmers are highly risk averse, especially compared to regular employees obtaining an income from the public or private employment.

The farmers in our sample prefer internal strategies for managing risk rather than strategies such as contracts, insurances and futures. This could be partly explained by the observation that, rather than the short-term price volatility, the longer term ratio of expenses versus receipts is one of the major concerns for farmers. Risk management instruments such as

futures and contracts protect farmers from in-season deviations from the expected prices. They do not protect the farmers, however, from the longer term price evolutions. Policy makers should take this into account when designing policy measures aimed to assist farmers in managing on-farm risks.

A cultural reason why strategies such as insurance and futures are not regarded as the relevant strategies by the farmers in our sample, may be the fact that these strategies are currently rather unfamiliar to farmers in Belgium. Whereas extra-legal insurances for farmers, for instance, are quite common in many countries, there is not yet much supply in Belgium for the moment. Hence, the opinions about such strategies might change as these strategies become more available and are applied more often. A methodological reason could be that an anchoring effect has occurred in our survey. We did not ask the respondents to compare the risk management strategies vis-à-vis each other. Yet, the first strategy that the respondents had to score was “maintaining a financial buffer”, which is regarded as the most relevant strategy. Some anchoring may have happened, whereby the respondents used the first strategy as the norm and scored all subsequent strategies with respect to this first one. However, while this may have happened to some extent, we consider it highly unlikely that that has changed the main conclusions of the survey.

In many countries, the focus of agricultural policy is at present directed towards insurances. Whereas we do not question the relevance and usefulness of insurances, our results suggest the need for stimulating more diversification in risk management strategies. The reluctance of farmers to subscribe to the extra-legal insurance unless high premium subsidies are paid by the government has previously been described by, among other, Freshwater (2007). He argues that farmers already take risk into account in their internal management, using strategies such as the debt and liquidity management and diversification. Given the high relevance, from the point of view of farmers, of risk management strategies such as the debt and liquidity management, it could be recommendable that some of the efforts and means of policy programs are directed towards providing conditions that support the debt and liquidity management and measure to reduce the credit risk. This could include the provision of cheap loans to overcome the short-term cash flow deficits, or investments support instruments.

Our proxy measure for the household risk balancing suggests that a substantial part of the farm

risk management is performed at the level of the household, rather than at the farm-level. This has important implications for researchers and policy makers. First, the researchers aiming to understand farm-level decision making and/or to assess the business impact of changes in the farming environment produce incomplete results when designing their models at the farm level. Second, given the important role of non-agricultural activities for farm households dealing with risk and uncertainty, there could be an important role for policy makers in the agricultural risk management that is situated outside the agricultural policy domain, but rather in the rural and regional development domain. A series of paper by Kostov and Lingard (2001; 2003; 2004) first introduced the idea that rural development can serve the purpose of risk management. The idea is that rural development broadens the opportunities for employment, income and farm-related activities such as agri-tourism and short supply chains. Rural development changes the environment in which the farmers operate, providing more opportunities for diversification in income sources. Hence, this can render farm households less exposed to the risks in agriculture, even when those risks remain unchanged. Further, provided with the possibility to diversify their income sources, farmers may be less reluctant to undertake riskier farm activities because the consequences of the adverse farm incomes become less severe for the household as a whole. Thus, a potentially effective role for policy makers in risk management is to expand non-agricultural income possibilities through rural development.

The use of a sequential mixed method, where the qualitative research precedes the quantitative data collection, enables focussing the survey on the relevant issues, which bears substantial methodological advantages. First, it avoids posing suggestive questions resulting in misleading results. This phenomenon can occur when the questionnaires are developed from a researcher's perspective and the closed question format induces farmers to provide an answer to a question even though the question is not relevant from the farmers' point of view. When conducting surveys aimed at eliciting the farmers' key perceptions and opinions, this may produce misleading results about the relevance of particular issues. Second, it allows reducing the questionnaire to a minimum length, which benefits greatly the response rate and the reliability of the survey answers. Third, a qualitative data collection stage enables eliciting the broader reasoning and argumentation behind certain perceptions and opinions, which is hampered when solely

using closed survey questions. For these reasons, we advocate the use of a sequential mixed method in survey research aimed at assessing the farmers' key perceptions and opinion on a particular matter. Especially the last reason enabled us to find a deeper understanding of the risk perceptions of farmers. Most previous studies found the price and production risk the most relevant risk sources, which, at first sight, is well reflected in the risk analysis and management literature. Yet, since agriculture is the process of transforming inputs into output (production) and selling these outputs at prices that – hopefully – are high enough to earn profit over and above the costs incurred for using the inputs, one can hardly say it is surprising that the price and production risk is a concern. However, our mixed method enabled us to get a deeper understanding about what it actually is about prices that is a concern to farmers, namely the narrowing margin between expenses and receipts, rather than the short-term, in-season volatilities in prices.

In sum: The farmers are more concerned about structural evolutions such as the margin between receipts and expenses, land availability and policy, rather than the shorter-term volatilities. To manage these concerns, they expect more benefit from the internal risk management strategies and use the household strategies as the important risk management strategies.

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