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Risks and Risk Management in Agriculture

Abstract. Agriculture has always been exposed to a wide spectrum of risks. But it is largely undisputed that farmers have faced growing risks in recent years. More volatile agricultural and input prices, climate change, ongoing discussions about the future of the Common Agricultural Policy, increasing difficulty in finding qualified farm workers, and growing criticism of modern intensive agriculture from the wider public and the mass media are just a few of the risks farmers have to cope with. Therefore, risk management has become highly relevant in agriculture. In this paper, we highlight the need for systematic risk management and outline a systematic agricultural risk management approach. Empirical results illustrate farmers' risk perceptions and their preferred risk management strategies.

Key words: agriculture, risks, risk management

RISKS IN AGRICULTURE

Farming has always been a risky business due to the handling of living organisms and its exposure to weather conditions and other natural phenomena (such as pathogens, animal diseases etc.). Other risks originate in the political and social environment of farms, for instance uncertainty about future agricultural and environmental policies, a growing lack of societal acceptance of intensive agriculture, and reluctance of qualified personnel to work in agriculture. Figure 1 enumerates some of the most important risks in agriculture.

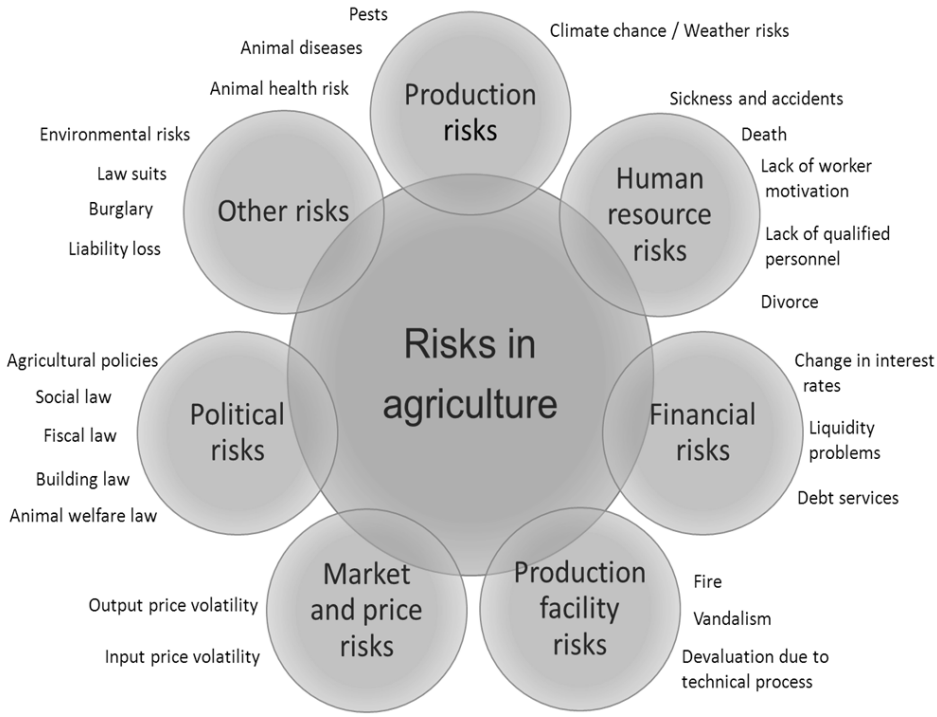
It is a widely shared assumption that several of the risks mentioned in Figure 1 have become more relevant for farms and farmers in recent years (Frentrup, Heyder and Theuvsen 2010):

- The Common Agricultural Policy of the European Union has undergone an incremental process of liberalization with the result that EU farmers are currently more exposed to world agricultural markets and world market prices than ever. As a consequence, EU farmers today face increasing price volatility. Furthermore, the future of the Common Agricultural Policy (for instance, the need for decoupled payments to European farmers) and other relevant policies (for instance, environmental and animal welfare policies) is becoming increasingly controversial.
- Climate change will result in changing weather conditions, including higher temperatures, changing quantities and seasonal distribution of rainfall, and more extreme weather phenomena, such as droughts, heavy rains, storms and extreme high or low temperatures.
- In many regions, agriculture has turned out to be less attractive for younger people, and it has become more difficult to find adequately trained and motivated farm workers and young farmers willing to continue family farming businesses.

- In many European countries, agriculture is subject to lively societal discussion and media debate concerning its environmental effects, prevalent animal welfare standards, use of genetically modified organisms etc.

More examples of growing risks in agriculture could be added. Against this background, it is a widely shared assumption that agricultural risk management has become more relevant than ever before, especially for modern farms, which can no longer rely mainly on family labour, their own land and equity capital. Instead, modern farms are often characterized by growth strategies that involve hiring paid farm workers, leasing major shares of their land and growing debt to equity ratios (Schaper, Deimel and Theuvsen 2011). Therefore, these farms face substantial fixed payments and the risk of insolvency should unforeseen major risks, such as longer periods of (very) low prices or the outbreak of an animal disease, occur. Therefore, it is the objective of this paper to outline the core elements of a systematic risk management process in agriculture, introduce important determinants of agricultural risk management strategies and present empirical results that shed some light on farmers' risks perceptions and preferences concerning risk management instruments.

Figure 1. Risks in agriculture



Source: Based on Näther and Theuvsen 2012; Lehrner 2002

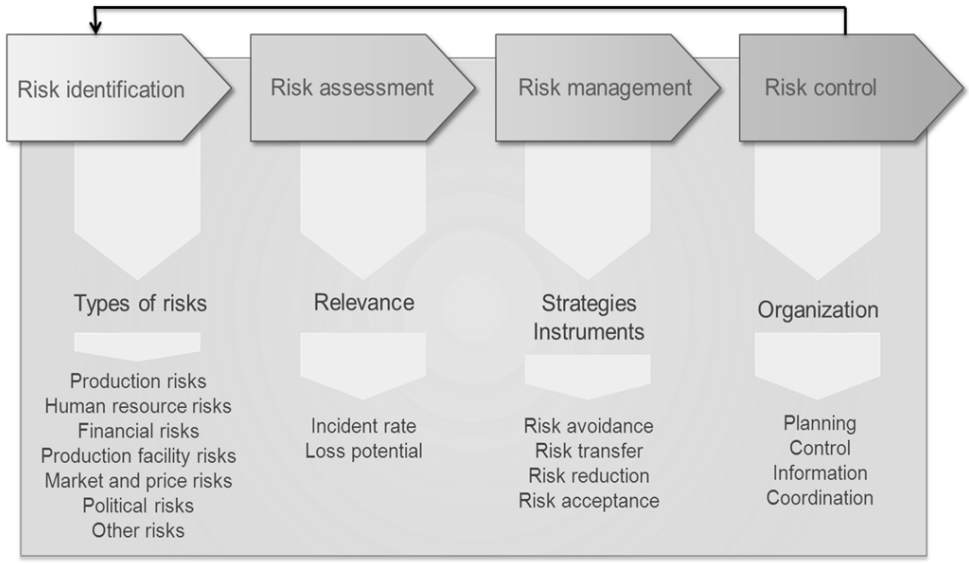
THE RISK MANAGEMENT PROCESS

Risk management comprises all measures that help to identify and manage risks that put a farm or a firm at risk (Wolke 2007). Its major goal is to identify, quantify, manage and control potential sources of losses. This contributes to the ongoing existence and success of a farm or firm. The literature distinguishes between general and special risk management (Mikus 2001). General risk management addresses all types of risks, whereas special risk management focuses only on risks that can be insured by an insurance company, for instance fire or hail risks.

The risk management process comprises four main steps (Figure 2):

- Risk identification: Which risks are relevant for a specific farm? Livestock farmers, for instance, face different risks than arable farms, producers of wheat different risks than producers of sugar beets and conventional farms different risks than organic farms.
- Risk assessment: How much attention do the risks identified in the first step deserve? Two assessment criteria are relevant from the point of view of risk management: (a) Incident rate: What is the probability that a specific risk will occur? In some cases information is available that makes it possible to quantify the incident rates of risks; this is true, for instance, in the case of weather risks, for which longer-term records exist. In other cases, farmers need to develop subjective assessments of incident rates, taking into account, for instance, prior experiences with occurrence of these risks. (b) Potential loss: What will be the financial loss if a risk, such as an animal disease or a hail storm, occurs?
- Risk management: After relevant risks have been identified and assessed, farmers have to decide how to cope with these risks. In general, farmers have four options for managing a risk: (a) Risk avoidance, for instance, if a risk can have catastrophic consequences. Horse farms, for example, often quit the risky breeding business and focus on more projectable horse boarding activities (Näther and Theuvsen 2012); (b) transfer of risks to third parties, such as insurance companies or financial investors in futures markets; (c) risk reduction through such means as concluding longer-term contracts or diversifying farm activities; and (d) risk acceptance, a strategy used mainly where incident rates and loss potentials are low.
- Risk control includes internal design of the risk management process (responsibilities, deadlines etc.); regularly supplying decision-makers with relevant information about topics such as new risks or changing incident rates and loss potentials; and critical control of the effectiveness of the risk management strategy applied, i.e. its potential to reduce risks to an acceptable level. If any need for a critical review of a farm's risk management strategy occurs, the whole risk management process has to be re-run.

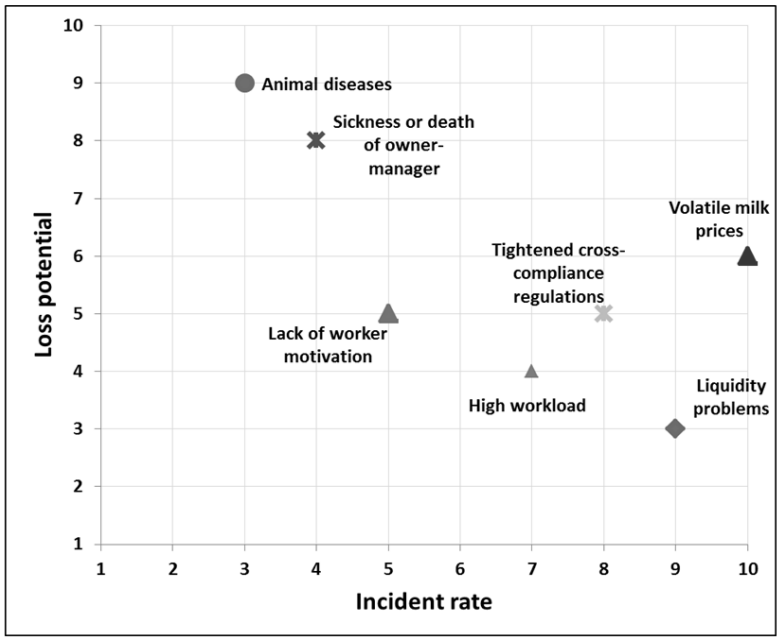
Figure 2. The risk management process



Source: Based on Wolke 2007
Source: Based on Wolke 2007

Incident rates and loss potentials are often displayed in a risk matrix that makes it possible to distinguish between more relevant risks, characterized by high incident rates and/or high, in some cases even catastrophic, loss potentials, and those less relevant risks that are extremely unlikely to occur and/or will have limited financial consequences. Figure 3 provides a simplified overview of the risks facing a dairy farmer.

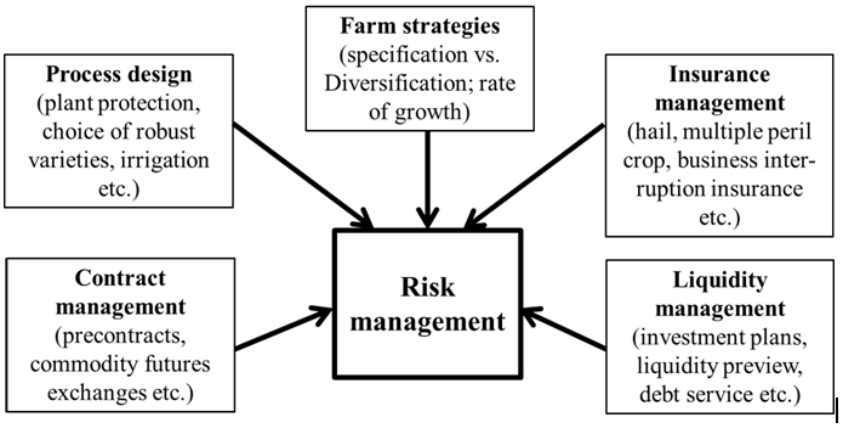
Figure 3. A dairy farmer's risk matrix



Source: Goeser 2010

In agriculture there is a wide spectrum of traditional and, in some cases, new risk management strategies that allow farmers to transfer or reduce risks (Figure 4).

Figure 4. Agricultural risk management strategies



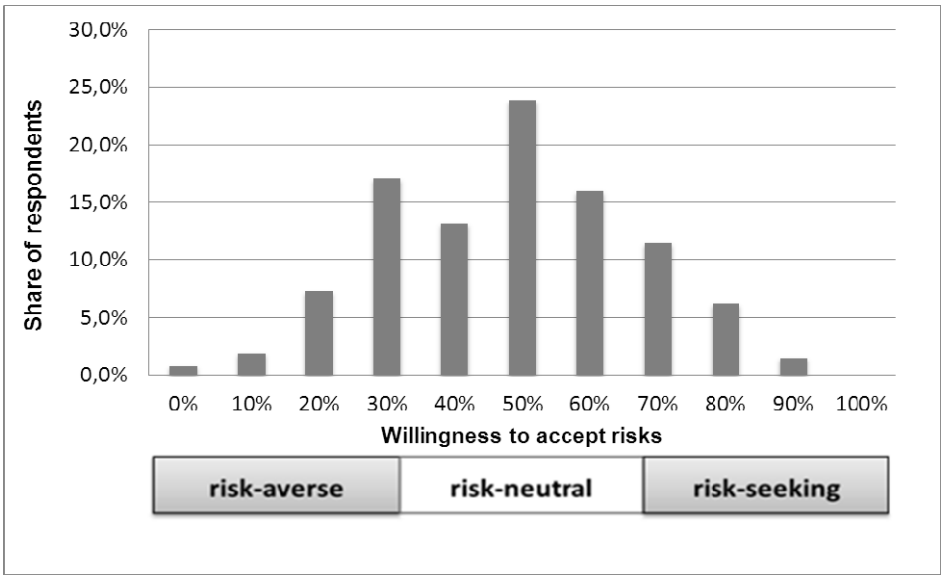
Source: Based on Hirschauer and Musshoff 2012

DETERMINANTS OF AGRICULTURAL RISK MANAGEMENT

According to contingency theory, there is no "one best way" of management; instead, it is a widely shared belief that situational determinants strongly influence the efficient design of management practices and that the fit between the situation and the design of management procedures determines the performance of a farm or firm (Perrow 1967; Lawrence and Lorsch 1967). With regard to agricultural risk management, two important situational factors can be identified: farmers' risk attitudes and a farm's risk-bearing potential.

The factor 'farmers' risk attitudes' denotes their willingness (or reluctance) to accept risks. People's attitudes towards risks are very diverse, including risk-averse, risk-neutral and risk-seeking behaviour (Hillson and Murray-Webster 2007). Similar results have also been obtained with regard to farmers' risk attitudes (Schaper, Spiller und Theuvsen 2010). Figure 5 exemplifies farmers' risk attitudes by referring to an empirical study in which 546 Eastern German farmers were asked to assess their own willingness to accept risks (from 0% = extremely risk averse to 100% = extremely risk seeking).

Figure 5. Farmer's willingness to accept risks



Source: Schaper, Bronsema and Theuvsen 2012

From a risk management perspective, a farmer's risk attitudes are highly relevant since they will strongly influence his or her decision to implement risk management strategies. If a farmer is highly risk-averse, he or she will be reluctant to accept many risks but will try to reduce, transfer or even completely avoid as many risks as possible. But if a farmer is highly risk-seeking, he or she will deliberately accept major shares of the risks facing the farm and will largely refrain from actively implementing strategies aimed at reducing, avoiding or transferring risks. Therefore, the exposure of farms to risks can be very diverse,

depending on farmers' risk attitudes (Schaper, Bronsema und Theuvsen 2012; Faff, Mailino and Chai 2008; Lucius 2009).

A second important determinant of agricultural risk management is the farm's risk-bearing capacity. This is an objective measure of how much financial loss a farm can bear without going bankrupt (Lucius 2009; Zeilbeck 2007). Thus, it is a measure that assesses a farm's robustness against negative financial outcomes resulting from the occurrence of risks, for instance, longer periods of lower prices, increasing costs of leasing land, higher prices of other input factors, or reduced productivity due to the spread of pathogens or the outbreak of animal diseases (Theuvsen 2012). Due to structural changes in European agriculture, fixed payments related to the increasing employment of non-family labour, growing shares of lease land and higher debt to equity ratios have become more relevant and threaten farms during times of crises. Similar to farmers' risk attitudes, farms' risk-bearing capacities also influence their assessment of risks and the choice of risk management strategies. The lower the risk-bearing capacity, the more risks have to be characterized as a potential threat to the ongoing existence of a farm – and vice versa. As a consequence, a farm with a low risk-bearing capacity has to undertake more efforts to reduce, avoid or transfer risks and, thus, needs a more systematic application of effective risk management strategies.

A farm's risk-bearing capacity is mainly determined by its ongoing cash flows (surplus of incoming payments over outpayments; investments and disinvestments; changes in debt and equity capital) and its realizable liquid assets (Lucius 2009). Realizable liquid assets are those assets for which an external market exists and which can be sold without considerably jeopardizing the future prospects of a farm. If a farm is run as a family business, non-farm income, debts and assets (real estate, securities etc.) also have to be taken into account since these payments and liquid assets can stabilize, but also destabilize a farm during crisis situations.

It is important to note that a farm's risk-bearing capacity has to be distinguished from its competitiveness. Competitive farms are able to produce at low, marginal or full cost, whereas a farm with a high risk-bearing capacity can successfully resist financial losses after the occurrence of a risk. Often a farm's competitiveness and its risk-bearing capacity are very dissimilar. Competitiveness is often the result of pronounced growth strategies that allow farms to realize economies of scale. But this advantage often comes at the price of a lower risk-bearing capacity since growing farms often face increasing debt to equity ratios, wage payments to hired farm workers and other fixed expenses. Fixed payments increase a farm's risk of bankruptcy. On the other hand, small family farms, which often produce at high cost, turn out to be very stable during crisis situations since these farms do not have to pay hired workers, rents for lease land or interest on debt capital. Therefore, small family farms often require only a few risk management strategies, whereas large farms have to effectively provide for potential risks.

SOME EMPIRICAL RESULTS

During autumn 2011, 546 farms in Eastern Germany (Saxony, Saxony-Anhalt, Thuringia, Mecklenburg-West Pomerania) were surveyed regarding their risk perceptions and risk assessment, their risk attitude and experience, and their preferred risk management strategies. A written questionnaire was sent to full-time farmers and management boards of

large agricultural enterprises. Table 1 shows some sample characteristics. The comparison with the average numbers of farms in the area under investigation shows that mainly larger farms were surveyed. We surveyed 126 arable farms and 420 livestock farms.

Table 1. Sample characteristics

	Sample average	**Average Eastern Germany**
Arable land	810.04 ha	232.5 ha
Grassland	174.83 ha	55.35 ha
Total acreage	1,015.24 ha	233.23 ha
Family workers	2.4	1.3
Hired farm workers	19.4	2.6
Total number of workers	21.8	3.9

Source: Schaper, Bronsema and Theuvsen 2012

Farmers and management board members were asked to assess the incident rates and loss potentials of various risks their farms face. In both cases, Likert scales (from 1=very low to 5=very high) were used. In order to get a ranking of risks, average assessments of incident rates and loss potentials were multiplied. Table 2 shows the top six risks as perceived by the respondents. It becomes obvious that farmers rank external risks they hardly can control – mainly price developments and political decisions – highest. On the other hand, risks, such as animal diseases, which have not occurred for several years are ranked very low (in this case, rank 21), even if they can have disastrous consequences. Additional analyses showed that the ranking of risks according to their severity is very robust; alternative operationalizations of severity only very slightly changed the ranking of risks.

Table 2. Top six risks in Eastern German agriculture

Rank		Incident rate	Loss potential	Total risk
		Mean values (std. dev.)	Mean values (std. dev.)	
1	Increasing leasing and purchasing prices for farm land	4.43 (0.794)	3.80 (0.902)	16.83
2	Decreasing decoupled EU payments	4.54 (0.786)	3.65 (1.003)	16.57
3	Increasing volatility of agricultural prices	4.21 (0.870)	3.32 (0.872)	13.97
4	Increasing volatility of input prices	4.22 (0.856)	3.28 (0.830)	13.84
5	Tightened cross-compliance regulations	4.15 (0.921)	3.14 (0.994)	13.03
6	Reduced availability of farm land	3.73 (1.150)	3.40 (1.072)	12.68

Source: Based on Schaper, Bronsema and Theuvsen 2012

With regard to the development status of agricultural risk management, it turned out that all in all 92.4% of the farmers surveyed assess the risks their farms face. Risk assessments are performed when considered necessary (59.7% of respondents), once a year (11.5%) or more frequently (21.2%). Regular risk assessments have become highly relevant for farms since most farms in our survey have already faced the occurrence of risks. In a considerable number of cases, the occurrence of these risks resulted in existence-threatening situations for the farms affected (Table 3).

Table 3. Risk experience of Eastern German farms

Risk	N	Already affected	Not affected	Threat to existence	No threat to existence
Animal diseases	220	27.3 %	72.7 %	23.3 %	76.6 %
Crop failure	437	89.7 %	10.3 %	23.7 %	76.3 %
Unexpected changes in input prices	470	92.5 %	7.5 %	16.3 %	83.7 %
Unexpected changes in output prices	448	89.9 %	10.1 %	24.6 %	75.4 %
Bankruptcy of customers	283	42.0 %	58.0 %	15.2 %	84.8 %
Non-compliance with quality requirements	279	38.0 %	62.0 %	12.3 %	87.7 %
Uninsured damage to buildings and production facilities	247	25.5 %	74.5 %	14.3 %	85.7 %
Lawsuits	328	66.2 %	33.8 %	16.6 %	83.4 %
Loss of lease land	422	85.0 %	15.0 %	15.9 %	84.1 %
Deficient availability of farm workers	291	44.3 %	55.7 %	9.3 %	90.7 %

Source: Schaper, Bronsema and Theuvsen 2012

In order to manage the risks they face, farms apply a multitude of risk management strategies (Table 4). Respondents were asked to assess various risk management strategies on 5-point Likert scales (1=very low relevance to 5=very high relevance). It is striking that there is a strong focus on management instruments to mitigate farm risks, while classical agricultural risk management strategies, such as irrigation, plant protection, choice of more robust varieties or purchase of agricultural insurance, rank in the middle of the range. Furthermore, complex risk management instruments, such as the use of commodity futures exchanges, rank very low. In the case of price risks, farmers clearly prefer pre-contracts and expect that their marketing partners, for instance, processors or traders, use commodity futures exchanges to manage price risks.

Table 4. Preferred risk management strategies of Eastern German farms

Risk management strategy	Mean values (std. dev.)	Low or very low relevance	High or very high relevance
Long-term safeguarding of farm land	4.77 (0.643)	2.2%	96.1 %
Liquidity reserves	4.30 (0.824)	3.0 %	85.5 %
Diversification	3.79 (1.115)	14.1 %	63.5 %
Using management consulting services	3.65 (0.996)	10.9 %	57.9 %
Training of employees	3.59 1.178)	16.5 %	61.3 %

Source: Schaper, Bronsema and Theuvsen 2012

It is interesting to see that farmers' risk attitudes influence their choice of risk management strategies. Respondents were asked, for instance, which share of their mineral fertilizers they contracted in advance through pre-contracts. The use of pre-contracts is very dissimilar. 15.3% of the respondents pre-contract up to 20% of the quantities needed, 8.1% 21–40%, 22% 41–6 %, 28.2 % 61–80 % and 19.1% more than 80%. Similar results were obtained with regard to farmers' preferences for pre-contracting feeding stuff. In both cases, actual behavior in general very much parallels farmers' willingness to take (or to avoid) risks. Nonetheless, additional cross-tabulations taking into account farmers' risk attitudes and their contract choices revealed that the actual risk behavior of farmers is diverse and that quite a number of outliers confound the initial findings on the influence of risk attitudes on the choice of risk management strategies.

Liquidity management has become an integral part of agricultural risk management. Of the respondents, 83.5% use their farm's balance sheet when managing liquidity, 63.6% make liquidity forecasts, 43.8 % build up liquidity reserves, and 35.7% negotiate extended credit limits with their banks. With regard to liquidity management, banks are farmers' preferred partners: 28% of the respondents talk about their farm's current situation with their bank if this is considered necessary, 53.1% inform their bank of current developments once, twice or three times each year, and 18.9% of the farmers surveyed talk to their bank more than three times per year.

CONCLUSIONS

Risk management has gained relevance in agriculture due to growing risks (for instance, agricultural and input price volatility, climate change), the limited and often decreasing risk-bearing capacity of farms and the intention of the majority of farmers to limit their farms' exposure to risks. Therefore, a systematic risk management process should be implemented and regularly performed on future-oriented farms. The importance of systematic risk management grows the more non-family workers are hired, the higher the debt to equity ratio, and the higher the share of lease land.

Empirical results show that farmers rank external market and political risks highest. They react to these risks by applying various risk management strategies. The latter often comprise a mix of management (such as diversification, liquidity management) and agronomic instruments (for instance, choice of robust varieties, irrigation).

These findings have interesting implications for farmers, public administrations and political decision makers. Farmers should critically control the development status of their risk management. This is most important where the farm's risk-bearing capacity has decreased due to pronounced growth strategies or where cooperations with other farmers or other incidents have sharply changed a farm's risk situation. Public administrations should check how they can support the implementation of effective risk management strategies in agriculture. Training activities might be necessary to sensitize farmers to the need for a more systematic risk management. Finally, politicians should be aware that political decisions are perceived as one of the most important risks in agriculture. This should motivate them to provide more reliable and more predictable agricultural (and other) policies. Furthermore, farmers rank price risks very high. This could influence the design of the safety net that the European Union plans to implement in the next phase of the Common Agricultural Policy to reduce the incidence of bankruptcies in European agriculture.

The results of the empirical study very much parallel earlier findings that have already highlighted the risk-conscious behavior of many farmers (Schaper, Lassen and Theuvsen 2010). Since the study only focused on large agricultural enterprises in Eastern Germany, future research should also include smaller farms, other farm types (for instance, organic farming) and farms in other European countries. This would make it possible to control for size and other factors and to determine whether agricultural risk management exhibits regional differences.

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