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Title
Extreme weather events in wine grape production: an economic assessment of mitigation measures at farm level

I want to submit an abstract for:
Conference Presentation

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Keywords
climate change, hail, late frost, mitigation measures, cost of production, risk management

Research Question
To identify efficient mitigation measures on farm level to cope with increasing damages from extreme weather events in wine grape production in Germany.

Methods
Based on typical farms, gross margins are compared for different scenarios of extreme weather events and use of mitigation measures. Farmer focus groups discussed feasibility and costs of mitigation measures.

Results
Hailstorms and late frost have potentially high impact on gross margins. Hail insurance can be recommended. Feasibility of hail nets, wind machines and frost candles depend on regionally specific conditions.

Abstract
Extreme weather events in wine grape production: an economic assessment of mitigation measures at farm level

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Introduction

Due to climate change it is expected that in Germany the frequency and intensity of extreme weather events will increase. Extreme weather events may cause severe damage in all types of agricultural production. For wine grape production, hailstorms, late frosts and droughts are the most relevant events, which are expected to increase in future. Hailstorms are spatially very much limited and can hardly be predicted but cause severe damages if occurring. Late frosts may impact vines when flowering. Observations of changing climate have revealed two contrary developments concerning late frost. First, with respect to defined periods, late frost incidence seems to decrease. Second, flowering of vines tends to start earlier in the year. However, the combined effect resulting from these two developments is not known yet Draughts may damage vines throughout the whole growing period.

Overall, a higher frequency of extreme weather events in the future means increasing production risk for wine grape growers. Therefore, the objective of this paper is to identify efficient mitigation measures on farm level to cope with increasing damages from extreme weather events in wine grape production in Germany.

Methodological approach

The analysis is based on the typical farm approach. Typical farms are farm models with a complete input and output data set including both, price and quantity data and are specific for a region and farm size. Data include production resources of the whole farm such as buildings, machinery, labor force and production inputs. The production system is then modeled by specifying the crop management with operations and the corresponding use of labor, machinery and inputs.

Data sources are regional statistics, expert knowledge of farm advisors and focus groups of farmers in the specific region.

The detailed data set of the typical farms allows specifying and assessing different scenarios of growing conditions or crop management practices. For the analysis of the effects of an increasing frequency on extreme weather events, gross margins of typical wine grape farms were calculated for different scenarios: First, the effect of particular extreme weather events was determined, by comparing the production system in 2013 with the hypothetical situation in 2013 including one of the extreme weather events (before and after analysis). Second, the hypothetical production system in 2013 with extreme weather was compared to a scenario, where the mitigation measures were implemented in the production system (with and without analysis). In a third step, the assumed probabilities of the occurrence of the extreme weather events was taken into account to calculate the net present values of the gross margins of the different scenarios over a period of thirty years. The efficient mitigation measures had the highest net present value of gross margins during this period.

Two typical farms were modeled for two important German wine producing regions. In Franconia the production of bottled wine was analyzed whereas in Rheinhessen bulk wine production was considered. Both regions are faced with different probabilities for the occurrence of extreme weather incidences. The expected damages from extreme weather events and the possible mitigation measures in each region were discussed with farm advisors and a focus group of wine grape farmers.

Results

Based on the experiences of farm advisors, researchers and farmers in the focus groups, five possible mitigation measures were identified: hail nets and hailstorm insurance to prevent crop and financial losses from hailstorms, wind machines and frost candles as late frost protection measures, and a minimum pruning trellising system (MP). The latter was suggested for the Rheinhessen region as a means to counteract both, hailstorms and late frost. It should be noted that MP is still in the research and demonstration phase although it is applied on farm level already. In Franconia, farmers expressed their skepticism and would not consider MP as relevant measure for their region. Irrigation would be the appropriate measure against drought. However, access to irrigation water is limited or even prohibited for many grape growers. For this reason, irrigation, although relevant, was not analyzed.

For Rheinhessen a 30 ha family managed vineyard is modeled in which grapes for bulk wines are produced. Main grape varieties are Müller-Thurgau, Riesling and Dornfelder. 30 % of the vineyard is managed with MP. Whereas in the standard system 162 labor hours per hectare are needed, in the MP this diminishes down to 102 h/ha. Further it is assumed that fewer insecticides are applied in MP. In the entire vineyard machine harvest is
conducted by contract labor. Based on this assumptions a gross margin of 6,596 €/ha was achieved in 2013. In Franconia a 10 ha family managed vineyard is modeled. For this typical farm it is assumed that grapes are vinificated on farm. Bottled wine is sold directly to consumers. Main grape varieties are Müller-Thurgau, Silvaner and Baccus. Only 70 % of the vineyard is machine harvested in contract work while the remainder is harvested manually. Compared to the typical farm in Rheinhessen more manual labor is applied in Franconia. For grape production, i. e. without vinification, 460 labor hours per hectare are needed. Due to higher grape quality in Franconia as compared to Rheinhessen the gross margin was higher with to 9,964 €/ha.

For both typical farms the extreme weather events hailstorm and late frost are analyzed. As the probabilities for their occurrence cannot be precisely predicted different scenarios are modeled. Hailstorms are more frequent in Rheinhessen than in Franconia. Without mitigation measures, gross margin losses due to hail range between 10 and 75 % in Rheinhessen and between 11 and 69 % in Franconia.

As mitigation measures in Rheinhessen hailstorm insurance and MP are analyzed while in Franconia only hailstorm insurance is investigated. Contrary to Rheinhessen in Franconia wine growers are reluctant to apply MP as negative effects on wine quality are expected. Hailstorm insurance is an efficient mitigation measure, sustaining liquidity in case of hail damage, at the cost of 4 – 5 % of gross margin in years without hail. MP might have positive results, but the system is still in experimental stage. Hail nets were discussed controversially, since farmers were concerned about negative landscape effects affecting tourism. Also the investment costs and labor intensive handling were mentioned as disadvantages. Nevertheless, for regions with higher frequency of hail storms, like Rheinhessen, hail nets could an economically efficient option.

Wind machines for mitigating late frost are a potentially profitable measure for larger farms with suitable vineyards, but not on steep slopes. Support for financing might be needed for wider adoption.

Conclusions
The results show, that different mitigation measures for extreme weather events are efficient for the different regions. The expected frequency of the damaging weather events, varieties and targeted wine quality are important factors for the choice of risk management measures. Measures that are linked to changes in vineyard management, such as hail nets or the minimum pruning trellising system are generally less likely to be used by farmers than hail insurance.