Subsidized Drought Insurance in Austria: Recent Reforms and Future Challenges

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Droughts pose a significant challenge to farmers as well as governments around the world and the situtation is expected to worsen in the future due to climate change. Austria is no exception. Recent droughts caused considerable damages to farmers as well as forcing the government to provide ad-hoc compensation. Given these increasing losses and the anticipated increase in risk to agriculture, the question of how to manage extreme droughts is gaining importance. One policy response is to provide subsidized drought insurance, as is the case in Austria. In this article we discuss the development of financial drought risk management in Austria, and provide a detailed account of the public and private efforts made so far. We subsequently quantify drought risk for one major crop in Austria, namely corn, in order to give an indication of how such risk might be incorporated into fiscal planning processes. Based on these considerations we identify potential challenges that may occur for the Austrian government and ways forward. Ultimately, drought risk needs to be considered in the context of the complex set of risks farmers are exposed to, which are caused not only by weather and climate, but are also rooted in regulatory uncertainty and changing markets.

1. Introduction

Agriculture is highly sensitive to weather extremes, including droughts, floods, storms, hail storms and heat waves. Droughts pose a significant challenge to farmers as well as governments worldwide (*UNISDR*, 2013) and the scientific community predicts a negative amplification of many of these impacts due to climate change (*IPCC*, 2012). In Austria the mean temperature has already risen by nearly 2 degrees since the 1880s, which is considerably higher than the global average increase of 0.85 degress (*AAR14*, 2014). Consequences are and will be manifold. For example, hot days are more common now than they used to be, which is a development that is predicted to continue in the future. It is also expected that drought events will increase, especially in already dry regions north of the Danube and in the easternmost parts of the country, the Austrian breadbasket (*AAR14*, 2014). As experienced in the recent past in Austria, damages from drought events can be large and seem to have increased in recent years. In 2012, agricultural damages, mainly due to droughts in Eastern Austria, amounted to approximately 120 million Euros. In 2015, damages from drought events amounted to more than 170 million Euro. By August 2017, 150 million Euro worth of agricultural damages had already been reported, 100 million due to droughts (see *Österreichische Hagelversicherung*, 2017). In the face of mounting losses one important question is how to manage extreme risks in the agricultural sector, particularly considering the amplifying effects of climate change. Whatever the answer will be, the government will very likely play an important role (*Lal et al,* 2012).

In OECD countries two policy strategies roughly describe how risks in the agricultural sector are managed; some countries put emphasis on training, competitiveness, liberalization and compensation for catastrophes, while others rely extensively on (subsidized) insurance mechanisms (*Meuwissen et al*, 2008). Subsidized agricultural insurance has a long history in high-income countries – indeed, the first federally-managed multi-peril program was created in the late 1930s in the US. Critics claim that the costs to US taxpayers are unacceptably high (*Babcock*, 2013); for example, agricultural premium subsidies in the US and other high-income countries amounted to almost USD 12 billion in 2007 (*Mahul/Stutley*, 2010). Despite the potentially high costs, such insurance mechanisms have received increasing attention and funding over the past two decades including at the European level. In response to increasing price volatility and climate change impacts, the European Union (through its Common Agricultural Policy [CAP]) has increasingly promoted agricultural risk management. Another objective is to move away from ex-post and ad-hoc compensation, which will soon become a burden that is difficult to manage with increasing but barely predictable drought events. In the 2014–2020 period, CAP funds may be actively used to subsidize insurance premiums by up to 65 percent (*EU*, 2016). As of yet, these offers have not been met with much response from Member States.

Austria's extensive and growing (subsidized) agricultural insurance program can be seen as one among a few examples, which follow the European Commissions push for a risk management based agricultural policy. In this article we review the development of financial risk management in Austria, especially with regards to drought risks. As insurance subsidies represent costs to the government, we propose an approach to assess drought risks and the related fiscal burden. Indeed, the quantification of risk is a core requirement for setting up risk financing instruments, including subsidized insurance products, and is important for short and long-term budget planning processes (*Schinko/Mechler/Hochrainer-Stigler*, 2017). However, in the context of extreme events, such as droughts, quantifying risk is especially challenging, particularly taking climate change into account. We discuss these challenges and propose a model approach that is able to overcome them. As an example, we quantify the drought risk at country level for corn. The results indicate important consequences for drought risk management. Most importantly, potential positive increases in total average annual crop yields in the future may go hand in hand with increases in extreme risks, eg the possibility to have very low yields.

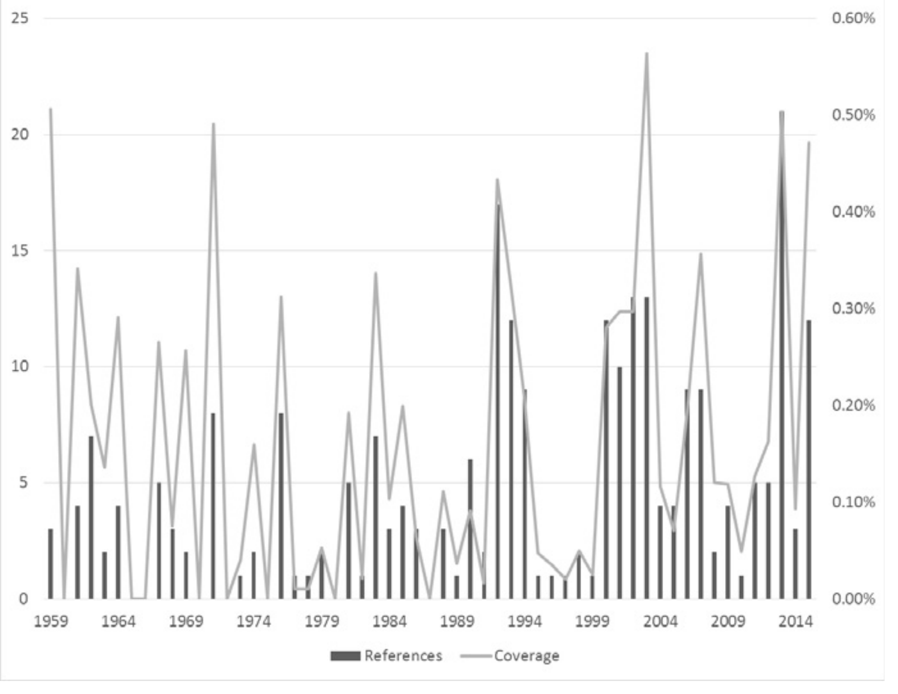
2. Past drought events and agricultural risk management options in Austria

General definitions of drought usually focus on precipitation deficiencies or high temperatures over an extended period of time (*UNISDR*, 2009). However, it is useful to further distinguish four different types or stages of drought. Meteorological drought manifests when certain weather variables, such as total amount of precipitation, remain under a predefined threshold level over a certain time and is realized if it is lower than a pre-specified threshold level. Hydrological drought is determined by significantly reduced water levels in waterbodies and ground water. Agricultural drought occurs when insufficient soil moisture and precipitation negatively affect yields. Finally, agricultural drought may turn into socio-economic drought when supply and demand of agricultural prodcuts are negatively affected (see also the seminal paper of *Wilhite/Glantz*, 1985). Drought risk management may address one or all of these four types.

2.1 Past drought events in Austria

The literature on droughts, drought risk and drought management in Austria is fragmented. “The Green Reports” (Grüne Berichte) of the Ministry of Agriculture, Forestry, the Environment and Water (BMLFUW), give an annual account of the state of Austrian agriculture dating back to 1959. Among many other issues, they provide a qualitative outline where drought events happened, how they affected different crops and yields, and in combination with which natural and economic events droughts interact. A systematic review of the German synonyms for drought, *Dürre, Trockenheit*, and *Hitze*, shows that meteorological drought is a frequent companion of farming life. Almost every year small meteorological drought events affect some crops regionally. However, changes in weather may still avoid doing lasting damage to plants. The reports implicitly reflect how hydrological drought in the Austrian East is very common, but irrigation measures and the selection of heat tolerant crops may mitigate damages to the plants. Even in the case of agricultural drought, which is not limited regionally and to individual crops, socio-economic drought is not an inevitable result. Lower yields at higher quality and competitive prices on the market may limit the overall negative effects of drought. However, in the case of large scale droughts farmers livelihoods and government budgets can be significantly affected.

Figure 1: **Drought events reported in the Green Reports (Grüne Berichte) of the Austrian Ministry of Agriculture**



Source: Own design based on annual Green Reports since 1959

The reports also indicate the ways in which the government provided support in cases of agricultural and socio-economic droughts. Figure 1 shows the quantitative analysis of the number of references in each report that refer to drought. Coverage is an indicator for how relevant the topic was quantitatively, compared to the overall report (the ratio of text related to droughts with other text). While the exact numbers are not relevant for our discussion, the figure in combination with the information from the reports provides a good indication of those years in which drought had a noticeable economic impact. For example, the drought event in 1962 led to reduced yields of several crops and a shortage of potatoes, but reported no political measures. In 1976, for the first time recorded in the Green Reports, the government initiated a series of measures and subsidies reacting to extensive drought events: subsidies for freight charges for feeding straw and hay; ban on hay exports; licensing requirements for straw exports; support for storage of *Auswuchsweizen*; reduced prices for feedstuff; working capital loans; and compensation payments for upland farmers (*Grüner Bericht*, 1976, 14). To mitigate problems with exports resulting from the drought, subsidized prices for beef were also launched. Due to insufficient feedstuff, more cattle had to be slaughtered. This measure helped buffer the consequentially low prices of meat. The year 1982 was also a very dry year, but the high numbers of references are in regards to drought elsewhere in Europe and the world. In this case, no public measures were reported.

2.2 Agricultural risk management

Drought risk management is only one, albeit increasingly important, part of agricultural risk management practices. Table 1 indicates that in principle many more measures to manage risk, both on farm and off farm, are available. Many of these measures are not directed exclusively at drought risk, but either deal simultaneously with a larger set of possible risks (eg livelihood related) or have a different primary objective (eg decrease in crop yield variability). Table 1 distinguishes between farm-internal risk management measures and external risk management measures to prevent, mitigate, or cope with agricultural risks. External risk management options may be provided by the markets, government, or both. As previously indicated, agricultural insurance is rarely only a market endeavor and governments tend to subsidize premiums heavily.

Table 1: **Classification of agricultural risk management measures**

	Internal	External	
	Farm	**Market**	**Government**
Prevention	Irrigation, heat-tolerant crops		Water management
Mitigation	Diversification of products, tillage	(Drought) insurance – yield Revenue insurance, income stabilization, Futures contracts, diversification of investments/income savings accounts	Regulatory measures Counter cyclical programs Fiscal/tax measures
Coping	Borrowing from family, friends, neighbors	Selling assets	Ad-hoc payments Agricultural support programs Fiscal/tax measures

Source: *OECD*, 2009

Most agriculture related insurance products in high-income countries are indemnity-based. Indemnity-based policies are written against actual losses. By contrast, index-based products are written against physical or econometric triggers, for example, if precipitation levels are below a given threshold over a certain period, claim payments are made. Hence, instead of the loss itself the insurance payouts depend on an index, which serves as a proxy for the losses. Index-based insurance first emerged in a developing country context, but recently has become a trend in industrialized countries such as Austria (*Kull/Mechler/Hochrainer-Stigler*, 2013). There are several advantages of index-based insurance over traditional indemnity-based instruments, such as timely payouts, reduction of administrative costs, adverse selection and moral hazard (*Linnerooth-Bayer/Hochrainer-Stigler*, 2015). The most important disadvantage of index-based insurance is basis risk; the probability that a loss occurs without the index being triggered. The Austrian system features a hybrid form, which we describe in more detail in the next section.

Two other important options which receive increasing attention, but are currently not available in Austria, are revenue insurance and income stabilization tools. Farmers opting for revenue insurance receive indemnity payments when actual farm production falls below a certain percentage of the target level of revenue for a certain crop, regardless of whether the shortfall results from low prices or low production levels (*Shields*, 2015). The US agricultural insurance for example features such an option which has proven popular since its introduction. Canada offers an income stabilization tool, which covers the entire farm income including farm inventory. In this system, farmers pay an annual participation fee, and receive payments if the annual financial performance falls below 70% of a defined reference margin. However, such a system requires complete insight into a farm's finances.

The measures described above may be provided in public-private partnerships, but there are other risk management options that are exclusively market-based or exclusively government-provided. Government measures may be engineering-based measures, for example improving water availability. In Austria a prominent example is the *Marchfeldkanal*, an artificial system of channels, which serves multiple purposes, but was primarily designed to deliver water from the Danube to agricultural areas. Most often, however, the Austrian government provides regulatory measures, fiscal measures or ad-hoc payments. Examples can be found both in the previous and the subsequent sections.

Other market-based risk management tools are for example futures contracts, ie legal agreements to buy or sell a commodity at a predetermined price at a future point in time. While they may be prominent market instruments elsewhere, Austrian farmers are currently not convinced of their effectiveness for agricultural risk management (*Larcher et al*, 2016). Hence, more traditional private risk management options such as saving accounts may be feasible for smaller risks. Diversification may be considered a traditional risk management tool as well. Off-farm it refers to diversified assets, investments and/or income, whereas on farm diversification regards crop selection and other production choices.

However, on-farm diversification choices are very much constrained by crop rotation, public regulations, and requirements linked to government payments, soil conditions, and restrictions due to pests. While it is possible to diversify in a manner conducive to drought risk mitigation, this may be restricted by aforementioned limitations. Similarly, adapted tillage practices are a risk management tool, which may mitigate drought risk – increasing the water retention capacity of the soil – if applied correctly. At the same time it may be unfavorable for certain crops and increase the need for herbicides. These are only some of the complexities inherent in agricultural risk management. As discussed further down below, drought risk is only a part of agricultural risk management, which needs to be considered within the large array of other risks. Indeed, only irrigation, where feasible, and drought insurance, where available and affordable, are measures with the principal aim to prevent or mitigate drought risk.

3. Financial drought risk management in Austria

While the previous section dealt with agricultural risk management in general, focusing on the Austria case, in this section the financial aspect of drought is the focal point. We first start with the government's efforts at financial drought risk management. Afterwards, we outline how drought risk was incorporated in agricultural insurance. Finally, we describe the current public-private partnership on financial risk management, which now covers drought next to many other climate-related risks.

Until the early 1990s, there was little governmental response to drought. Among several dry years 1992 and 1993 stood out (see Figure 1). In the first event more than 57 million Euros were spent on coping efforts for drought, and another 0.07 million Euros in the following year. In 2000 and 2001, over 2 and over 1 million Euros respectively were spent responding to droughts. From 2002 onwards, drought related spending is only reported jointly with spending on flood damages. Droughts were reported in 2002 and 2003, but as 2002 was also a year of extreme floods it is difficult to give numbers about public spending due to drought. From 2007, public spending is only reported for damages from natural events overall. However for 2013 some explicit numbers are available. For example, the government offered affected farmers financial compensation as an *Ankaufsaktion* for feed stuff in order to secure basic food rations. The national and provincial governments paid almost 20 Million Euro to over 13,000 farmers. For the first time, a one-time-only subsidy (*ha Beihilfe*) was offered for non-insurable crops (*Grüner Bericht*, 2014, 36). The Green Report for 2015 describes the drought impacts in great detail, but discussion on public measures taken is limited. *Agrarmarkt Austria,* the agency handling agricultural payments, data, and control, published a set of exceptional regulations and land use specifications which were introduced in response to drought events in 2015. The principal components were the use of green fallow, ie ecological priority areas may be used as pasture and to produce feed stuff; and the greening of agricultural crop land, ie the period between harvest of the first main crop and the second main crop was extended from 50 to 70 days. Especially in response to the 2013 and 2015 drought, as well as extensive frost damage in spring of 2016, the Austrian government amended the law on hail insurance (*Hagelversicherungsgesetz*), requiring that the existing subsidies for hail and frost insurance were extended to additional weather extremes like drought, excessive rainfall, and storm. The goal was to substitute any ad-hoc payments from the Austrian national disaster fund for insurable risks as required by the amendment to the law on the disaster fund (for more information see the discussions in Parlament, 2016, and also *BMLFUW,* 2017).

The main insurance vehicle for nearly all agriculture related insurance products is the Austrian Hail Insurance (*Österreichische Hagelversicherung VVaG – ÖHV*). The ÖHV was founded in 1947 by several hail insurance departments belonging to different Austrian insurance companies as an insurance association based on mutuality. This is a special business format for insurance as non-profit organizations. Thereafter the license to offer hail insurance belonged to the new association, while the sale of policies remained with the individual insurance companies. In 1995, the ÖHV introduced the first multi-peril insurance, which – in addition to hail – covered damage from frost. Since then, coverage has been extended to include other crops and weather risks. In 2000, drought risk was included for wheat and pumpkins. Ever since its foundation the ÖHV has offered indemnity-based products. Currently, the main product is *AGRAR Universal,* which insures many different crops against a long list of risks, such as hail, frost, drought, snow pressure, storm and torrential rain. Policy holders are obliged to insure the entire production for each insured crop. Drought insurance is available for all cereal crops, corn, potatoes, pumpkins intended for oil production, soybeans, sunflowers, and peas, but it is not available for grassland, sugar beets, vineyards and orchards. The insurance covers damages from drought if the precipitation during the vegetation period is less than 90% of the average precipitation during the last 10 years, the precipitation on 30 consecutive days is less than 10mm, or if yields per hectare remain below the defined threshold value for yield (*Ertragsgrenze*).

The first drought index insurance was introduced for grassland in 2015. Grassland is difficult to insure due to the differing number of harvests per year, and the small scale differences in damages. In 2016 and 2017 the list of insurable products was extended to corn, winter wheat, and sugar beets. More products might be added in the future. Currently, drought coverage as part of the *AGRAR Universal* (yield insurance) and the index insurance products run in parallel. The index insurance can only be purchased as an extension to an *AGRAR Universal* package. The drought index is based on the 10-year average precipitation. Claims are paid if precipitation remains below this average over a predetermined period. The Austrian agricultural insurance system, as a combination of private, but non-profit insurance, and public support has proven very successful in the past. *Sinabel et al* (2016) report high market penetration rates. As of yet, it is difficult to judge the index products and the expansion of premium-subsidies. Changes in risk due to climate change from a country perspective, which is needed to determine the costs for government which subsidizes the insurance products, is currently lacking due to risk quantification challenges described in more detail below.

4. Quantification of Drought risk at the Country scale

Quantification of risk (understood as) the probability and corresponding consequence of all possible future events, for example represented in the form of a loss distribution) is a prerequiste for any insurance related risk management strategies and therefore deserves special attention (*Grossi*, 2005). Droughts occur rarely but usually cause large losses when they do, and are therefore called low probability/high impact events. From an insurance perspective such events are especially challenging to insure (*Woo*, 2011). For example, a drought event is usually not a localized phenomenon but often impacts entire regions and thus will affect many farmers at once. The risk is highly correlated and the law of large numbers, stating that the variance of an average decreases with the number of items included, is not applicable here. Indeed, in highly correlated portfolios the variance of the average may be close to the variance of an individual loss. As a consequence insurers will have to pay large claim payments at once (*Kull/Mechler/Hochrainer-Stigler*, 2013). Therefore large backup capital is needed to avoid default due to such events, which can be costly. Premiums and subsidies are as a result becoming more expensive (*Froot*, 2001). In this section, we first discuss some of the major challenges for the quantification of subsidized drought insurance products at the country scale, explicitly taking into account climate change aspects. We then present a novel approach addressing these challenges. For demonstration purposes we run the model for corn. Corn is the second largest crop in Austria. Around 300.000 hectares of arable land are used for cultivating corn. On an aggregated scale other crops (excluding wheat) are of minor importance. Nevertheless they are very important for specific farming types, especially for smale-scale farmers.

4.1 Challenges

Generally speaking the detection and modelling of extremes, including climate change effects, is complicated. Current modeling approaches focus on average changes at the local scale and often do not incorporate regional dependencies. While for flooding some approaches are now available (see *Jongman et al*, 2014; *Prettenthaler et al*, 2015), for drought related risk (in the form of distributions) on larger scales such as the country level, a risk based approach which includes climate change impacts is still lacking. We identify at least four major challenges which need to be addressed in this context. First, drought and other extreme events are rare and therefore difficult to estimate statistically. Second, even if enough past data is available for estimating current extreme risks for today, given the importance of climate change for the agriculture sector future drought risk should be explicitly considered. Third, extreme droughts usually occur across large regions, but there is the question of how to take these regional correlations into account in a risk based approach. Assuming independence of risk across regions would underestimate losses due to extremes due to regional correlation. Fourth, upscaling probabilistic loss estimates from local to regional or country levels focuses on averages (as they can simply be summed up across regions) that are void of any information on the whole risk spectrum.

For example, averages do not give any information about the probability as well as impact of an extreme event. Consequently, management strategies based on the full spectrum of risks are not possible (*Hochrainer-Stigler/Linnerooth-Bayer/Lorant*, 2017). Given these challenges we nonetheless suggest some ways forward.

4.2 Possible ways forward for drought risk quantification on the country scale

Regarding the first challenge, ie estimation of extremes, a theory of its own is needed, namely extreme value theory can be useful (*Embrechts/Klüppelberg/Mikosch,* 2013). This theory addresses the stochastic behavior of the maximum (or minimum) of random variables. The distributional properties of extremes are determined by the tails of the underlying distribution. The greatest difficulty in estimating the tail is data scarcity as most empirical data is (naturally) concentrated toward the center of the distribution (eg the average). Standard estimation techniques which fit well where data has greatest density can be severely biased in estimating the tails. Extreme value statistics provide the tools for the assessment of extremes. In our suggested approach we tackle the first challlenge using extreme value theory and statistics to estimate the fat tails of underlying distributions (or in other words get non-biased estimators of extreme drought events). As indicated, even if enough data is available to calculate current risk there is the need to project risk into the future. Challenge two can be solved using approaches that simulate future situations and changes in risk. The challenge is then to develop models which can carry out this task. For drought risk we solve this challenge using an agricultural production model called EPIC (*Balkovich et al,* 2010) to simulate current and future crop yields. We address challenges three and four simultaneously using a copula approach. A copula separates the marginal distributions (that is, the drought distribution on the very local level) and the structure of the dependencies (for example given an extreme event happens in one region it also happens in a neighboring region too). A copula model can take regional dependencies explicitly into account and therefore enables the derivation of crop distributions at the country level, which includes the information about extreme events such as droughts. As one cannot use simulation runs for estimating the dependency between regions (as in the models the regions are usually simulated independently), a proxy for drought dependency is needed. We use the Standard Evapotranspiration Index for this task. It should be noted that large uncertainties exist and the presented numbers should be treated only as indicative. Some limitations of the approach are discussed below (the full model description can be found in *Hochrainer-Stigler et al,* 2017).

4.3 Results

We show results for corn at the country scale for a Representative Concentration Pathway (RCP) 4.5 ensemble (ie using several climate models) scenario, which is close to the 1.5–2 degree scenario currently set as a goal in the Paris

Agreement (for more information see *RCP database,* 2009). The results have to be treated with caution as considerable uncertainties can be expected, nevertheless they are indicative for the magnitude and change of risk. We show the risk assuming corn being planted where it is possible. It is clear that this is not the case in reality as not all areas where corn can be planted are actually planted (due to crop rotation and diversification reasons), but for our analysis it enables the comparison of today and future risks. Since we use an upscaled crop distribution at the country level, we transform crop yields into monetary terms using the five year average corn price of 175 Euros per ton; we acknowledge that in a real world decision-making situation large price fluctuations each year would need to be addressed. As insurance is usually used only for downside risk, ie losses, we define a drought event which is eligible for insurance compensation if the crop yields are below the long term average crop yield. Given that the state (and provinces) are paying half of the insurance premium and therefore risk, we assume that the government is responsible for financing half of the drought related insurance costs. Under these assumptions Table 2 below shows the results.

Table 2: **Current and future (2050) government fiscal risk for subsidized corn insurance. Mean Ensemble and Business as usual scenario.**

	Annual Costs to government (in million Euros)	
Annual return period	**Current**	**Future 2050**
5	25	33
10	42	58
20	55	79
50	69	103
100	78	120
250	88	140
500	94	155
1000	101	175
Annual Premium	13	18

In Table 2 the return period is shown in the first column. For example, a 50 year return period is an event which happens on average every 50 years. In other words every 50 years, on average, the government will have costs of around 69 million Euros from subsidizing crop insurance for corn. Based on these estimates we can determine the magnitude of fiscal risk if the government participates in such an insurance scheme. As Table 2 indicates, averages do not provide good indications of extreme event losses and we therefore focus on the whole scale (eg all return periods). As planned by the finance ministry, current and future risk management strategies should support insurance schemes by subsidizing it by 50 percent, which we identify as costs to the government in Table 2. In the case of a 100 year return period event the government would step in with around 78 million Euros. This number would increase to around 120 million Euros in 2050. For a more extreme event, say the 500 year return period event, the compensation would be around 94 million Euros and this would increase to around 155 million Euros in 2050. If one focuses on the actuarial fair premium this would be around 13 million Euros for today and would increase to 18 million Euros in the future. As can be seen, the numbers give a detailed picture on drought losses, responsibilities, and costs from a country level perspective and can also advise future risk management strategies for the government as well as insurance providers in more detail. For example, larger back-up capital will likely be needed in the future.

5. Discussion

We showed the development of financial drought risk management in Austria, and provided a detailed account of public and private efforts. We discussed these arrangements in light of new drought risk modeling results and in the context of current and expected EU agricultural policy. While the top-down risk-financing system is very advanced, more holistic bottom-up risk management needs should not be neglected. The current Austrian risk financing set-up is very much in line with the EU's vision on common agricultural policy which supports a risk management approach. From this perspective, subsidized premiums are the preferred solution when compared to direct farm payments. Austria has only recently scaled up the premium support for insurance. In light of our modeling results strikes us as manageable for the Austrian government, at least for corn and a very optimistic climate change scenario. The question however is how large the multi-risk portfolio for the government will finally be if all other crop varieties are also insured and price fluctuations are taken into account. Additionally, risk may be significantly higher, if climate change cannot be kept below manageable levels (we used a very optimistic future scenario for our analysis). It should also be noted that our modeling approach neglected important other issues such as soil degradation and loss in agricultural land area.

From a national perspective, drought risk financing appears to be resilient to the short- and medium-term challenges of climate change. However, drought risk cannot be seen in isolation. The agricultural sector and farmers in particular face a complex set of risks caused not only by weather and climate, but also resulting from political change and markets. Small farms in particular may struggle to finance insurance despite generous subsidies. Volatile prices, complementing the farm income from other sources, fulfilling funding requirements, and securing the succession, ie who will continue to run the business, cause additional pressure. Other risk financing avenues may be better suited in these cases, such as revenue insurance and income stabilization tools, yet are difficult to implement in Austria. Income stabilization, requiring comprehensive transparency of a farm's finances, will be difficult to accomplish as most Austrian farms are small enough to not require accounting (*Pauschalierte Betriebe*).

For many of these small farmers, other risk management options may be more feasible: the selection of heat tolerant crops (eg sorghum, Lucerne, alfalfa), a more diversified crop selection, adapted tillage water management practices, a focus on niche products (eg hemp, sunroot, chickpeas), as well as other and additional sources of income. This requires farmers to become even more adept in risk management than before. Public support will have to go beyond risk financing tools, and create synergies building on different policy domains, such as the agricultural environmental programs (ÖPUL), water management plans, and rural development programs. Climate change adaptation policy may provide an adequate framework for such integrated and holistic risk management approaches. However, to date drought has played only a marginal role. Identifying the relevant entry points, synergies and trade-offs for drought risk management remains an important task. Across the board, Austria‘s agricultural institutions have the capacity to ensure successful drought risk management, provided stakeholders seize opportunities such as the process of designing and implementing the Austrian Climate Adaptation Strategy for integrating drought risk concerns in an overall risk management strategy. Continued success will ultimately depend on a long-term iterative risk management approach, which requires collaborative and continuous stakeholder interactions, including the possible reframing of both learning and management processes (*Lavell et al*, 2012). Concrete suggestions for Austria in the context of fiscal risk management against extremes within such iterative processes are discussed in *Schinko/Mechler/Hochrainer-Stigler* (2017). A core requirement for success will be a high level of commitment from all stakeholders involved.

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Abstract **JEL-No: C14, C53, G3, Q54**

Subventionierte Dürreversicherung in Österreich: Aktuelle Reformen und zukünftige Herausforderungen

Die landwirtschaftliche Produktion ist generell sehr wetterabhängig. Wie in den letzten Jahren ersichtlich, stellen vor allem Dürren eine große ökonomische Herausforderung sowohl für Landwirte als auch den Staat dar. Dieser Artikel befasst sich mit der landwirtschaftlichen Dürre, ihren Auswirkungen und Möglichkeiten zur subventionierten Versicherung in

Österreich. Der Staat spielt hier eine wichtige Rolle und kann grundsätzlich als zentraler Akteur für die Beantwortung der Frage, wie mit Dürrerisiken jetzt und vor allem unter dem Aspekt des Klimawandels in der Zukunft, umgegangen werden soll, angesehen werden. Wir untersuchen den Werdegang finanzieller Risikomanagementstrategien gegen die Auswirkungen von Dürre auf staatlicher als auch privatwirtschaftlicher Ebene in Österreich. Diese Diskussion ergänzen wir mit Ergebnissen aus einem neu entwickelten Modell zur Quantifizierung von Dürrerisiken auf nationaler Ebene. Wir diskutieren die Herausforderungen und präsentieren Lösungsvorschläge zur Behandlung dieser Risiken im Kontext landwirtschaftlichen Risikomanagements.