# Extended Abstract

| Paper Title | Agroforestry Adoption in the Face of Regional Weather Extremes |
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**Abstract prepared for presentation at the 96th Annual Conference of the Agricultural Economics Society, K U Leuven, Belgium**

**4th – 6th April 2022**


| **Abstract** | ***200 words max*** |
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The cultivation of agroforestry systems is regarded as an effective strategy to synergistically mitigate and adapt to climate change in the face of an increasing number of regional extreme weather events. This study addresses the question if and under what conditions farmers are likely to adopt agroforestry and wood-based land-use systems in response to regional weather extremes. We conducted a discrete choice experiment to elicit farmers' preferences for agroforestry/wood-based land use systems and combined the results with geo-spatial weather data. Assuming adaptive weather expectations, we simulated land users' dynamic responses to extreme weather years in terms of adoption probabilities. We find that farmers in our case study region in Southeast Germany have a negative willingness to adopt agroforestry and short rotation coppice compared to an exclusively crop-based land use system. However, the results from the simulation of a 2018-like extreme weather year show that agroforestry systems might have a high probability of being adopted in the medium to long-run.



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| **Keywords** | Climate change, extreme weather, land use, agroforestry, discrete choice experiment |
| **JEL Code** | Q23 Forestry, Q24 Land, Q15 Land Ownership and Tenure; Land Reform; Land Use; Irrigation; Agriculture and Environment see: www.aeaweb.org/jel/guide/jel.php?class=Q) |


## Introduction

***100 – 250 words***

The latest assessment report of the Intergovernmental Panel on Climate Change reiterates the fact that climate change poses exceptional challenges to various sectors on a global scale (IPCC 2021). Beside affecting annual mean temperatures and precipitation, climate change also increases the occurrence of regional weather extremes such as droughts, heat waves, and heavy rain (Lüttger and Feike 2018). In this context, agriculture is seen as one of the most vulnerable sectors to such changes (IPCC 2007). However, it is also regarded as one of the most important contributors to climate change (Lynch et al. 2021).

One major channel through which agriculture can actively tackle climate change is land use. A promising pathway could be the wide adoption of agroforestry systems, which are recognized to play a key role in approaching adaptation and mitigation synergistically (Cardinael et al. 2021).

This paper addresses the question if and under what conditions farmers are likely to adopt agroforestry systems in response to regional weather extremes.

The study contributes to the literature in several ways. For instance, it quantifies the link between adverse weather and farmers' preferences for agroforestry, accounting for short- to long-run adaptation responses. Furthermore, by combining a discrete choice experiment, weather information and the simulation framework of Ramsey, Bergtold, and Heier Stamm (2020), we provide novel insights into farmers' responses to climate change considering multiple scenarios.

## Methodology

***100 – 250 words***

Conceptually, our analysis is based on random utility theory (McFadden 1973). We assume farmers' utility for a land use alternative varies with a set of decision-relevant characteristics. As agricultural land use heavily depends on weather, we further assume that farmers' utility also depends on expected weather at the time of the planting decision. Farmers are expected to have adaptive weather expectations that are based on past local weather history, where both short- and long-term trends might affect land use choices (Ramsey, Bergtold, and Heier Stamm 2020).

In our empirical analysis, we focus on farmers from Bavaria, a federal state of Germany, which can be characterized by its heterogeneous natural conditions and agricultural production systems. A choice experiment was used to elicit the influence of land use characteristics on farmers' decision on whether or not to cultivate agroforestry. Participants were repeatedly asked to state their preferred choice among agroforestry, short rotation coppice and a common crop rotation given different combinations of attribute levels. We then merged the survey results with local weather data from the ECA&D project (Cornes et al. 2018).

Regarding the statistical analysis, we used a correlated random parameter multinomial logit model. To examine the effect of a weather event on the probability of choosing a land-use option through time, we used the approach by Ramsey, Bergtold, and Heier Stamm (2020) to simulate one- to five-year adverse weather periods based on the 2018 drought in Bavaria and compare them to a baseline scenario reflecting long-term average weather conditions.

## Results

***100 – 250 words***

In total, 210 farmers participated in our survey. Descriptively, our sample is similar to the underlying Bavarian farmer population in several dimensions.

Preliminary results from our case study region show that farmers have a negative preference for planting agroforestry and short rotation coppice in comparison to an exclusively crop-based land use system, although there is a certain degree of heterogeneity in the sample with respect to this. Generally, agroforestry appears to be preferred over short-rotation coppice. We also find that policy interventions as well as the reduction of the minimum useful lifetime and returns variability can increase the willingness to adopt wood-based land use options.

The results from the simulation of an extreme weather period show that agroforestry might have a high probability of being adopted by farmers in the medium to long-run,

but only in response to longer lasting periods of adverse weather (i.e. several years). We can observe a decreased likelihood to adopt wood-based land uses directly after a shock. Through selected scenarios, we can also show that the adoption probability of the more climate change robust options varies with political and technological circumstances.

| **Discussion and Conclusion** | ***100 – 250 words*** |
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Our results show that by combining the econometric analysis of a discrete choice experiment and weather information in combination with the simulation of extreme weather periods provide a very flexible framework to evaluate the future potential of climate change robust land use options. In this regard, our study extends the findings of Ramsey, Bergtold, and Heier Stamm (2020), who focus only on widely cultivated crops.

Furthermore, the finding that farmers have reservations about agroforestry is in line with previous findings in the literature (e.g. Gillich et al. 2019). An interesting pattern that we found across our sample is that farms are inclined to stick to their status quo crop cultivation. Only after some time when the extreme weather period has settled and farms are able to recover from the shock, farmers might be capable of transitioning to more weather-robust land uses such as agroforestry. The fact that the agroforestry option becomes more likely to be adopted after a weather shock (in the longer run) can be seen as farmers' adaptive capacity to climate change (Siders 2019).

Finally, additional policy interventions such as agri-environmental payments can support farmers in the process of switching to agroforestry systems, i.e. legislation can actively contribute to farmers' adaptation to and mitigation of climate change.

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