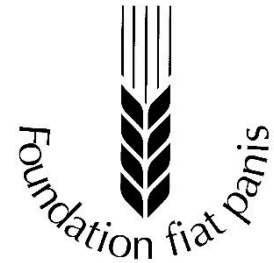


Hermann Eiselen-Wissenschaftspreisträgerin 2024

Hermann Eiselen-Science Award Winner 2024



Lisa Murken “Land tenure in a changing climate”, University of Kassel, 2023

Summary

Anthropogenic climate change fundamentally alters earth as we know it and poses a severe threat not only to the natural, but also the social world. Climate change and extreme weather have far-reaching impacts on agriculture. They do not only affect agricultural production, but also fundamental assets that shape agricultural livelihoods. In this dissertation, I explore impacts of weather and climatic conditions on a specific part of the agricultural domain, the relation between people and their land. As a fixed resource, land is particularly coveted and the basis for most economic activity. Yet, population growth, agricultural intensification and climate change put increasing pressure on land. Secure access to land is of vital importance for farmers, but insecure tenure is a reality for millions of farmers around the globe. They are unsure whether they will be able to continue farming their land in the future. This insecurity fundamentally affects their lives and can have implications for food security, well-being, and resilience in the face of climate change and extreme weather.

The main emphasis of land-related policy objectives and scientific analyses is on tenure security, as a desired state that may allow farmers to put land to its best use. Tenure security is often defined either based on perceptions or the legal situation of land. Perceptions of tenure security are frequently measured as the individual's worry about expropriation, whereas legal measurements refer to formal or informal land titles. The state of global tenure security is dire, especially in low- and middle-income countries (LMICs). Globally, almost one billion people are thought to live under insecure tenure arrangements, with wide-ranging consequences for their livelihoods. The share of tenure insecurity varies widely from country to country, with many Sub-Saharan African countries characterized by high levels of tenure insecurity.

In the existing literature, the importance of tenure security, land tenure arrangements and different types of land rights has been studied in detail with regard to agricultural development. Effects of tenure security or formalized land property rights have been found to influence agricultural investment, deforestation, biodiversity preservation, food security, land markets, credit uptake, migration, and nutrition, amongst others.

Despite this attention for land property rights in the economics, political science and anthropology literature, the relation of land tenure with weather and climate has rarely been studied. While the climate- and weather sensitivity of agriculture is well-known and subject of a large body of literature, potential weather and climate influences on land tenure systems and the relevance of land property rights for resilience towards climate change have so far received little attention.

This dissertation seeks to address this gap and is guided by the following questions:

- What empirical evidence exists on the land tenure-climate nexus?
- How do weather and climate affect agricultural land tenure?
- Which mechanisms can explain effects of weather on land tenure?
- How does tenure security influence farmers' investment decision-making?
- Which recommendations for research and policy can be drawn from the land tenure-climate nexus?

The primary objective of my dissertation is to advance the understanding of the link between land tenure, climate and weather and derive recommendations for both land- and adaptation policies targeted at supporting climate-vulnerable households in agricultural regions in LMICs. Specifically, I ask how extreme weather might affect rural land tenure, in particular tenure security, what this means in the context of climate change, and how important secure land tenure is for agricultural investment that can serve as climate change adaptation.

I draw on a range of methods for my analyses, from applied econometrics and climate econometrics to environmental psychology. Starting with a systematic literature review in the first chapter of my dissertation, I then merge household panel data with gridded weather data and analyze the datasets using econometric methods, based on techniques for causal inference. I conclude with a quasi-experimental research design based on mental models, which are scrutinized by means of network analysis and summary statistics. The geographical focus of my dissertation is East Africa, more precisely Tanzania and Uganda. However, the systematic review is global in scope and the empirical studies offer insights that are of relevance beyond their respective contexts.

The study of land property rights suffers from a myriad of methodological challenges. Particularly problematic is the presence of endogeneity, in particular bias introduced by reverse causality. While secure land rights can influence economic outcomes for land holders, economic actions such as investments can also affect (often strengthen) the security of land rights. Increasingly, randomized controlled trials (RCTs) are conducted evaluating large land titling programs. These studies provide the most rigorous evidence to date, but are costly and difficult to run. For one, they require close cooperation with government authorities for appropriate design of the experiment, since land tenure regulations and their implementation can only be instructed by sovereign governments. In addition, randomization has to occur at relatively high spatial aggregation, at least villages, better yet districts, to avoid spillover effects, which reduces statistical power and requires large study settings. Studying the development and changes of land tenure security, formal land rights and land acquisitions requires a different kind of experiment: Here, I rely on variations in weather as a form of natural experiment. I exploit exogenous spatial and temporal variation of weather characteristics to analyze weather influences on land tenure.

The data for my dissertation comes from three household survey data sets, one of which I collected myself. For reliable weather information, I merge global gridded weather data products with the household survey data, based on GPS identifiers. The first household survey data set I use is a panel data set from two regions in central Tanzania, comprising ca. 800 agricultural households. It was collected as part of the Trans-SEC project and implemented by Sokoine University of Agriculture, Technical University of Munich and University of Hannover. The Trans-SEC survey aimed at collecting detailed data on agricultural livelihoods

and food security in Tanzania. The regions and study villages were selected to represent different cropping systems and varying degrees of market access and livestock integration. The survey comprises three panel waves that were implemented in 2014, 2016, and 2018. Information on land tenure was collected in great detail, including perceived tenure security, which made this dataset particularly valuable for my research.

For my third dissertation chapter I used publicly available data: The data used in this study are three waves of the Uganda National Panel Survey implemented by the Uganda Bureau of Statistics in 2005/06, 2009/10, and 2010/11. The UNPS builds on the Uganda National Household Survey (UNHS) that was administered in 2005/06 and re-interviews a subset of the original UNHS sample. The UNPS comprises 3,123 households across Uganda. It is representative for Kampala city, other urban areas, central rural, eastern rural, western rural, and northern rural areas. The survey records detailed information on land tenure, crop production, and household demographics, as well as the exact location of the household's homestead, which allows us to match weather data from secondary sources with the household survey data. The survey separately records land ownership and land use rights, a unique feature of the data.

For the final chapter of my dissertation, I collected own data from farm households in Eastern Uganda, to contribute a new angle to the established literature on tenure security and agricultural investment. I collected data in one district, in which GIZ implemented a land tenure intervention. To exploit an exogenous change in the project implementation, we constructed a treatment and control group at sub-county level. We collected data in seven and ten villages in the two sub-counties, respectively. From all respondents, two types of data were collected: (i) mental models and (ii) socio-economic survey data (from here on "AGRICA survey") that recorded key socio-demographic, agricultural, and land-related information. Since land is a highly sensitive topic in Uganda, inquiries about land ownership, land certificates, and tenure security may raise suspicion and fear among survey respondents. Great care was taken to explain the research purpose, respondents' rights, and data protection provisions to respondents. In total we interviewed 253 farm households. The data collection was implemented together with our research partner NARO (National Agricultural Research Organization) and a team of six enumerators.

The four chapters of my dissertation are briefly summarized as follows:

The first chapter explores the state of evidence on links between land tenure and climate change in the context of agriculture. We systematically review the literature and analyze key studies using thematic network analysis. Based on 106 studies we devise a network of interactions between land tenure and climate change and identify three main connections. The first connection runs from land tenure to adaptation uptake and is best covered in the literature. The second connection concerns the influence of land tenure settings on household vulnerability to climate change. Effects of climate change and weather on land tenure constitute the third and least researched connection. Additionally, we study the integration of climate change in empirical land tenure studies and find important gaps with regard to inclusion of appropriate data, definitions and climate scenarios. The main suggestions based on this review are to further research the third identified connection, the influences of climate and weather on land tenure systems, in particular on the perception of tenure security. Better integration of climate data and climate scenarios into land tenure research is another key recommendation.

The following three chapters contain empirical studies that were designed based on selected

research gaps identified in chapter 1. Chapter 1 thus forms the frame for the subsequent empirical analyses and allows to place their findings into the wider context of the land tenure-climate nexus.

In the second chapter, we take up the most apparent research gap identified in the systematic literature review, the lack of rigorous empirical, quantitative studies about effects of weather and climate on land tenure. Focusing on tenure security, we analyze if exposure to weather risk affects the tenure security of smallholder farmers in rural Tanzania. We use three waves of household panel data from central Tanzania and combine it with high-resolution precipitation and temperature data. This allows us to use a household fixed effects approach, to eliminate time-invariant unobserved heterogeneity, and exploit exogenous variation in weather risk. We use two measures for weather risk: the occurrence of dry spells and precipitation variability. Results show that exposure to weather risk significantly lowers farmers' perceived tenure security, but increases land conflicts. At the same time, weather risk has mixed effects on the likelihood that farmers acquire land certificates. While exposure to precipitation variability considerably decreases the likelihood that farmers acquire land certificates, the experience of dry spells increases the acquisition of land certificates. Potential channels include the differential conflict types that are driven by weather risk, as well as income and guard labour effects.

While the second chapter presented a detailed study of two regions in Tanzania, in chapter 3 we study effects of drought specifically on households' land ownership across all of Uganda. We extend the literature studying distress land sales in the face of adverse weather and ask how droughts influence households' interest to purchase land at the extensive and the intensive margins. This links to the literature on farm assets and their role for household resilience. We use three waves of nationally representative household survey data from Uganda, which uniquely distinguishes between land that is owner-operated and land that is user-operated. This distinction allows us to estimate the effect of drought on land purchase intentions, when households are faced with the decision to convert land use rights into fully fledged ownership rights. We calculate the drought index SPEI using high-resolution precipitation and temperature data and estimate household fixed effects models. Results show that exposure to drought lowers households' reported intentions to purchase land and substantially reduces the price households are willing to pay for land. This finding complements Ricardian analyses of climate impacts on farmland values and provides novel evidence from a low-income country. It extends the findings from chapter 2, further showing how weather and climatic conditions influence farmers' relation with and interest in their land.

Chapter 4 adds an important further component identified as a research gap in chapter 1: a detailed study of the role of tenure security and formal land certificates in household decision-making on agricultural investment. Contrary to the existing literature that studies tenure security effects on adoption of agricultural practices, we focus on the decision-making process of agricultural investment as a whole and study the relative importance of tenure security for the adoption decision - both in its perceived and formalized version. We take the use of improved seeds as example for an agricultural investment that can be used as an adaptation strategy in the face of climate change. Using a method from psychology, mental models, we aim to understand the relative importance of tenure security and land certificates for short-term agricultural investments by farmers. We exploit the exogenous variation in access to a land formalization project run by GIZ in Eastern Uganda, which supported households in one sub-district in mapping and registering their land, while a neighbouring sub-district did not receive such support. We administered a survey to 253 farmers and asked them to map their decision-

making process regarding the use of improved seeds with pre-determined factors available for selection. A comparison of the resulting mental models shows few differences between the two groups. Overall, tenure security and the possession of a land certificate are among the least chosen factors, pointing to limited importance of tenure security in the investment decision-making process. However, households who include tenure security in their mental model assign a strong positive influence on the use of improved seeds. Interestingly, female headed households accord much more importance to land certificates than male-headed households. While the study is non-representative of a specific region, the smallholder farming context and land tenure setting studied resembles that of other regions in Eastern Africa and beyond. The study provides novel insights on the relative importance of perceived tenure security compared to other factors.

The main contribution of this dissertation is the addition of novel evidence to both the literature studying climate impacts on agriculture and the literature studying endogenous development and effects of secure land tenure. I have shown that land tenure systems and smallholder farmers' resilience to weather shocks and climate change are intricately linked. In particular, the security of land property rights is important in this context. Land tenure systems matter beyond the frequently studied effects of secure land tenure on farmers' incentive structures to invest in their land and adapt to climate change, they are also affected by weather patterns themselves. The empirical results underline the importance of not only considering directly visible effects of weather and climate on smallholder livelihoods, but also asking which opportunities are missed and how farmers' options are being limited in the face of weather risk. Such knowledge can help mitigate the risk of trapping households in vulnerable situations and downward spirals, where their tenure becomes ever more insecure in unfavourable climatic conditions.

The findings of this dissertation imply that land registration and conflict resolution efforts should be targeted in areas affected by weather extremes and weather variability. Such a focus on weather vulnerable areas can alleviate negative effects from weather risk on land tenure systems and the associated incentive structures that influence households' resilience. Particular attention should be paid to socio-demographic groups typically disadvantaged with regard to land access, such as women. With regard to land tenure incentives for agricultural investment, the findings from chapter 4 imply that strategies other than land formalization may be more effective and efficient - at least with regard to short-term practices such as using improved seeds and for the average farmer. However, for a subset of households, tenure security does matter considerably, these households should be targeted when aiming to increase investment through improved land tenure security. Yet, the results from chapter 4 also show that it is not straightforward to identify for whom tenure security matters in the investment decision making process. It is thus important to engage local experts in land tenure programs for appropriate targeting.

List of thesis publications

- Murken, L., Mager, G., Laudien, R., Kraehnert K. & Gomott, C. (2024). The impact of weather risk on tenure security - Evidence from smallholder farmers in Tanzania. *Land Economics*, <https://doi.org/10.3368/le.100.4.101422-0079R1>
- Murken, L., Kraehnert K. & Gomott, C. (2024). Is this land for sale? The effects of drought on land ownership in Uganda. *Ecologica / Economics*,

<https://doi.org/10.1016/j.ecolecon.2023.108095>

Murken, L. & Gomott, C. (2022). The importance of different land tenure systems for farmers' response to climate change: a systematic review. *Climate Risk Management*, <https://doi.org/10.1016/j.crm.2022.100419>

Murken, L., Kraehnert, K., van den Broek, K., Adriko, J. & Gomott, C. The Role of Tenure Security in Farmers' Decision-Making on Investment in Improved Seeds: Insights from Mental Models. *Ruhr Economic Papers*, <http://doi.org/10.4419/96973237>