Grantham Research Institute on
Climate Change and
the Environment

# Tenure insecurity and investment in soil conservation. Evidence from Malawi

Stefania Lovo

May 2013

Grantham Research Institute on Climate Change and the Environment

Working Paper No. 114

**The Grantham Research Institute on Climate Change and the Environment** was established by the London School of Economics and Political Science in 2008 to bring together international expertise on economics, finance, geography, the environment, international development and political economy to create a world-leading centre for policy-relevant research and training in climate change and the environment. The Institute is funded by the Grantham Foundation for the Protection of the Environment and the Global Green Growth Institute, and has five research programmes:

1. Global response strategies
2. Green growth
3. Practical aspects of climate policy
4. Adaptation and development
5. Resource security

More information about the Grantham Research Institute on Climate Change and the Environment can be found at: http://www.lse.ac.uk/grantham.

# Tenure insecurity and investment in soil conservation. Evidence from Malawi

Stefania Lovo

Grantham Research Institute for Climate Change and the Environment, London School of Economics

May 20, 2013

**Abstract**

Tenure insecurity can have important consequences for the conservation of natural resources. Land titling is often considered a solution to the problem of weak investment incentives under tenure insecurity. Using a large plot-level dataset from Malawi, this paper shows that land titling alone might not induce greater investment in soil conservation under the existing customary inheritance systems and that a reform of the rental market is in order. The paper focuses on two main sources of tenure insecurity: informal short-term tenancy contracts and customary gender-biased inheritance practices. Both sources of insecurity matter for soil conservation investments and are likely to be unaffected by the introduction of land titling alone. Further evidence suggests that soil erosion can have adverse distributional effects and that tenure insecurity accounts for one-third of the long-term loss in land productivity.

**Keywords**: tenure insecurity, soil conservation, erosion, tenancy, inheritance systems, Malawi.

**JEL**: Q15, Q24

This research is part of the green growth programme at the Grantham Research Institute on Climate Change and the Environment, which is funded by the Global Green Growth Institute, as well as the Grantham Foundation for the Protection of the Environment, and the Economic and Social Research Council through the Centre for Climate Change Economics and Policy. The author would like to thank Mintewab Bezabih and Antoine Dechezleprêtre for their helpful comments.

# 1 Introduction

This paper analyses the impact of tenure insecurity on the adoption of soil conservation measures in Malawi. Soil erosion is one of the principal causes of environmental degradation in Malawi and it has been increasing due to population pressure, deforestation, and unsustainable agricultural practices (Ministry of Finance and Development Planning, 2011). Soil erosion has important consequences for agriculture and other economic sectors threatening food security and downstream activities such as hydro-electric power generation and drinking water treatment services. Despite government's several campaigns on the adoption of soil and water conservation practices during the mid-1990s and the implementation of the National Environmental Policy in 1996, the adoption of soil conservation measures remains low. This paper provides new insights on why soil conservation measures are under-utilized with a focus on land tenure insecurity.

Most of the land in Malawi is under customary law. While use rights are well established, there is no formal market for land. Land is transferred through allocations by village headmen or, more predominantly nowadays, through inheritance. Given the increasing demand for allocable land, an informal rental market has emerged and is expanding. Initially started as a form of land borrowing between relatives, it has evolved over the past 20 years into one-season-long informal renting agreements mostly between non-relatives (Peters, 2010). Land transfers through inheritance are governed by customary tenure systems that vary across villages and are based on a mixture of marriage and residency customary practices. In the South, for example, the dominant system is matrilineal-matrilocal where the husband moves to the wife's village and does not retain property rights on the land after death of the partner or divorce. The Northern part of the country mainly adopts a patrilineal-patrilocal system that applies similar principles to wives. The gender-biased nature of these inheritance systems and the short-term nature of tenancy contracts constitute sources of tenure insecurity and are the focus of this paper.

Empirical analyses of the effects of land tenure insecurity on investment have produced contrasting results, in particular for sub-Saharan Africa (Deininger and Jin, 2006). While tenure insecurity is expected to decrease investment, investment itself could lead to higher tenure security if it can be claimed by the land user (Besley, 1995). Which mechanism prevails depends on the type of investment and on the nature of tenure insecurity. The lack of generalizable results, therefore, calls for in depth empirical investigations that take into account the local social, political and economic circum-

stances and the specific sources of tenure insecurity and types of investments. Thanks to a large and comprehensive dataset that covers different forms of tenure insecurity and types of investment, this paper contributes to the literature by providing an in depth exploration of the insecurity effects and feedbacks that characterise rural investment in Malawi .

The empirical analysis presented below uses a large plot-household-level dataset and exploits the variation in tenure security across plots belonging to the same household. This offers an advantaged over many of the existing empirical findings, often constrained by small sample sizes and limited geographical coverage, since it allows to control for household-level unobserved heterogeneity using household fixed effects. The results show that tenure insecurity matters. Inheritance-related insecurity and short-term tenancy contracts provide weak incentives for soil conservation investments. The results hold both in the fixed effects and cross section specifications. The effects are compared to those on investment in trees and on the adoption of hybrid seeds. Investment in trees exhibits security-enhancing properties that make it less prone to the negative effects of tenure insecurity. Given the lack of long-term benefits, instead, the adoption of hybrid seeds is not affected by tenure insecurity but is positively correlated with household wealth. The second part of the analysis provides an estimation of the economic costs of soil erosion which is found to reduce local maize yields by almost 20%. The impact on hybrid maize yields, more expensive and therefore adopted by wealthier household, is also negative but smaller and not significant. These points in the direction of potential negative distributional effects of soil erosion. Moreover, a-back-of-the-envelope calculation suggests that long-term productivities losses could be reduced by a third by tackling both sources of tenure insecurity.

Various failed attempts to implement a land reform in Malawi, have made a new land policy a high priority in the agenda of the Malawian government. The results suggest that a reform of the rental market is in order and could address the problems of weak investment incentives through the promotion of longer-term contracts. On the other hand, the introduction of legal land titles alone might not reduce the bias against land-related investments and might require a revision of inheritance laws or additional incentives or compensation measures to sustain conservation.

The remainder of the paper is organized as follows. Section 2 describes the customary land tenure in Malawi. This is followed by a description of the existing empirical evidence on the relation between tenure insecurity and land-related investment. By reviewing the literature, the section provides the theoretical framework underpinning the empirical analysis presented in

the paper. Section 3 presents the econometric approach while section 4 provides a description of the plot-household level data used in the analysis. The results pertaining to the impact of tenure insecurity on soil conservation investment are discussed in section 5 while the following section considers the consequences of soil erosion on land productivity. Finally, the conclusions and policy implications are presented.

## 2 Tenure insecurity in Malawi

Most of the land in Malawi is under a traditional customary land system where cultivation rights are granted by traditional leaders. Nowadays, however, only a small proportion of plots are allocated by village headmen and most land is transfer through inheritance (Peters and Kambewa, 2007). A new land policy was formulated in 2002 mainly to allow farmers to register their customary land as private property. The necessary legislative changes needed to make the policy operational, however, were not implemented and the reform process came to a halt. The question of land reform, therefore, remains high on the agenda of the Malawian government and has been subject to extensive public debate. In particular, major debates have focused on inheritance laws and the need to address the concerns of both owners and tenants in the rapidly expanding informal rental market (Peters, 2010).

These latter pressing issues are the main focus of the present study. Although the lack of ownership rights is an important source of concern, individual use rights over agricultural land are well-established (Place and Otsuka, 2001a). The country constitution mandates that farmers cannot be arbitrarily deprived of land and when land is required for public utility the government should provide adequate notification and compensation. Therefore, the presence or absence of legal titles is unlikely to constitute a major impediment to investment unless land can be used to access the credit market which will not be considered in this paper. A major concern is, instead, the absence of legal forms of land transfer. Although land can only be officially transferred through inheritance, an informal rental market has emerged and is in continuous expansion in response to the increasing scarcity of allocable land (Holden et al., 2008). The informal rental market is, however, dominated by short-term (one season) contracts that introduce uncertainty about future renewals and can prevent the adoption of soil conservation measures due to the fear that the investment and maintenance effort will be expropriated by the landlord.

Tenure insecurity is also caused by the presence of gender-biased inheri-

tance systems. There are different customary tenure systems in Malawi that are based on two main descendant practices: matrilineal and patrilineal, and residency practices: matrilocal, patrilocal and neolocal. In Malawi, marriage is almost universal and the customary system in place determines residency and inheritance. In the matrilineal system, land is inherited from the wife's relatives and is passed through inheritance to her brothers' children. Therefore, a family is an integral part of the wife's lineage. The patrilineal system applies the same principles to men. To each of these descendant practices is associated a residency practice. In neolocal systems the couple chooses a new location different from their home location. In a matrilocal system, instead, the husband moves to the wife's village while in a patrilocal system the wife moves to the husband's village. Divorce or death of a spouse under these two latter practices, effectively renders the non-local partner landless and he/she will have to return to the village of origin without any form of compensation for the investment operated on the land. It is worth noting that the probability of divorce in Malawi is among the highest within sub-Saharan Africa countries with almost half of all first marriages ending in divorce within 20 years (Reniers, 2003). Moreover, because land is bequeathed from uncle to nephew, bypassing the children, customary inheritance practices provide additional disincentives to longer-term investments.

The matrilineal-matrilocal (or Chikamwini) system is practiced mainly by three large tribes: Chewa, Lomwe and Yao, the most populous ethnic groups in Malawi that are located mainly in the South of the country. In this part of the country, a man is said to be expected to "leave with his blanket", meaning that he cannot claim any material goods from the household after a divorce or death of the spouse (Reniers, 2003). Due to increasing land scarcity in Chikamwini villages, however, the system is slowly being replaced by the matrilineal-patrilocal system (Chitengwa). In these villages and in matrilineal-neolocal villages a male land-user is not very secure because women are expected to own the land, however he may opt to invest more in order to be able to claim ownership of the land in the future Lunduka (2009). In the North of the country, the most common practice is the patrilineal-patrilocal system where the land is received through the father's side and the couple lives in the husband's village.

In the analysis below tenure insecurity is determined on the basis of the gender of the plot-specific decision maker and the main marriage system in place in the village of residency. Male decision makers are classified into three different levels of security. The most secure male decision makers are those living in a patrilineal-patrilocal system (category a) while the most insecure are those that moved to a matrilineal-matrilocal village

because of marriage (category c). Finally, a third category includes male decision makers residing in other mixed systems (matrilineal-patrilocal and matrilineal-neolocal) including those living in matrilineal-matrilocal villages but that did not moved there because of marriage (category b). Female decision makers are categorized only into two levels of security. Women are considered to have a stronger land security in matrilineal-matrilocal villages (category d) while all other female decision makers are grouped into one less secure category (category e). It should be noted, however, that land transactions do not necessarily follow these idealized models of customary land tenure. Actual transactions are likely to be more complex and flexible than these generalized rules, which, however, offer a reasonable proxy for the most common customary practiced in the village (Takane, 2008).

## 2.1 Tenure insecurity and land related investment

The relationship between tenure insecurity and land-related investment has been widely studied in the literature. The sources of tenure security considered range from lack of land titles (Bezabih et al., 2012), short-term tenancy contracts (Bandiera, 2007), lack of transferability (Besley, 1995) and risk of expropriation (Deininger and Jin, 2006). Fewer studies have considered the relationship between tenure insecurity and investments in soil conservation (Gebremedhin and Swinton, 2003). Ali et al. (2011), for example, find that the implementation of the land regularization program in Rwanda has notably increased investment in soil conservation in particular for women. Similarly, Holden et al. (2009) show that the Ethiopian low-cost land certification programme had a positive impact on investment and maintenance of soil conservation structures. In general, however, the results have been mixed, in particular for sub-Saharan Africa. While tenure security can positively affect investment by ensuring longer-term stability or favouring access to credit (Besley et al., 2012), empirical studies have also found that land-related investments can enhance security and therefore suggest a causal relationship that works in the opposite direction (Brasselle et al., 2002). Empirical investigations of the effects of tenure insecurity, therefore, need to be rooted in the specific context of the analysis and results cannot usually be generalized.

Deininger and Jin (2006) summarize the major difficulties encountered by most empirical studies. Many studies, for example, rely on small samples with limited geographical representativeness. Of major concern are the difficulties in discerning the security-enhancing properties of investment from the negative effect of insecurity on productivity-enhancing investments. The

authors employ a theoretical model where investment can potentially have both properties. The solutions of the model predict that when tenure security is exogenous, insecurity has a negative effect on investment (pure productivity-enhancement mechanism). On the other hand, when tenure security is increased by investment and investment does not enhance productivity, tenure insecurity will lead to more investment (pure security-enhancing mechanism). Finally, when investment exhibits both properties the impact of tenure security is ambiguous (mixed mechanism).

In Malawi, investment in soil conservation can, in principle, exhibit both properties. Soil conservation measures can help preserve soil nutrients and prevent productivity losses in the future (productivity-enhancing mechanism), on the other hand, conservation investment could help consolidate the tenure security of land-users. This is more likely to occur if tenants good farm practices increase the chances of contract renewals. This is, instead, less likely to occur in the case of strict gender-biased inheritance customary rules, commonly adopted in the South and north of the country, that are likely to be unaffected by the actions of the land-user, but more likely to affect land-users in mixed-systems where investment can potentially enhance security. Whether the security-enhancing effect prevails over the other depends on the source of tenure insecurity and will be investigated below.

Previous studies on the relationship between tenure insecurity and investment in Malawi have found some mixed effects. Place and Otsuka (2001b), for example, find that the investment incentives provided by the matrilineal-matrilocal tenure arrangement are generally weaker than those in tenure systems where patrilineal descent patterns prevail. The study focuses mainly on the adoption and extension of tobacco production. The study does not find a significant negative relationship between tenure-insecurity and terracing or water managing. As suggested by the authors, however, the results are likely to be influenced by the lack of controls for plot-specific characteristics and the small sample size. Lunduka (2009) finds that households in matrilocal villages tend to under-invest in trees planting. On the other hand, households in matrilineal-neolocal villages are found to invest more suggesting that in these systems investment in tree can help increasing security in the future. Finally, a study by Place and Otsuka (2001a) explores the relationship between customary land tenure and natural resource management. Using data from 57 communities, the authors do not find evidence of a relationship between tenure insecurity and the long-term management of woodland. The analysis presented below contributes to this literature by focusing on another form of resource management, soil conservation, and

by exploiting a larger and comprehensive sample of households across the entire country.

# 3 Empirical strategy

The effect of tenure insecurity on the adoption of soil conservation measures is analysed by estimating the following equation:

$$inv_{ij} = \alpha + \boldsymbol{\beta} d_{ij} + \boldsymbol{\gamma} z_{ij} + \boldsymbol{\delta} x_i + \epsilon_{ij}. \tag{1}$$

The dependent variable, $inv_{ij}$ is a binary variable and indicates the presence of soil conservation measures on plot $j$ belonging to household $i$. Tenure insecurity variables are indicated by the vector $d_{ij}$. They are all binary variables that indicate different levels of tenure security. In the first set of regressions these binary indicators represent different methods of land acquisition (granted, inherited, purchased and rented land) while in the second part of the analysis they indicate different levels of tenure insecurity depending on the gender of the decision maker and the inheritance system in place in the community. All specifications include district dummies and a dummy indicating whether the household is located in the lower Shiver valley where soil condition tend to be adverse to the use of soil conservation measures.

The vectors $x_i$ and $z_{ij}$ contain household and plot-level variables respectively. Although the survey offers a rich set of household and plot characteristics, these might not account for all the unobservable characteristics that might be associated to tenure insecurity. To address this concern, the specification above is also estimated including household fixed effects, $b_i$, i.e. by comparing plots belonging to the same household:

$$inv_{ij} = \alpha + \boldsymbol{\beta} d_{ij} + \boldsymbol{\gamma} z_{ij} + b_i + \epsilon_{ij}. \tag{2}$$

This is possible given the large sample size provided by the survey and the variability of tenure insecurity across a household's plots, features that are not often available in other studies (Holden et al. (2009), Place and Otsuka (2001b)). The main advantage of the latter specification is that estimates do not suffer from selection bias on household-level unobservables. On the other hand, by definition, it is not possible to analyse the impact of household-level characteristics on investment decisions. Moreover, the sub-sample of households included in the fixed effects estimations, i.e. those with multiple plots and different level of tenure insecurity, might differ from

the excluded ones under particular characteristics that will be discussed in the next sections.

All specifications are estimated using a linear probability model. Despite the binary nature of the dependent variable, a linear probability model is preferred because the inclusion of household fixed effects does not bias the estimates (Bandiera, 2007). Linear probability models provide good estimates of the partial effects for average values of the explanatory variables and the coefficients allow for a straightforward interpretation of the effects (Wooldridge, 2002). Measurement errors cause also less bias in linear model than in discrete choice models. However, because the residuals of a linear probability model are heteroskedastic by definition, all estimations report robust standard errors.

In the second part of the analysis, the impact of soil erosion on land productivity is analysed by estimating a production function with household-level fixed effects:

$$q_{ij}/h_{ij} = \alpha + \boldsymbol{\beta} d_{ij}^{E} + \boldsymbol{\gamma} z_{ij} + \boldsymbol{\rho} w_{ij} + b_i + \epsilon_{ij}, \tag{3}$$

where $q_{ij}/h_{ij}$ indicates the production of maize (in kilograms) per hectare obtained from plot $i$ of household $j$. This is specified in logarithmic form to deal with the skewness of the distribution. The binary variable $d_{ij}^{E}$ indicates the presence of high or moderate erosion. The model includes all the control variables considered in the earlier models, $z_{ij}$, and additional variables, $w_{ij}$, capturing the amount of inputs used on the plot.

# 4 Data

The empirical analysis uses plot-household-level data provided by the third Agricultural Integrated Household Living Standard (LSMS-ISA) survey that was conducted in 2010 by the Government of Malawi through the National Statistical Office. The survey collects information on more than 9000 households across the entire country. The survey data have been geocoded. However, to protect the confidentiality of the sampled households and communities, the geographical positioning system (GPS) coordinates were averaged at the enumeration area (EA) level. All geographical characteristics, therefore, are provided at this level of aggregation and include average rainfall precipitations, maximum and minimum temperatures, elevation, distance from the population centre, majority of land cover class and terrain roughness. The survey provides also a rich set of plot-specific information that can help control for plot-level heterogeneity. Variables include plot size, soil

quality (farmer's opinion), soil type (clay or sandy), distance of the plot from the household, slope and whether the plot is in a wetland.

The majority of the households in the sample have access to more than one plot (2 on average) and the average plot size is 0.4 hectares (plot size was measured using the GPS technology).

Table 1: Household characteristics by acquisition method

| Method of acquisition | Total | Allocated | Inherited | Purchased | Rented |
|---|---|---|---|---|---|
| Soil conservation (%) | 41.4 | 39.6 | 42.4 | 42.7 | 33.4 |
| Age* | 43.1 | 49.3 | 42.5 | 44.8 | 39.6 |
| Education (years)* | 5.2 | 4.7 | 5.0 | 6.1 | 7.0 |
| Household size | 4.9 | 4.9 | 4.9 | 5.4 | 5.3 |
| Plot size | 0.4 | 0.4 | 0.4 | 0.5 | 0.4 |
| Number of plots | 2.5 | 2.5 | 2.5 | 2.4 | 2.4 |
| Distance to pop centre | 39.0 | 41.8 | 39.3 | 36.2 | 32.6 |
| Steep (%) | 2.9 | 7.7 | 2.4 | 1.8 | 1.2 |
| Consumption per capita | 51130.1 | 48632.5 | 48827.4 | 79550.0 | 69584.2 |
| Observations | 17267 | 2051 | 13515 | 487 | 1214 |

Author's calculations from the LSMS-ISA survey. * refers to the decision maker.

Table 1 reports some descriptive statistics for the different methods of land acquisition. Most households in the sample have acquired land through inheritance (78%). The smaller share of households that accessed land through allocations by local leaders (11%) is indicative of the increasing scarcity of allocable land. Although only 7% of the plots in the entire sample are acquired through the informal rental market, this form of acquisition is likely to become a more popular way to reallocate land from land-rich households to those demanding access to land. Most contracts are short-term, usually for one season, and might involve a monetary and/or an in kind payment.

Encouraged by several government campaigns, farmers have adopted a range of soil management measures that include the planting of vetiver grass (Vetiveria zizanioides/Vetiveria nigritana) and the construction of soil bunds, contour box ridges and terraces. Vetiver grass is planted on contour lines to form a thin but dense hedge line to control runoff and improves moisture retention. Soil bunds are ridges and ditches made of soil across the slope and along the contour. Box ridges or tied ridges are made across the furrows from one crop ridge to the next and are spaced approximately every 2 meters; they help crop ridges infiltrate more water into the soil

(Government of Malawi, 1995).

Soil conservation is practiced by about 40% of the households in the sample. The most common measures are soil bunds and vetiver grass. Table 1 shows that the likelihood of adopting conservation measures is lower among rented plots than for any other form of acquisition. Rented plots are on average closer to population centres and less likely to be located in steep areas. Moreover, households renting plots tend to be younger, more educated and having higher average consumption per capita.

Table 2: Household characteristics by decision maker status

| | | Man | | | Woman | |
|---|---|---|---|---|---|---|
| Tenure security | Total | Secure patrilineal (a) | Mixed systems (b) | Insecure (c) | Secure (d) | Mixed systems (e) |
| Soil conservation (%) | 40.1 | 44.8 | 42.6 | 38.4 | 40.7 | 34.8 |
| Age* | 43.2 | 42.5 | 41.5 | 41.2 | 46.8 | 49.5 |
| Education (years)* | 5 | 7.5 | 5.3 | 5.1 | 3.1 | 3.4 |
| Household size | 4.9 | 5.5 | 5.1 | 5.1 | 4.2 | 4.5 |
| Plot size | 0.4 | 0.3 | 0.4 | 0.3 | 0.3 | 0.4 |
| Number of plots | 2.5 | 2.8 | 2.6 | 2.5 | 2.2 | 2.3 |
| Distance to pop centre | 39.7 | 49.3 | 38.7 | 37.6 | 34.9 | 43.3 |
| Steep (%) | 3 | 7.5 | 2.4 | 2.1 | 2.3 | 3 |
| Consumption pc | 48752 | 45821 | 50648 | 42711 | 49838 | 44127 |
| Observations | 16,410 | 2,023 | 8,832 | 1,174 | 2,896 | 1,485 |

Author's calculations from the LSMS-ISA survey. * refers to the decision maker.

In defining the level of tenure insecurity due to a gender-biased inheritance system, I combined information about the gender of the decision maker and the most common marriage/inheritance system in place in the village of residency. For each plot the survey asks about who makes decisions about crop planting, inputs use and timing and, therefore, allows to identify the gender and other characteristics of the decision maker. Unfortunately, the dataset does not allow to observe from who the plot was inherited, as available, instead, in Place and Otsuka (2001b) and Lunduka (2009). Nevertheless, the community-level survey provides information on the main inheritance system in place in the village, which constitutes a good proxy for how most land is likely to have been transferred. In villages with a matrilocal-matrilineal system, for example, land is likely to have been inherited from the wife's relatives. The survey reports five customary marriage systems: matrilineal-matrilocal, patrilineal-patrilocal, matrilineal-

neolocal, patrilineal-neolocal and matrilineal-patrilocal. It also contains an additional question that reports whether in the village descendants are commonly traced through their father or mother. This variable is also used to create a simplified measure of tenure insecurity. Table 2 reports the descriptive statistics of the main explanatory variables by levels of tenure insecurity, described in section 2, and considers only inherited and allocated plots. Secure decision makers are more likely to adopt soil conservation measures while no clear pattern emerges among other explanatory variables.

Table 3: Household characteristics and maize yields by degree of erosion

| Soil conservation | No Erosion | Low | Moderate | High |
|---|---|---|---|---|
| Yields per hectare | 1270.7 | 1231.3 | 943.0 | 949.2 |
| Yields per hectare (local) | 957.8 | 870.8 | 762.4 | 698.2 |
| Age* | 43.3 | 42.9 | 42.9 | 43.0 |
| Education (years)* | 5.1 | 5.3 | 5.3 | 4.8 |
| Household size | 4.9 | 5.0 | 5.2 | 4.9 |
| Plot size | 0.4 | 0.4 | 0.4 | 0.4 |
| Number of plots | 2.5 | 2.5 | 2.5 | 2.4 |
| Distance to pop centre | 38.7 | 39.3 | 42.2 | 39.2 |
| Steep (%) | 1.0 | 2.2 | 6.3 | 26.3 |
| Consumption per capita | 51121.6 | 51826.9 | 47221.1 | 51746.0 |
| Observations | 10,604 | 4,663 | 1,287 | 818 |

Author's calculations from the LSMS-ISA survey. * refers to the decision maker.

The degradation of soil resources has a direct and immediate impact on the livelihoods of rural households mainly through a reduction in crop yields. The loss of soil nutrients means that either less will be produced, or more fertilizers need to be used to sustain agricultural production. The loss of production due to erosion can be caused by the deterioration in soil physical and chemical properties such as infiltration rate, water-holding capacity, loss of nutrients needed for crop production, and loss of soil carbon. About 39% of the plots in the sample are subject to a certain degree of erosion (Table 3). The table considers only household engaged in the production of maize, which is the main staple crop in Malawi. The average total yields per hectare of highly eroded plots is 25% lower than of those with no sign of erosion and reaches 27% for plots cultivated with local maize. As expected, many plots subject to high erosion are found in steep areas while no other significant differences are observed among other variables.

# 5 Tenure insecurity and soil conservation investment

This section presents the empirical results on the relationship between investment in soil conservation and tenure insecurity due to short-term tenancy contracts and gender-biased inheritance practices.

## 5.1 Short-term tenancy and soil conservation investment

The first set of results considers how different methods to acquire land interact with soil conservation investments. Table 4 reports the cross-section (OLS) and fixed-effects (FE) estimates and shows that land acquisition methods matter: households are less likely to invest in soil conservation measures when their plot has been acquired through a short-term tenancy contract. In the cross-section specification, column 1, the probability of investing in conservation measures is 6 percentage points (18 %) lower for rented plots. This effect is relevant and is equivalent to a decrease in per capita consumption of 2% or a reduction in plot size of almost one hectare. The fixed-effect results show that the probability of investing in conservation measures is 8 percentage points or 20% lower for rented plots than for other plots. Because all contracts are fixed-term agreements, sharecropping is not a common practice in Malawi (T. et al., 2008), this effect is likely to indicate a commitment failure rather than a moral hazard problem. (Jacoby and Mansuri, 2008). Unfortunately, given the lack of data it is not possible to test whether differences in the duration of the tenancy would induce different investment outcomes.

When considering all methods of acquisition separately (column 2, 4 and 5), the cross-section and the fixed-effects specifications produce different results. This is partly due to the fact that the average observed characteristics of the households in the fixed-effects sub-sample differ from the overall average. The sub-sample includes only households that have multiple plots acquired through different methods. In particular, about 50% of these households have access to both inherited and rented plots, while about 20% have access to both inherited and allocated plots. Households in the sub-sample tend to be more numerous, wealthier and with younger household heads. The last column of table 4 considers only households that have the same decision maker across all plots. These results are preferred to previous ones as they deal with most of the unobserved differences across households and decision makers within the household. They show that allocated land also provides weaker incentives to invest in conservation measures. Although

Table 4: Acquisition methods and investment in conservation

| | (1) OLS | (2) OLS | (3) FE | (4) FE | (5) FE[a] |
|---|---|---|---|---|---|
| Short-term tenancy | -0.063*** | | -0.075*** | | |
| | (0.014) | | (0.023) | | |
| Allocated | | 0.064*** | | -0.025 | -0.054 |
| | | (0.017) | | (0.045) | (0.042) |
| Purchased | | 0.075*** | | 0.085** | 0.071* |
| | | (0.026) | | (0.041) | (0.041) |
| Inherited | | 0.063*** | | 0.086*** | 0.083*** |
| | | (0.014) | | (0.023) | (0.023) |
| Education(years) | 0.001 | 0.001 | 0.025 | 0.028 | |
| | (0.001) | (0.001) | (0.026) | (0.026) | |
| Consumption pc (log) | 0.039*** | 0.039*** | | | |
| | (0.007) | (0.007) | | | |
| Slope = moderate | 0.241*** | 0.241*** | 0.231*** | 0.227*** | 0.235*** |
| | (0.008) | (0.008) | (0.047) | (0.047) | (0.049) |
| Slope = steep | 0.315*** | 0.315*** | 0.287** | 0.298** | 0.330** |
| | (0.023) | (0.023) | (0.133) | (0.133) | (0.144) |
| Plot size (ha) | 0.050*** | 0.050*** | 0.099** | 0.094** | 0.080* |
| | (0.012) | (0.012) | (0.041) | (0.041) | (0.042) |
| Max temperature (village) | -0.003*** | -0.003*** | | | |
| | (0.001) | (0.001) | | | |
| District | Yes | Yes | No | No | No |
| Observations | 17153 | 17153 | 1721 | 1721 | 1616 |
| Households | | | 668.000 | 668.000 | 624.000 |

Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Cross section and fixed effects specifications include the following additional (not reported) variables: soil quality (good, fair, poor), soil type (clay, sandy). The OLS specifications include: number of plots, age, and gender of the decision maker and the other village level characteristics described in the text above. [a]Excludes households with multiple decision makers.

both inherited and allocated land fall under the customary law, inherited land has been cultivated for longer and is more likely to be considered more secure. No significant differences are observed between purchased and inherited land.

As expected, soil conservation measures are more likely to be found in steep or moderately steep plots that are more prone to erosion. Larger plots are more likely to have erosion control measures while education does not matter. Similar results are obtained when employing a logit model and are reported in the Appendix (table 8).

## 5.2 Customary land tenure systems and soil conservation investment

The results reported in table 5 explore the relationship between customary land tenure systems and the adoption of soil conservation measures. The table reports both the cross-section and the household fixed-effects estimates.

Table 5: Inheritance-related insecurity and investment in conservation

| | (1) OLS | (2) OLS | (3) OLS | (4) FE | (5) FE |
|---|---|---|---|---|---|
| Decision maker: male | 0.075*** | 0.037*** | 0.068*** | | |
| | (0.015) | (0.009) | (0.024) | | |
| Dummy: matrilineal village | 0.097*** | | | | |
| | (0.019) | | | | |
| (DM: male)x(Matrilineal) | -0.078*** | | | | |
| | (0.018) | | | | |
| Insecure man or woman | | -0.035*** | | -0.075** | |
| | | (0.008) | | (0.034) | |
| Insecure man (c) | | | -0.080*** | | -0.244* |
| | | | (0.026) | | (0.141) |
| Man in mixed systems (b) | | | -0.036* | | -0.095** |
| | | | (0.021) | | (0.045) |
| Insecure woman (e) | | | 0.018 | | -0.135** |
| | | | (0.018) | | (0.065) |
| Constant | 0.790** | 0.951*** | 0.952*** | 0.277** | 0.335*** |
| | (0.368) | (0.363) | (0.363) | (0.119) | (0.121) |
| District | Yes | Yes | Yes | No | No |
| Observations | 14803 | 15434 | 15434 | 335 | 335 |
| Households | | | | 143.000 | 143.000 |

Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
All specifications include the same control variables considered in previous table.

The results reported in the first three columns are cross-section estimates. The first column shows that while a male decision maker is more likely to invest in soil-conservation measures than a female decision maker, this effect is offset when the household resides in a village with a matrilineal inheritance system. Column 2 considers a simplified measure of tenure insecurity that indicates whether a male decision maker resides in a matrilineal village or a female decision maker resides in a patrilineal village. The results indicate that insecure decision makers are 3.5 percentage points less likely to invest in soil conservation measures. The effect is larger when controlling for household fixed-effects (column 4). Insecure decision makers are one average 7.5 percentage points less likely to adopt conservation measures. The effect is comparable to that of having acquired the plot through a short-term

tenancy contract.

Tenure insecurity is then disaggregated into different levels, described in section 2, that are included in the cross-section and fixed effects specifications reported respectively in column 3 and 5. In both specifications the omitted categories are the most secure male and female decision makers (category a and d). Column 3 shows that insecure male decision makers are 8 percentage points less likely to adopt conservation measures. Being a male decision maker in a mixed-system village has also a negative effect but the coefficient is halved. The fixed-effects estimations provide much larger estimates as they are obtained by comparing plots with different decision makers within the same household. These households tend to differ in terms of average characteristics from the average household in the sample. Moreover, because almost all households with multiple decision makers involve both a female and a male decision maker, i.e. there are no same-gender multiple-decision-maker households, the specification in column 5 de-facto compares an insecure male decision maker with a secure female decision maker or an insecure female decision maker with a secure male decision maker. The sample size is largely reduced, nevertheless, the effects are statistically significant. Insecure male decision makers are again found to invest less in conservation measures than their secure female counterparts. The marginal effect, 0.24, is very large if compared to the sample average of 0.48. Also less insecure male decision makers (category b) are less likely to invest but the effect is halved. Although this confirms that insecurity matters, the magnitude of these effects might not be generalized to the entire sample. Overall the results suggest that tenure insecurity has a negative effect on soil conservation investment even in mixed systems where a security-enhancing mechanism could be at work.

When considering the impact of insecurity on female decision makers' investment it is important to notice that only 27% of the female decision makers considered in the cross-section specifications are married, the remaining are either widowed or divorced. Divorced or widowed women are likely to have returned to their village and cultivate the family's plots which could explain the non-negative coefficient reported in column 3. In this case, therefore, the rationale adopted before to explain the results might not apply. However, when considering the fixed-effects sub-sample about 90% of the female decision makers are married and, in almost all cases, the other decision maker is the husband. Insecure female decision makers invest less than their secure male counterpart. While the negative effect could be inflated by a pure gender effect, it may also capture the much more severe "property grabbing" by the husband's relatives which women are subject to

upon the death of their husbands (Ligomeka, 2013).

Because some soil conservation measures could be complementary to the production model adopted by the household, the above specifications were applied to a sub-sample of households that produce only maize obtaining similar results. Comparable results are also obtained when employing a logit model and are reported in the Appendix (table 8).

Finally, it is worth noting that, although a particular marriage system might be predominant in a particular village, marriages can also be negotiated on neutral grounds and therefore using village-level information might not always provide a good measure of tenure insecurity. One potential problem could also arise if living in a village with a particular marriage system is an endogenous individual choice. Unfortunately, there is not enough information to address this problem. However, when individuals that moved to the village to look for a job, land or to start a new business (about 500 individuals, 6% of the sample) are removed from the sample the results remain almost unchanged.

### 5.3 Tenure insecurity, investment in trees and the adoption of hybrid seeds

The results discussed so far have shown that tenure insecurity provides disincentives to adopt soil conservation measures. While these measures have the potential to increase future productivity, they do not exhibit security-enhancing properties. Their adoption is discouraged by the threat of contract non-renewal and of the loss of use rights due to a gender-biased inheritance system even in villages with a mixed inheritance system.

In this section, tenure insecurity is related to other production choices with various degrees of similarity to conservation measures. Similarly to soil conservation measures, trees are another form of land-related investment that can increase productivity in the future but also generate short-term profits. Growing a mix of trees and annual crops, in fact, is generally more profitable that growing only crops (Bandiera, 2007). Given the visibility of this type of investment, however, it also has the potential of consolidating tenure security, in particular, in villages with a mixed-inheritance system where, despite an unfavourable lineage system, the land user, who resides either in a neutral village or in the village of origin, can use visible land-related investments as evidence in case of disputes (Lunduka, 2009).

The top panel of table 6 reports the cross-section and fixed effects results when the dependent variable is the probability of growing trees. Similarly to previous results, short-term tenancy contracts provide a disincentive to

Table 6: Tenure insecurity and investment in trees and hybrid seeds

| | OLS | FE | OLS | FE |
|---|---|---|---|---|
| Dependent variable: trees | (1) | (2) | (3) | (4) |
| Rent | -0.020** | -0.027* | | |
| | (0.008) | (0.016) | | |
| Decision maker: male | -0.004 | 0.177*** | 0.020 | |
| | (0.007) | (0.054) | (0.019) | |
| Insecure man (c) | | | -0.038* | -0.442** |
| | | | (0.021) | (0.175) |
| Man in mixed systems (b) | | | -0.008 | 0.074* |
| | | | (0.016) | (0.044) |
| Insecure woman (e) | | | -0.020 | -0.024 |
| | | | (0.014) | (0.042) |
| District | Yes | No | Yes | No |
| Observations | 17415 | 1746 | 19028 | 341 |
| Households | | 669 | | 143 |
| Dependent variable: hybrid seeds | (5) | (6) | (7) | (8) |
| Rent | 0.115*** | 0.043 | | |
| | (0.018) | (0.046) | | |
| Insecure man (c) | | | 0.033 | -0.295 |
| | | | (0.034) | (0.381) |
| Man in mixed systems (b) | | | 0.050* | 0.194 |
| | | | (0.028) | (0.141) |
| Insecure woman (e) | | | 0.003 | 0.064 |
| | | | (0.024) | (0.171) |
| Log of consumption pc | 0.086*** | | 0.079*** | |
| | (0.009) | | (0.009) | |
| Constant | 0.055 | -0.178 | 0.038 | 1.157*** |
| | (0.448) | (0.322) | (0.481) | (0.269) |
| District | Yes | No | Yes | No |
| Observations | 12087 | 1086 | 10941 | 220 |
| Households | | 653 | | |

Robust standard errors in parentheses. * $p < 0.1$, *∗ $p < 0.05$, *** $p < 0.01$
All previously considered controls are included but not reported.

grow trees. The probability of investing in conservation measures is 2 percentage points (10 %) lower for rented plots. Inheritance-related insecurity produces mixed effects on the decision of planting trees. Considering the fixed-effects estimates in column 4, insecure male decision makers in matrilineal-matrilocal villages are less likely to invest in trees. On the other hand, the effect is positive for male decision makers in mixed systems. This is in line with the findings of Lunduka (2009) where investment in trees in Malawi is found to be higher for those decision makers that can consolidate

their tenure security by investing. Similarly findings, although in a different context, are also reported in Deininger and Jin (2006) where investment in trees in Ethiopia is found to be positively correlated with tenure insecurity as their visibility can be used to manifest property rights. These results reveal that soil conservation investment lack security-enhancing properties which are instead found for investment in trees and suggest that the adoption of soil conservation measures is more negatively affected by tenure insecurity than other forms of investment.

The second panel of table 6 considers the decision of planting hybrid seeds. Hybrid seeds are in general more expensive but have higher average yields. They do not provide long-term benefits nor can help consolidate tenure security. Therefore, the decision of adopting hybrid seeds is not expected to be affected by tenure insecurity in a similar way to conservation measures. The results show that male decision makers in mixed-system villages are more likely to plant hybrid seeds although the effect is not robust to the inclusion of household fixed effects. Short-term tenancy contracts are also positively related to the use of hybrid seeds suggesting that other mechanisms might be at work. This is, in fact, in line with the findings of Chirwa (2005). The author suggests that rented plots are cultivated to generate commercial returns rather than to meet household subsistence needs and production decisions are, therefore, more heavily driven by short-term profitability concerns. Also this effect, however, becomes insignificant when including household fixed-effects.

# 6 Soil erosion and maize productivity

The last set of results analyse the consequences of soil erosion on agricultural output. The analysis focuses on maize producers only. Maize is the main staple crop in Malawi and is cultivated by about 72% of the households in the sample. Land-productivity is measured in terms of yields per hectare (in logarithmic form). The results are reported in table 7. All specifications consider only households with one unique decision maker to eliminate the influence of individual-level unobservables.

Soil erosion is measured according to farmers' perception about the quality of the plot and it is categorized under the following types: no erosion, low, moderate, and high erosion. This is undoubtedly an imperfect measure of soil erosion. The major drawback is the lack of a common reference scale since farmers might "anchor" their opinions at different levels depending on their knowledge, experience and the surrounding environment, mak-

Table 7: Soil erosion and land productivity

| | OLS | | | FE | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | kg/ha | local | hybrid | kg/ha | local | hybrid |
| Dummy: erosion | -0.067** | -0.107** | -0.033 | -0.143* | -0.307** | -0.183 |
| | (0.033) | (0.044) | (0.050) | (0.078) | (0.143) | (0.159) |
| Seeds (kg) log | -0.002 | -0.009 | 0.002 | -0.010 | -0.032 | 0.049 |
| | (0.013) | (0.017) | (0.019) | (0.035) | (0.050) | (0.069) |
| Dummy: hybrid | 0.239*** | | | 0.056 | | |
| | (0.021) | | | (0.060) | | |
| Dummy: fertilizer | 0.305*** | 0.282*** | 0.348*** | 0.056 | -0.240 | 0.400*** |
| | (0.026) | (0.034) | (0.041) | (0.098) | (0.201) | (0.147) |
| Observations | 11502 | 5693 | 5809 | 1940 | 959 | 981 |
| Households | | | | 1188 | 711 | 747 |

Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
All previously considered controls are included but not reported.

ing cross-households comparison problematic. By controlling for household fixed effects, however, this problem is substantially reduced since differences in erosion across plots within the same household are more likely to be comparable as the same reference scale is used by the farmer to judge the level of erosion of their plots. The measure of erosion reported in table 7 is a binary variable indicating whether the plot is subject to moderate or high erosion.

The results show that soil erosion has a large impact on productivity. Erosion affects mainly the productivity of plots cultivated with local maize while the impact on hybrid maize yields cannot be estimated with precision. Considering the fixed-effects results soil erosion reduces local maize yields per hectare by almost 30%. The effect could capture both a direct productivity effect due to the loss of soil nutrients and an indirect effect due to lower effort applied on worse quality plots. Unobserved effort, however, is likely to be control for by the amount of seeds and fertilizer used on the plot. Local maize is still a popular choice among farmers and it is grown by about 50% of the households in the sample. The slow adoption of hybrid seeds in Malawi has been found to be related to low income, low education, and risk aversion (Chirwa, 2005). The data used for the present analysis also show that households that adopted hybrid seeds tend to be wealthier and more educated, table 6. These results confirm the importance of tackling the causes of soil erosion since it significantly reduces land productivity in particular for lower quality crops that are cultivated by poorer households, raising concerns about the potential negative effects of soil erosion on rural

inequality.

In order to gauge the magnitude of the economic costs of tenure insecurity it is useful to use a simple back-of-the-envelope calculation based on the predictions of the above empirical models. According to the estimates reported in table 7, if the absence of soil conservation measures leads, in the long term, to high or moderate erosion, total annual maize production is expected to decrease on average by 8%, with the effect been larger for local maize production. According to the estimates reported in table 4 and 5, the overall adoption of soil conservation measures is expected to increase by 1.5% and 5%, in the case of short-term contracts and gender-bias inheritance practices respectively, if both sources of insecurity are addressed. These increases in the adoption of soil conservation measures are expected to reduce the loss in total maize production by 0.5% and 2%, respectively. Overall, therefore, the model suggests that both sources of insecurity, if not addressed, would account for one third of the long-term loss in total maize production.

# 7 Conclusions

Soil erosion is a serious threat to the long-term sustainability of agriculture in Malawi. The results have confirmed that soil erosion has severe negative effects on agricultural productivity in particular for poorer smallholders that are more likely to adopt lower quality seeds. A back-of-the-envelope calculation suggests that the absence of soil conservation measures can cause, in the long-term, a 8% decrease in maize production. Land tenure insecurity has important consequences for investment in soil conversation. Tenure insecurity in Malawi arises from the emerging informal land rental market that does only provide short-term contracts and from the gender-biased inheritance practices still adopted by the majority of the population. The nature of land transactions in Malawi are very complex and the simplification of tenure insecurity used in this paper, which is based solely on the matrilineal/patrilineal and matrilocal/patrilocal dichotomies, might neglect some of these complexity. Matchaya (2009), for example, discusses how tenure insecurity can also vary within a village depending on the indigenous or non-indigenous status of a person's parents. Nevertheless, the results are useful in raising important concerns that are relevant for the on-going land reform process in Malawi.

Land titling has often been assumed to increase security for landholders and, thereby, lead to greater investment. Nevertheless, existing empirical

evidence on sub-Saharan Africa and the findings of this study throw considerable doubt on this outcome from titling alone. Customary use rights are well established in Malawi and land titles would not necessarily increase security. Legal titles could, however, help households to access the credit market through the collateral use of land, possibility that is not discussed in this paper.

In the presence of gendered-bias inheritance practices, land-related investment is discouraged since the land user can be dispossessed of the land without compensation by the spouse's relatives who ultimately possess the land. Securing ownership rights, therefore, might not produce the desire effects on investment in conservation if ownership and use remain separate entities. In this regard, the New Land Policy of 2002, a proposal that was not implemented due to the lack of the necessary institutional framework, pointed into the direction of ensuring inheritance rights of children and surviving spouse in both patrilineal and matrilineal systems (Holden et al., 2006), providing a possible solution to the issues highlighted in this paper. The results also suggest the need for a reform of the land rental market to allow for longer-term contracts and more secure rights for both owners and tenants, issues that have not been taken seriously in previous attempt to reform the land market (Peters and Kambewa, 2007).

# Appendix

Table 8: Logit and fixed-effects logit estimates of the impact of tenure insecurity on investment in conservation

| | (1) Logit | (2) FE-logit | (3) Logit | (4) FE-Logit |
|---|---|---|---|---|
| Short-term tenancy | -0.274*** | -0.798*** | | |
| | (0.068) | (0.198) | | |
| Insecure man (c) | | | -0.396*** | -2.797** |
| | | | (0.121) | (1.424) |
| Man in mixed systems (b) | | | -0.177* | -0.990 |
| | | | (0.099) | (1.026) |
| Insecure woman (e) | | | 0.083 | -1.652* |
| | | | (0.087) | (0.987) |
| Observations | 18201 | 685 | 16335 | 111 |

Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
All controls considered in previous specifications are included but not reported.

# References


Ali, D. A., K. Deininger, and M. Goldstein (2011, Aug). Environmental and gender impacts of land tenure regularization in Africa : pilot evidence from Rwanda. Policy Research Working Paper Series 5765, The World Bank.

Bandiera, O. (2007). Land tenure, investment incentives, and the choice of techniques: Evidence from Nicaragua. *The World Bank Economic Review 21*(3), 487–508.

Besley, T. (1995). Property rights and investment incentives: Theory and evidence from Ghana. *Journal of Political Economy 103*(5), pp. 903–937.

Besley, T. J., K. B. Burchardi, and M. Ghatak (2012). Incentives and the De Soto effect. *The Quarterly Journal of Economics 127*(1), 237–282.

Bezabih, M., S. Holden, and A. Mannberg (2012). The role of land certification in reducing gender gaps in productivity in rural. Working paper, Centre for Land Tenure Studies, Norwegian University of Life Sciences.

Brasselle, A.-S., F. Gaspart, and J.-P. Platteau (2002). Land tenure security and investment incentives: puzzling evidence from Burkina Faso. *Journal of Development Economics 67*(2), 373 – 418.

Chirwa, E. W. (2005). Adoption of fertiliser and hybrid seeds by smallholder maize farmers in southern Malawi. *Development Southern Africa 22*(1), 1–12.

Deininger, K. and S. Jin (2006). Tenure security and land-related investment: Evidence from Ethiopia. *European Economic Review 50*(5), 1245 – 1277.

Gebremedhin, B. and S. M. Swinton (2003). Investment in soil conservation in northern Ethiopia: the role of land tenure security and public programs. *Agricultural Economics 29*(1), 69–84.

Government of Malawi (1995). The agricultural and livestock development strategy and action plan. Technical report, Ministry of Agriculture and Livestock Development,, Lilongwe, Malawi.

Holden, S. T., K. Deininger, and H. Ghebru (2009). Impacts of low-cost land certification on investment and productivity. *American Journal of Agricultural Economics 91*(2), 359–373.

Holden, S. T., R. Kaarhus, and R. Lunduka (2006). Land policy reform: the role of land markets and women's land rigths in Malawi. Noragric report no. 36, Norwegian University of Life Sciences.

Holden, S. T., K. Otsuka, and F. Place (2008). *Emergence of Land Markets in Africa: Impacts on poverty, equity and efficiency*. Washingthon DC: Resources for the Future press.

Jacoby, H. G. and G. Mansuri (2008). Land tenancy and non-contractible investment in rural Pakistan. *The Review of Economic Studies 75*(3), 763–788.

Ligomeka, B. (2013). Culture Malawi: Property grabbing impoverishes widows. Technical report, Inter Press Service News, 8 October 2003, accessed: 28 march 2013.

Lunduka, R. W. (2009). *Land rental markets, investment and productivity*. Ph. D. thesis, Department of Economics and Resource Management, Norwegian University of Life Sciences.

Matchaya, G. (2009). Land ownership security in Malawi. *African Journal of Agricultural Researach 1*(4), 001–013.

Ministry of Finance and Development Planning (2011). Economic valuation of sustainable natural resources use in Malawi. *Unknown Journal*.

Peters, P. E. (2010). "our daughters inherit our land, but our sons use their wives' fields": matrilineal-matrilocal land tenure and the new land policy in Malawi. *Journal of Eastern African Studies 4*(1), 179–199.

Peters, P. E. and D. Kambewa (2007, 8). Whose security? deepening social conflict over customary land in the shadow of land tenure reform in Malawi. *The Journal of Modern African Studies 45*, 447–472.

Place, F. and K. Otsuka (2001a). Population, tenure, and natural resource management: The case of customary land area in Malawi. *Journal of Environmental Economics and Management 41*(1), 13 – 32.

Place, F. and K. Otsuka (2001b). Tenure, agricultural investment, and productivity in the customary tenure sector of Malawi. *Economic Development and Cultural Change 50*(1), pp. 77–100.

Reniers, G. (2003). Divorce and remarriage in rural Malawi. *Demographic Research S1*, 175–206.

T., H. S., O. K., and P. F. (Eds.) (2008). *The Emergence of Land Markets in Africa: Impacts on Poverty, Equity and Efficiency*. Resources for the Future Press.

Takane, T. (2008). Customary land tenure, inheritance rules, and smallholder farmers in Malawi. *Journal of Southern African Studies 34*(2), 269–291.

Wooldridge, J. (2002). *Econometric Analysis of Cross Section and Panel Data*. Cambridge, Massachusetts.: The MIT Press.