



# Does prolonged illness contribute to adaptive land use practices among subsistence agricultural households in rural Mozambique?



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## ABSTRACT

The environmental effects of disease are broadly recognized but still not fully understood. The impact of health on economic development has been well-documented, as have how changes in land cover can contribute to poor health. However, little is known about how changes in health may impact land use and land cover. Fallowing has long been regarded as an advanced, sustainable land use decision employed by subsistence agriculturalists. In the presence of a prolonged illness, however, subsistence agriculturalists may also potentially use fallowing as a coping mechanism. In this paper we seek to understand the extent to which fallowing is used as a coping strategy by households facing a prolonged illness. If illness threatens a household's labor supply, it could affect their ability to cultivate all of their land and may impact food security and general economic well-being. Additionally, it may also impact the actual landscape, as previously agricultural land may revert to a transitional state or land abandonment. This study employs mixed methods to determine if unhealthy agricultural households use fallowing as a coping strategy, identifies whether or not unhealthy fallowing households are more vulnerable agriculturally and economically than their healthier fallowing counterparts, and examines whether there is a land cover effect that can be detected using Landsat TM/ETM + satellite imagery.

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## 1. Introduction

Health has long been recognized as a form of human capital (Becker, 1964, 1992, 2007), and many studies have examined how changes in the landscape impact human health (Lindblade, Walker, Onapa, Katungu, & Wilson, 2000; Patz et al., 2004; Vanwambeke et al., 2007; Vasilakis, Cardoso, Hanley, Holmes, & Weaver, 2011). However, few studies have examined the impact of health on the landscape in detail. Humans are inextricably coupled with their environment, and the strategic use of agriculture is particularly critical to survival in many developing countries. Many residents of poor countries still rely on agriculture as the basis of their overall wellbeing. This type of physically demanding livelihood closely links the health status of household members with the land they cultivate (Tschirley & Benfica, 2001), a microcosm of the human-environment interaction. We hypothesize that subsistence agricultural households may alter their land use decisions to cope with

prolonged illness and that this may have consequences for livelihood sustainability. The primary catalyst by which this would occur is through a decline in labor productivity.

We examine the impact of prolonged illness on agricultural land use and land cover change (LULCC) in Mozambique. Altered land use decisions may take multiple forms; reductions in the area cultivated or the rental of land represent possible opportunities to alter the household's land use. Fallowing is one of the many sustainable land use techniques employed by subsistence agriculturalists, which is typically classified as an advanced agricultural practice, aimed at improving output efficiency (Grisley & Mwesigwa, 1994; Sauer, Davidova, & Latruffe, 2012; Thangata, Hildebrand, & Kwesiga, 2007). Fallowing land can result in a temporary reduction of land under cultivation as agriculturalists leave an area unplanted to allow it to recover for future production. However, reducing the land area under cultivation may also be an unintended consequence of economic shocks that render households unable to cultivate all of their land; this may manifest itself as a temporary increase in fallowing. In this paper, we use mixed methods to explore the alternative use of fallowing as a coping strategy to deal with health shocks. Specifically, we posit that just as the practice of fallowing can be used for improving the land, so

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too can it be used as a coping strategy for unhealthy households. This paper examines the geography of prolonged illness amongst subsistence agricultural households and villages in rural Mozambique and the potential implications for LULCC.

To determine what role health may play in LULCC, mixed methods are employed hierarchically, that focus on altering household land use decisions as a possible coping strategy for unhealthy agricultural households. At the national level, the relationship between fallowing and prolonged illness is established using a regression framework with a nationally-representative agricultural data set known as The National Agricultural Survey of Mozambique, or the TIA, the acronym for the Portuguese title of the survey. At the regional level, we conduct an in-depth examination of households in Gaza Province in southern Mozambique. We focus on Gaza Province as it is an agricultural region with one of the highest disease burdens in the country. The regional analysis enables a more nuanced examination of households that report fallowing, and specifically allows us to identify how the agricultural, demographic, and socioeconomic characteristics of unhealthy households that engage in this practice differ from their healthier counterparts. Then, at the local level, we employ remote sensing techniques on Landsat imagery from two case study villages in the Chokwe district of Gaza Province to explore the potential to detect land cover change brought about due to prolonged illness.

### 1.1. Fallowing, health, and its detection

Fallowing has long been practiced by subsistence agriculturalists throughout much of Africa to help improve agricultural output on small parcels of land (Boserup, 1985). The classic practice of fallowing entails leaving cropland uncultivated for a season or more to help restore nutrients to degraded soils (Boserup, 1985; Drechsel, Gyiele, Kunze, & Cofie, 2001; Gaiser, Judex, Igué, Paeth, & Hiepe, 2011; Sauerborn, Sprich, & Mercer-Quarshie, 2000). This study contributes to a better understanding of the drivers behind the decision to fallow within the context of high disease burdens in rural areas heavily reliant on subsistence agriculture.

HIV/AIDS is a significant threat to food security in this region, ushering in what has been described as a new variant famine (deWaal & Whiteside, 2003). In Mozambique, many families rely heavily on agriculture, with maize and cassava representing the core staple crops for rural households. These crops are labor-intensive, often cultivated via a hand hoe, and are rain fed, requiring physically strenuous work and long hours (Donovan & Tostão, 2010). Thus, illness, particularly among young adults, has the ability to deplete a household's labor base. Mather and Donovan (2008) found that the death of a prime-age adult in Mozambique can have significant effects on the livelihoods of agricultural households, with the death of a male head accounting for an average loss of 25% in crop income and an average loss of 88% in non-farm income. Additionally, illness among adult members can affect a household's livelihood by diminishing its labor productivity and supply (Chicoine, 2012; Fox et al., 2004; Masanjala, 2007).

Remote sensing analyses of how LULCC affects health status is the dominant mechanism studied in the literature, many with a focus on how changes in LULCC can drive outbreaks of infectious disease (Estrada-Peña, 2002; Lindblade et al., 2000; Midekisa, Senay, Henebry, Semuniguse, & Wimberly, 2012; Patz et al., 2004; Vanwambeke et al., 2007; Vasilakis et al., 2011; Young, Tullis, & Cothren, 2013). Largely missing from the literature are studies examining the impact of health on LULCC. Boutayeb et al. (2009) examined how malaria impacts agricultural productivity in developing countries, but stops short of assessing the impact on the physical environment. Zhang, Castro, and Canning (2011) took their assessment one step further and examined the probability of a plot

of land being inhabited based on a risk assessment of malaria occurring within the area. The finding that plots were less likely to be inhabited in areas where malaria risk was high but this effect was partially mediated by non-resident farming of the plot. Thus, some limited evidence suggests that illness can reduce the amount of land cultivated by affected households.

## 2. Study area

Mozambique is a southern African country that has struggled to contain the spread of HIV/AIDS (Audet et al., 2010). This disease is notable for this study because of its concentrated impact on prime-age adults, who are the most economically and agriculturally active subset of the population. The 2009 estimated HIV prevalence for Mozambique is 11.5%, one of the ten highest rates worldwide (DHS, 2009). However, there is significant geographic variation, and prevalence is highest in the south. The region of focus for this study, Gaza Province, represents one of the most impacted populations with an estimated HIV prevalence of 25.1% in 2009 (DHS, 2009). The case study villages for this research, Chokwe and Conhane, are located in Chokwe district, an area characterized by high agricultural productivity.

Approximately 85% of the population in Mozambique engage in small-scale agricultural production as a primary livelihood strategy (FAO, 2015). Much of the area is smallholder agriculture with very limited use of technology, making households reliant on human labor (Jayne, Mather, & Mghenyi, 2010). In Mozambique, fallowing is typically practiced in the form of shifting cultivation (Nhantumbo, Ledin, & Du Preez, 2009). Chokwe district has the largest irrigation network in the country and as a result, the cash cropping system is strong in this region (Charlwood et al., 2013; Silva, 2008). There has been a growing emphasis on cash crops and the agricultural sector as a whole as part of the government's poverty alleviation strategies (PARPA, 2007; PARPA, 2011; Tschirley & Benfica, 2001).

The villages of Conhane and Chokwe were chosen from the TIA data to further examine the association between prolonged illness and alterations in agricultural LULCC. Both villages are located in the Chokwe irrigation scheme. Conhane is located roughly 18 km southeast of the provincial market center of Chokwe. Fig. 1 provides a map that situates the study villages with respect to Gaza Province.

## 3. Data and methods

This study uses a three-tier hierarchical mixed methods analysis to address whether or not prolonged illness has an impact on agricultural land use, and whether this effect can be detected on the landscape. First, we conduct a regression analysis at the national level using TIA data for the years 2002, 2005 and 2008<sup>1</sup> to determine whether or not unhealthy subsistence agriculturalists employ different land use practices as a coping strategy for experienced prolonged illness. Additionally, qualitative reports on coping strategies are explored for top approaches used to mitigate the impact of prolonged illness. Second, we explore regional dynamics using multivariate analysis of the TIA data for Gaza Province to construct household profiles for the sample that reports fallowing. This approach enables us to identify statistically significant differences between unhealthy fallowing households and their healthier fallowing counterparts. Finally, at the local level, we closely examine land cover changes between 2002 and 2008 in two agriculturally-reliant villages. These villages were chosen as they represent areas

<sup>1</sup> A TIA survey for 2012 exists but was not included in this research as this survey dropped health related questions.

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