



Land ownership and technology adoption revisited: Improved maize varieties in Ethiopia



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ABSTRACT

The lack of land ownership can discourage agricultural technology adoption, yet there is scarce evidence of the impact of land rental contracts on the adoption of improved crop varieties in developing countries. The current study investigates such impact using a nationally representative survey of Ethiopian maize farmers. In contrast to many previous studies, we show in a simple model that cash-renters are as likely to adopt improved maize varieties as owner-operators, while sharecroppers are more likely to adopt given that such varieties are profitable. Empirical analysis reveals a significant impact of sharecropping on improved maize variety adoption, and no significant impact from cash-rental, lending support to the above hypotheses. These results imply that improvements in land rental markets can potentially enhance household welfare through crop variety adoption in agrarian economies where land sales markets are incomplete or missing.

1. Introduction

Land ownership, or land tenure, has been increasingly investigated as a factor affecting modern agricultural technology adoption in Sub-Saharan Africa (SSA). From both theoretical and empirical perspectives, Gavian and Fafchamps (1996) find secure tenure encourages investments in soil conservation technologies in northern Ethiopia. Abdulai et al. (2011) conclude that land ownership tends to facilitate investment in soil-improving and natural resource management practices in Ghana. Oostendorp and Zaal (2012) also suggest that transfer rights, a measure of land ownership, stimulate the adoption of soil and water conservation technologies in Kenya. It is generally hypothesized that land ownership encourages agricultural technology adoption, while the lack of land ownership discourages it. The underlying argument is that the lack of land ownership, as usually reflected in land rentals, may preclude tenants from future technology-induced benefits due to the risk of eviction. Land ownership, on the contrary, can safeguard cash flows over time and facilitate asset liquidation given transferrable land rights and can also enhance access to resources such as credit (Feder and Nishio, 1998). All these factors can incentivize the adoption of technologies that require investments and that potentially increase the value of land.

Empirical findings of this literature, however, are mixed the hypothesized impacts can sometimes bear opposite signs and their magnitudes are usually small (see Brasselle et al., 2002; Place, 2009; Fenske, 2011 for literature syntheses from different perspectives). Such inconclusiveness is partly due to the failures to differentiate the varying characteristics of agricultural technologies. For example, Deininger and Jin (2006) show that the lack of land ownership, or tenure insecurity, can either discourage agricultural technology investment (if ownership security is exogenous) or encourage investment (if ownership security is endogenous). The latter observation accords with earlier literature that the threat of non-renewal may cause tenants to work harder and produce more (Cheung, 1969). Place (2009) further shows that the divergent impacts of land ownership on the adoption of different technologies in a comprehensive literature review. Hence, characteristics of agricultural technologies need careful differentiation to help disentangle any confounding impacts in search of policy implications.

While most studies in this literature focus on resource-conserving technologies, modern agricultural technologies also include productivity-enhancing ones such as improved crop varieties and fertilizer (Ersado et al., 2004), and possible impacts of land ownership on the latter need to be better understood. This literature bias could be partly driven by the belief that land ownership affects only long-term

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investments related to natural resource management but not short-term input use decisions. However, this is not generally true because even seasonal crop variety choices may have deferred impacts on productivity or risk-mitigation that could affect investments, which in turn depends on land ownership. Although a few recent studies have analyzed the impact of land ownership on the adoption of fertilizer (e.g. [Abdulai et al., 2011](#); [Ali et al., 2012](#)), these studies fail to consider crop variety choices which potentially affect fertilizer application decisions ([Heisey and Norton, 2007](#)). Despite land market imperfections, improved crop varieties have been a major driver of agricultural productivity growth in SSA (see [Evenson and Gollin, 2003](#) for a comprehensive cross-country analysis), which further results in welfare improvements in terms of poverty reduction ([Kassie et al., 2011](#); [Zeng et al., 2015](#)), and food security ([Shiferaw et al., 2014](#)). Understanding how land ownership affects improved crop variety adoption is therefore highly relevant in assisting ongoing market-oriented land reforms in SSA.

Empirical identification of the hypothesized impact is difficult due to confounding effects. For instance, resource-conserving practices such as tree planting can be adopted to demonstrate and strengthen claims to land rights ([Place and Otsuka, 2002](#)), while productivity-enhancing practices such as organic fertilizer that improves soil capital can also be adopted by tenants to increase the chance to continue land operation in the future ([Abdulai et al., 2011](#)). In both cases, causality can be reverse, but such potential endogeneity is not commonly recognized ([Brasselle et al., 2002](#); [Fenske, 2011](#)). Moreover, although the lack of land ownership is mainly manifested through land rental contracts,¹ few studies differentiate contract types such as cash-rental or sharecropping due to data limitations. These complexities need to be clearly understood by policy makers who hope to improve rural welfare from this perspective.

The current study assesses the impacts of land rental, as associated with two most important land rental contracts (cash rental and sharecropping), on improved crop variety adoption using a nationally representative survey of maize farmers in Ethiopia. We show in a simple model that, unlike the case of resource-conserving technologies, land rental does not discourage the adoption of improved crop varieties for cash-renters, but encourages adoption for sharecroppers if such varieties are profitable. Empirical evidence is robust in support of these hypotheses, suggesting that improvements in land rental markets can potentially enhance household welfare in agrarian economies where land sales markets are incomplete or missing.

2. Land ownership and maize production in Ethiopia

Land tenancy in Ethiopia has a long history, which stems from the feudal system that existed before the Derg government took power in 1974. Land distribution was skewed and a large share of land was operated by tenants. Early literature shows that the share of rented land was over 40 percent, and operating tenants represented a similar proportion of the total population ([Rahmato, 1984](#)). Sharecropping was the dominant type of land rental ([Holden et al., 2008](#)).

Land rental has been present in Ethiopia throughout history. Arbitrary eviction of tenants was a major feature of the land rental system in the feudal society ([Deininger and Jin, 2006](#)). The land reform in 1975 confiscated all land as state property, and cultivators were left with only user rights but prohibited from land rentals and labor hiring ([Holden et al., 2008](#)). Further, land redistribution through governmental power was common during the Derg regime under the stated objectives of overcoming inequality and landlessness ([Fenske, 2011](#)). Since the current government took power in 1991, land redistributions were largely reduced (with the exception of land redistribution in Amhara region in 1997–1998) and short-term land renting and labor

hiring were legalized. However, as permanent land transfer continues to be prohibited by enforced policies, the land sales market is still nonexistent in rural Ethiopia. Land inheritance is allowed and creates incentives for land rentals ([Crewett and Korf, 2008](#)). As a result, the short-term land rental market is expanding, and plot rentals are common due to land fragmentation ([Benin et al., 2005](#)). The scenario of Ethiopia therefore provides a unique context of study as the land rental market plays an active role to meet the expanding land demand without land sales market, and possible policy implications of the current study may also apply to other agrarian economies in SSA where land sales markets are underdeveloped and land rental widely exists.

Maize is one of the most important food and cash crops in SSA. In Ethiopia, maize accounts for the largest share of production by volume and is produced by more farmers than any other crop ([Chamberlin and Schmidt, 2012](#)). During the 2009–2010 production year, Ethiopia produced 3.89 million tons of maize on 1.77 million hectares of land ([Central Statistical Agency, 2010](#)). The average productivity of 2.20 tons per hectare was the highest among all cereal crops in the country.

In the last four decades, more than 40 improved maize varieties have been developed through joint efforts of the Ethiopian Institute of Agricultural Research and the International Maize and Wheat Improvement Center (CIMMYT). Improved maize seeds have been diffused mainly through the Ethiopian Seed Enterprise, the major seed producer and distributor, while regional seed enterprises such as Oromia Seed Enterprise, Amhara Seed Enterprise, and Southern Seed Enterprise also produce and sell maize seeds. Improved varieties are a major contributor of maize productivity growth. Recent literature associates the adoption of improved maize varieties in Ethiopia to a 47.6%–63.3% yield increase and consequently a 0.8–1.3 percentage reduction of poverty headcount ratio ([Zeng et al., 2015](#)).

Improved maize varieties can be categorized as either hybrid or open-pollinated improved varieties (OPVs). Hybrids have the highest yield, but are more costly to adopt as the restoration of hybrid vigor requires purchasing new seeds in each cropping season. The yields of OPVs are generally lower than those of hybrids (though still much higher than those of local varieties), but OPV seeds cost less than those of hybrids and may be recycled for up to three cropping seasons without significant yield loss. Many OPVs have specific traits which make their yields robust against challenging conditions such as droughts and pests. Seed recyclability also makes them especially attractive for areas with underdeveloped seed markets ([Jaleta et al., 2013](#)).

Adoption of improved maize varieties varies across agro-ecological regions throughout Ethiopia ([Jaleta et al., 2013](#)). Our data suggest that adoption rates as measured by area are higher in places of higher maize potential. No single variety dominates the whole adoption scenario, but hybrids are more popular than OPVs in general.

3. Theoretical framework

To illustrate the potential relationship between land rental contracts and the adoption of improved crop varieties, we build a simple theoretical model below. Our model is comparable to the mainstream literature that links land ownership and agricultural technology adoption (e.g. [Deininger and Jin, 2006](#)), but extends it to differentiate cash-rental and sharecropping contracts and to capture the specific characteristics of productivity-enhancing technologies. In this model, each farmer i is categorized as an owner-operator (O), a cash-renter (H), or a sharecropper (S). Regardless of land ownership, farmer i maximizes the present value (PV_i) of current cropping returns (R_i), net of total costs (C_i), plus the expected future net returns, V_i , consisting of all future revenues assumed to be realized in the second period and possibly downscaled by a tenure risk indicator, θ_i ($0 \leq \theta_i \leq 1$), due to the risk of losing land use rights (with r denoting the discount factor):

$$\max PV_i = R_i - C_i + \theta_i \frac{V_i}{1+r} \quad (1)$$

¹ Land rental contracts can be either written or oral, and it is often the latter in rural Ethiopia ([Holden et al., 2008](#)).

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