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Do Overlapping Land Rights Reduce Agricultural Investment?

Evidence from Uganda

Klaus Deininger
Daniel Ayalew Ali

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Abstract

The need for land-related investment to ensure sustainable land management and increase productivity of land use is widely recognized. However, there is little rigorous evidence on the effects of property rights for increasing agricultural productivity and contributing toward poverty reduction in Africa. Whether and by how much overlapping property rights reduce investment incentives, and the scope for policies to counter such disincentives, are thus important policy issues. Using information on parcels under ownership and usufruct by the same household from a nationally representative survey in Uganda, the authors find significant disincentives associated with overlapping property rights on short and long-term investments. The paper combines this result with information on crop productivity to obtain a rough estimate of the magnitudes involved. The authors make suggestions on ways to eliminate such inefficiencies.

This paper—a product of the Sustainable Rural and Urban Development Team, Development Research Group—is part of a larger effort in the group to assess the impact of land policies. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at kdeininger@worldbank.org.

Do overlapping land rights reduce agricultural investment?

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Klaus Deininger,[*] Daniel Ayalew Ali[*]

[*] World Bank, Washington DC

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1. Introduction

Investment, much of it attached to land, will be critical to ensure economic growth, poverty reduction, and sustainable natural resource management in the world's least developed countries, especially in Africa. Access to improved agricultural technology, infrastructure, and output as well as factor markets will increase the returns and therefore encourage such investment. Assuring investors that they will be able to reap the returns from investing through secure property rights will be fundamental to increase land-related investment. Yet, while a growing literature explores the impact of titling on investment and productivity of land use in Africa, the link between such programs and tenure security has often been tenuous. As a result, no clear consensus has yet emerged on whether insecure tenure is something one should be worried about and, if yes, what measures will be most effective in confronting it.

To address this issue, this paper quantifies the investment impact of property rights insecurity arising from overlapping land rights rather than comparing titled and untitled land. We do so for the case of Uganda, a country where overlapping property rights, many of them established a long time ago, are very common. This, together with the ability to rely on a large nationally representative household survey, allows us to go beyond the existing literature in three respects. First, while the historical genesis of overlapping rights makes it unlikely that such arrangements were chosen based on comparing the cost and benefits of different contractual forms, our ability to apply household level fixed effect estimation techniques to a large sample of (owner-cum-occupant) households who simultaneously operate own and usufruct parcels allows us to avoid many of the biases that have characterized cross sectional estimates in the past. Second, the existence of laws aiming to eliminate investment disincentives arising from overlapping property rights enables us to assess whether, and if yes to what extent, such laws have achieved their objective. This provides lessons on the scope to reduce underinvestment associated with insecure tenure through (legislative) means that stop short of changing the land ownership structure. Finally, information on tenants' willingness to purchase residual rights to land they currently occupy provides not only an independent indicator of the perceived efficiency losses associated with overlapping and insecure property rights, but can also help highlight options for possible decentralized mechanisms to change the land ownership structure and thus bring about efficiency gains associated with higher levels of investment in a way that may be more effective than what is proposed currently.

Our analysis contributes to the literature in three ways. First, we find that overlapping rights significantly reduce tenants' incentives to invest in trees, soil conservation structures and manure application, and that the effects are large by any measure. A conservative estimate suggests that investment disincentives from overlapping property rights alone can reduce productivity by up to 25% depending on the type of crop planted on the parcel. Second, we find that legal provisions aiming to give

de facto ownership rights to tenants on lands held only under usufruct helped to attenuate insecurity of property rights and brought investment incentives closer to that on own land but failed to fully eliminate underinvestment. This can partly be ascribed to limited knowledge of these provisions and fear about possible policy reversal even by those who know the policy. Third, the fact that a surprisingly large share of tenants is willing to pay for residual property rights and that the amounts offered vastly exceed the capitalized value of landlords' residual claims provides independent support to our results, suggesting that in situations where public sector efforts to enhance security of property rights are either infeasible or not credible, decentralized approaches to deal with these may merit greater attention.

The paper is structured as follows. Section two describes the evolution of Uganda's land tenure system, illustrating how overlapping land rights came into being and how the 1998 Land Act addresses them. It links land-related investment to poverty and equity by highlighting how low growth of agricultural productivity and declining soil fertility are at the root of a recent widening of rural-urban income gaps and introduces the conceptual framework and estimation strategy. Section three describes the data used and provides descriptive statistics on income sources, land rights, productivity, and land-attached investment for the overall sample and for the sub-sample of owner-cum-occupants used in the econometric analysis. Section four discusses results from the empirical analysis to make inferences on investment disincentives due to overlapping land rights, possible productivity implications, and the scope for solutions that may be satisfactory to both parties. Section five summarizes findings and policy implications.

2. Background and empirical approach

To motivate our analysis, this section highlights key historical events that have reduced tenure security for a large number of occupants and measures taken by the recently passed Land Act to restore such security, based on recognition of the importance of land-related investment and higher agricultural productivity for pro-poor growth that will help narrow the gaps between rural and urban well-being in Uganda. We use this to outline the estimation strategy to be utilized and discuss some of the associated econometric issues.

2.1 Origins and incidence of overlapping tenure in Uganda

The main reason for the prevalence of overlapping property in Uganda's land tenure system dates back to colonial occupation. Under the 1900 Buganda agreement,[1] the British awarded large tracts of "*mailo*" land, together with any smallholders occupying them, to the Buganda king and his notables (Brett 1973). Lands not covered under this agreement were declared Crown Land, allowing the government to alienate

[1] In this agreement, the total area of Uganda, estimated at 19,600 square miles, was divided into three broad classes. The first class, comprising 958 square miles, was given to the Buganda king (kabaka), the second one, amounting to a total of 8,000 square miles, was distributed equally among 1,000 chiefs and private land owners. The remainder was declared Crown Land and vested in the colonial Government (West 1972).

such land (including their occupants) under freehold or leasehold grants. This implied that peasants on customary lands had no ownership rights of their own but were instead declared tenants often with little security against eviction. In 1928, residual rights of original occupants recognized and strengthened through laws which put a limit on the rent to be paid and provided protection against eviction without compensation for improvements.[2] Still, the overlap and implied insecurity of rights is likely to have undermined incentives for land-related investment and provided a fertile ground for conflict.

Nationalization of land under Idi Amin's 1975 land reform decree added to this complexity. The decree abolished freehold and *mailo* ownership and converted all land held under these categories into leasehold but made no attempt to resolve the problem of overlapping land rights (Baland *et al.* 2007). In fact, overlapping rights (*kibanjas*) have become common outside of traditional *mailo* areas as well. The 1998 Land Act includes far-reaching steps to increase tenure security for occupants who had only use rights, customary land users, and women. Regarding the latter, the Land Act provides for formal recognition of customary land ownership and establishes procedures for customary owners to obtain a "certificate of customary ownership" that can be transferred through sale, rent, gift, or mortgage, and converted into freehold titles in an administrative process. It also aims to significantly strengthen women's land rights. However, effectiveness of these progressive features, many of which are effective without any formal process or survey, is hampered by flaws in the institutional designs for implementation (Hunt 2004). As a consequence, almost a decade after the Act's passage, hardly any implementation has happened, despite considerable grassroots demand (Rugadya *et al.* 2004).

Inability to resist political demands for reinstating *mailo* as a separate land ownership category or to abandoni *kibanjas* outside of *mailo* areas precluded award of full ownership to tenants, thus leaving overlapping land ownership structures intact. At the same time, attempts were made to attenuate disincentive effects from overlapping rights by granting far-reaching protection to tenants. *Bona fide* occupants, defined as those who had peacefully occupied a piece of land for 12 years before passage of the Act, were provided with permanent and inheritable usufruct rights in return for annual payment of a nominal ground rent.[3] Recognizing that the overlap of rights thus enshrined in law could undermine investment incentives and lead to inefficient land use, provisions were also made for a land fund, with applicability initially limited to Kibaale district, to provide resources to buy out landlords' residual claims (Hunt 2004). Although neither guidelines nor funds for its operation have been made available, expectation of government intervention in the land market has already led to significant rises in self-assessed land prices (Deininger *et al.* 2006). These in turn make it more difficult to economically justify

[2] The legal provisions are contained in the *busuulu* (ground rent) and *envujju* (tribute) laws.
[3] The ground rent amounts to USh 1,000 (US$ 0.6) per tenant, irrespectively of the area occupied. *Mailo* tenants were also given the option of applying for a certificate of occupancy that would provide rights to give, sublet, mortgage, and inherit land, and that could be converted into freehold title with consent of the registered owner although no such certificates have yet been issued.

such an intervention at a scale commensurate with the dimensions of the problem, implying that overlapping rights will continue to be an important issue in Uganda for some time.

While the literature on this topic has focused on the difficulty to contract for longer-term inputs, there are two additional reasons that lead us to expect negative impacts on investment and efficiency of overlapping property rights in the Ugandan context. On the one hand, knowledge of the favorable provisions of the Land Act, most importantly the fact that landlords can not impose limits on *bona fide* tenants' ability to make investments, remains limited (Deininger *et al.* 2006). On the other hand, even tenants who are aware of the provisions of the Land Act are concerned that the current favorable policy stance may be reversed at some point in the future. Both are likely to reduce incentives for investment, thereby reducing the efficiency of land use and leaving landlords as well as occupants worse off.

The continued importance of agriculture for economic development and poverty reduction in Uganda implies that, in addition to exploring the magnitude of possible underinvestment on lands without clear property rights, finding ways to increase investment could have high social benefits. With more than 85% of the population still living in rural areas and agriculture accounting for 77% of employment and 50% of total output (Belshaw *et al.* 1999), land-related investment will be critical for growth and poverty reduction. Household survey data point towards a large and possibly widening gap between rural and urban levels of consumption and recent increases in poverty. After decreasing from 59.7% in 1992 to 37.4% in 1999/2000, rural poverty increased to 41.1% in 2002/2003. The fact that poverty among crop farmers is much above the rural average (Kappel *et al.* 2005), something that is often attributed to limited agricultural productivity growth (Republic of Uganda 2005), implies that ways to increase agricultural productivity will be critical to prevent widening of rural-urban income gaps.

Land-related investments will be critical in this respect because the scope for expansion of cultivated area which, together with elimination of implicit and explicit taxation of the agricultural sector, provided the basis for increased levels of agricultural productivity in Uganda during the 1990s (Blake *et al.* 2002), is diminishing rapidly. Studies highlight that, despite a favorable environment in the 1990s, land-related investment and diversification of the productive sector remained limited (Belshaw *et al.* 1999) and that the area expansion at the expense of woodlots, wetlands and natural grazing lands on which it was based was unsustainable to begin with (Place and Otsuka 2000, Pender 2004). Rates of manure and fertilizer application remain extremely low even by African standards, implying that Uganda is drawing down natural capital at an alarmingly rapid rate (Pender 2004). While overlapping property rights could possibly explain part of this phenomenon, no studies have thus far explored this issue. Below, we first discuss empirical literature on the link between property rights and investment and use this to present our empirical strategy.

2.2 Conceptual framework

The conceptual link between tenure security and transferability of land and incentives for investment and efficiency of resource use rests on arguments emphasizing three aspects of property rights, namely: (i) security against eviction; (ii) transferability; and (iii) access to formal documentation, normally in the form of public registries that allows use of land as a low-cost collateral for credit. These three aspects build on each other, i.e. lack of tenure security in the form of a pending threat of eviction will make it harder to transfer land or result in a much discounted price for doing so. More relevant for the Ugandan case, land that is "encumbered" by either the presence of a tenant who can not be evicted or a landlord who holds residual rights to it will be virtually worthless as collateral even in cases where it is registered.[4]

Secure rights protecting them against eviction or other ways of land loss will provide land users with assurance that they will be able to enjoy the fruits of their labor, thereby encouraging them to make long-term investments and manage land in a sustainable fashion (Besley 1995). Adding the right to transfer land to others, either through rental or sale, has two effects. First, it will encourage investment as it makes it easier to liquidate such investment in case of an exogenous shock (Ayalew *et al.* 2005, Deininger and Jin 2006). Second, transferability is also a precondition for bringing land to more efficient uses, thus maximizing output and allocative efficiency and having labor move from agriculture to non-agricultural pursuits in the broader context of economic development (Kung 2002).[5] Finally, having a formal and low-cost way to unambiguously identify land ownership without a need of physical inspection, enquiry with neighbors, or interaction with an extensive bureaucracy will allow the use of land as collateral, thereby reducing the transaction cost of credit access. In the absence of other obstacles to the operation of financial markets, formalizing land tenure and establishment of registries can thus encourage development of financial markets and of more sophisticated financial instruments that draw on the abstract representation of property rights provided by formal titles (de Soto 2000).

Empirical quantification of the investment-disincentive effects of insecure tenure raises problems of measurement as well as attribution. The first set of issues arises as tenure insecurity is multidimensional and subjective and many of the relevant elements are easily observed or measured by

[4] Although our emphasis is not on credit effects, we note that as a title registration system was introduced and maintained for the about 15% of the area which was given out by the British as *mailo* lands, Uganda is one of few African countries where a functioning system of title registration covers a non-negligible share of land. However, failure to include encumbrances, in particular the presence of tenants, on the titles severely undermines the usefulness of these documents. Banks who lent against such titles discovered that, due to the presence of tenants with far-reaching rights on the land which they had accepted as collateral, the land was virtually worthless and the loans had to be written off. The widespread incidence of such encumbrances, together with the failure to disclose them on the title implies that it is near-impossible to use land title to gain access credit even for those who own unencumbered *mailo* land and, as a consequence, very few owners bother to update their titles. Unless it is accompanied by far-reaching changes in the type of information registered, modernization of the *mailo* registry is thus unlikely to improve impact on credit access.

[5] In fact, with rapid economic transition (e.g. at the urban fringe or in areas of rapid commercial expansion) and the associated increase in the number of transactions, ways of ensuring the legitimacy of land transfers and eliminate incentives for opportunistic behavior by one of the contracting parties have acquired great importance in many African land tenure systems (Lavigne-Delville 2006).

outsiders. While some studies investigated the impact of title or other forms of formal documentation (Pinckney and Kimuyu 1994, Migot-Adholla *et al.* 1994, Roth *et al.* 1994), possession of a formal document is not necessarily equivalent to higher levels of tenure security (Atwood 1990). Other studies have therefore used subjective measures of the threat of expropriation (Jacoby *et al.* 2002), composite measures of self-assessed transfer rights (Blarel 1994, Matlon 1994, Besley 1995, Place and Migot-Adholla 1998, Place and Otsuka 2001), or a combination of the two (Ayalew *et al.* 2005, Deininger and Jin 2006, Deininger *et al.* 2006). The results of any empirical study will have to be interpreted accordingly, bearing in mind that measures of transfer rights already incorporate tenure security aspects, thus making it difficult to separate the two.

A second empirical challenge is that tenure security will often not be exogenous. In our case, this concern is attenuated by the fact that many of the parcels[6] held under usufruct had been assigned long time ago rather than having been selected by the households cultivating them. In fact, the exogenous historical assignment of land, together with the lack of market transactions for encumbered land and the absence of readily available opportunities to change the tenure status of occupied land to full ownership provides us with a situation that is akin to a natural experiment.[7] It implies that, as long as we will be able to control for systematic differences across households, it will be possible to obtain an estimate of the impact of tenure status on investment. While some of the relevant household characteristics, e.g. access to capital and education, can be controlled for in a regression framework, others such as managerial skills and entrepreneurial drive are not easily observed. If, as one would expect, such unobservable attributes are positively correlated with a household's propensity to have title or other measures of tenure security and transferability of land failure to correct for this would result in upward bias on estimates of the impact of title even if one were to control for differences in title-holders' observed characteristics.

A standard way of correcting for the impact of unobserved characteristics in situations where multiple observations that differ in the characteristic of interest e.g. plots with different tenure status are available for the same unit of observation, normally a household, is to use within-household fixed effects estimates. Although this technique has been applied to test for differences in input intensity and outputs between sharecropped and owner-cultivated plots (Shaban 1987), its use for land-related investment has been limited. The fact that our sample includes a much larger number of households who simultaneously cultivate land held under usufruct and full ownership than has been available in similar studies allows us

[6] Throughout this paper, parcels are defined as contiguous pieces of land with no variation in tenure status whereas plots are contiguous pieces of land of given tenure that are cultivated with a specific crop or mixture of crops. The number of plots is thus always equal to or larger than the number of parcels.

[7] The combination of a very active market for unencumbered together with virtual non-existence of market transactions for encumbered land is visible from descriptive statistics which indicated that more than 40% of owned parcels but less than 4% of occupied ones had been acquired through purchase.

to use this method to empirically identify tenure security effects.[8] Moreover, as legal provisions imply recognition of the occupancy rights of tenants who have occupied their land for 12 years, we can assess whether, and if yes to what extent, such legal action to make usufruct rights permanent and heritable has been effective in bringing investment incentives closer to the social optimum by testing for differences in the level of investment between those tenants who are recognized and those who are not.

2.3 Estimation strategy

The types of land-related investment considered in our empirical estimation are establishment of fruit and coffee trees in the last 5 years; and short-term measures such as terracing and bunding, and manure application during the last year.[9] In each case, dummy variables are used to indicate whether or not this type of investment had been undertaken using a linear probability model which, according to the literature will yield consistent estimates of the parameters in question (Heckman and MaCurdy 1985, Angrist 1991, Hoxby 1996).[10] Letting *i* denote parcels and *h* households, the equation to be estimated is:

$$I^{Q}_{hi} = \gamma_T D_{hi} + \gamma_W W_h * D_{hi} + \gamma_M M_{hi} + \gamma_D M_{hi} * D_{hi} + \boldsymbol{\gamma}_L' \boldsymbol{L}_{hi} + \boldsymbol{\beta}' \boldsymbol{X}_{hi} + \alpha_h + \varepsilon_{hi}, \quad (1)$$

where I^{Q}_{hi} is a dummy that equals one if household *h* invested in land improvements of type *Q* on parcel *i*;[11] D_{ih} is a dummny equaling one if parcel *i* is owned by the household and zero if it is operated under usufruct; M_{hi} is a dummy indicating *mailo* or freehold tenure, $\boldsymbol{L}_{ih}$ is a vector of two dummies indicting whether a parcel held under usufruct enjoys legal protection; W_h denotes household wealth; $\boldsymbol{X}_{ih}$ is a vector of parcel-specific characteristics; α_h is the household-specific fixed effect; ε_{ih} is an unobserved parcel level error term with mean zero and constant variance; and $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ are the parameter vectors to be estimated. As noted earlier, the fixed effect α_h controls for unobserved household-specific factors, e.g. farming ability and motivation that affect the propensity to invest on owned and occupied parcels equally but which, unless controlled for, would bias any empirical estimates.

In this context, γ_T will provide a measure of the ownership effect, i.e. the increment in the probability of a specific type of investment having been undertaken on owned as compared to usufruct land by the same household. A key difference between customary and *mailo* or freehold land is that the latter is normally registered so that the coefficients γ_M and γ_D would indicate an impact of formal tenure

[8] With more than 1,700 households who simultaneously operate at least one parcel under ownership and one parcel under tenancy, our sample is an order of magnitude larger than that of other studies, e.g. a recent study on Nicaragua that relies on less than 100 households (Bandiera 2007).
[9] As neither of these requires large capital outlays, any impacts we may find would be attributable to tenure security- and transferability- than to credit market-effects associated with better definition of land rights.
[10] To deal with concerns about possible hetroskedasticity, we use robust standard errors and t-statistics throughout. For trees, the dummy variable is complemented with the number of trees planted during the last 5 years in a random effect tobit model. Results, which are very similar to those for the linear probability model, are available upon request. No ordinal measures of the intensity of investment (e.g. the length and height of terraces or bunds) were available that would have allowed us to do the same for our other measures of investment.
[11] Although it is not a measure of investment, we also include a measure indicating whether or not any trees existed on a given parcel. Among others, this allows to compare our results to those obtained in other studies.

status on investment, either independently or only for parcels that have ownership rights. To test whether possible investment-effects of ownership vary with household wealth, something that could point to either credit constraints or risk aversion affecting investment behavior, we include an interaction term with this variable. As the 1998 Land Act provides legal protection for usufruct parcels that had been occupied for 12 years or more, one of the elements of $\boldsymbol{L}_{ih}$ is a dummy for a parcel having been occupied for longer than this period. To be able to distinguish the impact of explicit legal protection from that brought about by the mere passage of time, we also include a dummy equaling one if the parcel had been occupied for longer than 5 but less than 12 years. Letting γ^1_L and γ^2_L be the coefficients corresponding to the former and the latter, respectively, we can test whether providing legal protection attenuates ($\gamma^1_L>0$) or completely eliminates ($\gamma^1_L= \gamma_T$) investment disincentives associated with usufruct and whether such an effect is associated with the legally stipulated period ($\gamma^1_L > \gamma^2_L$) or the mere passage of time. This effect may vary between *mailo* and non-*mailo* land. Finally, the vector of control variables includes parcel level measures of soil fertility, topography, length of possession, distance to homestead, and access to water sources.

With Y_{hi} denoting the monetary value of output or the amount of total or family labor days per acre in an output or input regressions, we can estimate an equation to compare outputs and key inputs between owned and occupied parcels cultivated by the same household as

$$Y_{hi} = \gamma_T D_{hi} + \boldsymbol{\beta}'\boldsymbol{X}_{hi} + \gamma_M M_{hi} + \gamma_D M_{hi} * D_{hi} + \varphi'\boldsymbol{K}_{hi} + \alpha_h + \varepsilon_{hi}, \quad (2)$$

where $\boldsymbol{K}_{ht}$ is a vector of crop dummies and the remaining variables are as defined above. The purpose of doing so is twofold. First, it allows us to test whether, once the fixed investment associated with the cultivation of permanent crops and other observable characteristics are accounted for, land tenure will still have a systematic effect on the level of output obtained or input use. As there is no justification in theory for such an effect, failure to reject the hypothesis that γ_T=0 in either regression would imply presence of systematic but unobserved differences between owned and occupied parcels and can thus serve as a test of the quality of our empirical framework. Second, as the element of $\boldsymbol{\varphi}$ corresponding to a particular crop in the yield regression is nothing but the percentage increase of output associated with planting a tree crop, it can, together with the coefficient for tree investment from (1), be used to approximate the potential productivity impacts of more secure land rights.

One of the difficulties of implementing (2) empirically is that, because of the prevalence of mixed and intercropping in Uganda, data on output, unlike information on inputs and crops grown which is available at the plot or parcel level, respectively, was collected only by crop. Thus, while we are able to estimate an equation for labor input at the parcel level, the output equation can only be estimated at the household level. To eliminate errors that would have been introduced by apportioning outputs to parcels

of different tenure in cases where the same crop was grown on owned and occupied ones, we drop parcels if, in the same household, there is another parcel of different tenure devoted to the same crop, either as a pure or mixed stand. This implies that, for the case of output, our sample contains owner-cum-occupants who cultivated different types of crops on at least one of their owned and their occupied parcels.[12]

3. Data and descriptive evidence

Descriptive evidence from a large and nationally representative household survey at household and parcel levels illustrates the large number of owner-cum-occupants who differ from pure owners and, to a lesser degree, occupants, in few of the variables of interest. At the same time, it points towards presence of systematic differences in investment between owned and occupied parcels which provide the motivation for more detailed econometric analysis.

3.1 Data sources and household characteristics

The data for our study come from the 2005/2006 Uganda National Household Survey (UNHS), fieldwork for which was conducted by the Uganda Bureau of Statistics from May 2005 to April 2006. The survey collected information at the community, household, and parcel level for about 7,500 households in 753 EAs including 30 IDP camps. Household level data cover demographics, main economic activities, education, health, assets, income levels and sources, as well as consumption and welfare indicators. The agricultural module provides information on ownership status, crop production, input use and land-related investment at the parcel level, complemented by other forms agricultural income.[13] The 2002 population census was used as a sample frame. Following stratification into urban (30%) and rural (70%) sub-samples, enumeration areas (EAs) were chosen with the probability of selection being proportional to size. Based on a listing of households in each of the selected EAs, 10 households per EA were randomly sampled. As table 1 illustrates, 5,530 of the sample households were involved in agricultural activities. Of these, about 31%, or 1,728 with 5,448 parcels, are mixed owner/occupants who operated at least one parcel under full ownership and one under usufruct. This sub-sample forms the basis for our analysis.

Descriptive statistics point towards a number of interesting features. First, cultivation of land that is only occupied rather than owned is widespread; only some 49% of cultivators are pure owners, 20% cultivate only occupied land, and about 31% are owner-cum-occupants who cultivate owned and occupied land simultaneously. Second, although per capita expenditure by those in agriculture is, with about 19

[12] To check whether this introduces any non-randomness, we compare total asset endowments and their composition, monthly consumption expenditure, and basic demographic characteristics between households who are included and those who have at least some parcels dropped. And find no significant differences in either of them.

[13] Information on crop output was collected at the crop level, separately for the two main agricultural seasons (July - December 2004 and January - June 2005). A diary was used for continuously harvested crops and prices, in addition to standard socio-economic information, were collected at the community level.

US$ per month,[14] significantly below that by non-agriculturalists (45 US$ per month), pure owners are better off than the rest in terms of total land owned (9.5 vs. 3.2 acres for owner-cum-occupants), the value of own land, livestock, and non-land assets (US$ 4,011, 968 and 1733 vs. 1651, 227, and 1252, respectively), and overall welfare as measured by per capita income (US$ 226 vs. 193). Third, while crop productivity[15] for pure occupants is not significantly different from that for pure owners (US$ 95.3 vs. US$ 96.7 per acre) it is below that achieved by owner-cum-occupants (US$ 110.8/ac.). While pure owners have access to more land than owner-cum-occupants, there is no significant difference in the amount of land cultivated by the two groups during the 2004/5 agricultural season. Pure occupants cultivated significantly less land than any of the two other groups and, as a result, derived a much larger share of their income (42%) from wage employment, as compared to mixed farmers (24%) and pure owners (30%). Finally, with only 16.5% of households and 9.5% of women knowing about the 1998 Land Act, legal awareness remains low.

3.2 Parcel level characteristics

Tables 2 and 3 provide evidence on physical characteristics, perceived property and transfer rights and the incidence of land-related investments, and on cropping patterns and intensity of input use, respectively, at the parcel level.[16] In all cases, information is provided for the full sample (cols. 1-3) and owner-cum-occupants (cols. 4-6), further distinguishing parcels under full ownership and under usufruct for each of them. There is little appreciable difference in physical parcel attributes such as land area, land quality, topography, or distance to the owner's homestead, between owned and usufruct land for any of the samples. Second, despite the lack of differences in physical characteristics, the perceived likelihood of conflict on parcels held under usufruct is, with about 20% as compared to 11% significantly higher than on own parcels, even within the same household and despite the fact that usufruct parcels are more likely to be held under *mailo*, freehold, or leasehold and thus can be formally registered. This provides a first indication that incentives to invest may be systematically lower on usufruct than on own parcels. Third, the fact that perceived rights to transfer and mortgage parcels held under usufruct are much more restricted suggests that, in addition to possible investment disincentives, limits on the ability to lease or otherwise transfer such parcels to others for (temporary) cultivation could further impair the efficiency with which they are used.[17] Despite the fact that there are no legal provisions constraining investment on

[14] To improve readability, we report values in US $ terms throughout, using an exchange rate of 1860 Uganda Shilling to the dollar.
[15] Crop productivity is defined here as plot area weighted average of the value of crop output per acre of the two agricultural seasons.
[16] As in the regression analysis of input intensities (table 3), the unit of analysis is a parcel in a given season, parcels cultivated in both of Uganda's two agricultural seasons will contribute two observations to this analysis.
[17] Of course, within-household analysis as conducted here will not be able to uncover allocative efficiency effects of this nature. A similar argument applies to the ability to use land as collateral, which will be available at the household level. For example, if inability to use land as collateral would reduce input intensity, this would be a constraint only to pure occupants whereas owner-cum-occupants would be able to avail of credit (which would then be likely to affect input intensity on all parcels cultivated, irrespectively of their tenure status) as long as one of the parcels—most likely the one under full ownership—will be suitable as collateral.

land held under usufruct, even owner-cum-occupants perceive not to have the right to plant trees on more than 90% of the parcels they occupy, compared to only about 5% on the parcels they own.

In view of this, it should not be too surprising to find differences in the stock of investment between owned and occupied parcels, overall and for owner-cum-occupants only. Panel 2 of table 2 demonstrates that the magnitudes involved are non-trivial. The share of occupied parcels with trees is less than half that for owned ones. With 138 trees per acre on owned as compared to 13 on occupied ones, variation in tree-density on parcels where some investment occurred are even more pronounced. Differences between owned and occupied parcels are equally marked if new tree investment in the last 5 years is considered. The incidence of such investment on occupied parcels is less than one-fifth of that encountered on owned ones throughout. For example, for owner-cum-occupants, trees were established on 25% of owned as compared to 3% of occupied parcels and even where tree investment was undertaken, the numbers differ markedly; with 28 trees on average on owned as compared to 6 on occupied parcels. While slightly higher, soil conservation measures such as bunding, terracing, and mulching, were applied on 11% of occupied as compared to 28% of owned parcels. While application of manure is low in general, the incidence of manure use is over three times higher on owned as compared to occupied parcels.

Table 3 highlights the impact on cropping patterns at the parcel level. We note that perennials, e.g. banana and coffee are grown disproportionately on owned parcels whereas occupied parcels are mostly planted with annuals i.e. cereals, pulses and oilseeds. While application of purchased inputs is low irrespectively of tenure status, manure is more often and more intensively applied on owned parcels. The same is true for intensity of labor use which is markedly higher on occupied as compared to owned parcels. All of this calls for more detailed multivariate analysis.

4. Econometric evidence

Household-level fixed effect for investment and productivity of land use on owned compared to occupied parcels point towards significantly reduced investment incentives on the latter. While tenure no longer affects productivity if crop choice is controlled for, much higher levels of productivity under perennials suggest a significant productivity impact of tenure. Legal provisions reduce, but can not eliminate tenure security and the associated under-investment.

4.1 Investment impact of overlapping land rights

Results from linear probability household fixed effect estimates for land-related investments at the parcel level are presented in tables 4 and 5, separately for whether a parcel had any tree crops (col. 1), whether trees had been planted during the last 5 years (col. 2), and whether soil conservation or manure had been

applied over the last year (col. 3 and col. 4). Tenure security effects are identified based on comparing owned and occupied parcels by the same household. Regressions provide strong evidence supporting the hypothesis that ownership has a significant and large effect on increasing investment incentives.

A first result of interest relates to the high significance and large magnitude of the estimated coefficients. Compared to the ones under usufruct, owned parcels are 31 percentage points more likely to have trees and the probability of past tree and soil conservation investments on them in the applicable reference periods is higher by 17 and 13 percentage points.[18] A highly significant effect, albeit of rather small magnitude, emerges for application of manure. *Mailo* or freehold tenure, which is often synonymous with registration, is estimated to have no direct effect on investment levels. At the same time, the ownership-induced increase in investment incentives for trees, but not soil conservation and manure application, is much larger on freehold or *mailo* where full ownership is estimated to lead to an increase of 38 and 31 points in the probability of tree presence and of tree investment having been undertaken during the last 5 years, respectively. Estimated increases in the share of plots with a particular type of investment due to a simulated change of tenure status to full ownership on all occupied parcels are summarized in the bottom of table 4 for all and only occupied parcels, respectively. On occupied parcels, giving full ownership will increase tree-investment more than five-fold, manure application more than two-fold and will more than double the incidence of soil conservation. This suggests that current institutional arrangements are indeed associated with considerable underinvestment and that finding ways to eliminate them is a policy priority.

While the potentially large productivity effects are of great relevance for policy makers in Uganda, it is of interest to note that, to the extent that it is possible to compare, these effects are not only much larger but also significantly more robust and based on a more elaborate sample than what has been found in the literature. Although tree presence is an imperfect proxy for actual investment, the magnitude of the ownership effect obtained here is significantly larger (3 times for freehold and *mailo*) than the 13% obtained for Nicaragua although high levels of tenure insecurity in this country (World Bank 2003, Bandiera 2007) would lead one to expect a larger impact of clarifying land rights. The point estimate for the effect of ownership on manure application is above the one obtained in Pakistan using a comparable methodology (Jacoby and Mansuri 2006).

Second, and in line with the notion that none of the investments considered here require any significant cash outlay, the presence of a wealth effect, which could have been interpreted as an indication of risk aversion or credit constraints is rejected in all equations. This implies that providing more secure

[18] Separate regressions, as reported in appendix table 1, suggest that owned parcels are 14% more likely to have been planted with fruit and 7% more likely to have been planted with coffee trees.

tenure will benefit rich and poor equally. It also supports the hypothesis that, in the Ugandan context, realizing potential credit effects from land titles will require a more comprehensive restructuring of the registry. Although their magnitude remains modest compared to that of the ownership dummy, other parcel characteristics have the expected signs. Length of possession is estimated to increase the propensity to undertake tree, soil conservation investment and manuring by 0.2 points per additional year. The distance to the owner's homestead will reduce the likely to make both short- and long-term investments. Soil conservation measures but not tree investments are more likely on good quality land and swamps and wetlands where the returns from doing so are likely to be higher. Trees are more likely to be planted on larger parcels although parcel size does not matter for soil conservation.

Finally, we aim to infer the effectiveness of legal protection from coefficients on dummies for longer-term possession (5-12 and > 12 years, respectively) as discussed earlier. Relevant regression results and tests for relationships between coefficients, presented in table 5, lead us to conclude that granting legal protection to *bona fide* occupants attenuates investment disincentives in a way that goes beyond the mere passage of time. In the case of tree investment and soil conservation measures γ^2_L is insignificant and γ^1_L significant, suggesting that what we find is a legal rather than just a time-effect. Still, while it is not surprising to find that tests consistently reject the hypothesis of $\gamma^2_L = \gamma_T$ at the 1% level, pointing towards significant under-investment on parcels that were occupied for longer than 5 years, the same equivalent hypothesis (i.e. $\gamma^1_L = \gamma_T$) is also rejected at 5% throughout. This implies that, compared to parcels they own, households invest significantly less in parcels to which by law they have been granted permanent and heritable occupancy rights. The magnitude of such under-investment remains large; according to the point estimates, *bona fide* occupancy on customary land reduces the investment disincentives associated with lack of full ownership by about half for both soil conservation (γ_T=0.13; γ^1_L=0.07) and tree planting(γ_T =0.18; γ^1_L=0.10). On land with *mailo* or freehold tenure, legal protection is estimated to have no (additional) significant effect on reducing investment disincentives for soil conservation and a rather limited one for tree planting ($\gamma_T+\gamma_D$=0.33; γ^1_L=0.10). In both cases, but especially where land owners have formal documents, lack of full ownership is as a key factor that may undermine long-term investment.

4.2 Input use, yields, and productivity

Household fixed effects estimates of parameters with the number of days of labor input per acre and the value of crop output per acre as dependent variables are presented in table 6. We find that, in line with expectations, once crop choice is accounted for, land tenure has little impact on intensity of input use or the level of output. While this supports the notion that no important variables have been omitted from the regressions, the results also point towards a large productivity advantage of tree crops. One notes that

banana, fruit, and coffee either require significantly less total labor[19] input (coffee and banana) or produce much higher output values (fruits and banana) than other crops. While banana requires about 50% less total labor, the value of output is about 20% above the average, whereas coffee produces average levels of output with 27% less labor and fruits produce 42% higher levels of output with average levels of labor. Compared to vegetables and root crops which yield higher output (by 55% and 34%) but also require 44% and 25% more labor, respectively, productivity of tree crops is thus very favorable.

To quantify the associated effects, we value labor very conservatively at a rate of US $ 1 per day and noting that the mean levels of labor input and value of crop output per acre amount to 65 days and US $ 101, we note that the expected net productivity gain from having full ownership as compared to only occupancy rights on customary land is expected to amount to 3.5% for coffee, 16.3% for fruits, and 20.0% for banana with correspondingly larger gains of 9.3%, 31.9%, and 39.1%, respectively, on freehold or *mailo* land. To interpret these figures, note that they are very conservative estimates as they completely neglect the value of soil fertility investment which can be very large according to recent studies valuing annual nutrient loss due to lack of soil conservation at 20% of average household income (Pender *et al.* 2004). Given that in addition we also exclude any credit-related investment incentives due to clear land ownership, the coefficients estimated here points towards substantial economic effects of overlapping property rights.

4.3 Options to increase tenure security

Our results thus far imply that, despite legal provisions aiming to strengthen property rights to land that is only occupied but not owned, significant and quantitatively large investment disincentives persist and cause productivity losses of considerable magnitude. This makes it important to explore other ways of bringing investment levels on such land closer to the social optimum. To explore this, our survey asked households who occupied land under usufruct about their willingness to pay to acquire full ownership rights. Results, as reported in table 7, suggest that 40% of 2,804 owners were willing to pay for about 37% of the 4,478 occupied parcels overall or 43% of the 1,519 parcels under freehold or *mailo*. The median willingness to pay, US$ 215/acre for customary and US$ 269 per acre for *mailo* or freehold land is surprisingly large, both if compared to owners' median self-assessed value of US$ 403/acre. It is also high in view of the fact that, at least in the case of *mailo* or freehold, the economic value of landlords' residual claims to a perpetual ground rent of about US$ 0.6 annually is minuscule.

Although part of the stated willingness to pay could have its origin in non-economic values of land ownership, the fact that a large number of households are willing to spend large amounts of

[19] As was highlighted earlier in the descriptive statistics, the use of purchased inputs such as improved seeds, fertilizer and pesticides remains very limited and we focus therefore on labor as the main input.

resources to acquire full land ownership supports our notion of significant economic gains from full ownership that can not be realized by just legalizing tenants. More importantly from a policy perspective, it would imply that a program for buying out such residual claims may indeed be feasible and that more thinking on its possible design may be of interest. While there is no justification for a land fund, it may be worth thinking of a credit program that would provide such funds on a credit basis.

To explore factors underlying this phenomenon, and in particular whether the willingness to pay varies with tenure status, legal recognition and wealth, we run cross-sectional probit and tobit regressions (detailed results not reported) for probability and amount of resources willing to pay, respectively. While we do not find any significant effects of tenure status and legal recognition, some suggestive evidence is derived regarding the relationships between household wealth (excluding the value of owned land) and their willingness to pay in order to obtain full ownership rights on occupied parcels. The marginal elasticity of the reported amount that occupants' are willing to pay with respect to wealth, though inelastic with 0.36, is positive and statistically different from zero. But wealth elasticity on the probability of willingness to pay is very negligible (0.03), implying that poorer tenants will possibly be over-bid even if they are equally willing to buy full ownership rights on occupied parcels.

5. Conclusion and policy implications

Although a large literature explores the effectiveness of titling interventions, and the impacts of tenure security on investment and productivity of land use, the African literature has not led to a consensus on whether insecurity should be of concern to policy makers or on how to most effectively address it. Our findings contribute to the methodological and the policy debate. Methodologically, the ability to use within household fixed effect estimates allows us to demonstrate that tenure insecurity has statistically very significant effects on investment and thus the productivity of land use. The fact that both our sample and the point estimates obtained are several times larger than what is reported in the few comparable studies suggests that, in the case of Uganda, higher tenure security could considerably affect agricultural performance. As none of the effects found here is likely to be attributable to credit supply effects, any ability to harness such effects could further increase benefits. Second, we note that, partly due to limited credibility that may originate in contradictory policy stances, legal provisions aiming to remove tenure insecurity, though not completely ineffectual, failed to achieve the desired impact. Not too surprisingly, we find that such measures were particularly ineffective in encouraging tenants to make long-term investments on land that continues to be registered in the name of the landlord, implying scope for particularly large productivity gains in such situations.

Although the institutional structures explored here are specific to Uganda, our findings are of much broader applicability. They will be of particular policy relevance in two types of situations. One is the traditional case of redistributive land reform that awarded permanent and often heritable use rights to tenants without fully extinguishing owners' residual claims (Binswanger *et al.* 1993). Similar configurations could arise where reform beneficiaries received use rights while ownership is vested with the state bureaucracy and can be revoked in case of 'inappropriate' behavior or diversion of land to non-agricultural uses. The fact that we find large impacts on investment even in a situation where landlords' rights have *de jure* been all but eliminated leads one to expect much more pronounced effects in circumstances where tenants continue to have to pay rent. A second type of circumstances that is particularly relevant for Africa arises where, under conditions of land abundance, in-migrants were given cultivation rights the nature of which is not precisely defined and where greater land scarcity implies that these arrangements are increasingly questioned and in danger of being 'adjusted' or even revoked. In both cases, exploring the size of investment disincentives, and of measures that could help to reduce or eliminate such impacts, would be of considerable interest. Methodologically, doing so could allow to better distinguish tenure security, transferability, and credit supply effects of land-related interventions and to provide evidence on their significance and magnitude in specific settings. From a policy perspective, it could help to illustrate the range of institutional issues involved and the number of interventions that will affect tenure security and transferability of land rights.

Table 1: Key household characteristics by ownership status

	Total sample	Pure owners	Pure occupants	Owner-cum-occupants
Basic household characteristics				
Household size	6.0	6.1	5.1	6.4
Number of children less than 15	3.1	3.0	2.6	3.4
Number of adults	2.7	2.7	2.3	2.8
Number of the elderly above 60	0.3	0.4	0.1	0.2
Age of the head of the household	43.7	47.4	38.5	41.1
Female headed households (%)	25.9	26.1	33.3	21.0
Household level knowledge of land law changes (%)	16.5	16.9	17.9	15.1
Male adult knowledge of the changes in the land law (%)	14.5	14.9	15.1	13.3
Female adult knowledge of the changes in the land law (%)	9.5	9.4	11.1	8.7
Monthly expenditure per capita in US$	18.9	20.0	20.1	16.5
Total income per capita in US$	214.0	226.6	215.3	193.4
Share of agriculture (%)	42.1	42.1	30.9	50.0
Share of wage income (%)	29.7	28.1	41.8	24.4
Share of non-farm enterprise profit (%)	28.1	29.8	27.3	25.6
Assets				
Value of livestock in US$	570.3	968.2	114.2	226.7
Value of household assets in US$	1336.7	1650.4	733.0	1215.8
Value of enterprise assets in US$	59.2	82.7	36.9	36.1
Value of household and enterprise assets in US$	1395.9	1733.0	769.8	1251.8
Value of land with full ownership in US$	3093.6	4011.1		1651.7
Share of land value in total value of assets (%)	61.1	59.8		52.8
Area of own land in acres	5.7	9.5	0.0	3.2
Area of usufruct land in acres	1.3	0.0	3.1	2.3
Total Area of land in acres	7.0	9.5	3.1	5.5
Number of own land parcels	1.9	2.1		1.7
Number of usufruct parcels	1.6		1.8	1.5
Total Number of parcels	2.4	2.1	1.8	3.1
Crop production				
Area covered under crops during the second season of 2004	2.6	2.8	1.6	2.8
Value of crop output during the second season of 2004	347.5	366.9	164.0	419.3
Area covered under crops during the first season of 2005	2.7	3.0	1.6	2.9
Value of crop output during the first season of 2005	190.2	194.2	140.9	212.2
Value of crop output per acre[a]	101.5	96.7	95.3	110.8
Number of observations (households)	5530	2726	1076	1728

Source: Own computation from 2005/06 UNHS III

Notes:[a] Plot area weighted average of the value of crop output per acre of the two agriculture seasons.

Table 2: Land-related improvements and key parcel level characteristics by ownership status

	Full sample			Owner-cum-occupants		
	All	**Own**	**Usufruct**	**All**	**Own**	**Usufruct**
Parcel characteristics						
Parcel area in acres	2.96	3.64	1.65	1.75	1.88	1.60
Good land quality	44.3	45.1	42.6	44.4	42.1	46.9
Medium land quality	45.1	44.6	46.1	45.0	46.0	43.7
Poor land quality	10.6	10.3	11.3	10.6	11.8	9.3
Rain-fed	96.4	97.4	94.5	95.7	97.5	93.6
Swamp/wetland	2.7	1.8	4.5	3.6	1.8	5.6
Hilly	10.2	10.6	9.3	11.2	11.1	11.3
Flat land	48.2	46.3	52.0	48.5	48.1	49.0
Gently sloped land	35.0	36.4	32.2	33.7	34.8	32.4
Valley	3.1	2.7	4.1	3.6	2.7	4.7
Distance from house in km	1.9	1.9	2.1	2.3	2.2	2.4
Tenure status & perceived rights						
Concerned about land conflict	14.2	11.1	20.2	15.1	11.4	19.3
Freehold, *mailo* and leasehold	25.3	20.8	33.9	22.4	19.4	25.9
Customary tenure	73.7	78.6	64.2	76.7	80.2	72.6
Sell without approval	17.7	25.8	1.9	13.7	25.1	0.7
Sell with family approval	30.5	44.7	2.8	26.0	47.5	1.5
Sell with outside approval	15.7	20.9	5.6	13.3	21.1	4.4
Plant trees without approval	26.0	37.2	4.1	19.4	35.0	1.7
Plant trees with family approval	30.3	44.2	3.0	26.1	47.7	1.4
Plant trees with outside approval	10.1	12.9	4.7	8.2	12.5	3.3
No right to plant trees	33.6	5.6	88.3	46.2	4.8	93.5
Use as collateral without approval	50.6	69.8	13.0	37.9	66.7	5.1
Use as collateral with family approval	17.0	24.7	1.9	15.3	27.9	0.9
No right to use as collateral	27.5	1.8	77.8	41.9	2.0	87.5
Land-related improvements						
Parcel has coffee trees	17.1	22.8	6.1	14.9	24.9	3.5
Parcel has fruit trees	39.0	46.5	24.4	33.4	47.0	17.8
Parcel has trees to improve soil fertility	12.2	13.2	10.1	10.1	13.0	6.8
Parcel has any type of trees	50.2	59.1	32.8	43.7	60.5	24.5
Number of trees per acre	71.1	99.8	15.1	79.7	138.3	12.8
Planted coffee trees during the past 5 years	8.7	11.7	2.8	7.3	12.8	1.1
Planted fruit trees during the past 5 years	16.2	21.2	6.5	12.3	20.9	2.6
Planted soil fertility trees past 5 years	3.8	4.8	2.0	2.8	4.8	0.5
Planted (any) trees during the past 5 years	18.6	24.4	7.3	14.5	24.6	3.0
Number of trees planted past 5 years	16.6	22.4	5.3	17.8	28.1	6.1
Soil cons. (bunds, terracing, mulching)	20.5	24.7	12.3	19.9	27.6	11.0
Use of manure during the past year	7.8	9.6	4.2	7.2	11.2	2.7
Number of observations (parcels)	13130	8652	4478	5448	2904	2544

Source: Own computation from 2005/06 UNHS III

Table 3: Cropping patterns and input intensity at the parcel level by ownership status

	Full sample			Owner-cum-occupants		
	Total	**Own**	**Usufruct.**	**Total**	**Own**	**Usufruct**
Cropping patterns						
Cropped plot area (acres)	1.3	1.4	1.0	1.1	1.1	1.1
Parcel has cereals	36.0	34.7	39.0	34.0	29.6	39.7
Parcel has pulses and oilseeds	29.3	29.1	29.8	26.0	23.4	29.4
Parcel has vegetables	2.0	1.8	2.5	2.0	1.6	2.6
Parcel has root crops	41.7	40.9	43.4	36.9	35.5	38.7
Parcel has fruit trees	1.7	2.0	1.1	1.3	1.6	0.9
Parcel has banana	26.5	33.5	10.4	23.5	38.1	4.9
Parcel has coffee	9.2	12.0	2.8	8.2	13.7	1.2
Parcel has other cash crops	5.2	5.8	3.7	4.9	5.7	4.0
Non-labor inputs						
Purchased seed dummy	30.8	30.2	32.1	27.1	25.6	28.9
Fertilizer use dummy	1.7	1.7	1.7	1.5	1.2	2.0
Pesticides use dummy	5.5	5.1	6.4	6.0	5.3	6.9
Manure use dummy	5.5	6.7	3.0	5.4	8.3	1.7
Labor inputs						
Male family labor dummy	68.6	71.0	63.4	67.4	69.8	64.3
Female family labor dummy	92.1	92.0	92.3	94.1	94.3	93.7
Hired labor dummy	30.2	30.5	29.7	27.7	25.0	31.1
Exchange labor dummy	17.6	16.9	19.3	16.4	13.6	20.1
Number of male family labor days per acre	20.4	19.7	21.8	20.2	19.2	21.4
Number of female family labor days per acre	44.5	40.1	54.7	48.9	42.4	57.2
Total family labor days per acre	64.9	59.8	76.5	69.0	61.6	78.6
Total exchange labor days per acre	2.7	2.4	3.3	2.5	1.6	3.6
Total family and exchange labor days per acre	68.1	63.0	79.8	72.3	64.6	82.3
Hired labor days per acre	3.2	3.2	3.4	3.3	3.0	3.7
Total labor days per acre	70.8	65.4	83.2	74.8	66.2	85.8
Number of observations (parcels)	18220	12658	5562	6628	3720	2908

Source: Own computation from 2005/06 UNHS III

Note: Unit of observation is a parcel (under crop) in a given season. Thus the same parcel could provide two observations if cultivated in both seasons in the reference period (July 2004 – June 2005).

Table 4: Determinants of land-related investments: Fixed effects linear probability models

	Any tree	Tree investment last 5 years	Soil conservation	Manure application
Ownership dummy	0.308***	0.168***	0.130***	0.057***
	(18.76)	(13.25)	(10.06)	(6.33)
Mailo or freehold dummy	-0.071	-0.002	-0.040	0.025
	(1.46)	(0.05)	(0.97)	(0.90)
Ownership**Mailo* or freehold	0.072***	0.141***	0.026	0.012
	(2.62)	(5.66)	(1.14)	(0.70)
Ownership*Household wealth*10^{-4}	0.004	0.015	-0.005	0.018*
	(0.37)	(1.49)	(0.41)	(1.92)
Parcel area in acres	0.002***	0.001**	0.000	0.000
	(3.69)	(2.20)	(0.89)	(0.70)
No. of years possessed	0.006***	0.002***	0.002***	0.002***
	(7.05)	(3.43)	(3.04)	(3.31)
Distance to house	-0.004***	-0.003***	-0.004***	-0.002***
	(3.73)	(4.06)	(5.18)	(4.24)
Good soil quality	-0.035*	-0.021	0.035**	0.027**
	(1.94)	(1.42)	(2.40)	(2.49)
Poor soil quality	0.056**	0.026	-0.024	-0.012
	(2.02)	(1.17)	(1.08)	(0.71)
Flat topography	0.050*	0.004	-0.010	0.050***
	(1.89)	(0.17)	(0.42)	(3.11)
Gently sloped	0.031	0.011	0.040*	0.065***
	(1.20)	(0.56)	(1.77)	(3.81)
Irrigated land	-0.045	-0.073	0.129	-0.062
	(0.41)	(0.59)	(0.94)	(0.56)
Swamp/wetland	-0.152***	-0.056**	0.099***	-0.017
	(4.13)	(2.05)	(2.69)	(0.72)
Constant	0.214***	0.025	0.099***	-0.037**
	(8.18)	(1.24)	(4.44)	(2.31)
Observations	5448	5448	5448	5448
Number of households	1728	1728	1728	1728
R^2	0.27	0.17	0.10	0.06
Overall investment impact of ownership	33.1	55.7	30.2	40.5
Investment impact on occupied plots	116.0	537.8	121.2	239.2

Robust t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 5: Determinants of land-related investments controlling for types of occupants: Fixed effects linear probability models

	Any tree	Tree investment last 5 years	Soil conservation	Manure application
Ownership dummy, γ_T	0.331***	0.177***	0.135***	0.055***
	(19.30)	(13.41)	(10.00)	(5.75)
Mailo or freehold dummy	-0.078	-0.006	-0.043	0.024
	(1.60)	(0.18)	(1.05)	(0.87)
Ownership**Mailo* or freehold, γ_D	0.093***	0.151***	0.033	0.012
	(3.38)	(6.06)	(1.43)	(0.72)
Ownership*Household wealth*10^{-4}	0.007	0.017	-0.004	0.018*
	(0.74)	(1.60)	(0.33)	(1.91)
Protected occupant: 5-12 years, γ^2_L	0.110***	0.025	0.005	-0.024
	(2.95)	(0.86)	(0.17)	(1.17)
Protected occupant: more than 12 years, γ^1_L	0.193***	0.100***	0.069**	0.007
	(4.37)	(2.60)	(2.10)	(0.25)
Parcel area in acres	0.001***	0.001*	0.000	0.000
	(3.36)	(1.85)	(0.82)	(0.76)
No. of years possessed	0.005***	0.002***	0.002***	0.002***
	(6.19)	(3.02)	(2.78)	(3.33)
Distance to house	-0.004***	-0.002***	-0.003***	-0.002***
	(3.56)	(3.90)	(5.14)	(4.26)
Good soil quality	-0.033*	-0.020	0.035**	0.027**
	(1.82)	(1.35)	(2.45)	(2.48)
Poor soil quality	0.060**	0.027	-0.023	-0.013
	(2.14)	(1.23)	(1.06)	(0.73)
Flat topography	0.049*	0.003	-0.010	0.050***
	(1.86)	(0.16)	(0.43)	(3.11)
Gently sloped	0.030	0.011	0.039*	0.064***
	(1.16)	(0.52)	(1.74)	(3.79)
Irrigated land	-0.041	-0.073	0.128	-0.064
	(0.38)	(0.59)	(0.93)	(0.58)
Swamp/wetland	-0.150***	-0.055**	0.100***	-0.018
	(4.03)	(2.02)	(2.70)	(0.74)
Constant	0.195***	0.018	0.095***	-0.035**
	(7.39)	(0.88)	(4.29)	(2.20)
Observations	5448	5448	5448	5448
Number of households	1728	1728	1728	1728
R^2	0.28	0.18	0.10	0.06
F-test: $\gamma_T = \gamma^2_L$	36.16***	27.11***	19.48***	15.58***
F-test: $\gamma_T = \gamma^1_L$	9.66***	3.98**	4.02**	3.02*

Robust t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 6: Intensity of labor input use and yield on owned and usufruct land: Household fixed effects estimates

	Parcel level		Household level
	Total labor	**Family labor**	**Crop output per acre**
Ownership dummy	0.018	0.034	-0.066
	(0.51)	(0.99)	(0.85)
Mailo or freehold	-0.000	-0.008	0.277
	(0.00)	(0.09)	(1.55)
Ownership**Mailo* or freehold	-0.065	-0.084	-0.128
	(1.26)	(1.63)	(1.23)
Distance to house	-0.009***	-0.010***	-0.016**
	(2.97)	(3.06)	(1.98)
No. of years possessed	0.000	0.000	0.008**
	(0.23)	(0.24)	(2.26)
Good soil quality	-0.005	-0.006	0.093
	(0.13)	(0.16)	(1.09)
Poor soil quality	-0.097*	-0.089*	-0.099
	(1.85)	(1.69)	(0.79)
Flat topography	-0.008	-0.006	0.081
	(0.18)	(0.12)	(0.76)
Gently Slope	-0.035	-0.032	0.003
	(0.77)	(0.71)	(0.02)
Irrigated land	-0.293	-0.334	1.073
	(0.99)	(1.13)	(1.46)
Swamp/wetland	0.262***	0.262***	0.506***
	(3.49)	(3.48)	(2.86)
Vegetables	0.444***	0.440***	0.546***
	(4.80)	(4.73)	(2.64)
Roots	0.247***	0.264***	0.339***
	(8.67)	(9.23)	(5.00)
Fruits	-0.055	-0.050	0.418**
	(0.44)	(0.40)	(2.15)
Banana	-0.494***	-0.475***	0.194**
	(12.15)	(11.62)	(2.20)
Coffee	-0.272***	-0.274***	-0.066
	(4.22)	(4.24)	(0.63)
Other cash crops	0.029	0.047	0.076
	(0.45)	(0.74)	(0.55)
Constant	3.867***	3.813***	3.768***
	(81.64)	(80.12)	(35.25)
Observations	6628	6628	2150
Number of households	1310	1310	1075
R^2	0.08	0.07	0.06

Absolute value of t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Notes: Unit of observation is a parcel (under crop) in a given season for the labor use regressions. A sub-sample of households who cultivate different types of crops on their owned and occupied parcels is used for the yield regression. The reference category for crop composition is cereals and pulses which are the dominant crops on occupied plots.

Table 7: Land values and rental price by ownership status and region

		Region				Tenure	
	Total	Central	Eastern	Northern	Western	*Mailo*/ Freehold	Customary
Parcels held under ownership							
Self-assessed land value (USD/acre; median)	403.2	430.1	430.1	161.3	536.6	537.6	358.4
Self-assessed land rental (USD/acre; median)	21.5	26.9	21.5	16.1	26.9	26.9	21.5
Number of parcels	8619	1440	2522	2026	2631	1784	6835
Parcels held under usufruct							
Would like to buy full ownership (%)	37.3	42.1	41.0	18.1	45.3	42.5	34.7
If yes, willingness to pay (USD/acre; median)	215.1	215.1	215.1	107.5	322.6	268.8	215.1
Paid rent (%parcels with owner's consent)	62.1	44.7	68.1	54.6	72.4	52.0	65.4
If yes, rent paid (USD/acre; median)	16.1	17.9	16.1	10.8	21.5	19.1	16.1
Number of parcels	4478	1219	1320	967	972	1519	2959

Source: Own computation from 2005/06 UNHS III

Appendix table 1: Determinants of investments in specific tree crops: Fixed effects linear probability models

	Any tree		Tree investment last 5 years	
	Fruit	**Coffee**	**Fruit**	**Coffee**
Ownership dummy	0.236***	0.138***	0.139***	0.072***
	(14.77)	(11.67)	(11.71)	(7.63)
Mailo or freehold dummy	-0.035	-0.078**	-0.002	-0.036
	(0.72)	(2.32)	(0.07)	(1.35)
Ownership**Mailo* or freehold	0.133***	0.151***	0.133***	0.118***
	(4.70)	(5.90)	(5.61)	(5.57)
Ownership*Household wealth*10^{-4}	0.008	0.007	0.014	0.017*
	(0.74)	(0.79)	(1.42)	(1.90)
Parcel area in acre	0.001**	0.000	0.001**	0.000
	(2.47)	(0.66)	(2.15)	(0.98)
No. of years possessed	0.005***	0.005***	0.002***	0.002***
	(6.19)	(6.85)	(3.51)	(3.96)
Distance to house	-0.003***	-0.003***	-0.002***	-0.001***
	(3.37)	(4.28)	(4.03)	(2.97)
Good soil quality	-0.015	-0.009	-0.029**	0.000
	(0.82)	(0.66)	(2.06)	(0.03)
Poor soil quality	0.029	0.036	0.017	0.016
	(1.04)	(1.63)	(0.84)	(0.95)
Flat topography	0.082***	0.021	0.018	-0.004
	(3.20)	(1.00)	(1.00)	(0.29)
Gently sloped	0.063**	0.037*	0.016	0.008
	(2.53)	(1.80)	(0.85)	(0.52)
Irrigated land	-0.089	-0.086	-0.120	-0.098
	(1.05)	(1.06)	(1.60)	(1.57)
Swamp/wetland	-0.099***	-0.068***	-0.047*	-0.024
	(2.65)	(2.64)	(1.80)	(1.17)
Constant	0.105***	0.022	0.015	0.010
	(4.13)	(1.11)	(0.83)	(0.68)
Observations	5448	5448	5448	5448
Number of households	1728	1728	1728	1728
R^2	0.22	0.19	0.16	0.11

Robust t statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

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