Rural land certification in Ethiopia: Process, initial impact, and implications for other African countries

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Abstract: Although many African countries have recently adopted highly innovative and pro-poor land laws, lack of implementation thwarts their potentially far-reaching impact on productivity, poverty reduction, and governance. We use a representative household survey from Ethiopia where, over a short period, certificates to more than 20 million plots were issued to decribe the certification process, explore its incidence and preliminary impact, and quantify the costs. While this provides many suggestions to ensure sustainability and enhance impact, Ethiopia's highly cost-effective first-time registration process provides important lessons.

1. Introduction

There is now a growing consensus that, even in rural African contexts where individual titling of land may not be desirable or feasible and use of land as a collateral for credit is at best a distant possibility, providing poor land owners or users, who are often female, with options to have their rights documented can yield significant benefits. These benefits, which come about largely due to the ability to draw upon formal mechanisms to enforce property rights, include incentives for land-related investment, enhanced gender equality and bargaining power by women, improved governance, reduced conflict potential, and lower transaction costs for productivity-enhancing land transfers through either rental or sale. A desire to reap these benefits provides the intellectual foundation for a recent wave of land law reforms that aim to give legal recognition to customary rights, strengthen women's property rights, and establish processes for creation and maintenance of documentary evidence that are less demanding and costly than titles while at the same time offering transparent and non-discriminatory options for upgrading as need arises.

While such legal provisions are hugely attractive in theory, progress in implementing them has lagged behind expectations. In fact, hardly any of the countries that introduced legal reforms with much fanfare have succeeded in developing, let alone rolling out, a low-cost system for land administration at a scale that is sufficiently large to provide an option for the majority of the poor. This made it difficult for many of the expected benefits from such legislation to materialize, implying that the poor often continue to be excluded from formal systems and vulnerable to land loss. More generally, failure to implement land legislation has raised doubts regarding the technical, institutional, and political feasibility of such reform.

To assess whether such doubts are justified and whether a decentralized and less demanding model of property rights reform can have impact on the ground, we draw on the experience of Ethiopia which, over a period of 2-3 years, registered the majority of rural lands in a rapid process at rather low cost. A nation-wide household survey is used to (i) assess whether the program met expectations regarding inclusiveness, fairness, and gender equity; (ii) obtain households' subjective evaluation and willingness to pay for certificates; and (iii) provide an estimate of its sustainability and impact on investment. We cost different options for first time registration -one of them being the program as implemented- as well as maintenance

of the land administration system to assess whether similar processes could be replicated elsewhere in Africa and use results to derive specific policy recommendations.

Doing so suggests that decentralized implementation through elected Land Use and Administration Committees (LACs) at village level allowed the program to make rapid progress without being biased against the poor; requirements in terms of procedures were adhered to reasonably well (though with variations across regions); and recipients appreciate certificates. While it would be useful to explore the scope to improve the process in a number of respects including coverage of common property resources (CPRs), clarity of policy guidelines, providing access to legal and policy information in written form, and ensuring better participation by women and, in some regions, their inclusion on certificates, the overall record of first-time registration is impressive. This is particularly notable given that the program has been implemented at a cost an order of magnitude below what is reported anywhere else in the literature.

The positive assessment of the program's impact is supported by beneficiaries' views and their willingness to pay. Econometric analysis suggests that certification has increased the probability of new investment and the time spent on such investment. At the same time, there is little doubt that ensuring sustainability of the program's impact will require serious efforts on establishing processes to ensure that land records will be updated in a coherent and consistent fashion and that ways to improve their quality in response to existing demand are available. Comparison to China, where property rights reform followed a similar trajectory also points towards policy issues that will need to be addressed to further enhance the benefits from land certification. These include ensuring payment of fair compensation if land is taken; an increase in the scope for decentralized transfer of land to more productive users; and more strict circumscription of conditions for land redistribution to prevent abuse and reduce tenure insecurity. This scope for improvements notwithstanding, the massive scale and relative success of land certification in Ethiopia demonstrates that technical problems or lack of resources alone can not explain the failure by African countries to put the innovative aspects of recent reforms to their land legislations into practice.

The paper is structured as follows. Section two describes challenges for land policy and administration in Africa together with recent initiatives to reform legal frameworks and establish accessible institutions in response to these. Against this background, it describes key characteristics of Ethiopia's land policy and its recent certification process. Section three uses village- and household-level data to describe the extent to which different stages of certification were implemented as planned and to explore the extent to which these varied along lines of gender or wealth. Section four provides evidence on impact as well as costs of first time registration as carried out now and with a spatial reference added and discusses options to ensure that the information generated is kept up to date and can sustain itself based on user fees. Section five concludes by highlighting lessons for Ethiopia and other countries, and avenues for future research.

2. Background and motivation

To motivate the paper and provide regional context, we contrast the large number of recent land law and policy reforms in Africa that helped to produce sophisticated laws or policies, but little implementation on the ground, to the case of Ethiopia which has made considerable progress on the ground within a legal framework that is often vague and which few would consider ideal. We then describe our data and use village level variables to outline the socioeconomic environment within which land certification was implemented. This is followed by a summary of the regulations guiding the land certification process.

2.1 Land administration reform in Africa: An unfulfilled promise?

A key tenet of land policy that has been supported by numerous studies is that providing owners or users with higher levels of tenure security (e.g. against eviction) will increase productivity by enhancing their incentives to make land-related investment, by allowing to temporarily transfer it to those able to make the most productive use of it, and -if a financial sector willing to lend exists- by providing scope for use of land as collateral in specific situations. It is now widely recognized that earlier approaches that focused almost exclusively on individual titling may not always be most appropriate because (i) title may provide little extra protection for communal and other secondary rights (e.g. those of women) that are often of great relevance to the poor -and may even weaken or extinguish them; (ii) high survey standards and the centralized nature of a title registration system may increase costs beyond what is affordable to most users; (iii) even if local institutions are deficient, they have evolved over a long time. Attempts to replace them with alternatives may be unsuccessful and, to the extent that they (often inadvertently) undermine traditional institutions without putting in place a viable alternative, increase the institutional overlap and confusion they set out to reduce. This is particularly relevant in environments where land values are increasing but where eliminating differential access to information and power is difficult. Experience has shown that, in these circumstances, land titling efforts may trigger attempts at land grabbing by local elites and bureaucrats and end up disempowering the poor who were expected to benefit from these programs (Jansen and Roquas 1998) and that attempts to replace local institutions that functioned reasonably well with “better” ones that fail to materialize can actually increase conflict (Deininger and Castagnini 2006).

The fact that titling is not always appropriate does, however, not imply that there is no demand for higher levels of tenure security and documentation of land rights. To the contrary, as greater integration of many rural areas into the market economy has increased the frequency of land transactions in settings where formal titles were either unaffordable or inaccessible, land owners all over Africa have resorted to informal means of registering land transactions at the local level. Examples include *petit papiers* in Madagascar (Jacoby and Minten 2006) and Mali (Benjaminsen and Sjaastad 2002), but are also reported from Burkina Faso, Benin (Lavigne Delville 2002), and Rwanda (Andre and Platteau 1998). Having private contracts

sanctioned publicly in this way can protect against opportunistic behavior by the other party, as long as this party submits to the same authority. Still high transaction costs and a limited set of possible partners constrain the scope for such arrangements; they will, for example, not provide any protection against land grabbing by outside interests. It is thus not surprising to find high demand for enforcement mechanisms coming with a formal endorsement, as highlighted by the fact that informal systems incorporate "official" boundary markers where they are available (Firmin-Sellers and Sellers 1999). High demand for low-cost means of boundary demarcation in Uganda, where more than 90% of households wanted to get a certificate, and 87% were willing to pay (Deininger *et al.* 2006a), points in the same direction.

To respond to such demands, ways to protect communal land rights have been actively explored (Fitzpatrick 2005) and many African countries passed innovative legislation aiming to assist in doing so. Key innovations include (i) recognition of customary tenure even without formal registration; (ii) measures to protect women's rights which are often neglected in traditional legislation and customary practice; and (iii) establishment of avenues for land users or owners to have their rights documented locally in a way that is less demanding and costly than title but that provides an option to draw on outside enforcement and allows to upgrade documentation through a transparent process if and when the need to do so arises. Examples include West Africa's *Plans Fonciers Ruraux* (Lavigne-Delville 2006), commissions of inquiry on land in Tanzania (Shivji 1998), Malawi, and elsewhere (Alden-Wily 2003), and new land legislation in countries such as Mozambique (Tanner 2002) and Uganda (McAuslan 2003).

Translating these approaches into practice on a large scale has, however, been surprisingly difficult and slow. For example, in Uganda, more than 8 years after passage of the Land Act provided a legal basis for issuing customary certificates of ownership, not a single such certificate has been awarded, despite demonstrated high demand. Opinions as to the reasons for lack of progress are divided; while some see it as a sign of bad governance and political resistance by those benefiting from a less transparent state of affairs,[1] others point towards the failure to *ex ante* assess the technical possibilities and financial requirements for widespread implementation (Hunt 2004). Whether the technical means for a large-scale decentralized process to issue and maintain low-cost certificates are available is thus an issue of more than academic interest. In this paper, we use the experience of Ethiopia to highlight some of the problems involved.

2.2 Ethiopia's land policy environment

Prior to 1975, land in Ethiopia was concentrated in the hands of absentee landlords, tenure was highly insecure, arbitrary evictions were common, and many lands were underutilized. High inequality of land ownership reduced productivity and investment and led to political grievances and eventually overthrow of

[1] As the author of the Tanzanian land law puts it "In the case of Tanzania, the pressure for the status quo to be maintained comes from some officials and politicians who as the implications of giving legal effect to the National Land Policy started to become apparent (more rights to citizens, less rent-seeking opportunities for officials, more transparency in, and more opportunities to challenge the exercise of powers by officials), began to voice doubts about the new approach." (McAuslan 1998).

the imperial regime. The Marxist government taking power in 1975 transferred ownership of all rural land to the state, established peasant associations at the village level, and embarked on massive collectivization. Together with lack of public investment, this led to rapid declines in productivity which, with a rapidly growing population, caused widespread soil degradation and erosion (Kebede 2002). Following the overthrow of the Marxist regime in the early 1990s, intentions to move more decisively towards a system of private land ownership did not fully materialize. In fact, the 1995 constitution highlights that ownership of land is with the state and upholds the right of every Ethiopian who wants to engage in agriculture to receive inheritable use rights to a piece of land for free, a principle that can be enforced through administrative reallocation of land but that will likely conflict with the goal of ensuring land users' tenure security. Subsequently, a 1997 federal proclamation (law) devolved responsibility for land policy to the regions, leading to considerable diversity in key provisions as illustrated below.

First, the fact that administrative redistribution of land is not an empty threat is illustrated by the fact that such action, partly in pursuit of political ends (Ege 1997), was carried out in Amhara as recently as 1997. In fact, a number of surveys highlight that a large number of farmers expect redistribution in the near future and that this reduces investment (Deininger and Jin 2006) and a desire to prevent this has led Amhara to more strictly circumscribe conditions for redistribution.[2] Second, although land transfers via rental have been allowed officially, award and continued enjoyment of land use rights is contingent on physical residence in the village, something that may prevent migration from rural areas (Rahmato 2003). Moreover, all regions except Amhara have legal provisions limiting the amount of land to be rented out -normally to 50% of holding size and setting a maximum duration for rental contracts.[3] Third, mortgaging and sale of land are prohibited everywhere. Finally, a 2005 federal proclamation aims to re-establish central guidance without clarifying how conflicts with existing regional laws are to be resolved. Together with a number of grey areas in the proclamations that are not resolved by regulations,[4] this leads to confusion and provides scope for bureaucratic discretion. Certification of land rights cannot eliminate systemic uncertainty of this type but is likely to reduce its impact on investment or land transfers, something that needs to be borne in mind when interpreting our empirical findings.

2.3 Data sources and characteristics of the sample

To reduce widespread tenure insecurity and its negative impacts on investment, the country's main regions started, in 2003, to implement a program of land certification modeled on an effort in Tigray during the late 1990s. To assess key elements of the process and potential impacts, we draw on the second round from a

[2] For example, in Amhara redistribution is only possible if it is approved by more than 80% of the land using households in the village.
[3] Rental contracts under "traditional" technology are limited to 3 years everywhere except Amhara (where land can be rented for up to 25 years) while those involving "modern" technology are allowed for up to 20 years in Tigray, 15 years in Oromia, and 10 years in SNNPR. All contracts longer than 2 years in Tigray and SNNPR and 3 years in Amhara and Oromia need to be registered although few guidelines exit on how to do so.
[4] For example, regulations everywhere are silent on whether long-term rental contracts entered into by a person who subsequently finds a non-farm job will have to be honored or not.

nation-wide panel survey of about 2,300 households in 115 villages (kebeles) conducted by the Ethiopian Economic Association (EEA) joint with the World Bank in July-August 2006. The sample was stratified by agro-ecological zone and region to ensure coverage of all the country's agricultural production systems. The first round, focused on extension services, was fielded in 2004 when, except for Tigray and some small pilots, no land certification had been undertaken anywhere in the country. At the time of the second survey, all except 9 kebeles had started implementation of land certification activities.

At the household level, standard elements of a multi-purpose household survey (roster, consumption, assets, credit, farm- and non-farm income) and information on land use and land-related investment were adapted to local conditions. Individual questions on involvement at different points of certification and a test of legal knowledge were added and administered separately to a male and female respondent -normally head and spouse- per household. A community questionnaire inquired about key steps of certification, composition of key local bodies involved (kebele administration, social court, LAC), and the legal knowledge of members of these bodies with questions identical to those used at the household level.

Table 1 illustrates key characteristics for the 115 kebeles in the sample by region (cols. 2-5) and by whether or not certificates had been issued 12 months before the survey date (cols. 6 and 7).[5] All kebeles are located in the Ethiopian highlands with mean elevation of 2,100 m and annual rainfall of some 1,200 mm, are given in table 1. An average kebele has 1,200 households (6,000 individuals) in slightly more than 5 sub-kebeles. 16% of households (27% in Tigray and 12% in the South) are female headed. With only 3.5 km to the next road (which in 44% of the cases is asphalt, and in only 15% dirt), and less than 10 km to the woreda capital and the next market, infrastructure access is quite good. About one third and 41% have a seed or fertilizer distribution center, respectively, and 87% and 61% (67% and 42% in the South and 100% for both in Amhara) have institutions providing short- and long-term credit. Mean daily wages for land preparation, which range from Birr (B) 6.6 in the South to B 12.5 (with an exchange rate of B 8.5 per US$) in Amhara, illustrate differences in the level of economic activity and availability of alternative opportunities.

Agriculture is the predominant economic activity; in the average kebele, 90% of households depend on agriculture only, a share that ranges from 93% in Tigray to 84% in the South. With only about 10% and 5% of households having self-employed or salaried members, the extent of economic diversification is very limited, reinforcing the pre-eminent importance of land as a source of livelihood and a key asset. Mean levels of human and physical capital are also low; 56% of households have a head who is illiterate, a value that ranges from 45% in Amhara to almost two thirds (65%) in the South. Overall, only 51% have a radio, 46% an iron roof, and 43% two or more oxen. Across regions, asset endowments are lowest in the South and highest in Amhara or Oromia. The importance of land is underscored by the generalized land scarcity,

[5] As the existence of certificates 12 months ago will be used in regressions below, the purpose of disaggregating information along this line is to check for presence significant differences in observables between kebeles who had completed certification at this point and those who did not.

especially in the South. With a mean land area of 2,075 ha per village, about three fourth of which (1,700 ha) cultivated individually, the per person land endowment amounts to only about 0.3 ha. Considering that only 6% of this land (virtually none of which is in the South) is irrigable, even a relatively 'large' endowment of 0.33 ha per person in Amhara, Oromia and Tigray will offer limited opportunities to generate marketable surplus. With only 0.15 ha per person, land is scarcer in the South than in China.[6] 90% of kebeles have communal and 61% have government land with 220 ha and 395 ha per kebele, respectively. With more than half of kebeles in the sample -from 93% in Amhara, 83% in Tigray, and 50% and 25% in the South and Oromia- having experienced one since 1991, land redistribution is still pervasive.[7]

2.4 Regional differences in the registration process

Key characteristics of the regional regulations and progress as of end 2005 are summarized in table 2.[8] In the about 14,000 kebeles affected, the program is implemented in a very decentralized manner. Following a meeting describing the program, a land use and administration committee (LAC), to be elected by popular vote, assumes responsibility for implementation in a labor-intensive and field-based process. Regulations set the term of the LAC at 2 or 3 years and require inclusion of at least one female member. The extent to which written material is provided to LAC members varies; while Amhara and Oromia prepared posters or a book of instructions, the lack of a common language prevented this in the South.

The requirement to register plots in a public process with neighbors present in the field, rather than based on existing -and possibly incorrect- records increases transparency and reduces scope for errors or manipulation. At the same time, it implies a heavy workload for LAC members involved in the process.[9] To cope with this, registration activities are generally undertaken in the off-season when LAC members face few competing labor demands from agricultural activities. In Amhara, the process is supervised by the woreda survey team together with specifically formed 'land administration teams' comprising of students trained in relevant procedures. In other regions supervision is much less intense; in the South, the kebele level rural development agent is responsible for supervision while in Oromia the LAC acts more independently but can call on experts at the woreda level to provide advice if needed.

Once registration has been completed and results have been discussed in public -although there are few formal requirements for doing so- households receive a preliminary registration certificate identifying their holdings and, once all the information for a kebele has been entered into the registry book, an official

[6] Although mean land endowments are, with 1.22 mu (0.08 ha) still smaller (Deininger *et al.* 2006b), the vast majority of such land is irrigable and capable of producing 2 or 3 crops a year compared to most Ethiopian lands that are rainfed.
[7] As table 7 below illustrates, about 14% of respondents in our survey expect either an increase or a decrease of their holding size due to land redistribution, illustrating that certification has not completely eliminated concerns about administrative reallocation of land.
[8] As the program is implemented in a decentralized fashion, it was not possible to obtain this information for a later date. We limit our discussion to the four regions (Amhara, Tigray, Oromia, and SNNPR) which contain the vast majority of Ethiopia's population and agricultural production.
[9] In group meetings, LAC members pointed to the need for them to stay overnight in distant sub-kebeles as one of the reasons for limited participation of females in the LAC.

certificate with holders' pictures and space for maps.[10] In a departure from the Tigray model where all the work was done by the kebele, most regions have woreda officials compile the registry book and prepare certificates for issuance and/or signature by officials at the kebele or woreda level. Copies of the registry book are kept at the kebele and woreda but it is not clear who has the ultimate responsibility for updating and which of the two books will, in case of discrepancy, be considered conclusive.

As the table illustrates, the program has made considerable advances, registering about 20 mn. plots by some 5.5 million households in a very short time. Originally in the process as developed in Tigray, field measures were recorded on a simple piece of paper which then also served as the landholding certificate. Other regions still furnish users with a preliminary registration document at the completion of fieldwork but subsequently issue formal certificates in the form of passport-sized booklets that also contain holders' pictures.[11] Whereas in Tigray the certificate was issued in the name of the head only, all other regions require it to be in the names of both head and spouse[12] and in Amhara and the South (but not in Oromia where only the head's picture is included), space is provided to include pictures of the two spouses.

First time registration only creates the basis for continued operation of a land administration system; in fact the key role of unambiguous roles and clear mechanisms for updating is illustrated by the case of Tigray where lack of such provisions led to huge differences among kebeles, implying that in some, information has already become outdated (Haile *et al.* 2005). While other regions have provisions to record transfers, some of these are complicated and, according to field visits undertaken in preparation for the survey, not always adhered to. The fact that all regions register leases without reference to the registry book suggesting that lack of clear processes and guidelines could, especially in areas with many transactions, quickly undermine the considerable accomplishments of first-time land registration.

2.5 Issues to be explored and methodological considerations

Despite the innovative nature of land certification in Ethiopia and the fact that inter-regional differences in modalities of program implementation could provide interesting lessons, little information is available on three key issues, namely (i) the extent to which the prescribed process have been adhered to in the field; (ii) the impact of first time registration in a number of dimensions; and (iii) the cost of the process. All of these have potentially far-reaching implications not only for Ethiopia but also for other countries and it will be useful to briefly review the methodology to be used for addressing each of them.[13]

[10] Addition of maps would mark the transition from the current 'first stage' to a 'second stage' certificate. It was, however, found to be too expensive at this point. See the more detailed discussion of cost below.
[11] In Amhara, the document also includes a rather elaborate summary of legal provisions and main rights and obligations by the land holder.
[12] In case of polygamy which is frequent in the South, the certificate is issued in the name of the head and main wife while other wives get a certificate in their own name.
[13] Recent pioneering qualitative assessments of certification in Tigray (Haile *et al.* 2005) and Amhara (Adenew and Abdi 2005) go a long way in addressing this issue but fall short in terms of coverage and lack of quantification. In fact, as responsibility is fully with the regions, even information on implementation of certification available at the central level is often quite inaccurate.

The first of these questions, i.e. the appropriateness of the process and the extent to which it suffered from wealth- and gender-biases commonly encountered in other land administration projects, is of direct relevance for Ethiopia.[14] To explore this, we combine data on kebele-level processes and overall results with household-level information, disaggregated by gender where needed, on participation at different stages in the process and the nature of certificates received. Comparing means of key variables for the richest and the poorest quintile in each of the regions allows us to test statistically for wealth bias.[15]

A second area of interest is whether, within a policy environment which many would consider to be far from ideal, land certification has made an impact and, if yes, whether its sustainability will be assured. To explore this, we draw on a combination of data and information sources, namely (i) village level information on the extent to which certificates are kept up to date; (ii) subjective assessments of the willingness to pay for certificates and their perceived impact on of tenure security by beneficiaries; (iii) a test of the extent to which households are aware of key legal provisions; and (iv) regressions of investment and its amount that include presence of a certificate as one of the right hand side variables.

Finally, to gauge the scope for replicating processes utilized in Ethiopia in other contexts and the potential to conduct registration of subsequent transactions with full or partial cost recovery in Ethiopia, we use data from Amhara, the region that adopted the most elaborate first-time registration process, to cost the current effort. Building on this, we can make inferences on the incremental cost of options to add a spatial reference and of computerization to ensure updating of the registry at different administrative levels.

3. Empirical evidence on process and impact

In this section, we provide empirical evidence from the village- and household-level to assess the extent to which different regions were able to implement the process as anticipated and to explore the gender dimension and potential wealth biases that may have arisen in doing so. To gauge the impact and longer-term sustainability of certification, we complement this with arrangements to update subsequent transactions, a test of legal knowledge by the population and LAC members.

3.1 Village level evidence on the process of first-time certification

Community-level data suggest that the process was largely implemented as planned, in particular that (i) in most locations public meetings were held before and during the certification process; (ii) land use committees (LACs) were popularly elected and represented most of the sub-kebeles; and (iii) adjudication

[14] Experience in a wide range of settings has shown that, to empower the poor rather than provide a pretext for land grabbing by those with better access to resources, political connections, or information, efforts at land titling -and by implication the award of lesser certificates- need to meet two conditions (Deininger 2003). To reduce the risk of spurious claims and to make the process cost-effective, documents need to be awarded on a systematic basis to everybody at once and proceedings be conducted in a participatory manner with strong community participation. Also, steps to award certificates should be preceded by information campaigns to ensure that all interested parties, including those who may hold secondary rights such as women or herders, be fully aware of the rules.

[15] With large inter-regional welfare differences use of the poorest or richest quintiles for the whole sample would not be sufficiently different from regional dummies, leading us to use the top and bottom quintile for each region. Results are very robust to the choice of cut-off point, i.e. remain virtually unchanged if we use deciles or quartiles rather than qunitiles of the per capita expenditure distribution.

made use of traditional village authorities (elders) to resolve disputes and demarcation was carried out in the field in the presence of neighbors. Shortcomings include that (i) with only 20% of LACs including a female member, women's representation was limited; (ii) access to written information on the law and the process and purpose of certification was far from universal; (iii) the process was focused on mapping of agricultural holdings to the detriment of common property resources and house plots; and (iv) although many boundaries were mapped in the field, measured by rope, and corner marks emplaced, certificates identify owners of neighboring parcels but contain neither a map nor a sketch of the parcel.

Panel 1 of table 3 illustrates that, beyond Tigray, where bodies equivalent to LACs were formed 11 years and distribution of certificates completed 7 years ago, certification commenced very recently. LACs were established 3.5, 2.3, and 1.5 years ago in Amhara, Oromia, and the South, respectively. Registration was normally completed over a period of about 8 months with strong local involvement. The fact that, even in the 46% where certificates have been distributed, it took 16 months from completion of registration to issuance of certificates is partly due to bottlenecks in designing and printing certificates.

With 12 people on average, LACs were rather large, allowing sufficient representation by sub-kebeles - from 95% in Amhara to 69% in the South and 63% in Tigray- and providing a basis to spread the load of work, all of which is being undertaken on a voluntary basis. 92% of LACs had their members directly elected with the remainder appointed by the (elected) kebele council. LACs in 70% of kebeles include at least one person in a leadership position. At the same time, low female representation is striking. Only 20% of LACs -from one third in Amhara to 8% in Oromia- include women representatives.

While the data point towards large numbers of information campaigns and training, emphasis was on oral rather than written communication. LACs received an average of 2.2 days training before registration started in 90% of kebeles (though only 56% in the South) and in 47% also during the process. However, their access to supplemental information was generally poor; only about two thirds of LACs received copies of the regional proclamation and only 10% (4% in Oromia) had access to other written material. Written information was even less available for kebele officials (54% and 7% for proclamation and written material, respectively) and community members (6% and 3%), despite the fact that in the vast majority of cases elders were expected to play an important role in conflict resolution.

Although the share of cases where kebele and sub-kebele boundaries are measured increased over time from 38% in Tigray to 82% in the South (70% and 52% in Amhara and Oromia), a focus on individuals is evident from the fact that registration included measurement of common property resources only in 39% of kebeles (about 25% in Tigray and Oromia, 44% in Amhara and 66% in the South). With house plots registered in less than 50% of the kebeles, from none in Tigray to 63% in Amhara, the program's focus is very much on individual agricultural land. Demarcation and measurement of plots is done in a public field-

based process with presence of neighbors in 90% or more of cases in all regions with the exception of Amhara.[16] Other community members and woreda officials were present in 70% and 56% of kebeles.

Process characteristics (e.g. representative LACs, training, transparency in measurement) as described above are necessary but not sufficient for certificates to enjoy broad social recognition. To assess the quality of the process more directly, we use two indicators, namely (i) whether any plots could not be registered in the field or certificates could not be awarded within the overall time frame; and (ii) registration forms or certificates that were disputed after they had been issued at the community level. While the first assesses the clarity and comprehensiveness of the underlying policy as well as the level of understanding by those applying it, the second points towards deficiencies in the process that may lead to exclusion of potential claimants.[17] On both counts, figures suggest satisfactory performance but high inter-regional variation. 38% of kebeles overall -from 88% in Tigray to 21% in the South- encountered issues with encroachment on public land and almost 60% ran into some kind of problem during certification. The fact that 36% of kebeles overall, but more than half (57%) in the South and 41% in Amhara compared to 28% in Oromia and 12% in Tigray, had land-holders that could not be registered in the field, points towards gaps in policy warranting attention. This is supported by a rather limited decrease in the share of kebeles who experienced problems at subsequent stages of the process, i.e. disputed registration forms, certificates that could not be awarded, and disputed certificates. In fact, the data indicate that, with the exception of Amhara where the figure is about 11%, less than 5% of land-holders could not be registered at the time of field measurement. Where certificates have been issued, only about 5% of households could not be awarded a certificate.[18] If taken as an input into formulation of policy, specific follow-up to identify the nature of the issues encountered could help to prevent such problems in the future.[19]

With the exception of Amhara where, in the majority of cases, certification was expected to be free of charge, households were to pay modest sums of money (B 2-5) to obtain a certificate, plus about B 4 for pictures. Kebele focus groups indicate that more than 80% of households are interested in a 'second-stage' certificate containing a basic sketch or map. While one should not interpret too much into relatively small differences, it is of interest to note that interest in this is highest in the regions -Tigray but also Amhara- where certificates have been in use for a longer period of time. An almost equally high level of interest exists in registering house plots where they are not already registered. The facts that 90% of those

[16] A key reason for the fact that only about one third of plots is measured using rope or tape in Amhara is that in this region land redistribution had been conducted only relatively recently so that in many cases it was possible to refer to records established in this process. The exceptionally high share of disputed certificates in Amhara as compared to other regions (see below) suggests that those concerned did not always consider the information from these records to be reliable. Although our data do not allow construction of a counterfactual, experience elsewhere suggests that use of more field-based adjudication could have reduced some of these problems.

[17] Of course this implies that exclusion of those affected is not so severe as to make them unable to exercise their rights at all. Also to the extent that *woreda* officials are likely to bypass 'difficult' areas, the figures reported here provide a lower bound.

[18] To put this into perspective, note that in a well-known and much-acclaimed World Bank project in Thailand, about 20% of plots could not be registered (F. Byamugisha, personal communication).

[19] Note also that in Amhara the share of kebeles with problems actually is higher at the certificate stage as compared to the registration stage, suggesting that strong technical involvement from the woreda level can not compensate for lack of clarity in the policy framework and the definition of processes.

interested in a sketch and 85% of those interested in registering house plots are willing to pay (B 13 for the former), suggest that at the community level affordable types of land certification are indeed in demand.

3.2 Household and parcel-level evidence

Cross-checking village level data with information more appropriately obtained at the household or parcel levels (table 4) allows us to explore the gender dimension of land certification and provides a basis for a preliminary assessment of the extent to which certification has been pro-poor. We find that (i) there is little evidence of wealth bias in access to the program or the information surrounding it; (ii) female participation in the early stages of registration was limited and there is considerable variation even among regions in the share of documents issued jointly or in the name of a female; and (iii) there is considerable interest in, and willingness to pay for, a map to complement the current verbal description of the land.

Aggregate data match well with community-level information, increasing confidence in the reliability of the latter; 89% of sampled households indicate to have their primary activity in farming, almost 50% have an illiterate and 13% a female head, and 58% live in houses with metal roof. Disaggregation for top and bottom quintiles of per capita consumption highlights that poor households are larger, more likely to have an illiterate head, and less likely to have a metal roof, but that there is no strong correlation between poverty and female headship or farming as main activity. Concerning participation in community leadership we note that, although the poor are as likely as the rich to participate in the kebele council, gender biases are pronounced as 23% of households have a male but only 6% a female participant.

With almost 90% of households indicating that information meetings were organized before the start of registration and 93% having had a household member attend such meetings at least once, oral information on the program is fairly accessible and not biased in favor of the rich. This is supported by the fact that almost 80% of households -equally for rich and poor- consider themselves to be well-informed about the program. At the same time, the share of those who received written material was low, with 15% overall (30% in Tigray, 21% inSNNPR, 16% in Amhara, and 9% in Oromia). Interestingly, the poor are significantly more likely to have received such information than the rich. Note that females from poor households were slightly more likely to participate than those from wealthier ones. The program does not seem to have overcome pre-existing gender biases; compared to 72% of females (and 83% of males) who voted in the last woreda and kebele elections, only 17% of women voted in LAC elections, only about 40% of households had a female member participating in public meetings on land and LACs are more male-dominated than the kebele council at large.

Rapid progress of certification is evidenced by the fact that almost 60% received a document to their land, 40% a preliminary registration paper and 60% a full certificate. Given the different times at which the process started, we find marked differences in the share of households with certificates across regions -

from 93% in Tigray and 84% in Amhara to 54% in the South and 39% in Oromia.[20] With the share of unregistered parcels by the richest quintile is almost double that of the poor, we can strongly reject the hypothesis of the process being biased to favor the wealthy. Parcel level information allows more precise inferences on modalities of measurement.[21] For almost three quarters (72%) of the 8,220 plots -from almost 90% in the South to 62% in Amhara- boundaries were measured with tape or rope rather than eye measurement or office-based estimates. Public participation was strong; in two thirds of the cases all neighbors were present and only in 10% (18% in Amhara and 3% in the South) none of them showed up. Physical markers were placed in 64% of cases, possibly because they already existed in others.

To assess whether outcomes are biased against women, we asked a female respondent, in most cases the head's spouse, to indicate whose name is written on the certificate and whether she knew where the certificate is stored. Although such information is available only where a certificate has been issued, it is revealing in three respects. Women's awareness of the certification process is high; in all regions 85% or more know where the document is stored and less than 2% do not know whose name is on the certificate. As one would expect, without regulations to mandate joint titling in the case of Tigray, the majority of certificates (71%) are issued in the husband's name rather than jointly (13%) or in the name of the spouse (14%). However, as all of the other regions had regulations requiring certificates to be issued jointly, the large variation in the share of certificates issued exclusively or jointly in the name of females in these regions is surprising. While less than 9% of certificates are in the husband's name in Amhara, 58% and 21% are so in Oromia and the South, respectively. Analysis to identify reasons for such differences would be desirable. An intriguing possibility is that the requirement to include women's picture on the certificate in Amhara and the South but not in Oromia is at the source of the neglect of women's rights in the latter.[22] Exploring whether this is the case, jointly with the extent to which possession of a joint certificate affects women's bargaining power and access to economic opportunities, would be of interest.

The perceived value of a certificate, obtained by asking holders how much they would be willing to pay to replace a lost certificate is, with B 12, significantly above the amounts charged currently. [23] While the poor paid marginally less than the rich (B 3 as compared to B 4), and are willing to pay less (B 8 vs. B 20), this is more than double of what was actually paid. Also, almost 90% of certificate holders, irrespectively of their wealth, indicate that they would like to add a sketch or map. The fact that 92% of these would be willing to pay, a figure that is marginally lower for the poor (88%) as compared to the rich (95%), points towards strong demand for a graphical element to be added to the current documents.

[20] Note that the high share (85% of those who have a document) of certificates in the South is due to the fact that in this region the paper stage was in many cases skipped, something that could also be a reason for the high level of conflicts as discussed earlier.
[21] The fact that, with 56%, the majority of parcels overall (from 88% in Tigray to 21% in the South) had been obtained through redistribution rather than through inheritance (41%) or other means reinforces the importance of redistribution as a means of land accessing and the time profile of when land was obtained closely matches the major redistributions in Amhara and Tigray.
[22] Recall from our earlier discussion that certificates in Amhara and the South but not in Oromia include space for putting the woman's picture.
[23] The notion that the perceived value of certificates exceeds the amounts currently charged for them is supported by the fact that 70% of those who do not have a certificate indicate that they would be willing to pay B 8-10 to obtain one.

3.3 Maintenance of registry books and legal knowledge

While the above data provide encouraging evidence regarding the inclusive and in some regions gender-sensitive nature of first-time registration, positive impacts from this intervention will be sustained only if records are kept up to date on a self-sustaining basis. Answers to community-level questions on this, as summarized in table 6, raise some issues. While almost 60% of kebeles report cases of inheritance,[24] new certificates were issued or registrations changed in only a quarter of cases. Lack of guidelines on updating of records could be one reason for such gaps, consistent with the wide variation in user fees charged -from nothing in most kebeles to B 33 for those that charge in the South. Household data also point towards large shares of non-reported leases.[25] As such gaps will decrease the value of land ownership records or undermine the scope for land markets in the future, having a policy to address them would be important.

Households' ability to exploit the opportunities afforded by certificates is affected by their and officials' awareness of the legal situation. A measure of legal knowledge will thus be important in its own right, in addition to allowing identification of gaps between perceptions and the law. We thus include questions on tenure security, land transfers, and gender, asked to males and females in the household, as well as kebele officials. Tenure security questions aim to assess awareness of the scope to leave the kebele without loosing land, the possibility of inheriting land to individuals other than direct offspring, and the extent to which mortgaging of land is allowed. [26] Land transfer questions ask for the number of years for which land can be leased and the minimum length of rental that requires registration.[27] On gender, we ask whether the respondent is aware of the proper (50/50) division of land assets in case of divorce.

Responses at the household level point towards variation across issues and regions.[28] While some 90% are confident that migrants' land can not be taken back provided they do not have a full-time job and the household remains resident in the kebele, only 53% do so in Tigray and 78% in the South. About 87% are aware of the proper division of land in case of divorce. The fact that only 44% know that mortgaging is prohibited points towards high levels of dissonance between beliefs and legal provisions, something that is also true for the possibility to inherit to non-children, which is known to less than 40% (and less than 10% and 20% in Tigray and Amhara). Awareness of households' transfer rights is even lower. Less than 2% know the exact duration of allowed rentals and 90% think that it is shorter than stipulated by law. Although

[24] Respondents seem to have understood these questions as referring to cases of inheritance actually reported to the authorities rather than the total universe of cases occurred; having 25% of kebeles without any inheritance in Tigray is implausible given that all of them had completed issuance of certificates about a decade ago. While the figures are thus likely to be an underestimate, they illustrate the lack of follow-up.

[25] Household level evidence highlights that 56% of rented plots (866 out of 1533) were transferred under a fixed term contract and 28% (246 plots) with a rental term longer than the minimum required for registration out of which 55% (134 plots) were not registered.

[26] Questions (correct answers in parentheses) are: "The head of the household has left the kebele where the land is located for 10 years. Does this affect the land use rights of the family?" (No everywhere); "Can a person bequeath land through inheritance to individuals who are neither his/her direct nor adopted children (No in Tigray; allowed everywhere else); "Is it legal for a household to mortgage the use right for its land?" (No).

[27] Questions read "What is the maximum number of years for which households can lease their use rights to others who will use modern technology" (20 in Tigray, 25 in Amhara, 15 in Oromia, and 10 in SNNPR) and "Rental contracts for a period longer than __ years have to be registered (2 in Tigray and the South, and 3 in Amhara and Oromia).

[28] As responses by males and females in the same household were quite consistent, we report knowledge at the household level, defined as the maximum level in a simple 'right-wrong' classification.

40% are aware of the need to register rentals, 35% think that contracts below the stipulated length require registration. Column 6 and 7 provide means for households with or without LAC members. The lack of significant differences suggests that LAC members have not been thoroughly exposed to other aspects of the legal environment.[29]

4. Impact and cost-effectiveness

The above suggests that Ethiopia's certification program was quite effective in covering a large area in a relatively egalitarian fashion. To assess the scope for replication and the sustainability of the model, this section provides qualitative and quantitative indications of possible impact. We then put an upper bound on total cost by quantifying the resource requirements of first-time registration and systematic updating of the registry for Amhara, the region with the most elaborate process. Subjective assessments, as well as actual data on investment, point towards a positive impact. Costing about US$ 1 per parcel, certification is an order of magnitude cheaper than 'low-cost' procedures reported elsewhere. Options to add a spatial component at reasonable cost and to meet recurrent costs of registry maintenance from user fees are available, leading us to conclude that the model can provide a benchmark for other African countries.

4.1 Subjective perceptions and investment impact

Perceptions by sample households on impacts of certification are presented in table 7. About 86% expect that compensation be paid for land that will be taken and 33% and 40%, respectively, think that certification makes receipt of compensation 'much more' or 'more' likely. Large majorities perceive certification to increase incentives for investment in trees (88%), soil and water conservation structures (86%), and sustainable management of CPRs (66%). Most households (85%) expect certification to also improve women's position and incentives to rent out land. Though clearly encouraging, this positive assessment may be biased, and should be backed up with direct evidence on actual investment behavior.

Our data contain information on whether households undertook new land-related investment, mainly on terracing and bunding, during the last 12 months as well as the amount of labor spent on such works none of which require any capital inputs. Under the assumption that land certification is exogenous and that the expectation of having their land certified at some point in the not so far future will not affect households' investment behavior, a simple OLS regression will provide a first estimate of the investment-impact of certification. Letting households be indexed by *i* and plots by *j*, we run a regression of the form

$$I_{ij} = \alpha_0 + \alpha_1 C_i + \alpha_2 \boldsymbol{X}_i + \alpha_3 \boldsymbol{Z}_j + \varepsilon_i \qquad (1)$$

where I_{ij} is either an indicator of whether or not investment was undertaken or the amount of hours spent making such investments, C_i is a dummy indicating whether certification had been completed by the kebele

[29] Similar tests for differences between households with kebele officials, members of the council, other office-holders, and the mean lead to qualitatively similar conclusions and are thus not reported separately.

at the beginning of the period,[30] $\boldsymbol{X}_i$ and $\boldsymbol{Z}_j$ are vectors of household and plot characteristics that affect the propensity to invest, α_1, α_2, and α_3 are coefficients or vectors of coefficients to be estimated, and ε_i is an *iid* error term. Variables in $\boldsymbol{X}_i$ include household size, total land size and other asset, and the head's age, gender, and access to non-agricultural employment. $\boldsymbol{Z}_j$ includes soil and topographic characteristics, as well as the length of possession, modality of acquisition, and current use of the plot.

Results, as presented in table 8, point towards a positive and highly significant investment effect of land certification both in probit and tobit regressions. The point estimate suggests that, in kebeles where plots had been certified before the reference period for investment (12 months before the date of the interview), plots were 5% more likely to receive new investment and the amount of new investment was 4.4% higher than where this was not the case. Coefficients on other variables also allow a number of other inferences of interest.[31] While it will be of interest to explore impacts of certification in other dimensions using the panel dimension of our data, two considerations imply that the investment effect found here is likely to be attributable to the program. First, use of an indicator of certification at the community- rather than the individual level implies that there is little reason to worry about endogeneity as the sequence of rolling out the program was determined at the woreda level based on non-economic criteria.[32] In fact, columns 6 to 8 of table 1 demonstrate that there are few significant differences between program and non-program kebeles in observable attributes. Second, our regressions implicitly assume that expectation of future coverage will not affect investment behavior. As the literature normally assumes that people will invest in anticipation of the program rather than they withhold investment until they actually have certificates, this would bias our estimate downward, thereby strengthening rather than weakening our result.

4.2 Cost of first-time registration

As a key reason often quoted for the lack of larger-scale progress in improving land administration in Africa is the cost or non-availability of the technical options to do so, in-depth analysis of costs will be important to assess the scope for transferring Ethiopia's experience to other settings. We compute the cost of first-time registration for Amhara where, as illustrated above (table 2) the process is much more costly than in other regions due to the involvement of a survey and land administration team in addition to the LAC. We use standard parameters for cost of staff[33] and transport[34] and note that for the average kebele

[30] We use an indicator at the kebele rather than the household level as the latter is likely to be endogenous because households may not have received certificates because their plots have some kind of problems.

[31] The significant coefficient on the head's age suggests that life-cycle considerations are important while the positive sign of total assets would imply that, rather than being substitutes, having other assets makes it more likely for households to invest in land improvement, pointing towards limited options for non-agricultural investment. Total land area is negative and significant in the tobit as one would expect due to greater competition for investment. The positive signs of plot size and irrigation suggest that large irrigated plots with annuals and border trees are more likely to receive investment whereas investment amounts will be lower on plots with perennials.

[32] Running the same regression at the plot level (results not reported) where the relevant right hand side variable is whether a certificate has been issued for the plot leads to somewhat higher point estimates of the marginal effect (8% in the probit and 6.6% in the tobit).

[33] The two types of teams involved are (i) a survey team consisting of one EPLAUA (regional) surveyor, two woreda-level surveyors, and one driver and (ii) a woreda level land administration team consisting of a woreda land administration expert and two students hired for this purpose. Salaries are B 1200/month for EPLAUA surveyors (plus per diem of B 70), B 530 (with a per diem of B 47) for drivers, B 900/month (with a per

first-time certification required one month of preparatory fieldwork by the land administration team, one month of joint fieldwork by the two surveying teams, and an additional month of office work by the land administration team. We assume that existing office facilities can be used but that, instead of requiring LAC members to work completely voluntarily, field-work participants on any given day (assumed to be 5) receive at least their opportunity cost of B 6 per day. With this, total staff and transport cost for the typical kebele add up to B 39,641. With about 1,554 land users who have 3.6 plots each, and adding B 4 per household for registry books and certificates, total cost of first-time survey under the current process would thus amount to B 29.5 per household or B 8.30 per plot. This value is close to the B 7 per plot obtained in an independent exercise to compare the resource and time requirements of various methods under actual field conditions carried out by the Ethiopian mapping authority (Alemu 2006).

In view of apparently high demand for a spatial reference, it will be of interest to identify the cost of a "second stage" that would add a map to the current process. To do so, all that is required is to add the cost of equipment and adjust time requirements to account for reduced speed. We consider two technical options, namely a high precision survey using electronic total stations and GPS which will produce results with cm-level accuracy (option one), and handheld GPS with an accuracy of about 1 m that will be sufficient for most of rural Ethiopia (option two). For option one, equipment costs and average speeds from a SIDA-financed pilot yield a cost of B 49.2 per plot or almost B 175 per household.[35] As option two would require less additional equipment and allow higher speed,[36] its cost of B 12.8 per plot or B 45 per household is only about 50% above the present process based exclusively on traditional technology.[37]

To put these figures into perspective, it is useful to compare them to other countries. In Madagascar, where the official cost (excluding bribes) for titling on demand estimated to amount to US$ 150 (Jacoby and Minten 2006), projections put the cost of issuing certificates in a simplified low-cost approach at US$ 7-28 per certificate (World Bank 2006). This is consistent with West African experience with the *plans fonciers ruraux* where a cost range of US$ 7-10 per parcel is considered as relatively inexpensive (Lavigne-Delville

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diem of B 35) for both woreda surveyors and LA experts, and B 500/month (with a per diem of B 25) for students on the LA teams. Note that we assume a total of 20 field days but only 15 productive working days per month with the discrepancy made up by sick leave, training, and holidays. Costs are B 422.33/field day for the surveying team and of B 211.67/field day and B 126.67/office day for the land administration team.

[34] In line with actual practice where vehicles were made available only to the survey teams, it is assumed that LA team use public transport, costs for which are assumed to be negligible and thus not included separately. The price of a vehicle is B 250,000 which, with a life of 100 months and 5% of annual maintenance implies a monthly cost of B 3541.67. With 150 km per day, 7.5 km/l, and fuel prices of B 4.33/l, 20 field days/month imply a cost of B 1732.00 for fuel or total monthly transport cost of B 5273.67.

[35] The process requires two total stations (unit cost of B 80,000) and GPS (Unit cost B 45,000), both with a life span of 50 months and for computers and software of B 950 per month implies a total monthly equipment cost of B 5950, and B 13720 for the survey team and its car. As productivity in the pilot was about 30 plots per day in easy terrain and about 15 plots in difficult topographical conditions, we assume that a team covers 20 plots per day.

[36] This process is assumed to use three handheld GPS (1 base station and 2 rovers) with a unit cost of B 8000 and a life span of 36 months, leading to imply monthly equipment cost of B 1617, computers included as well. While salary cost remains the same, use of GPS is faster, allowing the team to cover 60 plots per day on average. Note that even a tripling of equipment cost (to B 24,000 per GPS) would increase total cost by only B 1 per plot.

[37] Although there might have been some cost savings from conducting first and second stage in parallel, the fact that the first stage has been started virtually everywhere in the country implies that this is no longer an option. This has the advantage that a spatial component can be added as and when there is -community-level rather than individual- demand for doing so. It implies, however, that appropriate measures to ensure that data remain up to date will be critical.

2006). In Uganda, the cost of issuing certificates of customary ownership -albeit with a precision that allows their immediate conversion to title- is some US$ 40 per parcel. By all measures, and especially considering that the process followed outside of Amhara is less complex and thus cheaper, this implies that, largely because of strong local involvement, first time registration as implemented in Ethiopia as well as the preferred, proposed option for a "second stage" certification are highly cost-effective and could provide an important benchmark for other African countries.

4.3 Long-term sustainability

Although low by international standards, the cost of the process with a map is still above the level where, in line with households' stated willingness to pay, full cost recovery will be possible. While there is agreement that the one-time establishment of a cadastral system that is then maintained independently is a public good for which public funding can be justified, this focuses attention to arrangements to update the system. In fact, lack of attention to procedures for updating of the information generated through first-time registration has undermined the sustainability of many land administration initiatives. Preventing Ethiopia from suffering the same fate will require careful scrutiny of demand and options to meet it.

To assess the size of expected demand, we note that transfers that need to be recorded are inheritances, divorces, leases beyond a certain length, and land takings for public use. Assuming that 3% of households are involved in a transfer every year (1.5% inheritances, 0.5% divorces, 0.75% long-term leases, and 0.25% land takings for public use), the average number of annual transfers to be registered would amount to 47 per kebele, 1,274 per woreda, 13,500 per zone, or 135,000 per region.[38] This is insufficient to make the case for computerization at the kebele suggesting that at this level manual updating of records in a way that is subsumed under the kebele administration's regular tasks will be appropriate. However, at woreda level, it may make sense to have a dedicated person to record transfers, in addition to other tasks.

To decide at which administrative level computerization will be most appropriate, we compare the cost of an effort to computerize all woredas to that of a more selective approach. For the former, parameters from the field point towards monthly running costs per woreda of B 1,717, composed of salary (B 900) and equipment (B 817), or B 16.17 per transfer. Even if access to electricity were available in all woredas rather than only one third at present, these costs are unlikely to be sustainable in the long term. By comparison, computerizing only the 20% of woredas with the highest transaction volumes, assumed to be three times the average, could reduce costs significantly, to B 5.39 per transfer. In fact, as at current productivity levels staff would already be working at capacity, computerization at zonal rather than the woreda level would only marginally reduce costs, to B 4.58 per transaction.

[38] The region is assumed to have a population of 4.5 mn households in 10 zones, 106 woredas, and 2895 kebeles.

In both cases, a self-sustaining system based on user fees appears realistic in view of the fees actually paid for certificates (plus B 2 to 4 for photos) and users' willingness to pay for maps and replacement of lost certificates. Which option to choose will depend on the scope of integrating manual and computerized processes. As discussed above, with current level of productivity the cost per transfer is unlikely to fall significantly below B 5. Policy decisions requiring registration of instruments such as long-term leases will need to be cognizant of the cost of compliance, bearing in mind that users are unlikely to pay for registration unless the benefits they perceive from doing so will exceed the cost.[39]

5. Conclusion and policy implications

The evidence reported in this paper leads to a number of policy conclusions. First, the rapid speed, participatory nature, and low cost of Ethiopia's land certification, together with the positive results from this process and the absence of bias in favor of the wealthy or lack of access to information by the poor demonstrate that, contrary to what one might be tempted to conclude from experience in other countries, large-scale and rapid delivery of land certificates in a participatory way is possible. Users' positive assessment of the process, readiness to pay to replace lost certificates, high demand -and willingness to pay- for a spatial reference, and their positive assessment of likely impacts suggest that the way in which Ethiopia implemented land certification responded to local needs. The fact that most disputes could be resolved in the field, our failure to find outcomes biased in favor of the wealthy or against women, reinforced by initial evidence of positive investment- and transfer-effects, all support this view. This suggests that elements of Ethiopia's certification process, with modifications as needed, could serve as a model for other African countries to quickly scale up implementation of land legislation, the innovative provisions of which have thus far been largely ineffective.

This does not imply that Ethiopia's process could not be improved; in fact to sustainably realize the full potential of the country's first time registration, action in four areas may be required. First, procedures to update information collected can be improved by (i) redesigning registry books and ensuring that no new certificates be given out without cancelling old ones; (ii) defining institutional responsibilities to eliminate gaps and time lags which currently are a potent source of possible inconsistency; and (iii) spelling out protocols to ensure broad and public access to information. Lack of updating could create problems particularly in commercial areas with higher transaction frequencies and jeopardize trust in the overall system. Second, although considerable effort is expended for first-time registration of individual holdings, failure to consistently include common property resources (CPRs) and house plots makes it difficult to use the data generated as a basis for an integrated land administration system. Demand for inclusion of house plots is already high and consistent mapping of CPRs, possibly in combination with land use planning and

[39] The scope of being able to use, on a part-time basis, computers that might become available at the woreda level through other initiatives could also be a relevant issue. Also, note that a number of Indian states have achieved very positive results with making land records available over the internet (Ahuja and Singh 2006) and that options to do so and thus increase transparency may be considered in Ethiopia as well.

assignment of group rights could help confront serious resource degradation and soil erosion at rather low additional cost. Third, while registration demarcates boundaries in the field, it does not create a graphical record and may thus fall behind expectations in terms of reducing boundary disputes. As technology to meet demands for a low-cost map in a way consistent with the decentralized process is available, ways to include it on a systematic basis may need to be explored. Finally, the longer-term impact of certification will increase with a more conducive policy environment, including (i) well defined compensation in case of land taking; (ii) protection of contracts and security against arbitrary redistribution; (iii) transferability of land use rights for longer time periods.

The scope for improvements notwithstanding, the massive scale and relative success of land certification in Ethiopia demonstrates that technical problems or lack of resources can not explain the almost universal failure by African countries to put the innovative aspects of recent reforms to their land legislation into practice. Using some of the quantitative indicators defined here to monitor implementation would seem appropriate. At the same time, it will be desirable to complement our analysis, which is intended to be no more than a first description of the process, with a more rigorous analysis of certification impacts on productivity and land market behavior and an assessment of possible differential impacts by gender and poverty group. All of these topics, which will need to draw on our panel data, are left for future research.

Table 1: Characteristics of sample communities

	Total Sample	Tigray	Amhara	Oromia	SNNPR	Program[1]		
						Yes	No	
General characteristics								
Mean elevation (m)	2134	1785	2330	2171	1926	2146	2129	
Average annual rainfall (mm)	1199	1191	995	859	2358	1029	1258	
No. of sub-kebeles	5.37	8.75	3.00	5.69	5.67	7.65	4.71	*
Kebele population	5851	6898	7276	5137	5275	6761	5586	
Households in kebele	1200	1484	1765	883	1108	1366	1151	
Depending on agriculture only (%)	89.75	93.25	92.63	90.12	84.00	93.42	88.67	
With members self-employed (%)	9.51	2.91	10.88	11.78	6.09	10.32	9.28	
With salaried members (%)	4.84	5.33	5.89	5.18	2.50	7.04	4.20	
Female headed (%)	16.13	27.25	19.31	14.04	11.50	18.32	15.51	
With illiterate head (%)	56.33	56.92	45.70	56.83	65.17	54.17	56.90	
With radio (%)	50.79	46.82	45.25	60.04	38.13	51.58	50.57	
With iron roof (%)	46.23	37.67	63.93	50.40	21.58	55.92	43.40	
With 2 or more oxen (%)	43.49	47.58	55.00	47.21	20.92	50.35	41.47	
Infrastructure and factor markets								
Distance to main road (km)	3.48	12.89	2.26	2.67	1.77	3.46	3.49	
Type is gravel	40.87	41.67	40.74	32.69	58.33	0.31	0.44	
Type is asphalt	44.35	41.67	51.85	48.08	29.17	0.65	0.38	*
Distance to woreda capital (km)	6.86	10.83	6.85	6.97	4.63	8.17	6.47	
Distance to nearest market (km)	4.76	7.29	5.23	4.59	3.32	5.04	4.67	
Seed distribution center exists	33.91	41.67	74.07	21.15	12.50	0.38	0.33	
Fertilizer distribution center exists	40.87	41.67	59.26	42.31	16.67	0.54	0.37	
Institutions providing short term credit exist	87.83	100.00	96.30	90.38	66.67	0.88	0.88	
Institutions providing long term credit exist	60.87	100.00	85.19	48.08	41.67	0.77	0.56	
Mean wage for land preparation (B/day)	9.23	10.83	12.48	8.25	6.59	11.88	8.42	*
Land endowment								
Total land area in kebele (ha)	2075	3076	2411	2092	1161	2819	1858	*
Area individually cultivated (ha)	1627	2141	2010	1798	585	2013	1513	
Share individually cultivated	83.86	70.71	84.23	89.25	78.36	78.47	85.45	
Land area per individual	0.29	0.33	0.33	0.33	0.15	0.33	0.28	
Land area per household	1.42	0.98	1.47	1.85	0.68	1.48	1.40	
Share under perennials (%)	17.06	4.27	5.22	21.53	27.65	7.41	19.82	*
Any communal land (%)	90.43	100.00	92.59	90.38	83.33	0.96	0.89	
if yes area (ha)	221.0	556.5	404.2	94.3	88.4	369.99	173.84	*
Any government land (%)	60.87	75.00	66.67	48.08	75.00	0.69	0.58	
if yes area (ha)	395.5	502.7	149.8	338.5	666.6	650.03	307.33	
Any land redistribution since end of Derg (%)	52.17	83.33	92.59	25.00	50.00	0.73	0.46	*
if yes, number	1.47	1.30	1.44	1.92	1.17	1.42	1.49	
if yes, years since last redistribution	9.44	12.90	9.04	8.46	8.36	10.63	8.88	
No of observations (kebeles)	115	12	27	52	24	26	89	

Source: Own computation from 2006 EEA/WB Land certification survey.

[1]Program kebles are defined as having had certificates issued 12 months before the survey date, the indicator used in regressions table 8 below. Stars indicate significance of differences between the two groups; * significantly different at 5% and ** significantly different at 1%.

Table 2: Key features of the land registration process Ethiopia's four main regions

	Tigray	Amhara	Oromia	SNNPR
Basic information				
Year started	1998	2003 (pilots 2002)	2003	2005 (pilots 2004)
No of woredas / kebeles	34	106	200	104
No of kebeles	630	2895	6000	4431
Households registered[40]	632,000 (88%)	2.4 mn. (79%)	2.4 mn.	700,126 (40 %)
No. of certificates issued	n.a. (delays)	1.3 mn.	n.a. (delays)	Only in pilot areas
Fee for certificate	B 3	Free of charge	B 5	B 2
Type of certificate	Blue cardstock A4 ("form 3")	Passport sized booklet listing rights & obligations	Green booklet	Green booklet
Women's rights	Certificate in name of head; no photo.	Certificate joint: 2 photos	One certificate per family; 1 photo	Joint cert. W. 2 names & photos[41]
CPRs demarcated	No (only pilots)	Yes	No	Kebele discretion
Procedures				
Initial training by	Kebele; woreda staff	Woreda officials	Woreda	Kebele; training centers
Written materials used	Few copies of Proclamation	Posters (delayed)	Yes; proclamation & book	No due to language problems
Supervision of data collection	Students backed up by technicians	Woreda survey team (3) & Land Adm. team (1 + 2)	Expert advice from woreda on demand	Rural development agent
Data collection in field	Not always	Yes; not always done	Yes	Yes
Presentation of results	Discussed in kebele council	Meeting with woreda official present	Yes, details at discretion of LAC	Yes, details at discretion of LAC
Registers & certificates				
Plot map/sketch	No	No, except in pilot kebeles	No, pilot proposal	No
Certificates written by	Kebele, signed by kebele chairman.	Woreda LA team	Kebele; signed by woreda chairman	Woreda LA expert
Registry book written by	Kebele	Woreda LA team	Woreda LA expert	Woreda LA expert
Book kept at kebele?	Yes	Yes	No, only copies of data collection forms	Yes
Book kept at woreda	Yes	Yes	Yes, very condensed (only few plots/hh)	Yes, data at household level (clumsy size)
Updating procedures				
General format	Discretion of kebele	Interplay between kebele & woreda`	Woreda book with columns for transfers	Woreda book still being developed
Procedure for inheritance	Transfer of certificate or return & new issue	New certificate; old cert. not closed; no cross-reference	New certificate; no clear procedure yet.	Not clear
Divorce	Wife gets half the land but no certificate	Wife gets half the land, but no certificate	Wife gets share of land	Wife gets half the land
Recording of leases	Unclear	Not in book	Not in book	Not in book

Source: Field visits to regional EPLAUA offices and 24 kebeles in all four regions; Sept. 2005.

[40] Numbers as of Aug. 2005, the latest date for which information was available.
[41] Additional wives receive a joint certificate with their name first and their photo included.

Table 3: Village level evidence on the certification process

	Total Sample	Tigray	Amhara	Oromia	SNNPR
Timing and coverage					
Years since land use committee established	3.08	10.99	3.58	2.29	1.46
Years since registration started	2.55	8.33	2.73	2.17	1.63
Years since registration was completed	2.22	7.05	2.07	1.53	1.15
Duration of registration (months) if complete	9.56	22.50	8.38	8.36	8.16
Months betw registration & certificate issuance	16.00	15.00	15.21	15.87	17.33
Any preliminary registration documents (%)?	48.15	75.00	66.67	38.00	39.13
Any certificates distributed (%)?	46.30	87.50	37.04	38.00	60.87
Land use committee (LAC)					
Established through popular election	91.67	100.00	85.19	96.00	86.96
No. of committee members	12.19	20.88	13.96	9.42	13.09
Share of sub-kebeles represented (%)	81.10	63.32	94.75	82.36	68.54
Any women in the committee (%)	20.37	25.00	33.33	8.00	30.43
Any members with leadership position (%)	69.44	50.00	74.07	70.00	69.57
LAC got training before start of registration (%)	87.96	100.00	92.59	98.00	56.52
LAC got training after registration started (%)	47.22	37.50	70.37	44.00	30.43
Meetings and written dissemination					
Public meetings before start of registration (%)	92.59	75.00	100.00	92.00	91.30
Public meetings after start of registration (%)	62.96	75.00	70.37	54.00	69.57
LAC got copies of proclamation (%)	65.74	75.00	96.30	50.00	60.87
LAC got other written material (%)	10.19	12.50	22.22	4.00	8.70
Kebele officials got copies of proclamation (%)	53.70	75.00	74.07	42.00	47.83
Kebele officials got other written material (%)	7.41	12.50	18.52	4.00	0.00
Community members got proclamation (%)	5.56	12.50	11.11	0.00	8.70
Community members got written material (%)	2.78	12.50	0.00	2.00	4.35
Coverage and field processes					
(Sub)-kebele boundaries identified & mapped	62.04	37.50	70.37	52.00	82.61
Common property resources mapped	38.89	25.00	44.44	26.00	65.22
Are house plots registered in kebele?	46.96	0.00	62.96	53.85	37.50
Measurement done by tape/rope (%)	77.78	100.00	33.33	90.00	95.65
Measurement by eye/pacing (%)	15.74	0.00	48.15	8.00	0.00
Elders played significant role in adjudication	69.90	62.50	62.50	77.08	65.22
Any woreda official present (%)	55.56	75.00	62.96	44.00	65.22
Neighbors present(%)	82.41	100.00	74.07	84.00	82.61
Conflicts and sustainability					
Any problem in process (%)	58.33	50.00	66.67	52.00	65.22
Any cases of encroachment on public land (%)?	37.96	87.50	55.56	28.00	21.74
If yes, solution was leaving things for later	40.74	25.00	41.67	37.50	66.67
Any holders that could not be registered in field (%)	36.11	12.50	40.74	28.00	56.52
Share of holders who could not be registered in field (%)	3.31	0.69	2.35	4.29	3.22
Any cases where registration form disputed (%)	35.19	25.00	37.04	34.00	39.13
Any cases of certificate could not be awarded (%)	36.11	12.50	51.85	32.00	34.78
Share of holders who did not receive a certificate (%)[42]	4.37	0.13	11.19	3.64	2.33
Any cases where certificate disputed	34.26	12.50	48.15	28.00	39.13
Interest in follow up					
Households interested in second stage?	82.41	100.00	85.19	80.00	78.26
if yes, willing to pay?	90.22	90.91	82.61	97.50	83.33
if yes, how much (B)	12.55	5.00	9.45	16.21	11.93
Any interest in having house plots registered	74.07	87.50	70.37	72.00	78.26
If yes, willingness to pay?	85.54	88.89	84.21	97.22	63.16

Source: Own computation from 2006 EEA/WB Land certification survey.

[42] Figures may be higher than those for holders who could not be registered as the figure is computed only for kebeles where certificates have been issued.

Table 4: Household level evidence

	Total Sample	Tigray	Amhara	Oromia	SNNPR	Richest quintile	Poorest quintile	
Basic characteristics								
Household size	6.66	5.98	6.03	7.12	6.76	5.91	7.25	*
Metal roof	57.58	58.26	69.71	63.03	31.32	69.13	50.00	*
Head illiterate	49.26	53.94	47.11	51.93	43.63	44.20	56.49	*
Head female	13.09	17.77	10.75	14.09	11.27	15.43	14.44	
Primary activity is farming	88.55	83.88	90.32	90.35	84.97	87.83	87.50	
Male member of Kebele council	22.81	14.88	23.12	25.77	20.04	23.48	23.06	
Male w. other leadership position	14.95	11.57	10.75	19.11	12.53	16.96	12.93	
Female member of Kebele council	5.75	8.30	2.73	6.49	6.37	6.04	5.24	
Female w. other leadership position	2.85	5.81	1.45	2.95	2.76	2.91	3.49	
Knowledge of and participation in program								
Meetings before start of the program	87.11	80.59	90.30	85.56	90.09	88.89	86.25	
Household member attended at least one	93.34	89.01	96.69	92.12	93.86	93.75	93.06	
Female attended meeting before start	38.09	50.62	38.00	32.45	43.95	35.35	43.01	
Female attended meeting after start	33.26	49.38	34.73	28.42	33.76	31.10	37.12	
Female participated in LAC election	17.29	23.24	20.91	12.59	20.17	14.99	20.09	
Got written material about the program	15.54	30.80	16.23	9.06	20.51	12.80	20.40	*
Is a member of the LAC	11.04	7.17	8.77	11.80	14.29	12.32	10.20	
Well informed about the program	77.92	80.17	81.72	73.23	82.26	78.74	77.16	
Meetings after start of the program	77.41	75.11	81.72	77.45	73.27	78.74	79.16	
Household member attended at least one	92.87	89.33	94.52	93.33	91.51	92.02	92.44	
Nature and gender dimension of certificate								
Has a document to household holdings	59.09	92.83	83.96	38.99	53.92	56.04	61.42	
Preliminary registration paper	39.44	31.05	55.28	40.38	15.52	45.85	43.68	
Book of holding/certificate	60.24	68.95	44.49	59.07	84.05	54.15	55.60	
Months since certificate obtained	24.89	87.03	15.90	10.61	5.56	26.37	23.95	
Certificate is in the name of husband	35.68	70.51	8.58	57.95	21.43	34.06	36.23	
Certificate is joint	51.68	13.36	79.23	28.98	68.91	49.35	49.43	
Certificate is in name of wife	11.12	14.29	10.84	11.36	8.40	14.85	13.58	
Don't know whose name on certificate	1.52	1.84	1.35	1.70	1.26	1.75	0.75	
Female knows where certificate is stored	85.67	84.86	89.93	80.95	85.48	84.55	88.81	
Cost and possible next steps								
Total amount paid for certification	3.84	0.22	3.98	4.26	4.70	4.37	3.42	*
WTP pay to replace lost certificate (B)	11.78	4.71	8.85	22.23	7.42	19.52	8.43	
Would like to add a map/sketch	90.35	92.73	88.00	94.86	85.47	90.09	89.53	
Willing to pay for a map (%)	92.62	92.16	89.39	95.16	95.00	95.22	88.31	*
Like to have a certificate (if don't have)	97.51	70.59	96.51	98.27	98.00	96.70	97.70	
If yes, willing to pay	93.26	91.67	87.95	94.20	92.86	97.16	85.88	*
No of obs. (households)	2315	242	558	1036	479	464	460	
Parcel level characteristics								
Obtained through redistribution	55.92	88.44	58.79	61.53	20.58	50.18	57.11	*
Obtained through inheritance	41.11	10.02	39.83	35.63	72.33	47.14	39.60	*
Parcel not yet registered	9.87	5.78	7.57	10.71	13.64	12.06	6.36	*
Tape or rope used to measure[1]	72.34	78.47	61.55	73.27	89.54	76.43	68.74	
Pacing/eye used to measure[1]	23.78	16.60	31.93	25.31	5.09	20.19	24.70	*
All neighbors present at registration[1]	66.04	71.15	59.97	73.48	53.69	66.10	61.83	
More than half of neighbors present[1]	11.60	15.02	10.58	8.39	22.11	11.34	11.25	
Half of neighbors present at registration[1]	6.82	4.54	6.17	5.14	14.37	7.43	6.55	
Less than half of neighbors present[1]	5.31	0.98	5.36	5.37	7.00	6.22	5.15	
No neighbors present at registration[1]	10.23	8.30	17.92	7.62	2.83	8.91	15.22	*
Boundary marks on the ground	63.51	78.23	67.54	66.29	41.39	61.76	64.77	
No of obs. (plots)	8220	562	2567	3795	1296	1692	1462	

Source: Own computation from 2006 EEA/WB Land certification survey. Stars indicate the significance of differences between poorest and richest quintile: * significant at 5%; ** significant at 1%.
Note: [1]for parcels that have been registered only.

Table 5: Households' knowledge of the land law

	Total Sample	Tigray	Amhara	Oromia	SNNPR	LAC Member			LAC[b]
						Yes	No		
Tenure security									
Households' land use rights w. migration	87.39	52.89	94.80	95.95	77.66	87.82	87.34		90.09
Inheritance to people other than children	39.61	7.44	19.35	56.37	43.22	39.08	39.67		46.91
Mortgaging use rights allowed	43.80	59.09	35.13	49.32	34.24	49.58	43.14		51.85
Land transfers:									
Less than the maximum rental period[a]	89.50	88.43	88.71	90.15	89.56	91.60	89.26		87.99
Know maximum rental period[a]	1.56	0.00	1.97	1.16	2.71	3.36	1.35	*	9.12
Less than needed years to register rental	35.21	26.86	47.67	34.17	27.14	26.05	36.25	*	37.42
Registration of rental contracts	40.95	48.35	24.19	52.99	30.69	47.48	40.20	*	44.44
Gender aspects									
Division of land in case of divorce	86.61	99.59	99.46	80.89	77.45	85.29	86.76		80.18
Number of observations	2315	242	558	1036	479	238	2077		111

Source: Own computation from 2006 EEA/WB Land certification survey. Stars indicate the significance of differences between LAC members and non-members: * significant at 5%; ** significant at 1%.

[a] For modern technology only. [b] The average score of three LAC members from the community survey.

Table 6: Village level evidence on registration of subsequent transactions

	Total Sample	Tigray	Amhara	Oromia	SNNPR
Inheritances					
Any inheritances since certificates issued (%)?	57.14	75.00	78.26	50.00	36.84
If yes, formal change was made (%)	34.32	44.44	42.58	26.32	23.81
Have to pay to get inheritances registered (%)	18.07	50.00	16.67	18.75	5.26
If yes, amount (B)	19.92	7.75	28.75	20.00	33.00
Have to pay for new book/certificate (%)	46.59	100.00	4.35	63.89	42.86
If yes, amount (Birr)	3.99	2.25	4.60	5.56	2.33
Leases and other interests					
Any leases registered in 2005/06	50.62	75.00	54.55	48.39	40.00
Have to pay to get leases registered	22.73	50.00	14.29	20.83	20.00
If yes, amount (Birr)	11.13	5.75	15.00	15.60	9.00

Source: Own computation from 2006 EEA/WB Land certification survey.

Table 7: Subjective certification effects at household level

	Total Sample	Tigray	Amhara	Oromia	SNNPR	Richest quintile	Poorest quintile	
Land redistribution and takings								
Experienced changes in landholding 5 yrs?	50.32	39.67	56.99	53.58	40.92	52.83	49.35	
Don't expect changes of land holdings next 5 yrs	71.58	69.20	70.38	73.15	70.80	66.59	77.01	*
Expect increase due to land redistribution	8.34	12.40	7.53	9.46	4.80	7.39	8.84	
Expect decrease due to land redistribution	6.13	11.98	10.22	3.19	4.80	9.13	3.66	*
Expect compensation if land taken	86.29	86.78	90.32	87.23	79.33	90.43	83.19	*
Compens'n now much more likely than 5 yrs ago	32.88	18.64	21.08	39.51	39.45	35.81	31.37	
Compensation now more likely than 5 yrs ago	40.39	36.02	46.67	41.27	33.33	41.05	37.25	
Land management								
Certificate reduces no. of inheritance conflicts	84.67	87.19	88.71	82.82	82.67	84.57	84.70	
Wanted to undertake land related investments	77.93	83.47	92.83	77.32	59.08	77.83	77.37	
Certificate encourages soil & water conservation	86.31	84.71	95.16	90.54	67.64	88.48	79.74	*
Certificate encourages planting trees	87.52	80.17	92.29	91.89	76.20	90.43	80.82	*
Certificate improves position of women	85.05	81.40	90.14	83.88	83.51	86.52	81.03	
Certificate increases confidence to rent out land	84.96	87.29	90.84	85.08	76.68	87.77	82.00	
Certification encourages CPR soil conservation	66.13	82.64	77.06	60.91	56.37	68.91	63.36	
Certification will reduce encroachment on CPRs	75.64	92.15	85.13	68.24	72.23	79.35	74.78	

Source: Own computation from 2006 EEA/WB Land certification survey. Stars indicate the significance of differences between poorest and richest quintile: * significant at 5%; ** significant at 1%.

Table 8: Investment impact of land registration

	Probit	Tobit	
	Marg. Effect	Coef.	Marg. effect
Kebele issued certificate before Sept. 2005	0.050**	3.721**	0.044
	(2.85)	(4.58)	(4.35)
Head's age	-0.001	-0.071*	-0.001
	(1.65)	(2.25)	(2.25)
Has wage or non-farm employment	-0.021	-2.002*	-0.021
	(1.36)	(2.40)	(2.50)
Total asset value (log)	0.012*	1.247**	0.014
	(2.26)	(4.89)	(4.94)
Value of livestock owned (log)	-0.003	-0.203	-0.002
	(1.05)	(1.69)	(1.69)
Total land size in ha (log)	-0.009	-1.252*	-0.014
	(0.82)	(2.14)	(2.14)
Total household size	-0.001	0.001	0.000
	(0.39)	(0.00)	(0.00)
Female headed	-0.015	-1.613	-0.017
	(0.61)	(1.40)	(1.46)
Land size in ha (log)	0.017**	1.674**	0.018
	(3.40)	(4.11)	(4.13)
Plot acquired through redistribution	0.027	2.091	0.023
	(0.85)	(0.93)	(0.94)
Plot acquired through inheritance	0.024	1.718	0.019
	(0.76)	(0.77)	(0.76)
Plot irrigated	0.081**	6.515**	0.085
	(2.64)	(4.93)	(4.30)
Years under possession	0.000	0.039	0.000
	(0.05)	(0.82)	(0.82)
Plot with trees	0.020*	1.546*	0.017
	(2.03)	(1.98)	(1.96)
Plot under annuals	0.057**	5.384**	0.054
	(3.29)	(3.76)	(4.16)
Plot under perennials	-0.031	-3.378	-0.035
	(1.35)	(1.87)	(2.02)
Slope meda	-0.058*	-4.559*	0.054
	(2.00)	(2.51)	(2.35)
Slope dagetama	-0.004	0.173	0.002
	(0.16)	(0.09)	(0.09)
Soil quality lem	0.009	0.286	0.003
	(0.50)	(0.26)	(0.26)
Soil quality lem-tef	0.013	1.046	0.012
	(0.73)	(0.92)	(0.90)
Black soil	0.011	0.952	0.010
	(0.66)	(0.98)	(0.98)
Red soil	0.024	1.871	0.021
	(1.49)	(1.90)	(1.87)
Constant		-44.733**	
		(10.25)	
Observations	7944	7944	
Log likelihood	-2855.48	-6533.81	

Robust z statistics in parentheses. * significant at 5%; ** significant at 1%.
Regional dummies included but not reported.

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