

Gender, Rural Land Certification, and Tenure Security

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ABSTRACT. Advancing economic and institutional policies requires a deep understanding of socioeconomic-group-specific challenges that determine the effectiveness of these policies in achieving growth and development impacts. This paper explores the effect of rural land reform in Ethiopia's Amhara region on perceived tenure security of female land holders compared to their male counterparts. Tenure security defines use, control, investment and transfer decisions on land assets with important implications on the livelihood of women who play a central role in farming activities in Sub-Saharan Africa. Using household level panel data on land certifications and socioeconomic characteristics we find that issuance of usufruct rights increases the overall likelihood of perceived tenure security, but the magnitude of the impact is found to be insignificant for female headed households. The results imply that land certification programs alone may not be sufficient to eliminate gender differentials in tenure security without addressing other key determinants of tenure security such as access to farming resources, farmland productivity, and social capital.

1. Introduction

Effective property rights institutions are critical elements of secured legal rights to landholdings and in turn can lead to enhanced land related economic outcomes (North *et al.*, 1973; Knack *et al.*, 1995; Acemoglu *et al.*, 2001; Besley *et al.*, 2010). Existing literature points to three different channels by which secure property rights can impact economic outcomes related to land ownership, use, investment, and transfer: First, well-defined property rights to land and the ability to draw on public enforcement lower the risk of eviction, reduce the need for land owners to expend resources to stake out or defend their claims and, in turn, increase incentives for land-related investments. Second, registering ownership of land reduces the cost of renting and selling transactions and encourages increased levels of exchange. Finally, formalization of land rights

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eases the use of land as collateral and increases access to credit (Besley, 1995; Deininger *et al.*, 2011; de Soto, 2000).

The benefits of secured landholdings extend to both male and female landholders. However, improving female rights to landholdings is particularly important because women are traditionally susceptible to greater economic and socioeconomic discrimination and are often among the most vulnerable groups in rural societies (Joireman, 2008). In the past couple of decades, development work around the world has demonstrated the importance of programs that target and reach women and not only households. Development practitioners and researchers find that households often do not fully share their resources among all members and that the distribution of resources depends on who in the household has access and control over assets (Haddad *et al.*, 1997).

Land is a crucial economic asset for women in poor rural communities: it is a fundamental input for agricultural production; it can be used as collateral to access capital; and, it can generate income directly if it were rented or sold. Land can also provide women with economic security as they age, or in the event they become heads of households as a result of their husbands' migration for work, abandonment, or death. Moreover, land rights improve access to social capital by raising women's status and shaping their identity as productive members of their families and communities. Secure rights to land are particularly important for women when their families or communities lack formal sources of social security or access to other social safety nets (Giovarelli, 2009).

While secured land rights can enrich women's overall well-being, its advantages extend well beyond the direct female beneficiaries and can lead to improved economic and socioeconomic outcomes for their families and their communities. For example, using survey data from Peruvian urban households between 1995 and 2003, Field (2007) finds that receipt of ownership title led to former urban squatters, and women in particular, to participate in the formal labor market in place of staying at home to protect their land, which in turn led to increase in income and reduction in the incidence of child labor among these households. In particular, studies have shown that improvements in women's land rights can be linked to a number of positive economic and socioeconomic outcomes. When women's land rights improve: a) women are less likely to report experiencing long-term physical and psychological domestic violence (Panda, 2006; Gupta, 2006); b) their families' nutrition is likely to improve (Allendorf, 2007; Katz and Chamorro, 2002); c)

their children's educational achievements are likely to improve (Katz and Chamorro, 2002); d) their fertility is likely to decrease (Field, 2003); and e) women's ability to participate in their households' decision making is likely to increase (Allendorf, 2007).

One of the objectives of Ethiopia's rural land certification program was to strengthen women's land holding rights. However, formal evidence on the gender specific impact of this rural land policy reform in the Amhara region is missing. This paper fills this gap in the literature by empirically exploring the effect of the rural land reform in the Amhara region on tenure security of female land holders compared to their male counterparts. Identification of this impact requires taking into account the socioeconomic factors that define the use of land in rural Amhara, and the extent to which these factors determine the effect of rural land certificates on female land tenure security, such as access to farming resources, type of land-use, and presence of male support.

To assess the impact of land certification on women's perceived tenure security, the analysis employs household level panel data in a Chamberlain random effects probit model which assumes strict exogeneity of the vector of household level control variables conditional on accounting for unobserved heterogeneity across households. To test the robustness of the baseline estimation strategy, the paper subsequently employs a household fixed effects linear probability model estimation of the outcome variable. Finally, to account for potential issues of endogeneity of the treatment variable, i.e. household certification status, the linear probability model is re-estimated using a two-stage-least-squares instrumental variable (IV) strategy.

The empirical results reveal that issuance of usufruct rights (land use certificates) in the Amhara region increased the overall likelihood of perceived tenure security. However, the magnitude of this effect was found to be lower for female headed households relative to male headed households, and is insignificant. The results imply that land certification programs alone may not be sufficient to eliminate gender differentials in tenure security without addressing other key determinants of tenure security such as access to farming resources, farmland productivity, and social capital. This results from the linear probability and IV model estimations remain robust to the baseline evidence.

2. Background

Gender disparities in land access and tenure security can severely affect the livelihood of households that are headed by women, especially if they are widowed and unschooled. Female-headed households in rural areas like Amhara tend to be poorer and relatively more disadvantaged than households headed by men in terms of access to economic resources that are vital for sustained livelihoods. The new Amhara regional land policy was introduced by the Ethiopian government in 2002 with the objective of strengthening female land security by formalizing women's usufruct rights. The objective of the program was also to provide equitable rights to land by protecting women against risk of potential socioeconomic vulnerabilities, land disputes, discrimination, and expropriation. Notwithstanding, efforts in improving access to land rights through state interventions alone may not be sufficient in providing women equal control over land relative to men. The effective ability to secure women's land rights is ultimately determined by several interrelated factors at play.

For example, security of tenure is highly influenced by access to male labor as well as assets such as oxen. Other factors including mode of production², social and economic status, family support, and social capital are also important determinants of tenure security. Aspects such as class and economic status influence the land rights of both women and also men, because they determine the position and influence of individuals and their households within a community. As a result, socioeconomic factors also play an important role in the ability to secure land rights.

The protection of a woman's land rights in the Amhara region is to a great degree also correlated with the level of family support she can mobilize. For example, culturally, if a woman has male and able family members it is considered an embarrassment for them if they do not protect her rights. Family support becomes even more relevant in traditional societies where female members of the household often have greater constraints to access to literacy relatively to male members, which may hinder women's ability to safeguard their own rights. For instance, when rights dictated in official documents may not be enforced due to the presence of weak institutions regulating natural resource management, female land holders may lack the capacity (perhaps due to lack of legal knowledge procedures or old age) to contest their rights formally due to any

² Differences in the mode of production between male and female landholders are looked at in the first research paper regarding household welfare and land certification.

disputes, even when legal mechanisms are present. Since land is a scarce commodity in rural Amhara, property rights to land is a sensitive issue in the region; therefore, securing land rights of individual household members is regarded as adding resources and assets to the family as a whole (Teklu, 2005).

Finally, social capital is also expected to determine women's land rights in the Amhara region. In the existing literature on rural land reform, informal channels of securing resource rights include "*social capital*" which is generally defined by many aspects. Social capital is defined as an aggregate of actual and potential resources linked to membership in a group or as a stock of trust and emotional attachment to a group (Bourdieu, 1986; Coleman, 1988). It has also been referred to as tacit knowledge, a collection of networks, an aggregation of reputations, and organizational capital, or as features of social organization such as networks, norms and social trust that facilitate coordination and cooperation for mutual benefit (Stiglitz, 1999; Putman, 1995). Therefore, social capital in the form of organizational memberships, networks, and various social support systems are expected to affect the status of women within the community, and in turn determine women's land tenure security. Whether formal or informal means are used to achieve some level of land tenure security, the objective of such security is to "allow right holders to gain a social and legal recognition of their rights and to reaffirm it against challenging claims" (Burnod *et al.*, 2012).

Even though the primary goal of the rural land certification program is to strengthen women's land entitlement, the non-economic literature on women and land rights in the Amhara region points to limitations on the extent to which certificates alone can fully achieve the program's intended objectives. The existence of these limitations are also supported by the survey evidence found in this paper. For example, the patriarchal nature of the Amhara society, in addition to the cultural norms and traditions restrict women from taking part in certain modes of production on their land. Mere implementation of land certificates are not expected to significantly affect these underlying barriers to strengthening women's usufruct rights to land that are deeply rooted in Amhara's traditional rural society. Therefore, the determination of the degree to which the certification programs affect tenure security needs to be assessed in light of the complex interaction between key economic and societal factors and the land certificates provided to women.

3. Literature Review

An extensive and growing body of empirical literature on land-use certificates and their impact on tenure security provides important insight on the usefulness of land titling, short of granting private ownership deeds. Nonetheless, the mainstream literature on the role of certification in improving tenure security has not formally incorporated the gender differential impacts of land certification schemes on improving land use rights. Given the important and growing role of women in rural farming activities in Amhara and that women face greater traditionally defined productive and reproductive constraints relatively to men, the exclusion of gender in formal analysis can lead to spurious results and mislead policy implications of such certification schemes.

Burnod *et al.* (2012) examines the impact of the Malagasy land reform in the form of introducing land certificates on “household’s sense of tenure security” using cross-sectional data of rural households in four regions and nine communes of Madagascar. The authors define tenure insecurity through “land holders’ perception that someone can challenge their land rights, and eventually, make them lose their rights” (Burnod et al, 2012, p. 8). This definition of tenure insecurity is based on the context of Madagascar in which the authors assert that possession of a land title does not imply a sense of tenure security for several reasons i.e. “land conservation system is not up-to-date, torn or lost land register, title in the name of the dead parents, or if State land administration practices are not transparent (clientelism, corruption)” (Burnod *et al.*, 2012, p.8).

Moreover, the authors point that landholders may feel secure about their land holdings even without possessing a document to secure their land rights by having “strong social recognition” (Burnod *et al.*, 2012, p.8). The authors applied a linear probability model on two sets of regressions: (i) a regression examining correlations between plot and household characteristics and lack of fear in terms of “feeling of security; (ii) a regression exploring whether the effect of a document in the form of a title, a certificate, a *petits papiers*³ or a tax receipt differs between plots attained through purchase, inheritance, or other forms of acquisition. Overall the authors found that the reform significantly contributed to the reduction of households’ perception of tenure

³ “A system in Madagascar in which “people try to prove their property rights to a particular plot of land by having a piece of paper describing their plot of land drafted on a computer and stamped by any government office” (Sandra F. Joireman, 2012, p. 78)

insecurity and led to fewer households fearing the risk of competing claims on their plots in the short term. However, the majority of the households acknowledged that they are not protected against all risk of contestation in the long term. The paper concluded that land certificates are viewed as complements to *petits papiers* i.e. households' increased demand for land-use certificates did not lead to a reduction in the demand for *petits papiers*.

Specifically, the results showed that the probability of tenure insecurity increases when the plot's economic value increases (through production of rice and perennial crops), when plots are obtained through improvement (especially under lack of presence of land document), and when plots are owned by the family plots and when plots are obtained through donation. In addition, tenure insecurity was found to be higher among those who are foreign born (interviewed people whose family's tomb is not located in their village of residence) and are new comers to the village. The regressions also showed that the distance between the house and the plot has no impact on perceived tenure insecurity. Among the female landholders in Madagascar, perceptions of tenure security are not impacted by the fact that women may not fare out well in local and inheritance rules in addition to facing the risk of plot expropriation by their in-laws upon becoming widowed. Burnod *et al.*, 2012 also found that the probability of perceived tenure insecurity falls when the number of plots (proxy of wealth or importance of the family) increases. A strong sense of tenure security was correlated with inherited and donated plots due to owners of such plots being protected against claims from relatives (owners enjoying a "strong social role and position inside their large family", Burnod et al, p. 12) while such social role may not provide protection against competing claims from outsiders on purchased plots. Household wealth was found to be an insignificant determinant of the probability of perceived tenure insecurity. The analyses also showed that the probability of tenure insecurity decreases when the rights of the landholders are formalized and legalized. However, the authors indicated that in the context of Madagascar, the lack of land document does not necessarily mean households are tenure insecure as the majority are not concerned about losing their rights in the short-term.

Do *et al.* (2008) examine the impact of a legal reform in land rights in Vietnam based on a 1993 land law which granted rural households to exercise certain rights i.e. inherit, transfer, exchange, lease and mortgage their land. In essence this was executed through the issuance of land-use certificates to all households. The authors examine the impact of such reform on various economic outcomes such as crop choice, labor decisions, and consumption expenditure or

agricultural income. The analyses used data from two survey rounds i.e. Vietnam Living Standards Survey conducted in 1992-1993 followed by a second round survey in 1997-1998. The first round survey is taken as the baseline capturing households before the land reform. Using differences-in-differences estimation strategy, the authors found that land-use certificates provided incentives to households to undertake long-term agricultural investments (significant increase in the proportion of cultivated area devoted to multiyear crops), allocate more labor time to non-farm activities, no significant impact on overall household consumption expenditure or agricultural income.

Do *et al.* (2008) also examined the channels which such impacts were occurred. The analyses indicated the lack of evidence that land-use certificates increased access to credit, as well as increased land market activity. Hence the authors concluded that the observed impacts of certification were the result of increased security of tenure of the rural landholders defined as “*guarantee against future expropriation by the state*” (Do *et al.*, 2008, p. 570).

Using data from four waves of a rural panel survey conducted in the Amhara region, Deininger *et al.* (2011) empirically investigated the impact of the land certification program on perceived tenure security. The dependent variables used in the analyses are two i.e. the regressands take a value of one if a household expects an increase or a decrease in the size of its landholdings due to administrative intervention in the five years following the survey. The empirical model assesses changes in the size of the household’s landholdings (increase or decrease) on various independent variables, including the treatment variable (certification status) i.e. if the household lives in a treated village and also if the treatment is at the household level; a vector of controls at the household level; household-specific unobserved effects; time dummies; and the iid error term.

The hypothesis tested was that certification increases tenure security. The authors tested the hypothesis using the Chamberlain random effects probit, allowing for correlation between the household-specific unobserved effects and the average of the time-varying covariates at the household level. As robustness checks, household fixed effects linear probability model was used. The authors found that despite certification in the Amhara region failing to eliminate tenure insecurity, it did have a significant reduction in fear of land loss by nearly 10 percentage points. This result was found to be robust across specifications. Specifically, the results showed that land tenure for households with certificates is significantly more secure due to less household expectations of administrative interventions. The Chamberlain village-level estimation results indicated that certification decreased by nearly 14 percentage points the share of those expecting

to gain and nearly 9 percentage points in the share of those expecting to lose from land redistribution. The robustness check estimates from the household fixed effects linear probability model showed that the results are consistent for the case of decreases in the landholding size, but insignificant for increases. The authors conclude that while certification has a positive impact, substantial levels of tenure insecurity remain due to threat of expropriation resulting from the effects of the Ethiopia's land policy environment. Deininger *et al.* (2011) point that a full realization of the potential of certification requires in addition to honoring the existing certificates that the policy environment does not undermine the value of the land-use certificates.

None of the aforementioned literatures undertook an empirical assessment of the gender impact of land-use certificates. Specifically, the studies have not assessed whether there were differential impacts of the certification program between male and female headed households and what were the mechanisms driving these impacts.

Other important determinants of rural land tenure security has also been discussed by empiricists in the formal literature. For example, with respect to the role of household member composition on perceived tenure insecurity, Deininger *et al.* (2011) find an insignificant impact of the number of adult males and adult females (defined as household members between ages 15 and 60) on household's expectation of an increase or decrease in landholdings over the coming 5 years due to land redistribution and reallocation. These results are found to be consistent regardless of whether the land certification treatments are examined at the household or village level.

On the role of "social capital" in promoting land tenure security, Katz (2000) uses a comparative analysis of two regions in Guatemala and finds that, a significant endowment of social capital among natural resource users fosters a sense of ownership and respect for boundaries, and provides the foundation for usufruct rules, monitoring, and enforcement mechanisms which help preserve the natural resource base. In contrast, an absence of social capital in a situation where property rights are poorly defined can lead to resource mining in both private and common property regimes.

4. Data and Methodology

4.1 Data Source

The data for the empirical analysis is drawn from a set of household level panel surveys pertaining to “Studies for Sustainable Land Use in the Ethiopian Highlands”⁴. The information captured for the purposes of this paper includes household level variables from the four waves of rural household surveys conducted in 1999, 2002, 2004, and 2007. The first wave of the surveys covered the period before the certification program was formally implemented. It is important to note that this survey was not originally designed to capture the Amhara certification program, and the potential impact on agriculture and rural livelihoods. The objective of the survey was to analyze the impact of a sustainable development program and comprehensive aspects of the certification program was added at a later stage of the survey, mainly in the fourth round of the wave.

4.2 Summary Statistics

The final survey dataset constructed for the purposes of this paper is an unbalanced panel consisting of 6541 observations that are comprised of 1,864 unique surveyed households⁵. 83 percent of the observations are obtained from male headed households. Across the aggregate survey period the number of male headed households increased until 2004 when a total of 16 households disappeared from the sample relative to the previous year. Conversely, the number of female headed households increased throughout the survey years. **Table 4.1** depicts the distribution of the male and female headed households during 1999-2007 as captured in each survey year:

⁴ The survey was conducted by the Department of Economics of Addis Ababa University in collaboration with Gothenburg University, Ethiopian Development Research Institute, and the World Bank.

⁵ 1413 households were captured in each of the four survey waves. In 1999 there were 1,189 and 224 male and female headed households, respectively; in 2002 there were 1,206 and 207 male and female headed households, respectively; in 2004 there were 1,174 and 239 male and female headed households, respectively; and in 2007 there were 1,157 and 256 male and female headed households, respectively.

Table 4.1: Distribution of Male and Female Headed Households

	1999	2002	2004	2007
Male	1265	1290	1436	1420
Female	251	228	312	339

Source: Own estimation from “Studies for Sustainable Land Use in the Ethiopian Highlands” panel survey.

The certification program was not introduced until 2002 which was the “pilot” year for the reform program. Due to the lengthy certification process, it was not until the following years in which households actually began to receive land-use certificates for their holdings. For example, a substantial proportion of both male and female headed households acquired certificates during 2005-2007 as depicted in **Table 4.2**. In 2004, nearly only 1 percent of the male headed households received certificates, and in 2007, 77 percent of the male headed households were certified. In the female headed households, nearly 2 percent and 78 percent received certificates in 2004 and 2007, respectively.

Table 4.2: Distribution of Household Certification Status Across Survey Years

Certification Status	Male Headed Households				Female Headed Households			
	1999	2002	2004	2007	1999	2002	2004	2007
No	1265	1290	1422	316	251	228	305	73
Yes	0	0	14	1097	0	0	7	266
.	0	0	0	7	0	0	0	0

Source: Own estimation from “Studies for Sustainable Land Use in the Ethiopian Highlands” panel survey.

In the total panel sample, nearly 79 percent of observations report no certificates and mainly include observations from the first three survey waves, i.e. 1999, 2002, and 2004. Out of the total 6541 observations, only 20 percent with certificates come from female headed households, while among observations with no certificates, a mere 17 percent are linked to households headed by women. However, these distributions are not surprising given that there are likely to be fewer female headed households relative to male headed households in the surveyed area in general, which is subsequently reflected in the gender distribution of land certification recipients. Nonetheless, there is sufficient variation in the survey data that allows carrying out the gender analysis in this paper.

4.3 Descriptive Statistics

This sub-section provides an overview of the households' perceived tenure security over their land holdings, disaggregated by sex of the household head and certification status. In addition, the section includes a discussion of the socio-economic characteristics of the surveyed households. The descriptive statistics presented in this section are important in assessing the potential channels by which land certificates could impact tenure security, in addition to exploring the heterogeneity of these channels and household characteristics which affect tenure security (as complements or substitutes to certificates) across male versus female headed households.

The panel surveys capture information on the perceived tenure security of the households over their land holdings which is the primary variable of interest and analyses in this paper. Specifically, household heads are asked "What do you expect about changes in the size of your land holdings over the next five years"? Possible household responses include "increase", "decrease", "no change" or "don't know". In this paper, these response categories "decrease", and "don't know" are treated as proxies to represent *tenure insecurity*, while "increase" and "no change" represent "*tenure security*".

In the context of Ethiopia's usufruct rights, a decrease in the size of land holdings can be administratively induced through village redistributions and land reallocations. A decrease in the size of land holdings holds a negative perception of tenure security, as such change implies a *loss* in landholdings. Also, households responding "don't know" may face some level of tenure insecurity as they are *uncertain* about the occurrence of changes in the size of their land holdings. Although the change may be positive in the sense of increased land size holdings, this paper assumes that lack of certainty about the direction of change is a reflection of tenure insecurity, especially in a policy environment where land is government owned with a likelihood for future land redistribution and reallocation by the state. Therefore, moving forward, this paper assumes that both survey responses of "decrease", and "don't know" regarding expectations about changes in the size of land holdings will proxy for "*tenure insecurity*" (negative perception about land size holdings or *reduction in tenure security*).

On the other hand, a response of "no change" or "increase" are treated in this paper as proxies for *tenure security* (positive perception about land size holdings) among households. "No change" or "increase" indicate households' confidence that their land size will be at least not

changing derived from a perception of not expecting land loss, and if there is expected change it will be an increase.

Categorizing the variable of interest as in the aforementioned manner allows for capturing a decent sample of female headed households in the analyses since nearly only 17 percent of the observations belong to such households. Analyzing tenure insecurity by each type of expected changes in the size of landholdings reduces the sample size of female headed households which posits a challenge for empirical estimations by gender.

The survey also captures another variable to measure households' perception over how secure they feel about their landholdings. This is captured only in the 2007 survey in which households are asked "have you ever been concerned about land related conflicts?"⁶ This paper did not take this variable to proxy for whether households are secure about their landholdings or not because it reflects households' perceptions in the past. Therefore, the fact that the survey does not ask this question in each year poses a challenge for capturing a correlation between possessing a land-use certificate and households' perception about the security of their landholdings.

Using the panel information from the survey, **Table 4.3a**⁷ presents households' perceptions about the size of their land holdings disaggregated by sex of the household head and perceptions across the years. Overall, nearly 35 percent of the panel observations hold a negative perception over their land tenure security as reflected by their responses of "decrease", and "don't know" with respect to changes in the size of their land holdings. On the other hand, nearly 65 percent of the panel observations are linked to a positive perception over the size of their land holding as reflected by "no change" and "increase" response categories).

⁶ Nearly 78 percent of the households responded "No".

⁷ The 1999, 2002, and 2004 surveys do not have the "Don't know" category in the variable capturing households' expectations about changes in the size of landholdings.

Table 4.3a: What do you expect about changes in the size of your landholdings?

	Male Headed Households					Female Headed Households									
	1999	2002	2004	2007	Total	1999	2002	2004	2007	Total	1999	2002	2004	2007	Total
Decrease	24.12	28.11	29.2	20.32	24.96	24.6	28.62	29.97	21.93	25.91	21.69	25.23	25	13.57	20.26
Don't Know	0	0	0	32.78	9.82	0	0	0	31.03	9.01	0	0	0	40.12	13.85
"Tenure insecure"	24.12	28.11	29.2	53.1	34.78	24.6	28.62	29.97	52.96	34.92	21.69	25.23	25	53.69	34.11
No change	26.38	33.4	39.26	38.93	34.37	24.44	32.86	38.79	38.79	33.57	36.14	36.49	41.86	39.53	38.39
Increase	49.5	38.49	31.54	7.97	30.84	50.96	38.52	31.24	8.25	31.52	42.17	38.29	33.14	6.78	27.49
"Tenure secure"	75.88	71.89	70.8	46.9	65.21	75.4	71.38	70.03	47.04	65.09	78.31	74.78	75	46.31	65.88

Source: Own estimation from “Studies for Sustainable Land Use in the Ethiopian Highlands” panel survey.

Note: percentages do not add to zero in each year due to missing observations

Disaggregating the response on expectations about changes in the size of land holdings by sex of the household head shows that the perceptions over feeling “tenure secure” and “tenure insecure” are evenly distributed in both male and female headed households, with both feeling relatively “tenure secure”. However, this does not imply that both male and female headed households overall share the same level of “tenure security” across the board. This is because within each gender-group, a greater share of observations from female headed households expect “no change” and fewer of them expect a “decrease” in the size of their landholdings compared to their male counterparts. In addition, looking at each category separately, 14 percent of observations from female headed households seem to exhibit some level of uncertainty over the future of their land holdings relative to the 9% of male headed households.

The last land redistribution in the Amhara region was in 1996 (E.C.) which corresponds to the year 2002/2003. The table shows the decline in perceived tenure security from 1999 to 2004, and the pattern holds across both the male and female headed households. This is interesting to observe since the perceived tenure insecurity seemed to increase even during the early stages of the certification program implementation. Households continued to remember the last land redistribution and this impacted their perception of tenure security over their land holdings as depicted by the increase in the percentage of households citing expected “decrease” from 1999 to 2004 in both male and female headed households. However, this percentage began to decline across all households after 2004 which can be potentially attributed to the issuance of certificates

to households decreasing their expectation that the size of their landholdings may be reduced in the next five years.

Table 4.3b shows the relationship between households' perception about the expected changes in the size of their landholdings and certification status.

Table 4.3b: What do you expect about changes in the size of your landholdings by certification status?

	No Certificates					Certificates				
	1999	2002	2004	2007	Total	1999	2002	2004	2007	Total
Decrease	24.12	28.11	29.28	30.08	27.24	--	--	0	17.49	17.45
Don't Know	0	0	0	30.85	2.67	--	--	0	33.21	33.14
"Tenure insecure"	24.12	28.11	29.28	60.93	29.91	--	--	0	50.7	50.59
No change	26.38	33.4	39.28	29.56	32.18	--	--	33.33	41.73	41.72
Increase	49.5	38.49	31.44	9.51	37.92	--	--	66.67	7.57	7.7
"Tenure secure"	75.88	71.89	70.72	39.07	70.1	--	--	100	49.3	49.42

Source: Own estimation from "Studies for Sustainable Land Use in the Ethiopian Highlands" panel survey.

Note: percentages do not add to zero in each year due to missing observations

The correlations show that certification failed to eliminate tenure insecurity of households as well as not clearly demonstrating whether households' tenure security has been enhanced. For example, relatively the same percentage of household observations with certificates are affiliated to a positive perception over the size of their land holdings as those with a negative perception i.e. 51 percent and 49 percent of observations with certificates belong to households feeling "tenure insecure" and "tenure secure", respectively. As for household observations with no certificates, a greater share hold positive perceptions regarding expectations about changes in the size of their land holdings. It is interesting to note that more household observations with certificates expect changes in the form of a "decrease" or "increase" relatives to those without certificates. Also interesting to note is that certification may not have reduced the level of uncertainty as determined through the "Don't know" response relative to the observations with no certificates, and at the same time certification may have increased the confidence of households to expect "no changes" relative to households with no certification.

Table 4.3c examines the correlation between perception of tenure security and certification status by sex of the household head.

Table 4.3c: What do you expect about changes in the size of your landholdings by gender and certification status?

Male Headed Households										
	No Certificates					Certificates				
	1999	2002	2004	2007	Total	1999	2002	2004	2007	Total
Decrease	24.6	28.62	30.03	30.06	27.76	--	--	0	19.54	19.51
Don't Know	0	0	0	30.38	2.54	--	--	0	31.05	30.99
"Tenure insecure"	24.6	28.62	30.03	60.44	30.3	--	--	0	50.59	50.5
No change	24.44	32.86	38.76	30.7	31.36	--	--	50*	41.28	41.29
Increase	50.96	38.52	31.2	8.86	38.34	--	--	50*	8.13	8.2
"Tenure secure"	75.4	71.38	69.96	39.56	69.7	--	--	100	49.41	49.49
Female Headed Households										
	No Certificates					Certificates				
	1999	2002	2004	2007	Total	1999	2002	2004	2007	Total
Decrease	21.69	25.23	25.15	30.14	24.48	--	--	0	9.02	8.99
Don't Know	0	0	0	32.88	3.36	--	--	0	42.11	41.95
"Tenure insecure"	21.69	25.23	25.15	63.02	27.84	--	--	0	51.13	50.94
No change	36.14	36.49	42.11	24.66	36.5	--	--	0	43.61	43.45
Increase	42.17	38.29	32.75	12.33	35.66	--	--	100*	5.26	5.62
"Tenure secure"	78.31	74.78	74.86	36.99	72.16	--	--	100	48.87	49.07

Source: Own estimation from “Studies for Sustainable Land Use in the Ethiopian Highlands” panel survey.

Note: percentages do not add to zero in each year due to missing observations

* denotes one observation only.

The descriptive shows that *certification may have reduced the expectations of change in the size of land holdings in in both male and female headed households*. For example, both male and female headed households with no certificates expect a change in the form of “decrease” and “increase” relative to their counterparts with no certificates. Nevertheless, less female headed households expect such change relative to their male counterparts, regardless of the certification status.

However, it is interesting to note that more female headed households expect “no change” than their male counterparts even when certification status is taken into account. In addition, female headed households seem to be uncertain in terms of their “don’t know” response than their male counterparts, regardless of the certification status. A potential explanation for the differential in perceptions among male and female headed households could be lack of knowledge about the land policy environment among female household heads relative to their male counterparts due to

their relatively low literacy and lack of active participation in the society outside of the confines of the home space.

The statistics reported in **Tables 4.3a-4.3c** highlight the importance of exploring the reasons behind the response patterns that are observed across male and female headed households. From the survey data, the reasons can be grouped into two categories: “administrative” and “non-administrative”⁸. Administrative reasons include village redistributions which refer to across the board distribution of land on the basis of household size, and land reallocations which are designed for a more specific purpose such as land could be given to nearby town, future church/road/school construction, increasing population pressure, land changed to common land Both are government induced changes in the size of land holdings. On the other hand, non-administrative changes in the size of land holdings are due to factors not induced by formal authorities, such as family redistribution, inheritance from head’s parents, inheritance from spouse’s parents, inheritance from other relatives of head, buying, mortgaging, bequest/gift to others, other.

Table 4.4 depicts the reasons for households’ expectations about changes in the size of their land holdings. Given Ethiopia’s land policy environment, majority of the households (over 74 percent) expect changes due to administrative reasons, regardless of the certification status. However, the table also shows that certification seems to provide some level of tenure security from administrative related changes to the size of land holdings. This pattern holds for both male and female headed households, although there is no visible difference in the female headed households with and without certificates. The last administrative change in the Amhara region occurred in 1996 (E.C.) due to village redistribution⁹. **Table 4.4** also shows declining trend of households citing administrative reasons for expectations about changes in the size of their land holdings from 1999-2004. After 2004, administrative reasons have been increasingly cited for changes in land holding size as households seem to recall the last and most recent village redistribution.

⁸ Administrative reasons include village redistribution, land reallocation, land could be given to nearby town, future church/road/school construction, increasing population pressure, land changed to common land. On the other hand, non-administrative reasons include family redistribution, inheritance from head’s parents, inheritance from spouse’s parents, inheritance from other relatives of head, buying, mortgaging, bequest/gift to others, other.

⁹ This was around 2003/2004 in Gregorian calendar.

Table 4.4: Reasons for expectations about changes in the size of land holdings % ?

	No Certificate					With Certificate				
	Panel	1999	2002	2004	2007	Panel	1999	2002	2004	2007
Non-administrative	17.4	11.6	22.4	22.3	9.94	25.6	--	--	--	25.4
Administrative	82.5	88.4	77.6	77.7	90.1	74.4	--	--	--	74.6

MALE SAMPLE

	No Certificate					With Certificate				
	Panel	1999	2002	2004	2007	Panel	1999	2002	2004	2007
Non-administrative	17.5	11.9	22.1	22	9.9	26.4	--	--	--	26.49
Administrative	82.5	88.1	77.9	78	90.1	73.6	--	--	--	73.51

FEMALE SAMPLE

	No Certificate					With Certificate				
	Panel	1999	2002	2004	2007	Panel	1999	2002	2004	2007
Non-administrative	17.5	9.7	24.1	23.6	10	19.5	--	--	--	17.5
Administrative	82.5	90.3	75.9	76.4	90	80.5	--	--	--	82.5

Source: Own estimation from “Studies for Sustainable Land Use in the Ethiopian Highlands” panel survey.

The data shows that there are woredas (districts) that achieved full or near full certification while others were far from this outcome (see **Table A-1** in appendix for reference). This differential in certification status may have potentially contributed to variations in tenure security perceptions across the woredas, and to the varying patterns of perception between male and female headed households. These perception patterns across woredas and the sex of the household heads are demonstrated in **Table 4.5**.

Table 4.5: Household perceptions of tenure security across woredas (%)

Perceptions	East Gojam				South Wollo			
	Machakel	Gozmin	Enemay	Debre Elias	Tehuldere	Tenta	Harbu/kal	Desse Zuria
Tenure secure	59.6	59.4	64.9	58.5	72.1	65.8	72.9	47.1
Tenure insecure	40.4	40.6	35.1	41.5	27.9	34.2	27.1	52.9

MALE SAMPLE

Perceptions	East Gojam				South Wollo			
	Machakel	Gozmin	Enemay	Debre Elias	Tehuldere	Tenta	Harbu/kal	Desse Zuria
Tenure secure	58.7	58.8	64.6	58	71.4	66.5	74.7	52.2
Tenure insecure	41.3	41.2	35.4	42.1	28.6	33.5	25.3	47.8

FEMALE SAMPLE

Perceptions	East Gojam				South Wollo			
	Machakel	Gozmin	Enemay	Debre Elias	Tehuldere	Tenta	Harbu/kal	Desse Zuria
Tenure secure	67.4	63.3	66.4	62.5	74.8	63.5	63.8	31
Tenure insecure	32.7	36.7	33.6	37.5	25.2	36.5	36.2	69

Source: Own estimation from “Studies for Sustainable Land Use in the Ethiopian Highlands” panel survey

From the data, it is evident that Gozmin and Enemay woredas located in East Gojam zone are the two woredas with the lowest percentage of households with land-use certificates, relative to other woredas in the same zone, including woredas in the South Wollo zone. In Gozmin and Enemay, 48 percent and 51 percent of households had land-use certificates, respectively (see **Table A-1** in appendix). **Table 4.5** shows that above 42 percent of the households across woredas in East Gojam feel tenure insecure, relative to households in woredas of the South Wollo zone (exception is Desse Zuria). Even though all households in the Machakel and Debre Elias woredas in East Gojjam had land-use certificates, the lack of certification among almost half of the households in two other woredas in the same zone may have contributed to negative perceptions of tenure security across the board in the East Gojjam zone relative to in South Wollo¹⁰.

Analyzing the information in **Table 4.5** by sex of the household head reveals that relatively less female headed households feel tenure insecure than their male counterparts across woredas in the East Gojam zone. However, with the exception of the Tehuldere woreda, the converse is true in the South Wollo zone i.e. there is a higher percentage of male headed households in South Wollo feeling tenure insecure than female headed households. Comparing within same-sex group, more male and female headed households in East Gojam feel tenure insecure than their counterparts in South Wollo.

Table 4.6a-c provides a description of the household characteristics by outcome variable¹¹ for all households (including a disaggregation by sex of the household head), and across the survey years. It is evident from the descriptive statistics that *feeling tenure secure may not be correlated to households' certification status*. For example, on average, the majority of households who feel tenure secure as well as tenure insecure have no certificates (82.37 percent and 66.08 percent, respectively), and this pattern holds across both the male and female headed households, although slightly more female headed households who feel tenure secure (20.25%) have certificates compared to their male counterpart (17.09%).

¹⁰ According to media reports, the last land redistribution was relatively aggressive in the East Gojjam than in South Wollo and farmers from the former zone marched to Addis Ababa to demonstrate the redistribution.

¹¹ Households who feel “tenure secure” are those expecting “no change” or expect an “increase” in the size of their land holdings in the next five years. Households who feel “tenure insecure” are those expecting a “decrease” in the size of their land holdings in the next five years or “don’t know” what to kind of change to expect in the next five years.

Households who feel tenure secure are younger in age, linked to high average years of schooling, and have lower average number of prime-age males than households that are tenure insecure. This pattern holds for both the male and female headed household samples.

As for the correlation between perceptions of tenure security and the households' parcel characteristics across all households, those *who feel tenure insecure are endowed with larger average land size holdings relative to those who feel tenure secure.* This may be due to increased vulnerability that households may feel as a result of potential future redistributions of fairly large land size holdings. The same holds true across male and female headed households. Also that for the entire sample, and for both male and female headed households *those feeling tenure insecure are those with a relatively higher share of land size rented out (as a fraction of total household land size), relative to those feeling tenure secure.* Once again, this may increase household's vulnerability level due to fear that rented-out land may be taken away. Furthermore, *households who feel tenure secure are those with a relatively higher share of fertile parcels (as a share of total number of parcels in the household), relative to households who feel insecure.* This is true in male headed and female headed households.

Households feeling tenure insecure grow perennial crops relative to households feeling tenure secure, and this holds true across both male and female headed households (a fewer percentage of female headed households grow perennial crops compared to their male counterparts). This could be explained by the fact that households who feel insecure about the size of their landholdings may decide to undertake productive investments such as growing certain type of crops in order to secure their landholdings. It is interesting to note that the percentage of households growing perennial crops significantly increases after 2004 as observed in both male and female headed households. The increased issuance of certificates after 2004 may have provided households with sufficient incentives to do so.

Interestingly, *households feeling tenure insecure are those owning more bulls and/or oxen than households feeling tenure secure.* This is true in both male and female headed households. Households with wealth may feel threatened that their resources may be taken away, including land.

*Participation in community organizations*¹² which this paper takes as a proxy for households' endowment of "social capital" shows no correlation with tenure security in the entire sample, including when the data is disaggregated by the sex of the household head. This is largely attributable to the fact that this variable lacks variation in the sample as almost all households participate in some form of community organization. It is also important to note that households feeling tenure insecure may have the incentive to invest in acquiring and strengthening their social capital as an informal mechanism to enhance the security of their landholdings. Similarly, those feeling tenure secure could be the households with some form of social capital.

Overall, female headed households who feel tenure insecure are those who mostly do not have certificates; are older in age; have lower average years of schooling; have lower number of prime age males in the households; exhibit lower average land size holdings; rent out a greater size of their total land holdings; have a lower share of fertile parcels; fewer of them grow perennial crops; and own fewer number of bulls/oxen, relative to the male headed households who also feel insecure about their landholdings.

¹² Since there was no consistent variable across the survey years to proxy for the same "social capital" type, this paper uses household's participation in any community organization as listed in the different survey years. In the 2007 survey this includes households' participation in any of the community organizations: kebele council, kebele administration, kebele social court, land use and administrative committee, service cooperatives, political party, religious assembly committee, iddir (burial association), iqub, microfinance institutions. In the 2004 survey participation in community organizations includes households' trade relations through credit, wenzel, mekenadjo, free labor, exchange of grains and other materials, information exchange on market/weather, religion, ethnic, idir, iqub, credit associations, kebele associations, or professional associations. In 2002, the survey includes households' participation in any of the following community organizations: religious or spiritual, ethnical, community organizations, finance/credit/savings groups, production groups, peasants associations, or professional associations. The 1999 survey does not include any variable to capture participation in community organizations.

Table 4.6a: Household characteristics by outcome variable (All Households)

Household Characteristics	Tenure Insecure					Tenure Secure				
	1999	2002	2004	2007	Total	1999	2002	2004	2007	Total
Certification status (%)										
No	100.00	100	100	25.57	66.08	100	100	99.62	18.47	82.37
Yes	---	---	0	74.43	33.92	---	---	0.38	81.53	17.63
Age (mean)	48.27	48.56	49.75	52.84	50.64	45.9	48.02	49.9	49.42	48.07
Years of schooling (mean)	1.70	1.06	1.21	0.80	1.08	1.43	1.11	1.19	1.12	1.22
Number of prime-age males (mean)	0.72	0.86	1.18	1.24	1.06	0.62	0.77	1.03	1.14	0.86
Total parcel size (mean)	0.0005	0.0038	0.0022	0.2418	0.1138	0.0008	0.0038	0.0020	0.1334	0.0321
Share of rented-out land size to total HH land size	0.1634	0.1766	0.2046	0.2161	0.1968	0.1874	0.1941	0.2123	0.1873	0.1944
Share of fertile parcels to total number of parcels in HH	0.5731	0.6159	0.5884	0.5701	0.5830	0.6161	0.6085	0.5935	0.5802	0.6015
Grow perennial crops (%)										
No	85.03	92.34	91.05	64.08	78.44	91.63	91.03	93.91	61.10	85.70
Yes	14.97	7.66	8.95	35.92	21.56	8.37	8.97	6.09	38.90	14.30
Number of bulls/oxen (mean)	1.25	1.28	1.42	1.79	1.53	1.04	1.08	1.23	1.68	1.23
Participation in community organizations (%)										
No	---	0.00	0.31	2.56	1.46	---	0.00	0.76	4.34	1.55
Yes	---	100.00	99.69	97.44	98.54	---	100.00	99.24	95.66	98.45
Observations	24.12	28.11	29.20	53.10	34.78	75.88	71.89	70.80	46.90	65.22

Source: Own estimation from "Studies for Sustainable Land Use in the Ethiopian Highlands" panel survey.

Table 4.6b: Household characteristics by outcome variable (Male Headed Households)

Household Characteristics	Tenure Insecure					Tenure Secure				
	1999	2002	2004	2007	Total	1999	2002	2004	2007	Total
Certification status (%)										
No	100	100.00	100.00	25.64	67.39	100.00	100.00	99.70	18.77	82.91
Yes	---	---	0.00	74.36	32.61	---	---	0.30	81.23	17.09
Age (mean)	47.95	48.10	48.78	52.19	49.98	45.46	47.47	49.62	49.33	47.70
Years of schooling (mean)	1.88	1.18	1.35	0.94	1.23	1.61	1.24	1.36	1.25	1.38
Number of prime-age males (mean)	0.71	0.84	1.17	1.27	1.06	0.61	0.76	1.00	1.13	0.84
Total parcel size (mean)	0.0005	0.0037	0.0022	0.2296	1.0420	0.0008	0.0039	0.0011	0.1420	0.0330
Share of rented-out land size to total HH land size	0.1379	0.1489	0.1604	0.1470	0.1480	0.1446	0.1482	0.1581	0.1271	0.1447
Share of fertile parcels to total number of parcels in HH	0.5720	0.6132	0.5847	0.5834	0.5879	0.6192	0.6176	0.6033	0.5898	0.6092
Grow perennial crops (%)										
No	83.39	91.99	90.75	64.02	78.15	90.46	90.83	93.17	60.84	85.04
Yes	16.61	8.01	9.25	35.98	21.85	9.54	9.17	6.83	39.16	14.96
Number of bulls/oxen (mean)	1.37	1.38	1.52	2.03	1.68	1.17	1.19	1.36	1.87	1.36
Participation in community organizations (%)										
No	---	---	0.35	1.50	0.87	---	---	0.61	3.35	1.18
Yes	---	100.00	99.65	98.50	99.13	---	100.00	99.39	96.65	98.82
Observations	24.60	28.62	29.97	52.96	83.58	75.40	71.38	70.03	47.04	83.08

Source: Own estimation from "Studies for Sustainable Land Use in the Ethiopian Highlands" panel survey.

Table 4.6c: Household characteristics by outcome variable (Female Headed Households)

Household Characteristics	Tenure Insecure					Tenure Secure				
	1999	2002	2004	2007	Total	1999	2002	2004	2007	Total
Certification status (%)										
No	100	100	100	25.27	59.4	100	100	99.22	17.2	79.75
Yes	---	---	0	74.73	40.6	---	---	0.78	82.8	20.25
Age (mean)	50.09	51.5	56.14	55.51	54.03	48.04	51.06	51.36	49.79	49.9
Years of schooling (mean)	0.67	0.32	0.28	0.25	0.33	0.55	0.38	0.34	0.58	0.47
Number of prime-age males (mean)	0.74	0.96	1.26	1.12	1.05	0.66	0.83	1.19	1.18	0.94
Total parcel size (mean)	0.0011	0.0041	0.0026	0.2917	0.1630	0.0009	0.0032	0.0071	0.0972	0.0276
Share of rented-out land size to total HH land size	0.3090	0.3563	0.4943	0.5012	0.4451	0.3950	0.4451	0.4893	0.4430	0.4383
Share of fertile parcels to total number of parcels in HH	0.5790	0.6334	0.6127	0.5153	0.5579	0.6008	0.5589	0.5436	0.5394	0.5637
Crow perennial crops (%)										
No	94.34	94.64	93.02	64.44	80.14	97.35	92.12	97.67	62.5	89.05
Yes	5.66	5.36	6.98	35.56	19.86	2.65	7.88	2.33	37.5	10.95
Number of bulls/oxen (mean)	0.56	0.66	0.74	0.82	0.74	0.4	0.48	0.59	0.88	0.57
Participation in community organizations (%)										
No	---		0.00	7.23	4.55	---	---	1.56	8.72	3.40
Yes	---	100.00	100.00	92.77	95.45	---	100.00	98.44	91.28	96.60
Observations	21.69	25.23	25	53.69	16.42	78.31	74.77	75	46.31	16.92

Source: Own estimation from “Studies for Sustainable Land Use in the Ethiopian Highlands” panel survey.

Table 4.7a-c describes the household characteristics by treatment variable (household certification status) across the survey years and by sex of the household head. The table shows that *overall certification did not eliminate tenure insecurity, and this is true in both male and female headed households*. Infact, there is no difference in the perceived tenure security of households between those with and without certificates, and regardless of the sex of the household head.

Households with certification are older in age, linked to lower average years of schooling in both male and female headed households, and have higher average number of prime-age males than households without certification. This pattern holds for both the male and female headed household samples.

As for correlations between parcel characteristics and households’ certification status overall, *certified households have relatively larger parcel sizes than those without certificates.* Comparing both male and female headed households shows that the latter group with certificates

is endowed with larger total parcel size. In addition, *certified households rent-out a fewer portion of their parcels (however, the difference compared to non-certified households is not significant), with female headed households renting-out greater shares of their parcel area relative to their male counterparts regardless of the certification status.* Furthermore, overall there is *no difference in the share of fertile parcels in certified and non-certified households. However, male headed households have a relatively higher share of fertile parcels than male headed households without certificates. The opposite is true in female headed households.*

Table 4.7a: Household characteristics by treatment variable (All Households)

Household Characteristics	No Certificate					Certificate				
	1999	2002	2004	2007	Total	1999	2002	2004	2007	Total
Tenure Secure (%)										
No	24.12	28.11	29.28	60.93	29.91	---	---	0.00	50.70	50.59
Yes	75.88	71.89	70.72	39.07	70.09	---	---	100.00	49.30	49.41
Age (mean)	46.51	48.23	50.04	50.94	48.53	---	---	50.19	51.25	51.24
Years of schooling (mean)	1.49	1.08	1.19	0.69	1.21	---	---	1.48	1.03	1.04
Number of prime-age males (mean)	0.64	0.79	1.06	1.01	0.86	---	---	0.76	1.25	1.24
Total parcel size (mean)	0.0008	0.0038	0.0021	0.2340	0.0207	---	---	0.0004	0.1765	0.1741
Share of rented-out land size to total HH land size	0.1819	0.1887	0.1967	0.2516	0.1941	---	---	0.3058	0.1872	0.1890
Share of fertile parcels to total number of parcels in HH	0.6071	0.6126	0.5843	0.5127	0.5939	---	---	0.3719	0.5934	0.5900
Grow perennial crops (%)										
No	90.06	91.44	94.26	78.92	91.13	---	---	95.24	58.06	58.67
Yes	9.94	8.56	5.74	21.08	8.87	---	---	4.76	41.94	41.33
Number of bulls/oxen (mean)	1.09	1.13	1.35	1.54	1.22	---	---	1.10	1.80	1.79
Participation in community organizations (%)										
No	---	---	0.87	2.31	0.64	---	---	0.00	3.69	3.63
Yes	---	100.00	99.13	97.69	99.36	---	---	100.00	96.31	96.37
Observations	100.00	100.00	98.80	22.20	78.82	---	---	1.20	77.80	21.18

Source: Own estimation from “Studies for Sustainable Land Use in the Ethiopian Highlands” panel survey.

As for the correlation between certification and whether households grow perennial crops, **Tables 4.7a-c** show that in the overall sample as well as in male and female headed households, *certification may have provided the incentives for households to grow perennial crops relative to non-certified households. Furthermore, it seems that certification may have provided greater*

incentive for male headed households to undertake such production activities than for female headed households.

Moreover, households with certificates have a higher average number of bulls/oxen than households without certificates, and regardless of the sex of the household head. Male headed households with certificates own a larger number of bulls/oxen than female headed households, irrespective of the certification status.

Participation in community organizations shows no correlation with certification status in the entire sample, including when the data is disaggregated by the sex of the household head.

Table 4.7b: Household characteristics by treatment variable (Male Headed Households)

Household Characteristics	No Certificate					Certificate				
	1999	2002	2004	2007	Total	1999	2002	2004	2007	Total
Tenure Secure (%)										
No	24.60	28.62	30.03	60.44	30.30	---	---	0.00	50.59	50.50
Yes	75.40	71.38	69.97	39.56	69.70	---	---	100.00	49.41	49.50
Age (mean)	46.14	47.72	49.57	50.86	48.09	---	---	47.79	50.76	50.72
Years of schooling (mean)	1.67	1.21	1.35	0.75	1.36	---	---	2.21	1.18	1.20
Number of prime-age males (mean)	0.64	0.78	1.05	1.06	0.85	---	---	0.86	1.25	1.24
Total parcel size (mean)	0.0007	0.0038	0.0018	0.2334	0.0201	---	---	0.0004	0.1727	0.1707
Share of rented-out land size to total HH land size	0.1433	0.1485	0.1388	0.1850	0.1464	---	---	0.1362	0.1219	0.1221
Share of fertile parcels to total number of parcels in HH	0.6091	0.6180	0.5918	0.5156	0.5991	---	---	0.4112	0.6078	0.6053
Grow perennial crops (%)										
No	88.74	91.20	93.60	78.93	90.42	---	---	92.86	57.77	58.22
Yes	11.26	8.80	6.40	21.07	9.58	---	---	7.14	42.23	41.78
Number of bulls/oxen (mean)	1.22	1.24	1.48	1.78	1.35	---	---	1.36	2.01	2.00
Participation in community organizations (%)										
No	---	---	0.91	1.71	0.60	---	---	0.00	2.56	2.53
Yes	---	100.00	99.09	98.29	99.40	---	---	100.00	97.44	97.47
Observations	100.00	100.00	99.03	22.36	79.44	---	---	0.97	77.64	20.56

Source: Own estimation from “Studies for Sustainable Land Use in the Ethiopian Highlands” panel survey.

Table 4.7c: Household characteristics by treatment variable (Female Headed Households)

Household Characteristics	No Certificate					Certificate				
	1999	2002	2004	2007	Total	1999	2002	2004	2007	Total
Tenure Secure (%)										
No	21.69	25.23	25.15	63.01	27.83	---	---	0	51.13	50.94
Yes	78.31	74.77	74.85	36.99	72.17	---	---	100	48.87	49.06
Age (mean)	48.42	51.11	52.24	51.27	50.73	---	---	55.00	53.26	53.31
Years of schooling (mean)	0.57	0.36	0.43	0.44	0.45	---	---	0.00	0.39	0.38
Number of prime-age males (mean)	0.68	0.86	1.11	0.77	0.89	---	---	0.57	1.26	1.24
Total parcel size (mean)	0.0010	0.0035	0.0036	0.2369	0.0241	---	---	0.0004	0.1919	0.1877
Share of rented-out land size to total HH land size	0.3766	0.4160	0.4670	0.5398	0.4332	---	---	0.6448	0.4563	0.4611
Share of fertile parcels to total number of parcels in HH	0.5974	0.5820	0.5494	0.5001	0.5678	---	---	0.2933	0.5338	0.5276
Grow perennial crops (%)										
No	96.72	92.83	97.38	78.85	94.78	---	---	100.00	59.61	60.95
Yes	3.28	7.17	2.62	21.15	5.22	---	---	0.00	40.39	39.05
Number of bulls/oxen (mean)	0.43	0.51	0.74	0.49	0.57	---	---	0.57	0.95	0.94
Participation in community organizations (%)										
No	---	---	0.66	5.56	0.86	---	---	0.00	8.43	8.21
Yes	---	100.00	99.34	94.44	99.14	---	---	100.00	91.57	91.79
Observations	100.00	100.00	97.76	21.53	75.84	---	---	2.24	78.47	24.16

Source: Own estimation from “Studies for Sustainable Land Use in the Ethiopian Highlands” panel survey.

4.4 Estimation Strategy

The impact of land certification on households’ perceived tenure security is estimated using Equation (1) which follows the empirical strategy adopted in Deininger *et al.* (2011). In Equation (1) household’s perceived tenure security, Y_{it} , is modeled to depend on household land certification status and a number of household level explanatory variables to control for observed differences among households. The empirical strategy of this paper departs from Deininger *et al.* (2011) in that it examines the gender dimension of certification impacts in more detail by isolating household characteristics that are relevant to rural livelihoods of female headed households in the Amhara region. Specifically, this paper explores the mechanisms through which certifications affect female versus male headed households.

$$Y_{it} = \lambda_t + \beta_1 W_{it} + \beta_2 X_{it} + c_i + u_{it}, \quad (1)$$

Specifically, Y_{it} is a dummy variable that takes a value of one if household i feels “secure” (increase, no change) about the size of its landholdings due to administrative and non-administrative interventions over the next five years and zero otherwise. The group of explanatory variables Equation (1), w_{it} is the policy variable of interest (one if household has a landholding certificate, 0 otherwise); x_{it} is a vector of controls at the household level that include (the head’s gender, age, years of schooling), family support (number of prime-age males), household wealth (number of bulls/oxen owned), parcel characteristics (share of fertile parcels, share of parcel size rented out, total household parcel size), mode of production (whether household grows perennial crops), social capital (participation in community organizations). Finally, c_i captures household-specific unobserved effects, t is a full set of time dummies; and u_{it} is an iid error term.

The following hypotheses are tested:

H1: Certification does not eliminate tenure insecurity for both male and female headed households.

H2: Certificates reduce tenure insecurity more for male than female headed households.

Equation (1) is estimated using the Chamberlain’s (1980) Random Effects probit model. A traditional random effects probit model would have sufficed if c_i was known to follow a normal $(0, \sigma_u^2)$ and *i.i.d.* distribution. This arbitrary set of assumptions is avoided by employing the Chamberlain’s Random Effects probit model, which is a special case of a traditional random effects model that permits dependence between c_i and the vector of control variables, where c_i represents potential unobserved heterogeneity in the model (Chamberlain, 1980; Chamberlain, 1984; Wooldridge, 2001). In effect, Chamberlain’s model works under a correlated random effects framework in which unobserved heterogeneity is independent of the time-dependent covariates. In other words, this approach maintains the strict exogeneity assumption on x_{it} conditional on c_i , but allows for arbitrary correlation between c_i and x_{it} in the following way:

$$c_i = \gamma + \bar{x}_I \zeta + a_i, \quad (2)$$

In equation (2), \bar{x}_i represents a vector of the mean time-varying household covariates for household i across the years, and a_i is an error term. The idea behind this approach is to replace the unobserved effect c_i with its linear projection onto the explanatory variables in all time periods, in addition to the projection error (Woolridge, 2002). This continues to be fixed effects estimation and x_{it} comprises only time-varying explanatory variables. This approach was used in empirical studies to assess the impact of a similar land reform on land-related investment and productivity, and in a second study to assess the impact on tenure security by Holden, Deininger, and Ghebru (2009), and Deininger, Ali, and Alemu (2011), respectively. A conditional logit model with household fixed effects could be have bene used but doing so would result in dropping a large part of the sample and less flexibility to compute the marginal effects (Woolridge, 2002).

Next, I use a household fixed effects linear probability model to check the sensitivity of the Chamberlain random effects probit by estimating the following specification:

$$P (Y_{it} = 1 | X_{it}) = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \dots + \beta_k X_{kt} , \quad t = 1, 2, \dots, T \quad (3)$$

in which the X_j represents the explanatory variables. The estimation assumes that X_1 is not functionally related to the other explanatory variables, $\beta_1 = \partial P (y = 1|x) / \partial x_1$. Therefore, β_1 is the change in the probability of success given a one-unit increase in X_1 . On the other hand, if X_i is a binary explanatory variable, β_1 represents the difference in the probability of success when $X_1 = 1$ and $X_1 = 0$, holding the other X_j fixed. The linear probability approximates the response probability for common values of the covariates and this takes care of potential values of X that may not be within a restricted range (Woolridge, 2002). As the linear probability model with exogenous explanatory variables is based on standard regression, the zero conditional mean assumption $E(\varepsilon|X) = 0$.

In the presence of endogeneity and/or measurement error, the corresponding assumption $E(\varepsilon|X) = 0$ applies, with the set of instruments Z , including the exogenous elements of X . Given that household certification status in equation (3) is potentially endogenous, a linear probability model by two-stage-least-squares (2SLS) is estimated where,

$$y_1 = 1[z_1 \delta_1 + \alpha_1 y_2 + u_1 > 0] \quad (4)$$

$$y_2 = 1[z \delta_2 + v_2 > 0] \quad (5)$$

The aforementioned equations will be estimated using the unbalanced panel and the 2007 cross-section survey data. In addition, the equations will be estimated for the total sample of male and female headed households, followed by separate estimations on a male as well as female headed households samples.

5. Estimation Results

5.1 Chamberlain Random Effects Probit

Table 4.8 reports baseline results from the Chamberlain random effects probit model. Column (1) shows the impact of land certifications on perceived tenure security of male and female headed households. In particular, results from the pooled sample indicate that, overall, land-use certificates did not eliminate tenure insecurity in rural Amhara. Nonetheless, certifications significantly enhanced tenure security at the 1% level and positive certification status is associated with a 28 percent increase in the perceived probability that households' land size holdings will increase or remain unchanged in the future. This result is found to be robust across specifications involving different measures of parcel characteristics, namely, share of fertile parcels and share of parcel rented-out.

Next, Equation (2) is separately re-estimated for the sample of male and female headed households, and the results are reported in Columns (2) and (3) respectively. Under all specifications employing different parcel characteristics, the results derived from estimating Equation (2) using the sample of male-headed households are closely consistent with the pooled estimation results demonstrating a positive and significant impact of certifications on perceived tenure security of male land-holders. Conversely, estimation results using the female sample show a positive but insignificant effect of land-use certificates on perceived tenure security of female headed households. The joint findings indicate that the positive influence of certification in improving tenure security observed using the pooled data is largely driven by the sample of male-headed households and that certification may have been relatively more important in improving male land holders' tenure security.

Table 4.8
Impact of land-use certification on perceived changes in land size holdings
Marginal Effects from Chamberlain Random Effects Probit Model

	(1)	(2)	(3)
	Pooled sample	Male-headed households	Female-headed households
Certification Status	0.278*** (0.082)	0.287*** (0.089)	0.245 (0.229)
Sex	0.028 (0.061)		
Age	-0.006 (0.009)	-0.007 (0.010)	-0.002 (0.024)
Years of Schooling	-0.002 (0.009)	0.000 (0.009)	-0.023 (0.040)
Number of prime-age males	-0.026 (0.022)	-0.038 (0.024)	-0.003 (0.060)
Number of bulls/oxen	-0.047*** (0.018)	-0.048** (0.019)	-0.036 (0.059)
Total HH parcel size	-0.066* (0.038)	-0.053 (0.042)	-0.148 (0.110)
Growing of perennial crops	0.011 (0.056)	0.004 (0.062)	0.023 (0.151)
Year dummies	Yes	Yes	Yes
N	3973	3371	602

Note: Standard errors are presented in parentheses. Significance at the 10%, 5%, and 1% confidence levels are denoted by *, **, and *** respectively. Variable definitions are presented in Table A-2 of the Appendix. Additional household characteristics include Age-squared.

As for the impacts of household characteristics on tenure security the following are the results: the results of the “sex” variable on the outcome indicates that household headed by females have a higher likelihood of being tenure secure relative to their male counterparts, although the impact is insignificant. A potential explanation for this is that female landholders may not be well informed about the land related laws as much as the male landholders. Older household have a higher likelihood of feeling insecure although the impact is insignificant. Increased years of schooling increase tenure security in the overall and male headed household samples, but the reverse holds in the female headed households. However, across all specifications and samples, the impact of schooling on tenure security is insignificant.

The number of prime age males in the household has an insignificant impact in all specification and samples but seems to increase the likelihood of feeling tenure secure in female rather than in male headed households. The insignificance of the variable is an interesting result. This suggests the presence of interplay between the power structure in households (as presence of

more male members in a household may suggest potential reduction in the size of the households' landholdings due to family redistribution) versus the economic need of income generating labor (presence of male member is particularly necessary in female headed households of rural Amhara due to the cultural constraints which determine their role on the farm).

Wealth as proxied by the number of bulls/oxen owned by the household increases the likelihood of perceived tenure insecurity but appears to be insignificant in the female sample. Wealthy households may fear reduction in their land size holdings in favor of the poor landholders through for instance through land redistributions by the state. Parcel characteristics do not seem to have a significant impact on household's perception of tenure security, except for in Column (3) of **Table 4.8** in which an increase in the average parcel size belonging to the household increases the likelihood of perceived tenure insecurity.

Household's mode of production/livelihood strategy i.e. growing cash crops has an insignificant impact on perceived tenure security. Interesting to note despite its insignificance is that the impact seems to be greater in the female than male headed households. Overall, the results do not change due to the different specifications of parcel characteristics i.e. total parcel size, share of fertile parcels, and share of rented-out parcels.

The results imply that land certification programs alone may not be sufficient to eliminate gender differentials in tenure security without addressing other key determinants of tenure security such as access to farming resources, farmland productivity, and social capital.

5.2 Robustness Analysis

Table 4.9 shows results from estimating the household fixed effects linear probability model, which are consistent with those obtained from the random effects probit model across all samples, i.e. the pooled data and disaggregated sample of male and female headed households. The magnitude of the effects of certification on tenure security appears to be slightly smaller according to the results obtained under the linear probability estimations, but the direction and significance remain unchanged. The linear probability estimations show that certification status is positively associated with a 10 percent change in the perceived probability that households' land size holdings will increase or remain unchanged in the future.

Another notable difference is that under the fixed effects linear probability estimation is that the wealth effect as measured by the number of bulls/oxen is no longer significant. The

significance and direction of effect of all other variables representing household and parcel characteristics remain unaffected.

Table 4.9
Household Fixed Effects Linear Probability Model
Impact of certification on perceived changes about land size holdings

	(1)	(2)	(3)
Certification Status	0.104** (0.041)	0.100** (0.044)	0.115 (0.132)
Sex	-0.010 (0.060)		
Age	0.005 (0.008)	0.001 (0.010)	0.030 (0.032)
Years of Schooling	-0.004 (0.008)	-0.003 (0.009)	-0.066 (0.064)
Number of prime-age males	-0.022 (0.020)	-0.028 (0.022)	-0.021 (0.069)
Number of bulls/oxen	-0.004 (0.013)	-0.005 (0.013)	0.055 (0.046)
Total HH parcel size	-0.030 (0.018)	-0.028 (0.020)	-0.032 (0.051)
Growing perennial crops	-0.031 (0.030)	-0.052 (0.033)	0.016 (0.102)
Year dummies	Yes	Yes	Yes
N	3973	3371	602

Note: Standard errors are presented in parentheses. Significance at the 10%, 5%, and 1% confidence levels are denoted by *, **, and *** respectively. Variable definitions are presented in Table A-2 of the Appendix. Additional household characteristics include Age-squared.

Endogeneity of the variable capturing certification status of the household poses a significant econometric concern when estimating certification effects on household's perceived tenure insecurity resulting in biased estimates. Several significant factors can determine which parcels and thereby households are certified. In such instances it is difficult to identify whether perceived household tenure security is driven by the household's certification status or by an unobserved variable jointly determining household's certification status and perceived tenure security. If land-use certificates were randomly assigned, establishing causality would be as easy as ascertaining whether certification and perceived tenure security are correlated.

To deal with the potential endogeneity of households' certification status, the household fixed effects linear probability model would be estimated using the instrumental variables (IVs) technique to predict the certification status of households. Although it is a challenge to obtain IVs

that could potentially demonstrate high predictive power for the endogenous variable without affecting unobserved components in the error term, the panel data provides rare information on spatial aspects of households such as “distance to the nearest road” from the household. It is plausible that some households may have lacked certification due to the proximity of the household’s location from the nearest road i.e. households farthest away from the nearest road may have been inaccessible by the authorities granting the land-use certificates during the certification process. However, it is also plausible that this instrument variable may be linked to household’s perceived tenure security. However, the direction of impact is not clear. For example, distant households without certificates may feel tenure insecure as a result of their lack of certification. At the same time, households farthest away from the road may feel tenure secure since being close to the road may increase the risk of reduced landholdings due to increased urbanization. Therefore, it is not clear whether “distance to nearest road” has a significant impact on perceived tenure security.

The full specification given by equation (3) potentially contains multiple endogenous variables capturing household’s perceived tenure security such as household’s livelihood strategies (proxied by whether perennial crops are grown), wealth accumulation (proxied by the number of bulls/oxen owned by the household) and participation in community organizations. To avoid over-identification in the IV specification, only the key variable of interest is instrumented i.e. household certification status.

Results of the instrumental variables linear probability model are reported in **Table 4.10**. Column (2) shows in the first-stage regressions that “distance to nearest road” significantly determines the household’s certification status (1% significance level). The father away the household is from the nearest road, the less is the likelihood that a household is certified. Furthermore, wealth, producing perennial crops, and number of prime-age males appear to significantly increase the likelihood of certification. This implies that wealth, household’s livelihood strategies, and male support determine who obtains the land-use certificates.

Land-use certificates continue to be a significant and positive determinant of perceived tenure security as exhibited in Column (1) although the significance level is now at 10% compared to the result in column (3) of **Table 4.9**. In particular, IV estimation results indicate that land-use certificates lead to a 10 percent increase in the perceived probability that households’ land size holdings will increase or remain unchanged in the future.

Table 4.10
IV Linear Probability Model
(IV for certification status: distance to nearest road from the household)

Variables	Second stage IV Regressions	First stage IV Regressions
	Tenure security	Certification status
	(1)	(2)
Certification status	0.218* (0.00005)	
Sex	-0.0106 (0.0607)	-0.016 (0.031)
Age	0.00554 (0.00781)	0.003 (0.004)
Years of schooling	-0.00521 (0.00793)	0.001 (0.004)
Number of prim-age males	-0.0212 (0.0257)	0.046*** (0.010)
Number of bulls/oxen	-0.00781 (0.0135)	0.012** (0.007)
Total parcel size	-0.0295 (0.0186)	-0.003 (0.010)
Grow perennial crops	-0.0399 (0.0437)	0.087*** (0.016)
Participation in community	-0.244** (0.0999)	-0.065 (0.050)
Distance to nearest road		-0.0009382*** (0.0001641)
Constant	0.894*** (0.22)	0.047 (0.114)
Year dummies	Yes	Yes
Observations	3,921	3,921
# of households	1746	1746

Note: Standard errors are presented in parentheses. Significance at the 10%, 5%, and 1% confidence levels are denoted by *, **, and *** respectively. Variable definitions are presented in Table A-2 of the Appendix. Additional household characteristics include Age-squared.

The joint findings of the baseline model and the alternative specifications using linear probability and IV indicate that the positive influence of certification in improving tenure security observed using the pooled data is largely driven by the sample of male-headed households and that certifications may have been relatively more important in improving male land holders' tenure security. These results imply that the rural land reform program achieved at least one of its objectives of enhancing overall tenure security. However, it may not have fully achieved the improvement in women's self-perception of tenure security through its second objective of

strengthening the land-holdings rights of women. The results suggest that strengthening tenure security of female household heads who are likely to be relatively more insecure may require measures beyond issuance of usufruct rights. Land certification programs alone may not be sufficient to eliminate gender differentials in tenure security without addressing other key determinants of tenure security such as access to farming resources, farmland productivity, and social capital.

6. Conclusion

An extensive body of literature provides important insight into the effects of land-use certificates on tenure security of landholders in the different regions of Ethiopia. However, the empirical literature on the gender impact of land-use certificates on tenure insecurity is missing. This paper fills the gap in the literature by empirically assessing the impact of land-use certification on perceived changes in the size of landholdings of both male and female headed households. It also examines potential gender differentials in the impact of certifications on tenure security.

To undertake the empirical analyses, the paper uses household data from the Amhara region of Ethiopia collected by the Department of Economics of Addis Ababa University in collaboration with Gothenburg University, Ethiopian Development Research Institute, and the World Bank. The data is an unbalanced panel of rural households from 1999 to 2007. The survey was not originally designed to capture the rural land certification program and impacts on agriculture and rural livelihoods.

The paper infers that certification impact requires taking into account the socio-economic and cultural factors that define the use of land in rural Amhara, and the extent to which these factors determine the effect of the certificates on land tenure insecurity of both male and female landholders. The analysis seeks to uncover whether the land policy environment of Ethiopia, and/or the socio-economic and cultural factors play a key role in strengthening land holding rights of the female land holders in the rural Amhara region.

The estimation strategy of this paper to assess the gender impact of certification on perceived tenure insecurity of households is through the Chamberlain random effects probit which assumes strict exogeneity of the vector of controls in this case at the household level conditional on the household unobserved effects. This is followed by a household fixed effects linear probability model estimation of the outcome variable to test for robustness of the Chamberlain

random effects probit estimation. To take into account the potential endogeneity of the treatment variable i.e. household certification status, the linear probability model is estimated with a two-stage-least-squares estimation. A panel data at the household level is used for the estimations.

The empirical results reveal that issuance of usufruct rights (land use certificates) in the Amhara region increased the likelihood of perceived tenure security in both male and female headed households. However, the impact is significant and relatively greater for male-headed households. In fact, when the sample is disaggregated by the household heads' gender, the effect of land certification of female headed households becomes insignificant. These results remain robust to household fixed effects estimation and the instrumental variable estimation. Notwithstanding, the paper recognizes that the sample of female headed households is rather small and introduces analytical limitations for an extensive gender analyses. Nevertheless, the paper gives a first cut into the issue from a gender perspective.

The results imply that land certification programs alone may not be sufficient to eliminate gender differentials in tenure security without addressing other key determinants of tenure security such as access to farming resources, presence of male support, farmland productivity, and social capital. Advancing women's economic and social standing through rural land reform requires a deeper understanding of their group-specific challenges that interact with the effectiveness of land policies. As a result, there is a need for a more comprehensive assessment of the determinants of tenure security in the Amhara region, particularly for female household heads who are prone to relatively greater economic and social constraints.

APPENDIX

Table A-1: Certification status of households by woreda (%)

Do you have a certificate to your landholdings?	East Gojam				South Wollo			
	Machakel	Gozmin	Enemy	Debre Elias	Tehuldere	Tenta	Harbu/kal	Desse Zuria
No	4.2	51.7	47.1	0.8	10.3	0.8	16.6	6.7
Yes	95.8	48.1	51.3	99.2	89.7	99.2	83.4	91.6

Source: Questionnaire for Sustainable Land Use in the Ethiopian Highlands 2007

Table A-2: Panel Summary Statistics (Male and Female Sample)

Variable	Variable Description	Obs	Mean	Std. Dev.	Min	Max
Security	Dummy for household's perceived tenure security: =0 if HH is insecure; 1=HH is secure	5865	0.6521739	0.4763211	0	1
Household's certification status	Dummy for HH certification status: = 0 if HH is not certified; 1=HH is certified.	6534	0.2118151	0.4086258	0	1
Zone	Zone location of HH: 0=East Gojam; 1=South Wollo	6541	0.5245375	0.4994357	0	1
Woreda	1=Machakel, 2=Gozmin, 3=Enemay, 4=Tehuldere, 5=Tenta, 6=Harbu/Kalu, 7=Dessie Zuria, 8=Debre Elias	6541	4.106712	1.935801	1	8
Sex	Sex of household head: 0=male, 1=female	6541	0.1727565	0.3780655	0	1
Age	Age of household head	6499	49.11202	15.54186	13	102
Years of schooling	Years of schooling of household head	6541	1.17031	2.607572	0	19
Number of prime-age males	Number of prime age (15-45 years old) males in the household	6541	0.9371656	1.086839	0	8
Number of bulls/oxen	Average number of bulls/oxen owned by the household	6541	1.34215	1.295385	0	25
Share of fertile parcels	Share of fertile parcels in HH	6518	0.5929661	0.3286421	0	2
Share of rented parcels	Share of parcel size in HH rented-out	6541	0.1933908	0.3602261	0	1
Total parcel size	Total parcel size in HH	6223	0.0552629	0.4873398	0	11.11543
Perennial Crops	Dummy for whether a household grows perennial crops:0=No; 1=Yes	6337	0.1543317	0.3612949	0	1
Participation in community organizations	Dummy for whether a household participated in a community organization: 0=no participation, 1=participation	4950	0.9852525	0.1205526	0	1

Source: Authors' own estimation from the "Sustainable Land Use in the Ethiopian Highlands" survey.

Table A-3: Panel Summary Statistics (Male Sample)

Variable	Variable Description	Obs	Mean	Std. Dev.	Min	Max
Security	Dummy for household's perceived tenure security: =0 if HH is insecure; 1=HH is secure	4883	0.6508294	0.4767568	0	1
Household's certification status	Dummy for HH certification status: = 0 if HH is not certified; 1=HH is certified.	5404	0.2055885	0.4041684	0	1
Zone	Zone location of HH: 0=East Gojam; 1=South Wollo	5411	0.5048974	0.5000222	0	1
Woreda	1=Machakel, 2=Gozmin, 3=Enemay, 4=Tehuldere, 5=Tenta, 6=Harbu/Kalu, 7=Dessie Zuria, 8=Debre Elias	5411	4.072815	1.967542	1	8
Sex	Sex of household head: 0=male, 1=female	5411	0	0	0	0
Age	Age of household head	5375	48.64279	15.55141	13	102
Years of schooling	Years of schooling of household head	5411	1.32397	2.733752	0	19
Number of prime-age males	Number of prime age (15-45 years old) males in the household	5411	0.9299575	1.094977	0	8
Number of bulls/oxen	Average number of bulls/oxen owned by the household	5411	1.485123	1.301467	0	25
Share of fertile parcels	Share of fertile parcels in HH	5394	0.6002321	0.326762	0	2
Share of rented parcels	Share of parcel size in HH rented-out	5411	0.1419084	0.3147161	0	1
Total parcel size	Total parcel size in HH	5152	0.0530974	0.4788992	0	11.11543
Perennial Crops	Dummy for whether a household grows perennial crops:0=No; 1=Yes	5303	0.1608523	0.3674294	0	1
Participation in community organizations	Dummy for whether a household participated in a community organization: 0=no participation, 1=participation	4102	0.988786	0.1053138	0	1

Source: Authors' own estimation from the "Sustainable Land Use in the Ethiopian Highlands" survey.

Table A-4: Panel Summary Statistics (Female Sample)

Variable	Variable Description	Obs	Mean	Std. Dev.	Min	Max
Security	Dummy for household's perceived tenure security: =0 if HH is insecure; 1=HH is secure	982	0.6588595	0.474334	0	1
Household's certification status	Dummy for HH certification status: = 0 if HH is not certified; 1=HH is certified.	1130	0.2415929	0.4282383	0	1
Zone	Zone location of HH: 0=East Gojam; 1=South Wollo	1130	0.6185841	0.4859494	0	1
Woreda	1=Machakel, 2=Gozmin, 3=Enemay, 4=Tehuldere, 5=Tenta, 6=Harbu/Kalu, 7=Dessie Zuria, 8=Debre Elias	1130	4.269027	1.76779	1	8
Sex	Sex of household head: 0=male, 1=female	1130	1	0	1	1
Age	Age of household head	1124	51.35587	15.30525	15	92
Years of schooling	Years of schooling of household head	1130	0.4345133	1.709053	0	18
Number of prime-age males	Number of prime age (15-45 years old) males in the household	1130	0.9716814	1.046777	0	5
Number of bulls/oxen	Average number of bulls/oxen owned by the household	1130	0.6575221	1.018196	0	6
Share of fertile parcels	Share of fertile parcels in HH	1124	0.5580969	0.335483	0	2
Share of rented parcels	Share of parcel size in HH rented-out	1130	0.4399137	0.4511508	0	1
Total parcel size	Total parcel size in HH	1071	0.0656796	0.5261677	0	7.1393
Perennial Crops	Dummy for whether a household grows perennial crops:0=No; 1=Yes	1034	0.1208897	0.3261569	0	1
Participation in community organizations	Dummy for whether a household participated in a community organization: 0=no participation, 1=participation	848	0.9681604	0.1756766	0	1

Source: Authors' own estimation from the "Sustainable Land Use in the Ethiopian Highlands" survey.

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