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Abstract: This study finds that female-headed households have 23% smaller owned landholdings and 54% smaller operational landholdings. Differences in characteristics such as age, labor, oxen and previous divorce explain less than half the differences in landholding sizes, while the remaining can be attributed to differences in returns to these characteristics. This indicates that there is a gender bias in access to land, even after land reforms that intended to strengthen women's rights. The main policy recommendation is to further gender-sensitize the land certification process, strengthen women's opportunities to cultivate their land and continue the process of securing women's tenure rights.

Keywords: Ethiopia**,** property rights, discrimination**,** Oaxaca decomposition

JEL: Q15, J16

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1. INTRODUCTION

This paper analyses if and how the gender of the head of household is a determinant of tenure rights to arable land in Tigray, in the northern highlands of Ethiopia.

Worldwide, women have less access to land compared to men (World Bank 2011). Widespread social perceptions of women as dependent and men as breadwinners is one reason why men are often seen as the legitimate claimant of land (Agarwal 2003), and Agarwal (1994b) argues that the gender gap in control and ownership of property is the main contributor to the gender gap in social status, empowerment and economic well-being. Investigating what drives the differences in tenure rights to land is therefore key to understanding and correcting the differences in these outcomes.

In Ethiopia, all land is state land, and households are allocated land on which they are granted limited tenure rights in the form of usufruct rights for the purpose of sustaining a livelihood, depending on the needs and ability to cultivate (Holden et al. 2011). The Ethiopian land reform was implemented in the Tigray region in the late 1990s. It aimed to secure access to arable land for peasants without differentiation between genders, and to improve tenure security by issuing certificates to land owners (Deininger et al. 2008a). Yet, in Ethiopia, female-headed households are recognized as less tenure secure compared to their male counterparts (Holden and Bezabih 2009), and several studies have found that they have less access to agricultural land (Tadesse and Amare 2000; Teklu 2005; Yigremew 2005; Kebede 2008). There are two main explanations provided for the gender inequality in earlier studies. First, female-headed households are typically divorced or widowed households and smaller in size. The tenure system in Ethiopia aims at allocating land based on livelihood needs, and one can therefore argue that smaller households need smaller landholdings. Second, female-headed households have less non-

land resources needed to cultivate the land, such as oxen and male labor. Further, there are two main institutional factors that might drive differences in landholdings between male and female-headed households. First, the institution of patrilocality (women moving to the husband's village upon marriage) may cause a gender bias as land policies indicate that access to land depends on one's residential area. This implies that women forfeit their chances to acquire land, or have to give up the rights for the land they have, when at the time of marriage they move from their parent's to their husband's village. Women also risk losing access to land if they leave their marriage residence when they become widowed or divorced (Tadesse and Amare 2000; Yigremew 2005). Second, the tradition of plough cultivation and the cultural perceptions of women as weak farmers may explain the difference in landholdings. In addition to the physical requirements of this activity, there is a social taboo against women ploughing, further strengthening the perceptions of women as weak farmers (Teklu 2005; Yigremew 2005; Holden and Bezabih 2009).

The objective of this paper is to investigate whether there is a gender bias in household landholdings in Tigray, and whether differences in landholdings across households can be explained by differences in household size and non-land resources or if it is due to discrimination towards female-headed households. In addition to comparing simple means of landholdings and running regression analysis to control for determinants of land access, I use the Blinder-Oaxaca decomposition to estimate the share of the difference that is due to observable household differences in endowments and characteristics and the share that is due to differences in returns to the endowments and characteristics as a measure of gender bias. I use data from 370 households in 17 villages across the Tigray region, collected in 2006.

The war between Eritrea and Ethiopia in 1998-2000 left many widows behind in the villages. In addition, there is a panel data effect of husbands being relatively older than their

wives that will further raise the share of female-headed households in our sample (Holden et al. 2011). Overall, 29.5 % of the households in our sample are female-headed, which makes it very suitable for our purpose.

I find that female-headed households in the sample have smaller landholding size than male-headed households, and the difference remains after controlling for observable characteristics such as household characteristics, non-land resource endowments and village fixed effects. The results of the decomposition indicate that differences in observable characteristics and endowments account for less than half of the inequality in land distribution while the rest can be attributed to differences in returns to these characteristics and endowments.

2. TENURE RIGHTS AND GENDER

(a) Conceptual issues

Tenure rights are a set of rules and norms that determine who can use what resource, under what conditions and for how long (FAO 2009). Tenure rights define to what extent a household or an individual can get access to the benefit streams generated by land, and provide a set of benefits that have positive impacts on livelihood outcomes as well as other factors that can further improve livelihood, such as access to credit, bargaining power and social status for rural households (Agarwal 1994a).

As an analytical tool to identify rights holders, Schlager and Ostrom (1992) distinguish between four bundles of rights. These rights include: (1) *access and withdrawal*, defined as the right to enter a physical property and obtain the products, (2*) management*, meaning the right to regulate use patterns and improve the resource by transforming it, (3) *exclusion*, the right to determine who has the right to access the resource, and 4) *alienation*, the right to sell or rent out

some or all the above mentioned rights. They identify four types of right holders: the *authorized user*, who holds access and withdrawal rights only; the *claimant*, who also holds the management rights; the *proprietor*, who in addition to the above mentioned rights also hold the right to exclude others; and the *owner*, who holds all four rights. These rights are reviewed below, both generally and in the context of Tigray. All rights have complementary duties or responsibilities, but for the purpose of this paper the focus is on the rights.

Two measures of landholdings are used in this paper: owned and operational landholdings. The category *owned* landholdings is the area of land the household has owner rights to. This includes the owned land they use themselves, and the owned land they rent out for a tenant to use. *Operational* holding is the area of land the household uses themselves for cultivation in the twelve months prior to the survey. It includes land owned and not rented out, and additional rented in land. This is the amount of land the household has at least the authorized user rights for.

(b) Empirical evidence on gender bias in access to land

A growing body of literature has documented a gender bias in the use of agricultural inputs (Udry 1996; Chen et al. 2011), asset ownership and welfare outcomes, both within and across households around the world (Agarwal 2003; Quisumbing and Maluccio 2003; Deere and Doss 2006). Worldwide, female farmers have less access to land (World Bank 2011), and studies on ownership and control of land have found gender inequalities in countries in Latin America (Deere and Leon 2003), Africa (Udry 1996; Bomuhangi et al. 2011), and Asia (Estudillo et al. 2001; Agarwal 2003). In general, gender bias can be defined as a preference for or favoring one sex over the other (Blackwell Encyclopedia of Sociology 2007). In this paper, gender bias is defined more specifically as the difference in returns to observable endowments and

characteristics, analogous to the definition of *gender discrimination* in the labor literature (Jones and Kelley 1984).

Agarwal (2003) emphasizes the social perceptions in the society to be the reason why men are seen as the legitimate claimant of land. The perception of women being dependent and as having less capability as farmers is highly relevant for Ethiopia as well, where farming is dependent on plough cultivation. Boserup (1970) argued that due to physical strength, men on average have an advantage in farming compared with women, resulting in a specialization of production along gender lines in societies that traditionally practiced plough cultivation.

There are three main sources of access to arable land: the state, the family and the market (Agarwal 2003), and these are also the dominant sources of access to land in Ethiopia (Yigremew 2005). In her study from India, Agrawal (2003) found access through all three sources to be gender biased.

The state can distribute land in a number of different ways. How this is done, and whether the recipient is the household as a whole, or specific individuals within the household, has major implications for individuals' access to land. If titles are issued to an individual, such as the head of the household, other members of the household might be denied rights to the land (World Bank 2005). The practice of registration varies throughout Ethiopia. In some regions the names of both spouses are on the certificate, while in Tigray land is registered in the name of the household head only. In 2006, the responsibility to allocate land from the state was with the Peasant Associations (PAs), functioning as local community governments. Administrative redistribution by the state has been the most important mechanism of access to land for peasants (Yigremew 2005).

All land ultimately belongs to the state, but the land certification process started in the late 1990s in order to secure the land tenure rights of peasants. Article 4(1) of the national Rural Land

Proclamation states: "Without differentiation of the sexes, any person who is willing to personally cultivate land shall be allotted rural land sufficient for his maintenance and that of his family" (cited in Frank 1999:8). Ethiopia is one of the countries with the most equitable distribution of land, yet systematic differences across households remain. Yigremew (2005) found that the administrative reallocations have not met the equity requirements in the rural land policies, and that female-headed households have smaller landholdings. This is also supported by the country-wide study by Kebede (2008), who finds both inter- and intra-village variation in landholdings allocated by the PAs. In general, the factors considered by government when land is allocated vary. Size of the household is a typical determinant (Agarwal 2003), and has been the main criteria for land allocations in Ethiopia since 1975 (Holden and Yohannes 2002).

The second source of access to land is through transfers within the family. This can take two different forms: first, *inter-generational* transfers in the form of either (a) inheritance after parents' death, or (b) inter-vivos transfers, such as land gifts upon marriage or anticipated inheritance. The other form of transfer within the family is *intra-household* allocation of plots to specific members (de Janvry et al. 2001). The family as a source of land is of great importance, especially when land markets are poorly developed or large-scale redistributive land reforms are not feasible (de Janvry et al. 2001). Intra-household allocation of land is not very relevant to Ethiopian households as men and women generally do not cultivate plots individually, but inter-generational transfers may become increasingly important. The land reform limited large-scale land redistributions, and this makes questions regarding who gains access to land from the family, and who are marginalized, increasingly important. When examining patterns of parental transfers of assets and marriage in Ethiopia, Fafchamps and Quisumbing (2005) found that brides receive less land and other assets than grooms from their parents upon their first marriage, and women inherit less upon the death of their parents. However, there are regional differences. The

Tigray State land law is designed to both ensure and limit inheritance of land. The law ensures inheritance, in order to increase security and further investment in land, but it also limits inheritance, in order to prevent land from becoming sub-divided into pieces that are too small to be economically viable. In addition, the law is designed to ensure that parent's land is given to the descendants most in need. To achieve this, land is not to be fragmented below 1 tsimdi (0,25 hectare) if possible, and it should be given to the one child (usually only one child qualifies) without land or any other sources of income that stayed with the parents(Haile et al. 2005). This makes married women less likely to inherit land, as the custom of patrilocality leads women to move away from their parents' village to live with their husband's kin (Fafchamps and Quisumbing 2005). For the purpose of this study, the state and the family are not treated separately, given that by far most of the land a household owned at the time of data collection was allocated by the state.

The market is the third main source of access to land, either in the form of a sales market or a rental market. Land sales are still illegal in Ethiopia after the passage of the new land law in 1997, but land rentals are common with short-term sharecropping contracts dominating the market (Holden et al. 2011). In this way tenant households gain access to a limited bundle of rights, similar to that of an authorized user with access and withdrawal rights in the framework of Schlager and Ostrom (1992). A common feature of this market in Ethiopia, contrary to the rental market stereotype, is a reverse tenancy system with *poor landlords and rich tenants.* The tenants typically have better access to other important farming inputs, such as male labor and oxen. In the presence of imperfect factor markets for labor and oxen, land is rented in to equalize marginal productivities of the different inputs across farms (Deininger et al. 2008b). Female-headed households are commonly poor in these assets, and this - in addition to the physical requirements and social taboo against women ploughing the land - leads female-headed households to rent out

their land more often and engage in sharecropping arrangements with male-headed households (Tadesse and Amare 2000; Teklu 2005; Yigremew 2005; Kebede 2008; Holden and Bezabih 2009; Holden et al. 2011).

3. STUDY SITE AND DATA

(a) Setting

The Ethiopian land reform of 1975 made all land the property of the state. In order to provide land for new households and maintain a more or less equal distribution, follow-up redistributions were required. This created a situation of high tenure insecurity. Renting out land increased the risk of losing land in redistributions, as it could be perceived as a lack of both cultivation ability and need for land. Tenure insecurity also reduced the incentives to invest in the land (Deininger and Jin 2006). To address the tenure insecurity, a new law was passed in 1995, allowing regional governments to be responsible for land administration (Deininger et al. 2008a). The Tigray regional state responded by proclaiming the state legislation for land management in 1997, and the number of land redistributions were reduced. The proclamation aims to provide higher tenure security, reduce instances of litigation and dispute, and facilitate land transactions through the rental market. All land continued to be owned by the state and selling land was still not allowed. Perpetual rights for access and withdrawal, management and exclusion were given to households, and tenure right holders were given the right to make short-term land rental contracts as a limited right for alienation. Plots were measured and demarcated, land registry books established at district levels, and one page handwritten certificates with information about the soil quality, location and size of the plots were issued in the name of the household head. The

method was low cost, and by 1999, more than eighty percent of the rural households in Tigray had land certificates (Holden et al. 2011).

Within the framework of Schlager and Ostrom (1992), the tenure rights given to the households are similar to those of an owner, even though the rights to alienate are limited to the right to rent out the land. However, this right is also restricted; a household can rent out no more than 50% of total household land, and in short term contracts only (Deininger et al. 2008a). The tenants, meaning the households renting land from other households, usually get access and withdrawal rights only. What tenure rights one has beyond access rights have an impact on potential benefits derived from land. Access and withdrawal is a source of income, while other levels of rights might be needed in order to gain access to credit, membership of associations, or have an impact on bargaining power. There are no well-functioning factor markets for non-land resources, such as male labor and oxen for draft power, to help female-headed households overcome their shortage of male labor within the household. Whether it is the lack of physical capacity, a social taboo against women ploughing, or a combination of the two that causes the constraint, the result is the same; men may be preferred as land owners and operators. Using data from the same sample used in this paper, Holden et al. (2011) found that female-headed households are more likely to rent out their land than their male counterparts.

(b) Data

The household and individual response data used in this article was collected in Tigray, in the Northern Highlands of Ethiopia in the period June to August 2006 with the help of 27 local bilingual enumerators, and is part of a panel data set started in 1997/1998. The sampling method for the data was administered at two levels. At the village level there was stratified sampling,

taking into account agricultural potential, population pressure, access to irrigation and access to the market. At the household level, 25 households were randomly sampled from each village. Despite the fact that the dataset is part of a panel, some of the specific data used in this paper was collected in the 2006 round only, and thus the analysis is limited to cross-section analysis. Due to attrition, the number of households from each village varies in the 2006 round, and the total number of households included in the analysis is reduced to 370.

Responses from 199 individuals drawn from the sample of the 370 households are also utilized in our analysis. In order to test whether gender had an impact on the allocation of household land in the case of household dissolution, responses from individuals that had previously been through either a divorce or death of spouse were used. In order to get their responses, we asked the head of household whether she/he had previously been married. In male-headed households we also asked the spouse the same, and interviewed the spouses separately about their previous marriages. The individual males are thus head of households, while the responses from individual females include both female head of households and spouses to male heads of households.

4. EMPIRICAL STRATEGY

In this paper, gender bias is defined as a preference for one sex over the other in the allocation of tenure rights for land from the state, the family and the market. This bias exists when the same characteristics and endowments are valued higher for male-headed households compared to female-headed households, or vice versa.

As we know that most female-headed households are the result of divorce or death of their husband, the allocation of land upon household dissolution is potentially an important determinant of female-headed household's land holdings, and the first hypothesis tested is:

Hypothesis 1: Gender has no impact on the allocation of land upon household dissolution due to divorce or death of spouse.

The second hypothesis is related to the landholdings at the time of the survey:

Hypothesis 2: Female headship has a negative impact on the size of a household's owned and operational landholdings.

(a) Allocation of land upon household dissolution

The land proclamation from 1997 states that men and women should receive equal shares of household land upon divorce (Deininger et al. 2008a). It also strengthens women's rights in case of death of husband. In Tigray, certificates are issued in the name of the household head only, not both spouses jointly. Further, the level of updating them in accordance to land ownership after a household dissolution has only been taking place to a limited extent. Whether this matters for the allocation of land upon divorce or death is uncertain, and the first hypothesis to be tested is that gender has no impact on the allocation of land upon a household dissolution.

Matching in the marriage market is not random (Fafchamps and Quisumbing 2005), and neither is divorce. Tilson and Larsen (2000) found that 45% of all first marriages end in divorce in Ethiopia, and that early age at marriage and childlessness increased the likelihood of divorce among first married couples. Further, allocation of land from the state is dependent upon marriage, thus some choose to get married in order to be allocated land. Couples that did not receive land upon marriage are more likely to divorce.

To test the hypothesis on allocation of land upon household dissolution, a sample of 199 *individual* responses from both men and women that had been through a household dissolution, either due to death of spouse or divorce, was used. Respondents who indicated that the couple did not have any land in their previous marriage are omitted from the analysis. This does not solve the problem of the non-randomness of marriage and divorce, but due to lack of data on the previous marriage, this is as far as the data set allows me to partly correct for this selection bias.

We asked the respondent what share of the household land they received upon the household dissolution. This is recorded as a number from 1 to 5, where 1 indicates that the respondent received no land after the divorce or death of spouse, 2 means she/he received land, but less than half, 3 means the respondent received half the land, 4 means the respondent received more than half, but less than all, and 5 indicates that the respondent received all the household land upon divorce or death of the spouse.

OLS regression analysis may not be the most appropriate method for estimating models where the dependent variable is discrete rather than continuous (Greene 2002). Thus, ordered probit models are used to analyze the probability of a respondent receiving a particular share of land upon household dissolution. For each individual, *i*, there is an underlying response variable Y^*_i. The variable is defined by

$$Y^*_i = \beta' X_i + \varepsilon_i \qquad (1)$$

where β is a set of regression parameters and ε is the random, normally distributed disturbance term with constant variance and zero mean. Y^*_i is not observed, but an indicator variable, Y_i, is observable, and this variable follows the sign of Y^*_i:

$Y_i = 1$ if $Y^*_i \leq 1$ (if receive no land),

$= 2$ if $1 < Y^*_i \leq \mu_2$ (if receive land, but less than half)

$= 3$ if $\mu_2 < Y^*_i \leq \mu_3$ (if receive half the land) (2)

$= 4$ if $\mu_3 < Y^*_i \leq \mu_4$ (if receive more than half but less than all)

$= 5$ if $\mu_4 \leq Y^*_i$ (if receive all land)

where the μ's are unknown threshold parameters, or cut points, that are estimated with the β's. Given this, the probabilities of receiving land of different degrees are the following:

$$\text{Prob } [Y=1] = \Phi(-\beta' X_i)$$

$$\text{Prob } [Y=2] = \Phi(\mu_2 - \beta' X_i) - \Phi(-\beta' X_i)$$

$$\text{Prob } [Y=3] = \Phi(\mu_3 - \beta' X_i) - \Phi(\mu_2 - \beta' X_i) \quad (3)$$

$$\text{Prob } [Y=4] = \Phi(\mu_4 - \beta' X_i) - \Phi(\mu_3 - \beta' X_i)$$

$$\text{Prob } [Y=5] = 1 - \Phi(\mu_4 - \beta' X_i)$$

Φ is the cumulative normal distribution function, and the sum of the above probabilities equal one. In order to obtain the estimates of the β's and μ's, the log-likelihood function is maximized (Greene 2002), with White's (1982) robust standard errors. There are five dummy variables included as explanatory variables in the model, all of which are listed and explained in table 1. The effect of remarrying is ambiguous, and may also be endogenous. It might be that people did not receive land because they were more likely to re-marry and gain access to land through their new marriage. Or that they received more land upon household dissolution because they were less likely to re-marry. Further, the amount of land an individual possesses might influence their value in the marriage market, and that people who received more land are more attractive on the marriage market and thus more likely to re-marry compared to individuals who received less land. Due to the potential endogeneity of this variable, the models are run with an alternative model specification excluding this variable. Finally, in order to capture the potential effect of the reform, a dummy variable indicating whether the household dissolution happened

before or after the land reform is included in the models. As the implementation of the land reform is a process, we asked whether the household dissolution happened before or after the *certification* in the village. The models are run on three different samples: male respondents only, female respondents only, and a pooled sample with both males and females. In the last models, a dummy variable indicating whether the respondent is male or female is included in order to capture potential gender differences. Land is split differently upon divorce and death, but due to the limited number of responses, the sample cannot be split further to allow for separate models for divorced and widowed respondents.

Table 1: Overview of variables

Variable	Description	Obs	Mean	Std.dev	Exp
Comparisons of means					
Household size	Total number of members in the household	370	5.10	2.50	
Age hh head	Age of household head (in years)	370	54.43	14.40	
Oxen (number)	Number of oxen the household owns	364	0.91	0.98	
Male wf	Male workforce, number of men aged 15 up to 64	370	1.38	1.16	
Female wf	Female workforce, number of women aged 15 up to 64	370	1.35	0.87	
Owned holding	Area of land the household has owner rights to, in tsimdi[1]	364	3.78	3.39	
Operational holding	Area of land the household use for cultivation, in tsimdi	364	3.83	2.70	
Per cap owned holding	Per capita owned landholding in tsimdi (Owned holding/Household size)	364	1.03	0.06	
Per cap oper hold	Per capita operational landholding in tsimdi (Operational holding/Household size)	364	0.90	0.06	
Ordered probit models					

[1] 1 tsimdi is a local measure based on the area a pair of oxen can plough in a day and is approximately 0.25 hectare

Land received	Share of land received upon household dissolution, 1=no land, 2=some, but less than half, 3=half, 4=more than half but less than all, 5=all	210	2.75		
Dissolution after cert.	Dummy indicating when the dissolution happened, 0=before certification, 1=after	228	0.33		+/-
Sex of the respondent	Dummy variable indicating the sex of the respondent , 0=male, 1=female	230	0.63		0
Literacy	Dummy indicating whether the respondent is literate, 0=no, 1=yes	216	0.18		+
Reason dissolution	Dummy variable indicating the reason for household dissolution, 0=death, 1= divorce	228	0.54		-
Stayed in the village	Dummy indicating whether the respondent stayed in the village after the divorce/death of spouse, 0=no, 1=yes	227	0.75		+
Married today	Dummy indicating whether the respondent was married at the time of interview, 0=no, 1=yes	230	0.58		-
OLS models					
Operational holding	Area of land the household use for cultivation, in tsimdi	364	3.83	2.70	
Owned holding	Area of land the household has owner rights to, in tsimdi	364	3.78	3.39	
Sex of the hh head	Dummy variable indicating the sex of the household head, 0=male, 1=female	370	0.29		0
Age hh head	Age of household head (in years)	370	54.43	14.40	+/-
Literacy	Dummy variable indicating whether the household head is literate, 0=no, 1=yes	365	0.32		+
Dependents	Number of household members below 15 and above 64	370	2.37	1.65	+
Male wf	Male workforce, number of men aged 15 up to 64	370	1.38	1.16	+
Female wf	Female workforce, number of women aged 15 up to 64	370	1.35	0.87	+
Divorcee	Dummy indicating whether the household head has been divorced, 0=no, 1=yes	370	0.27	0.45	-
Oxen	Dummy indicating whether the household have one or more oxen, 0=no, 1=yes	364	0.57		+
Village	Dummy variables indicating which village the household is located in				+/-

Source: Own survey data

(b) Gender bias in landholdings

To test the second hypothesis, two measures of landholdings: owned holding and operational holding were used. The size of the owned landholdings reflects how much land the household accesses through the state and the family, while the operational holdings reflects how the household is adjusting its amount of land through the market. There are different potential benefits related to the different measures. Owned landholding is the most important, as this is likely to yield positive impacts to all the outputs, such as livelihoods, bargaining power and social status. Operational holding is mainly related to production output only. The reason for including operational holding in the analysis is that the market can be an increasingly important source of access to land given the decrease in land distributed by the PAs. Renting land is allowed with some restrictions and land owners are more tenure secure after the certification. Both these factors motivate participation in the land rental market (Holden et al. 2011). The most common contract is sharecropping contracts where the tenants provide all the inputs and labor, and the landlord gets a fixed share of the output of the crop after the harvest. The farming capacity of the tenant is thus of interest for the landlord.

Three approaches are used. First, means of household landholdings are compared to see whether there are differences between female and male-headed households. Second, OLS regressions are used to correct for observable differences. The following equation was estimated:

$$Y_h = \alpha + \beta X_h + \varepsilon_h \qquad (4)$$

where Y_h is the landholding variables of the household, and X_h is a set of independent variables expected to be important for determining the amount of land households own and operate. There are several factors that can potentially influence the landholdings of rural farmers,

and by estimating OLS models these variables can be controlled for. A list of the variables is included in table 1.

To control for village fixed effects, village dummy variables are included in the models. To test the hypothesis, a dummy variable indicating whether the head of the household is female (or not) is included in the model. This is done to see whether there are gender differences in landholdings after controlling for the household and geographical variables. As these variables might affect male and female-headed households differently, the sample is split according to that criterion and the same models are run again. Due to the use of cross-section data, heteroskedasticity is tested for by running the Breusch-Pagan test (Breusch and Pagan 1979). To correct for heteroskedasticity, robust standard errors are estimated, referring to a minimum ignorance estimator (White 1982).

Third, the Blinder-Oaxaca technique is used to decompose the landholding differences and estimate how much of the differences can be explained by differences in observable characteristics and endowments, and what can be explained by differences in returns to these characteristics and endowments (Blinder 1973; Oaxaca 1973). Jones and Kelley (1984) identify discrimination to exist when the same bundle of productivity related characteristics are valued differently between men and women. Thus, the measure of discrimination and gender bias is the residual left after controlling for the differences in characteristics and resource endowments. This measure will depend on how well the model is specified and the level of measurement error. The possibility that a share of what is measured as discrimination is due to unobservable characteristics other than gender cannot be ruled out, but by including the variables known to influence land holdings, the residual measured will give an indication of the level of discrimination.

Separate regressions are estimated, one for male-headed households (superscript *m*) and one for female-headed households (superscript *f*):

$$Y_m = X_m\beta_m + \varepsilon_m \quad , \; E(\varepsilon_m) = 0 \tag{5}$$

$$Y_f \; = \; X_f\,\beta_f \; + \varepsilon_f \quad , \; E\big(\varepsilon_f\,\big) = 0 \tag{6}$$

where Y is the is the mean land holding, X is a vector of the observed characteristics and endowments also included in the OLS models and a constant, β contains the slope parameters and ε is the error term with zero expectations. The mean difference in landholdings ($\overline{D}$) can be expressed as the difference in the linear prediction at the gender-specific means of the regressors:

$$\big(\overline{D}\big) = \; \overline{X}_m\,\hat{\beta}_m - \overline{X}_f\,\hat{\beta}_f \tag{7}$$

Following Jones and Kelley's (1984) and Jann's (2008) application of the technique developed by Blinder (1973) and Oaxaca (1973), this can be rearranged and decomposed into three parts:

$$\big(\overline{D}\big) = \; \big(\,\overline{X}_m - \;\overline{X}_f\big)\,\hat{\beta}_f \quad + \quad \overline{X}_f\big(\hat{\beta}_m - \;\hat{\beta}_f\big) \quad + \quad (\,\overline{X}_m - \;\overline{X}_f\,)(\hat{\beta}_m - \;\hat{\beta}_f) \tag{8}$$

The first part of the right hand side of equation (5) measures the share of the landholding differentials that can be explained by differences in characteristics and endowments between male and female-headed households. This is also referred to as the endowment effect. The second part measures the share of the differences that is due to differences in the coefficients, meaning the returns to the endowments and characteristics. This is often referred to as the *unexplained* differences, and measure the level of discrimination. The third part is an interaction term, taking into account the fact that differences in endowments and coefficients occur simultaneously between male and female-headed households. Whether or not the interaction term is included in the measure of discrimination depends on whether there is an argument to include it, otherwise it

should be kept separate (Jones and Kelley 1984). In this paper, I treat the interaction term as separate, and not included as a measure of discrimination against female-headed households with respect to allocation of land and their position in the land rental market.

5. RESULTS AND DISCUSSIONS

(a) Differences in endowments and characteristics

There are significant differences in key characteristics between male and female-headed households in Tigray (see table 2). Most female-headed households are the result of household dissolution, either because of divorce or death of husband, and as a consequence the number of people in the households is usually smaller compared to male-headed households. In addition, female head of households are on average younger, and the literacy rate is much lower (13% vs. 40%). Female-headed households are also significantly poorer in land and important non-land productive assets, e.g., male and female labor and oxen ownership.

Even though most female-headed households in Tigray are the result of split households due to either divorce or death of husband, this cannot explain the differences in landholdings. The differences in landholdings remain (0.8 tsimdi) when comparing unmarried male and female-headed households as well. Further, the reason for the dissolution matters for how the household land is shared. In the case of a divorce, land is split between the husband and wife. In the case of a death to one of the spouses, the land is either kept in full by the surviving spouse, or split between the surviving spouse and the deceased spouse's children. We see that households where the head is previously divorced have smaller landholdings compared to households where the head is previously widowed. Previously divorced male-headed households have 10% smaller

owned landholdings compared to previously widowed households, while previously divorced female-headed households have 36% smaller owned landholdings. Further, the difference between previously divorced male and female-headed households is larger than the difference between all households and between the previously widowed households.

Table 2: Comparison of means between male and female-headed households

	Mean values for *all* households				
Variable	Male	Female	Difference	t-value	N (m+f)
Household size	5.80 (0.15)	3.41 (0.19)	2.39 (0.26)	9.31***	261+109
Age hh head	55.7 (0.85)	51.5 (1.50)	4.21 (1.63)	2.58**	261+109
Oxen (number)	1.15 (0.06)	0.31 (0.06)	0.84 (0.11)	7.97***	259+105
Male wf	1.69 (0.07)	0.63 (0.08)	1.06 (0.12)	8.82***	261+109
Female wf	1.40 (0.06)	1.22 (0.08)	0.18 (0.10)	1.84*	261+109
Owned holding	4.10 (0.18)	3.17 (0.22)	0.93 (0.31)	3.02***	258+106
Operational holding	4.48 (0.22)	2.08 (0.22)	2.41 (0.37)	6.49***	258+106
Per cap owned hold	0.91 (0.06)	1.32 (0.13)	-0.42 (0.13)	-3.45***	258+106
Per cap oper hold	0.96 (0.07)	0.75 (0.11)	0.21 (0.13)	1.70*	258+106
	Mean land holding size for *subgroups* of households				
Variable	Male	Female	Difference	t-value	N (m+f)
Mean values for unmarried households					
Owned holding	3.94 (0.46)	3.14 (0.22)	0.80 (0.46)	1.72**	34+101
Operational holding	3.96 (0.50)	1.98 (0.22)	1.98 (0.47)	4.19***	34+101
Per cap owned hold	1.40 (0.17)	1.36 (0.13)	0.04 (0.24)	0.18	34+101
Per cap oper hold	1.34 (0.20)	0.75 (0.11)	0.59 (0.23)	2.58**	34+101
Mean values for households where head is previously divorced					
Owned holding	3.64 (0.28)	2.24 (0.26)	1.40 (0.48)	2.88**	73+27
Operational holding	3.53 (0.30)	1.16 (0.26)	2.38 (0.52)	4.53***	73+27
Per cap owned hold	0.80 (0.09)	0.91 (0.17)	-0.11 (0.18)	-0.63	73+27
Per cap oper hold	0.76 (0.09)	0.41 (0.11)	0.35 (0.16)	2.13**	73+27
Mean values for households where head is previously widowed					
Owned holding	4.04 (0.34)	3.48 (0.36)	0.55 (0.49)	1.13	68+54
Operational holding	4.11 (0.48)	2.47 (0.35)	1.65 (0.62)	2.64**	68+54
Per cap owned hold	1.09 (0.12)	1.65 (0.22)	-0.55 (0.23)	-2.39**	68+54
Per cap oper hold	1.07 (0.14)	0.97 (0.20)	0.10 (0.24)	0.42	68+54

Significance levels:* p<0.1, ** p<0.05, *** p<0.01. Standard error of the mean in brackets.
Source: Own survey data

Per capita landholdings are potentially important determinants of land scarcity at a given time. When comparing all households, we see that female-headed households have significantly larger per capita owned landholding. However, this is not true when comparing unmarried and previously divorced households.

Table 3: Overview of the land rental market in percentages

	Households participating in the land rental market								
Variable	Male-headed			Female-headed			All		
Renting out land (landlord)	21			45			28		
Renting in land (tenant)	38			8			29		
Type of land rental contract									
Fixed rent (cash)	1			1			1		
Fixed rent (kind)	< 1			0			< 1		
Sharecropping (output after deduction of input costs)	5			1			3		
Sharecropping (output only)	91			97			93		
Share of output to landlord	*50%*	*33%*	*25%*	*50%*	*33%*	*25%*	*50%*	*33%*	*25%*
	57	16	23	66	14	20	60	15	22

Source: Own survey data

From Table 3, one can see that a larger share of female-headed households is renting out their land, and few participate in the market as tenants. The most common contract is output sharing only, i.e., the landlord receives 50% of the crop after harvest and avoids the drudgery of work.

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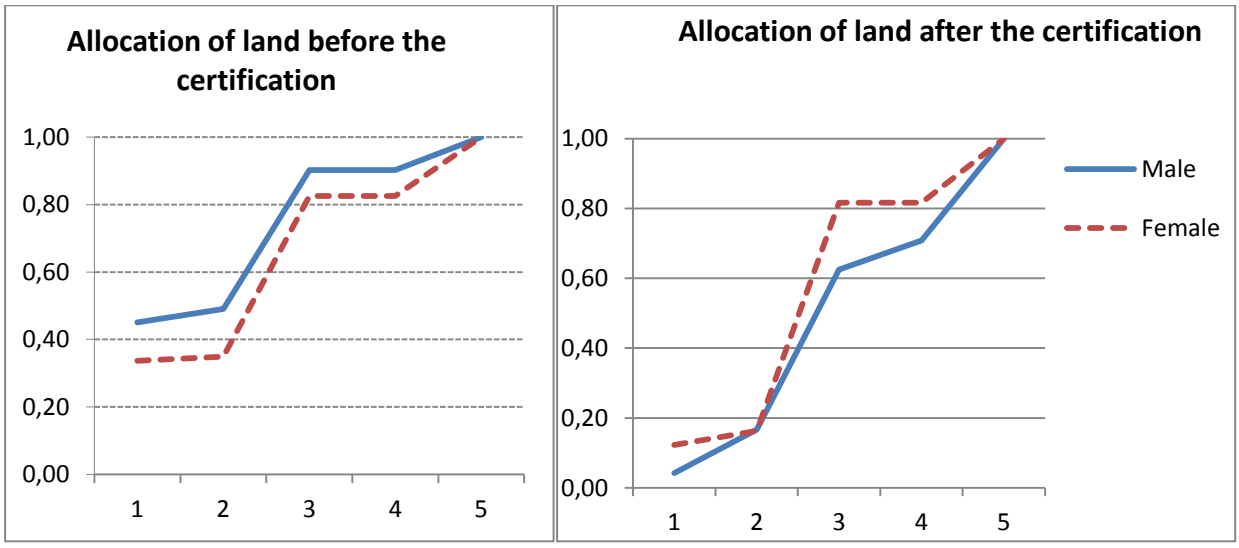
(b) Allocation of land upon divorce or death

In order to explore what drives the differences in landholdings between male and female-headed households, I start by analyzing what happened with the household land upon household

dissolution, either by death of one of the spouses or divorce. For this purpose, I use the sample of the 199 individual responses. This sample includes not only responses from unmarried head of households, but also individuals that are remarried. Figure 1 illustrates the share of household land received upon death or divorce by men and women in our sample, before and after the certification process.

Figure 1: Share of land received upon divorce or death of spouse



1=Nothing, 2=Less than half, more than nothing, 3=Half, 4=Less than all, more than half, 5=All
Source: Own survey data

Overall, a higher share of the male respondents received more than half of the household land upon divorce or death of spouse compared to the female respondents before the certification process, while the opposite is true after the certification. Also, a higher share of the female respondents received no land after the certification, but so did a higher share of the male respondents.

Table 4 present descriptive statistics for the individual responses, including characteristics of the previous marriages. Compared to the male respondents, a smaller share of the female

respondents is literate, and a smaller share is previously divorced. This means that a higher share of the female respondents is widowed. Looking at the shares of male and female respondents that stayed in the village after the divorce or death of spouse, we see the effect of the tradition of patrilocality. Whereas 83% of the men stayed in the village, only 72% of women did the same. The difference is particularly large when comparing individuals that have been divorced. While 76% of the men stayed in the village, only 51% of the women stayed in the village after a divorce.

Table 4: Descriptive statistics, individual response samples

Variables	Male sample			Female sample			Pooled
Literacy			32%			8%	17%
Reason dissolution : divorce			57%			48%	51%
Dissolution after certification			32%			38%	36%
	Widowed	*Divorced*	*Total*	*Widowed*	*Divorced*	*Total*	
Stayed in the village after the diss.	*94%*	*76%*	83%	*85%*	*51%*	72%	76%
Married today	*68%*	*90%*	81%	*21%*	*62%*	41%	55%
N	*31*	*41*	72	*66*	*61*	127	199

Source: Own survey data

In order to control for the different characteristics, ordered probit models were used to analyze the responses of individuals that had the experience of divorce or death of spouse. A positive coefficient indicates a higher probability that the respondent received more land upon divorce or death of spouse.

Models were run for the male and female respondents separately, and again for the pooled sample (table 5). The variable indicating whether the respondent stayed in the village after the divorce or death of spouse is positive and significant in the first model for female respondents. This variable captures the effect of patrilocality, and indicates how women are often expected to move away from the village and back to their blood relatives after a household dissolution.

However, this effect is not significant when the variable capturing remarriage is included, which indicates that the effect is not robust.

Table 5: Ordered probit models on share of land received upon household dissolution

	Male respondents		Female respondents		Pooled models	
Variables	ModelM1	ModelM2	ModelF1	ModelF2	ModelP1	ModelP2
Dissolution after cert 0=no, 1=yes	0.89*** (0.28)	0.80*** (0.29)	0.31 (0.21)	0.28 (0.21)	0.53*** (0.16)	0.48*** (0.16)
Sex of respondent 0=male, 1=female					0.03 (0.18)	-0.17 (0.21)
Literacy dummy 0=no, 1=yes	-0.33 (0.31)	-0.37 (0.30)	-0.41 (0.36)	-0.37 (0.36)	-0.35 (0.24)	-0.37 (0.23)
Reason dissolution 0=death, 1=divorce	-0.84*** (0.29)	-0.76*** (0.28)	-0.77*** (0.22)	-0.67*** (0.24)	-0.81*** (0.18)	-0.70*** (0.18)
Stayed in the village 0=no, 1=yes	-0.03 (0.34)	-0.07 (0.34)	0.61** (0.26)	0.45 (0.30)	0.39 (0.21)	0.24 (0.22)
Married today 0=no, 1=yes		-0.52 (0.42)		0.40 (0.28)		-0.48** (0.22)
N	72	72	127	127	199	199

* p<0.10, ** p<0.05, *** p<0.01. Heteroskedasticity robust standard error in brackets
Dependent variable: Share of land received upon divorce or death of spouse (1=Nothing, 2=Less than half, more than nothing, 3=Half, 4=Less than all, more than half, 5=All)
Source: Own survey data

A divorce rather than the death of the spouse decreased the probability that the respondent received more land in all models. This is as expected, and supports the findings from the comparisons of mean landholdings. The dummy variable meant to capture the effect of the certification is non-significant in the model with female respondents (F1 and F2) while it is positive and significant for male respondents (M1 and M2), and in the joint models (P1 and P2). The positive coefficient indicates a higher probability that men received more land upon household dissolution after the reform compared to before the reform. This might appear to

contradict the findings in figure 1, but the story behind the distribution is affected by who these respondents are, particularly whether they are divorced or widowed. Thus it is important to control for the reason for the dissolution. The positive effect for men only runs contrary to the intentions stated in the land reform. This strengthens the arguments for changing the certification system to also include the name of the spouse on the certificate in the future.

(c) Estimation of the gender bias

The second approach explores what drives the differences in landholdings by running OLS regressions. As we see from table 2, the mean values for the potential determinants of access to land vary significantly between male and female-headed households. In order to correct for this and see whether these biases drive the gender bias in landholdings, these variables are included in the OLS models. There might be systematic differences in terms of where male and female-headed households live that cause a systematic difference between how much land male and female-headed households possess. In order to control for differences in land availability and village fixed effects, village dummy variables are also included in the models (table 6). Several of the village variables are significant, indicating that there are geographical differences in land availability across the study area. However, the variables are not displayed in table 6. Whether the household has oxen or not might be endogenous, and in order to check for reverse causality between landholding and oxen, an alternative model specification excluding the oxen dummy variable is included as a robustness check.

Each model was run on three different samples: the complete sample of all households (*pooled*), a sub-sample of male-headed households only (*male hhh*) and a sub-sample of female-headed households only (*female hhh*). The samples of unmarried, divorced and widowed households are too small to run separate regressions.

Table 6: Owned and operational landholdings

	Owned landholdings			Operational holdings		
Variables	*Pooled*	*Male hhh*	*Female hhh*	*Pooled*	*Male hhh*	*Female hhh*
Sex of household head (0=male, 1=female)	-0.657** (0.304)			-1.534*** (0.378)		
Age of household head (in number of years)	0.009 (0.008)	0.032** (0.011)	-0.034* (0.018)	-0.012 (0.010)	0.002 (0.014)	-0.026 (0.021)
Is the household head literate? (0=no, 1=yes)	-0.045 (0.268)	0.129 (0.263)	-0.409 (1.000)	-0.289 (0.346)	-0.141 (0.352)	-0.430 (1.238)
Total number of dependents (<15, >64)	-0.029 (0.072)	-0.067 (0.077)	0.102 (0.132)	0.039 (0.093)	-0.002 (0.107)	0.174 (0.153)
Male work force (no of men b/w 15 and 64)	0.461*** (0.110)	0.406*** (0.120)	0.564** (0.255)	0.495*** (0.183)	0.489** (0.221)	0.344 (0.257)
Female work force (no of women b/w 15 and 64)	0.112 (0.117)	0.204 (0.129)	-0.300 (0.306)	-0.036 (0.167)	-0.027 (0.220)	-0.099 (0.234)
Has hh head been divorced ? (0=no, 1=yes)	-0.401 (0.206)	-0.329 (0.259)	-1.165*** (0.432)	-0.938*** (0.271)	-1.004*** (0.354)	-1.466** (0.521)
Does the household have oxen?(0=no, 1=yes)	0.297 (0.270)	0.189 (0.314)	0.816* (0.472)	1.811*** (0.358)	1.743*** (0.460)	2.186*** (0.525)
Village dummies	16 village dummies included in the analysis. but left out of the table					
Constant	3.076** (0.962)	1.910 (1.173)	5.258*** 1.268	1.641 (1.070)	1.036 (1.052)	1.080 (1.153)
R-squared	0.506	0.576	0.535	0.463	0.480	0.448
N	357	254	103	357	254	103

*p<0.1, **p<0.05, ***p<0.01. robust standard errors

Source: Own survey data

The results suggest that female-headed households have smaller owned landholdings (on average 0.66 tsimdi) and operational holdings compared to male-headed households after controlling for size of the household, non-land resources, previous divorce and local land availability. The negative marginal effect of female headship is relatively large and robust over alternative model specifications. The effect is larger for operational landholdings, as female-headed households have at least 1.5 tsimdi smaller holdings. Again this supports the findings from other studies that indicate the market is not a source of access to land for female-headed households. Female work force and the total number of dependents in the household are not significant in any of the models. This indicates that household size is not a significant determinant for the amount of land a household holds, either for its owned land or operational holdings. This might be surprising, but does give a clear indication of the importance of looking into other possible determinants and not accepting household size as the most important factor. While the experience of a previous divorce has a large negative effect (-1.165) for female-headed households, there is no significant effect for male-headed households. The difference in the coefficients is significant at the 10% level. This is not necessarily a result of a biased allocation of land upon divorce, but can also reflect that male-headed households are more likely to be compensated for "the lost land" through additional land allocations from the PAs and/or through inter-generational transfers. Female-headed households are less likely to inherit land from parents if they moved to the husband's village upon marriage and stayed there after the divorce. The results of the sub-sample models indicate that female-headed households who are older have less land, while the opposite is true for male-headed households. This difference in coefficients is significant at the 5% level.

Operational holding is affected by how the household is positioned in the land rental market. Access to non-land resources, such as oxen and total male work force, are important

determinants for access to land through the land rental market. However, this is only significant in the pooled model and in the model for male-headed households. According to the results of the pooled models, owned landholding is not correlated with whether the head of household has been divorced, and this is also true for the models run on the sample of male-headed households. The results of the models for female-headed households only do show a negative and significant effect of this dummy variable. Female-headed households that are the result of a divorce rather than death of spouse have on average at least 1.2 tsimdi less land. The results of all three models for operational holdings indicate that those who are previously divorced have less land. This is in line with the previous findings when comparing simple means of landholdings across previously divorced male and female-headed households as well.

The results of the OLS models indicate that access to land through the main sources of land in Ethiopia, the state and the land rental market, are influenced by more or less the same variables. The exception is the effect of oxen holding. This does not seem to have a significant impact on owned landholdings, while it does have a large and highly significant marginal effect on operational holdings. The importance of oxen holding, or lack thereof, is in line with previous studies of the land rental market. The results of the analysis reject the hypothesis that the gender of the household head has no impact on household landholdings. The evidence suggests that female-headed households are distributed significantly less land from the state, and that the market is not a source of *access* to land for female-headed households in Tigray.

Due to heteroskedasticity, White's robust standard errors are estimated (1980). This does not affect the results of the analysis. The standard errors change, but not the coefficients, and a comparison of models with non-robust standard errors, robust standard errors, and models with and without the oxen dummy can be found in the appendix (table A1).

Land rental markets can help adjust the household's operational land holdings to endowments, but this is not what the results of the analysis suggest. Even after controlling for non-land agricultural inputs such as labor and oxen ownership, the negative marginal impact of female headship is even more than twice as large for operational holdings compared to owned landholdings. In order to divide the differences in land holdings between male and female-headed households into a share that can be explained by observable differences and what can be explained by the *returns* to these observables, the mean differences are decomposed based on the OLS models. The results are presented in table 7.

In the first panel, the mean predictions of male and female-headed households' landholdings and the differences are reported. The results in the second panel indicate how much of the observed differences are due to differences in endowments and characteristics and how much are due to differences in returns to the endowments. The first term, *observed endowments*, reflects the predicted mean increase in female-headed households' landholdings if they had the same endowments as male-headed households. The second term, *return to endowments*, reflects the level of gender bias. This number quantifies the changes in female-headed households' landholdings when applying the male-headed households' coefficients to the female-headed households' endowments.

Table 7: Decomposition of land holding differences

	Owned landholding	Operational landholding
Mean landholdings maleheaded households	4.100*** (0.182)	4.496*** (0.228)
Mean landholdings female-headed households	3.188*** (0.235)	2.067*** (0.241)
Mean difference	0.911*** (0.297)	2.429*** (0.332)
Decomposition estimates		
Observed endowments	0.529 (0.499)	1.278** (0.516)
Return to endowments	0.695* (0.372)	1.657*** (0.489)
Interaction	-0.312 (0.559)	-0.506 (0.650)
Number of observations	357	357

* p<0.10. ** p<0.05. *** p<0.01. robust standard errors
Source: Own survey data

There are at least three alternative explanations for this difference. First, it might be that older female-headed households give more land to children compared to their male counterparts. This could be a rational solution to a lack of male labor available in the household as sons grow up and are ready to start their own households. However, the difference between male workforce available in households headed by older females (age 65 and above) and other female-headed households is small (-0.03) and not significant. On the other hand, it might be that female-headed households have lost land in previous land allocations while male-headed households have gained land. If that is the case, this could indicate a higher status of older males compared to older women, and a gender bias in the reallocation of land. A third alternative explanation is that the gender bias has decreased, and that younger women have been able to keep more land in the

case of a household dissolution and/or that younger female-headed households have been allocated more in land reallocation or inherited more from their parents compared to female-headed households that were formed a long time ago. This could indicate a positive effect of the land reform. However, the results presented in table 5 do not support this. There is no significant effect of the variable controlling for whether the dissolution happened before or after the certification in the ordered probit models for the female respondents. An interaction variable was added to the OLS model for female-headed households in table 6 in order to test for the effect of being older and previously divorced, but the variable was not significant.

Differences in returns to endowments are not necessarily a result of gender bias and discrimination as such, but may reflect a rational response to productivity differentials across male and female-headed households. Previous studies have found that plots operated by female-headed households are less productive compared to plots operated by male-headed households (e.g. Holden et al. 2001; Pender and Gebremedhin 2008). This may motivate female-headed households to rent out their land to more productive male tenants and restrict female-headed households' access to the land market on the tenant's side. On the other hand, studies of the land rental market in Ethiopia have found that productivity is lower on plots rented out by female-headed households (Holden and Bezabih 2009; Ghebru and Holden 2012). This may be due to their relatively lower bargaining power in the land rental market. Due to female-headed households' tenure insecurity and economic dependency, they are less able to screen tenants and have limited power to evict them. Both factors may adversely affect the sharecroppers' effort (Holden and Bezabih 2009; Ghebru and Holden 2012) and reduce the potential gain for female-headed households when renting out land.

As mentioned in section 2, certificates in the Tigray region were issued in the name of the household head. According to Ethiopian law, this means the male spouse, if there is one present. Within our sample, there are differences between male and female-headed households (table 8).

Table 8: Who holds certificates, in percentage of all households in the sample

	Households headed by		
	Males	Females	All
The household holds a certificate for their landholdings	87	83	86
The household head is stated as the owner on the certificate	94	73	88
The sex of the owner of the certificate is male	96	23	74

Source: Own survey data

A larger share of the female-headed households compared to male-headed households does not have a certificate for their owned landholdings at all. Further, within the sample of households that do have a certificate for their landholdings, 27 percent of households headed by women do not have a certificate issued in their name, while the same share for male-headed households is only 6 percent. Within the same sample of households that do hold a certificate, 23 percent of female-headed households have certificates issued in the name of a male. These numbers indicate that there might be a bias in favor of male-headed households in terms of issuing certificates as a proof of tenure rights to allocated landholdings, and particularly that there are significant lags with respect to updating the certificates when a household dissolves. It is not possible to draw conclusions about the implications for tenure rights and tenure security to land based on this analysis. However, given that other studies from Ethiopia have found that a certificate to the landholdings have a positive impact on tenure security in general (e.g.Deininger and Jin 2006; Holden et al. 2011), lack of updating certificates might have a gender biased impact

on tenure security, distribution of land when a household dissolves, and female-headed households' ability to protect their rights to keep the land in the case of a land conflict.

6. CONCLUSION

Comparing owned landholdings and operational landholdings gives insight into how male and female-headed households are able to access land through the two main sources: allocated land from the state, and the land rental market. The total landholding is mainly determined by the land allocated from the PAs, and female-headed households have on average significantly smaller total landholdings. The comparison of total operational holdings supports the findings from previous studies of the land rental market in Ethiopia; this is not a source of access to land for female-headed households. The differences between male and female-headed households' landholdings are larger compared to owned landholdings across all households and in all the sub-sample comparisons as well. The same is true when comparing per capita operational holdings, except for the sub-sample of widowed households where the difference is small and not significant.

The reform with the land certification and the proclamation targeting enhanced gender equality did not eradicate the gender bias with respect to household's tenure rights to land. Moreover, the smaller landholdings of female-headed households cannot be explained by smaller household size and less non-land productive resources alone. There is a gender bias in access to land, and the results of the decomposition indicate that women are discriminated against both in the land market and in terms of access to land allocated from the state.

Based on this analysis, further improvements may be required to assure female-headed households tenure rights to land with respect to allocations from the state and inheritance from

the family. Further improving the tenure security for households renting out land is important. There are laws regulating how much of the total land a household can rent out and under what contract the land can be rented out regarding length and payments. Households breaking these laws are in danger of losing the rights for their land. Limitations in the land rental market are likely to affect female-headed households more compared to their male counterparts, as they both rent out land more often and also rent out a larger share. The perception of female farmers is another important issue in terms of securing female-headed households tenure rights to arable land. The reason for their constraint in farming their land could be due to either physical requirements or a social taboo against women ploughing, or both. The outcome may be the same; smaller owned landholdings for female-headed households and that are more likely to rent out their land. Targeting the social taboo could be a wise first step for national policy makers and local Peasant Associations to ensure that women who would like to undertake this activity are not harassed or stigmatized in any way. If the reason is lack of physical capacity, on the other hand, measures to improve the functioning on non-land input markets and secure the tenure rights of landlords in the land rental market would be positive policy interventions. There are few non-agricultural livelihood opportunities for women in rural areas, and thus their rights to land must not be undermined by their need to engage in sharecropping arrangements with male tenants. A second policy recommendation concerns the certificate itself. For now, only the household head is registered as the "owner" of the land. This has been emphasized as a constraint for the spouse's access to and control of land in other studies, and including the names of both the husband and the wife on the certificate would give more secure rights to women when a household dissolves, and improve tenure security in areas with slow or non-existing updating of issued certificates.

Too little research is conducted on the different titling systems in Ethiopia to draw harsh conclusions on the negative impacts of non-joint titling, and therefore a comparative study of the

impact of certification on gender and tenure rights for land across the regions in Ethiopia is needed. Further, a study of the dynamics of changes in household land would be useful to yield insight into how male and female-headed households gain and lose access to land from the state and the family over time.

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Table A1: Comparison of models with and without robust standard errors and oxen dummy

	Models on owned landholdings			Models on operational landholdings		
Variables	*Non-robust*	*Robust*	*Robust& no oxd*	*Non-robust*	*Robust*	*Robust& no oxd*
Sex of the household head (0=male. 1=female)	-0.657**	-0.657**	-0.772***	-1.534***	-1.534***	-2.164***
	(0.306)	(0.304)	(0.290)	(0.402)	(0.378)	(0.390)
Age of household head (in number of years)	0.009	0.009	0.009	-0.012	-0.012	-0.011
	(0.008)	(0.008)	(0.008)	(0.011)	(0.010)	(0.011)
Is the household head literate? (0=no, 1=yes)	-0.045	-0.045	-0.070	-0.289	-0.289	-0.375
	(0.262)	(0.268)	(0.264)	(0.344)	(0.346)	(0.350)
Total number of dependents (<15, >64)	-0.029	-0.029	-0.014	0.039	0.039	0.142
	(0.077)	(0.072)	(0.068)	(0.101)	(0.093)	(0.093)
Male work force (no of men b/w 15 and 64)	0.461***	0.461***	0.487***	0.495***	0.495***	0.644***
	(0.107)	(0.110)	(0.106)	(0.170)	(0.187)	(0.156)
Female work force (no of women b/w 15 and 64)	0.112	0.112	0.121	-0.036	-0.036	-0.030
	(0.128)	(0.117)	(0.116)	(0. 168)	(0.167)	(0.177)
Has hh head been divorced ? (0=no. 1=yes)	-0.401	-0.401	-0.421**	-0.938***	-0.938***	-1.085***
	(0.245)	(0.206)	(0.207)	(0.321)	(0.271)	(0.291)
Does the household have oxen?(0=no. 1=yes)	0.297	0.297		1.811***	1.811***	
	(0.257)	(0.270)		(0.338)	(0.358)	
Village dummies	16 village dummies included in the analysis. but left out of the table					
Constant	3.076***	3.076***	3.194***	1.641	1.641	1.641
	(1.004)	(0.962)	(0.976)	(1.318)	(1.070)	(0.917)
R-squared	0.470	0.470	0.470	0.424	0.424	0.376
N	357	357	359	357	357	359

* p<0.10, ** p<0.05, *** p<0.01.

Source: Own survey data