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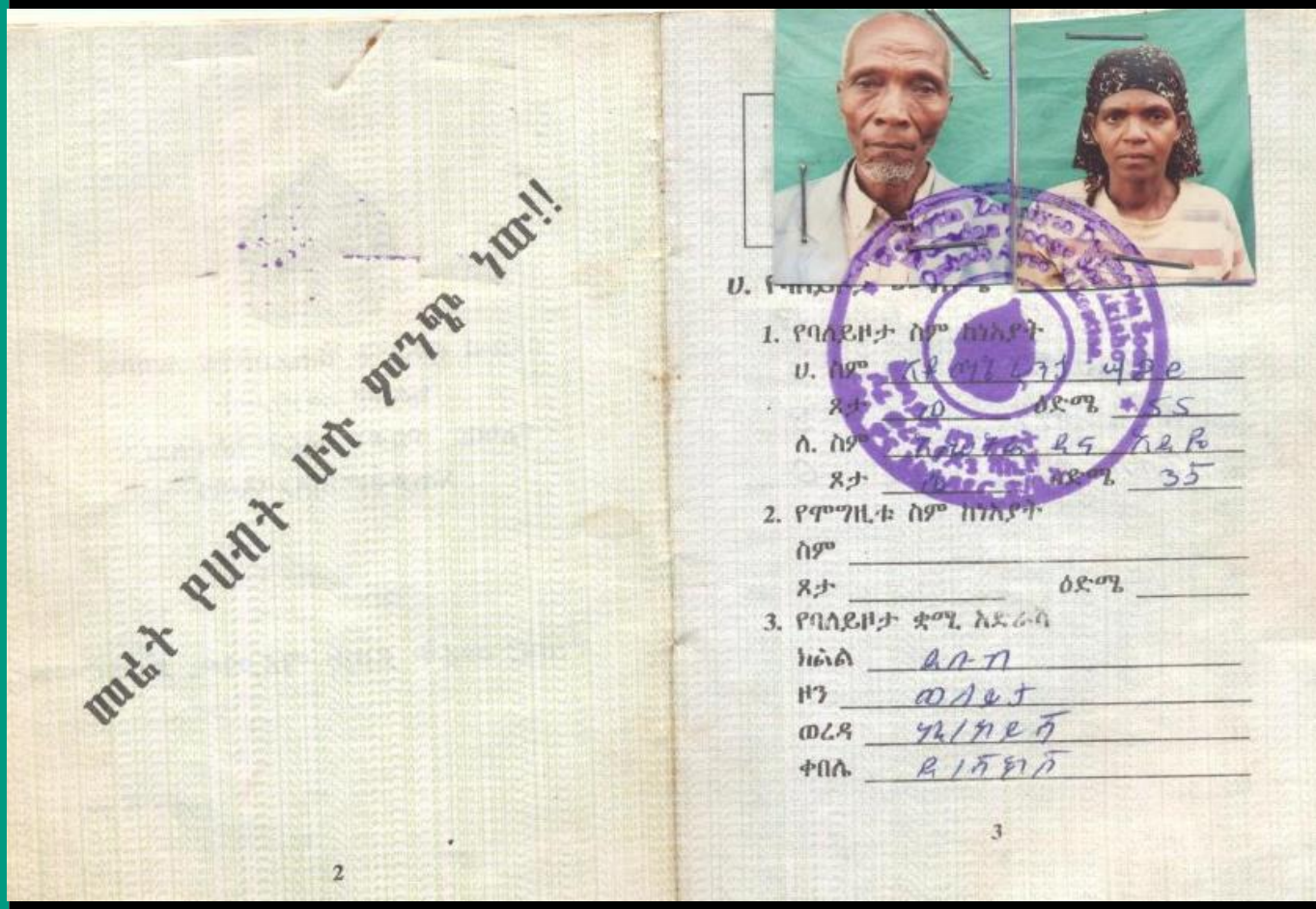

CLTSNMBU

Centre for Land Tenure Studies Working Paper 06/14

Joint Land Certification, Gendered Preferences, and Land-related Decisions:

Are Wives Getting More Involved?[1]

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Abstract

We have investigated whether joint land certification in Southern Ethiopia has contributed to a strengthening of the perceived land rights of women and an increase in their intra-household involvement in land-related decisions. We use gender-disaggregated household panel data and generate indices for wives' and husbands' land rights attitudes and for wives' involvement in land-related decisions. After controlling for endogeneity of land certification, using a control function approach, we find that receipt of land certificate has strengthened wives' awareness of their land rights. We also find evidence of an intra-household bargaining effect and an intra-community social process effect that both contribute to stronger involvement of wives in land-related decisions within households.

JEL codes: Q15, J16, D03.

Key words: joint land certification, gender, empowerment of wives, Ethiopia.

1. Introduction

Gender discrimination in land distribution and rights is widespread in many parts of the world, including Africa (Deere and Doss 2006). The policy goal of gender equity may therefore need a stronger focus on female land rights as such rights have been found to enhance women's decision-power within households and may also thereby indirectly enhance the food consumption and education of their children (e.g., Allendorf 2007; Doss 2006; Hoddinott and Haddad 1995; Duflo 2003). Several recent land tenure reforms have therefore attempted to strengthen women's land rights also within households. Reforms that emphasize joint ownership

[1] Acknowledgements: This research is part of the project, "Joint Land Certification and Household Land Allocation: - Towards Empowerment or Marginalization?" with project number 213591, under the FRISAM program, Research Council of Norway. We acknowledge funding from UN-Habitat, Global Land Tools Network for the 2007 survey and support from Research Council of Norway for the 2012 survey and social experiments. Tewodros Tefera and Million Tadesse provided valuable help with the organization of the 2007 survey. Eirik Schmidt Holst has provided valuable help with the organization of the data. We have received valuable comments from Daniel Ali Ayalew, Sonqing Jin, Agnes Quisumbing and participants in the World Bank Land and Poverty conference 2014 and in the Nordic Conference in Development Economics 2014 in Helsinki on earlier versions of this paper. The usual disclaimers apply.

of land for husbands and wives have been implemented in various developing countries in recent years, including Peru, Vietnam and Ethiopia (Wiig 2013; Newman et al. in press; Holden et al. 2008a; b).

There is a vast theoretical literature on intra-household decision-making, from the unitary household model, which was expanded in various ways by Gary Becker (1964; 1981), to the cooperative and non-cooperative bargaining models (Manser and Brown 1980; McElroy and Horney 1981; Lundberg and Pollak 1993). The latter models show that extra-household factors, such as legal reforms, can affect within-household bargaining outcomes and welfare distribution. Important contributions that focus more explicitly on land include Agarwal (1997; 2003), who addresses many complex issues that are not adequately captured in earlier bargaining models, such as gender asymmetries, the roles of social norms, subjective perceptions and opinions, and voice. Despite legal reforms, women's property rights, in practice, often depend on how laws are interpreted and implemented at the local level. The relative influence of laws versus local norms varies with women's social position/class, education, and degree of urbanization. When there is a wide gap between a new law and traditional norms, there may be a gradual transition before the law is implemented (if it materializes at all), a transition that may take considerable time.

Ethiopia has undertaken new land tenure reforms since the late 1990s aiming to enhance household tenure security and individual land rights. This reform includes issuing joint land certificates to husbands and wives in some regions of the country. Positive effects of the low-cost land registration and certification in Ethiopia are now well documented (Deininger et al. 2008; 2011; Holden et al. 2009; 2011a; 2011b), including effects on female-headed households (Holden et al. 2011a; Holden and Ghebru 2013; Ghebru and Holden 2013; Bezabih et al. 2012). However, intra-household effects have not yet been well researched in regions in which empowerment of women through joint certification of husbands and wives has been emphasized. The objective of this paper is to investigate the effects of joint land certification on the awareness and preferences of men and women, on wives' position and their empowerment regarding land within households. Such insights may potentially be used to identify ways to further refine the reforms. To measure women's empowerment in relation to land management, we have used the extent of participation and influence in a set of land management decisions, including crop choice and land-rental decisions.

This paper builds on research in two regions in Southern Ethiopia in which joint land certificates for husbands and wives have been issued since 2005, based on new land laws that were enacted starting in 2004. Women have traditionally had a weak position in the patriarchal societies of Southern Ethiopia and have generally been considered the property of men, as evidenced by the payment of bride prizes, arranged marriages where girls typically had very little influence on whom they would marry, requirements of widows to remarry the brother of the late husband to remain on household land, and the kidnapping of young girls as a common traditional method of

obtaining a wife in some communities. The step from being mere property to becoming an equal owner can therefore be long and difficult, even with legal reforms that support women's equal land rights (Holden and Tefera 2008a).

We aim to test a number of hypotheses regarding the effects of the joint land certification reform on men's and women's attitudes and preferences regarding women's land rights and regarding the reform's effects on wives' empowerment in relation to land within households. We hypothesize that joint land certification of husbands and wives has strengthened wives' awareness of their land rights (awareness effect). We also hypothesize that wives' attitudes towards women's land rights and husbands' preferences for the traditional weak position of women affect wives' involvement in land-related decisions in opposing directions (intra-household bargaining effects). Furthermore, we assess whether the extent of certification in the community has an additional effect on the empowerment of wives related to family land (social process effect)

We benefit from a detailed baseline survey, conducted in 2007 when the reform was underway, that focuses particularly on the intra-household and gender effects of the reform. The survey covered above 600 households. The sample's farming system diversity includes annual and perennial crop zones, subsistence-oriented rain-fed production and cash crop-oriented production with irrigation and varying market access, four ethnic groups and three religions (muslims, orthodox and protestant Christians). The baseline survey included separate interviews of husbands and wives, interviews that with some modifications were repeated in 2012.

By 2007, the 2005 reform has had some, albeit small, impact on women's ability to influence farm management (Holden and Tefera 2008a; 2008b). The relatively small effect may be due to the strong tradition of male dominance in household-farm decision-making. By 2012, it appears that women have become more involved in farm management decisions, in particular, in crop choice decisions. Additionally, they have become more involved in land rental decisions. We cannot reject the hypothesis that the joint land registration and certification reform has enhanced women's awareness of their rights after we have controlled for endogeneity of land certification using a control function approach. The proportion of wives who claim for all their land rights increased from 41% in 2007 to 72% in 2012. On the other hand, about 36 percent of the husbands do not attempt to retain any of their dominant positions by claiming any of the traditional weak rights of wives. The wives' index for participation in land-related decisions increases with the share of households in the community having land certificates and is positively correlated with attendance in land reform meetings. We thus find evidence of awareness effects, intra-household bargaining effects and social process effects that have contributed to empowerment of wives in relation to land.

To our knowledge this is the first study to assess the impacts of joint land certification on the preferences and awareness of husbands and wives regarding women's land rights and how these

directly and indirectly through these preferences affect wives' involvement in land-related decisions in households that have received joint land certificates.

The paper is structured as follows. We review relevant empirical literature in part two and provide a theoretical framework with our hypotheses in part three. The data and methods used, including our estimation strategy, are presented in part four, where we also include descriptive statistics. The results are presented and testing of the hypotheses discussed in part five and we conclude the paper in part six.

2. Review of relevant empirical literature

There is a large and diverse literature on intra-household decision-making and resource allocation and its complexities. We refer to Doss (2013) for a recent review. As is illustrated in her review the complexity relates to, among others; who make the decisions, the type of decisions such as; partner choice, homestead choice, generosity towards the spouse and other family members, bargaining power within the household, bequeath decisions, activity choice, allocation of time, input use, sharing of output within the family, and investment in education. The "black box" of the household is therefore hard to penetrate, important variables such as individual preferences are unobservable, one often has to resort to use of rough proxy variables, and causality can go in many directions. Great care is therefore needed in the interpretation of findings.

The disadvantage of cooperative and non-cooperative bargaining models is that they do not offer any strong predictions or clear guidelines on which variables are relevant to include (Pollak 2005). Variables that have commonly been seen as affecting the bargaining power of spouses include; assets brought into marriage; laws and regulations that affect how resources are distributed among parties in case of divorce, the opportunities (reservation utility) each party has outside or within marriage; the cultural norms for behavior within marriage; legal and informal protection in cases of abuse; cognitive and other human capital abilities of spouses; and social networks of spouses (Fafchamps et al. 2009; Pollak 2005).

One strand of the literature investigates whether intra-household decisions are efficient. In-efficiencies in resource allocation may be an indicator of within-household disagreements. Udry (1996) assessed the efficiency of farming in Burkina Faso in areas where husbands and wives operate separate plots within households, finding substantial inefficiencies in the use of household resources in farming. Iversen et al. (2011) conducted experiments to investigate intra-household cooperation in Uganda, finding that limited cooperation and opportunistic behavior within households are common. They suggested that more work should be done to develop non-cooperative models of intra-household decision-making. Kebede et al. (2013) employed a variety of experimental games played by married couples in one urban and two rural settings in Ethiopia, finding significant deviations from Pareto-optimal behavior by the majority of couples. Such

findings provide reason to question the Pareto-optimality assumptions that follow from the unitary and collective household models.

Based on this we believe it is safe to assume that resource allocation within households is not necessarily Pareto-optimal and it may therefore be preferable to rely on the separate spheres model of Lundberg and Pollak (1993), which allows for both Pareto-efficient and Pareto-inefficient outcomes. However, we are leaving for future work to assess the possible intra-household efficiency implications of joint land certification.

There are few studies that have investigated the effects of joint land ownership while this type of reform is now attempted in several countries but when it comes to impacts there are many unfilled gaps in our knowledge. This is a summary of the few studies we are aware of.

Wiig (2013) assessed the impacts of joint titling in Peru utilizing random variation in the introduction of the reform as a natural experiment. He found a significant empowerment effect for seven out of 26 different types of decisions according to the female respondents and for six out of 26 for the men. He also found significant positive effects of joint titling on an aggregate empowerment index constructed from the decision variables.

Widman (2014) assessed the land tenure reform providing formal land title deeds in Madagascar from a gender perspective. It is concluded that the reform has strengthened both men's and women's formal claims to land. However, lack of gender equality principles and mechanisms for joint tenure security have contributed to continued male dominance in land ownership.

Newman et al. (in press) have investigated whether joint land titling is affecting land productivity in Vietnam. They conclude that there is no trade-off between joint titling and productivity. Joint titles are therefore potentially an effective way to improve women's bargaining power within the household without any associated efficiency losses. It remains to be seen whether this finding generalizes to other settings.

Holden and Tefera (2008a; 2008b) investigated the early impacts of joint land certification in Southern Ethiopia but their study was undertaken just after the introduction of the reform and it was thus too early to see much impacts. They found at the time of the survey that 80 percent of the land had been registered and that 60 percent of the households had received their certificates. About 90 percent of those that had received land certificates had the names of the wives included. The share of husbands and wives in households that perceived that joint land certification had no effect on wives' involvement in land-related decisions varied from 24 to 58 percent for men and from 26 to 57 percent for women across the districts studied. 23 to 48 percent of the men and 20 to 35 percent of the women across the districts studied thought that joint land certificates should give wives a stronger position in case of divorce. In 2007 less than

five percent of the men and women thought that joint land certificates would lead to stronger involvement of wives in land-related decisions within marriage; that wives would gain more control of income from the land; or get more involved in work on the land. Respondent expectations were therefore very moderate regarding the impacts we study in this paper where we were able to assess the situation five years later.

3. Theoretical framework

Household bargaining models can serve as a useful starting point for understanding complex land rights and intra-household decision-making issues. One may examine joint certification as a natural experiment involving households that have received such certificates (Wiig 2013). However, if there are elements of targeting or self-selection related to allocation of joint land certificates, such endogeneity and selection issues need to be addressed.

In the Nash-bargained household model (McElroy 1990; McElroy and Horney 1990), divorce is labeled as a threat point, and the introduction of joint land certificates may alter both the bargaining power and the threat points, so that the balance of power changes, and the probability of divorce may also change as the threat points change. However, this will also depend on the extent to which rights based on land law and land certification are enforced or involve high enforcement costs. The model may serve as a basis for assessing whether joint certification has affected within-household outcomes (our focus) as well as the probability of divorce and outcomes regarding how land is shared in cases of divorce (a topic left for future research). Several studies have shown that better outside family opportunities for household members affect their intra-household access to resources (McElroy 1990). Assets brought into a marriage and the timing of marriage versus the timing of receipt of joint certificates can be used to test whether these factors influence intra-household resource allocation and land distribution in cases of divorce or the death of the husband.

However, intra-household decisions may also result from non-cooperative bargaining. The separable spheres model (Lundberg and Pollak 1993) presents a picture in which conflicts within households do not necessarily lead to divorce but rather to non-cooperative outcomes within households, where the fallback position may be based on a traditional division of labor and available resources. This model will be used as a basis for analyzing intra-household conditions following land certification. One may use it to assess to what extent there is a cooperative or non-cooperative solution within households with respect to control over land resources and household decisions over land and to what extent this solution changes after the introduction of joint land certification.

On the one hand, the initial weak household tenure rights due to earlier tenure reforms and policies in Ethiopia may cause men and their families to perceive their land rights as weak and insecure before receipt of land certificates (Deininger et al. 2008; Holden and Tefera 2008a). Men may also, therefore, perceive benefits in receiving joint land certificates, although the

certificates imply a re-allocation of power over land within households. On the other hand, if men and their kin family perceive enhanced land rights of women through joint certification as a threat to their land rights, they may react opportunistically and be willing to fight for their traditional decentralized property rights, leading to increased within-household tensions or no change in the involvement of women on land-related issues. Certification may thus lead to a new Nash bargaining equilibrium or a new non-cooperative solution within households (Lundberg and Pollak 1993). Such tensions could also lead to increased intra-household friction, violence, divorce, and disputes in the court system.

We start from a very general standard household bargaining model:

$$(1)\quad N = \left(U^m - U^{*m}\left(A^m\right)\right)\left(U^f - U^{*f}\left(A^f\right)\right)$$

where N is the bargained product, U is utility, U^* is the threat point, which also coincides with reservation utility, the superscripts m and f represent husband and wife, respectively, and A is a vector of assets, rights, attitudes, awareness and other factors that may affect individual bargaining power within households.

The disadvantage of cooperative and non-cooperative bargaining models is that they do not offer any strong predictions or clear guidelines on which variables are relevant to include (Pollak 2005). Variables that have commonly been seen as affecting the bargaining power of spouses include; assets brought into marriage; laws and regulations that affect how resources are distributed among parties in case of divorce, the opportunities (reservation utility) each party has outside or within marriage; the cultural norms for behavior within marriage; legal and informal protection in cases of abuse; cognitive and other human capital abilities of spouses; and social networks of spouses (Fafchamps et al. 2009; Pollak 2005).

In the present study, we are particularly interested in the effect of the legal reform that aims to provide equal land rights to wives and husbands through requiring equal sharing of land in cases of divorce and provision of joint land certificates as written documentation of shared land rights. Wives' empowerment in form of participation in land-related decisions in the household could be seen as itself a welfare effect or as a means of achieving higher welfare outcomes for family members that more closely correspond to the preferences of wives. Cooperative bargaining outcomes should at least go in that direction as long as solutions are found within the household and bargaining costs are less than bargaining gains. However, such bargaining may not always yield cooperative solutions, and there could be a net loss to the household. For individual household members, the net outcomes of such bargaining can be positive or negative.

In our study, we have chosen to examine the decision-power of women or the degree of change in their involvement and influence over land-related decisions. This outcome is represented by N

(*N* is the decision-power index = degree of involvement in land-related decisions given that households have received land certificates) in equation (1) and depends, in reduced form, on a set of factors indicated in equation (2):

$$N\big|_{Certificate=1} = f\left(AttitudeWLR^{f}, AttitudeWTradP^{m}, Landreformmeet, c_v\right)$$

(2) $$AttitudeWLR^{f} = f(Certificate, Landreformmeet, c_v)$$

$$AttitudeWTradP^{m} = f(Certificate, Landreformmeet, c_v)$$

where *Certificate* is indicating jointly owned land based on the joint land certification reform, $AttitudeWLR^{f}$ is the awareness and attitude of wives of their land rights, $AttitudeWTradP^{m}$ is the attitude of the husbands in favor of the traditional weak rights of women, *Landreformmeet* is a dummy variable for whether or not the household attended land reform meetings, c_v captures observable and unobservable community (*kebelle*) characteristics. Opposing attitudes about women's rights and position in the household between the husband and wife can pull in opposite directions. In particular, $\frac{\partial N}{\partial AttitudeWLR^{f}} > 0; \frac{\partial N}{\partial AttitudeWTradP^{m}} < 0; \frac{\partial N}{\partial Landreformmeet} > 0.$

It is assumed that there can potentially be a direct effect on empowerment from participation in land reform meetings or the effect goes through the change in the awareness and attitudes of the wives and their husbands. Furthermore, we assume that joint land certificates (*Certificate*) as well as awareness creation through participation in land reform meetings (*Landreformmeet*) may strengthen women's land rights and decision-power over land:

$$\frac{\partial AttitudeWLR^{f}}{\partial Landreformmeet} > 0; \frac{\partial AttitudeWLR^{f}}{\partial Certificate} > 0; \frac{\partial AttitudeWTradP^{m}}{\partial Landreformmeet} < 0; \frac{\partial AttitudeWTradP^{m}}{\partial Certificate} <> 0.$$

In particular the last term above illustrates the potential bargaining conflict that can cause husbands to resist or accept the reform causing the effect of receipt of land certificate to be ambiguous.

Although land certification is a reform that has been imposed from above we cannot rule out that actual access to land certificates is affected by endogenous processes that can be correlated with household characteristics (Holden et al., 2009; 2011; Deininger et al., 2011). We therefore expand from the parsimonious models above by allowing receipt of land certificates to be endogenous. Furthermore, the extent of certification within a community (*kebelle*) may also influence the degree of empowerment of wives through inter-household social interactions. We therefore include a variable ($Certshare_v$) for the share of households within the community that has received land certificates with the proposition; $\frac{\partial N}{\partial Certshare_v} > 0$

Based on our theoretical framework and the empirical literature, we set out to test the following hypotheses about joint land certification and the empowerment of women in Ethiopia:

H1. The joint land certification reform has strengthened wives' awareness of their land rights (awareness effect).

H2. The land certification reform aiming to strengthen women's land rights within households is blocked by men/husbands who prefer that women retain their traditional weak land rights.

H3. Wives' preferences for strengthened land rights of wives positively influence, and husbands' preferences for the traditional position of wives negatively influence, the degree of involvement of women in land-related decisions (bargaining effect).

H4. The within-community extent of joint land certification enhances the within-household involvement in land-related decisions (social process hypothesis).

Greater exposure to markets, education and the external world may enhance women's position, while traditional culture may push women toward their traditional weak position. The general resource situation of the household may also affect bargaining within households. If resources are relatively limited, bargaining may be tougher, as the husband may be more reluctant to give up control over scarcer resources.

We provide more detailed specifications of the variables used to test the hypotheses in the following section on data and estimation strategy.

4. Survey locations, data and estimation strategy

4.1. Survey locations and sampling

Most of Ethiopia is dominated by plough agriculture, under which pairs of oxen are used to pull ploughs. Exceptions are the perennial zone, where plows are less used, and the pastoral areas. Our sample includes districts dominated by traditional plough agriculture (Sashemene and Arsi Negelle districts) and two areas in the perennial zone, one dominated by rain-fed subsistence-oriented production (Wollaita) and one dominated by perennial cash crop production with supplementary irrigation (Wondo Genet). The Oromo ethnic group dominates in the Sashemene and Arsi Negelle districts, the Sidama ethnic group dominates in Wondo Genet, and the Wollaita ethnic group dominates in Wollaita. A substantial number of Oromos have, however, also settled in Wondo Genet, and a separate district, Wondo Genet Oromo, has been established recently. Sashemene, Arsi Negelle and Wondo Genet Oromo districts are part of the Oromia Region while Wondo Genet and Wollaita are part of the Southern Nations, Nationalities and Peoples (SNNP) region.

The degree of market integration varies across locations, with Sashemene as a market center. Sashemene and Wondo Genet are located very close to Awassa, the largest town in this part of Ethiopia and the administrative centre of SNNP Region. Arsi Negelle and Sashemene are located along the main road between Awassa and Addis Ababa and therefore have very good market access. The cash crop producing area, Wondo Genet, is also located near Sashemene and has good roads facilitating market-oriented cash crop production. Wollaita, which is located in a

more remote rural setting and has poorer market access, is characterized by more traditional subsistence-oriented production, with enset (false banana) as the main staple crop, and extremely high population densities, implying very small farm sizes and high levels of poverty. Communities (*kebelles* or "Peasant Associations") were strategically sampled within each district to obtain additional within-district variation in distance to market. Within each community, households were sampled randomly from lists of households obtained from the community administration.

4.2. Household-individual panel survey

We build on a baseline survey in 2007, covering 613 households (15 percent polygamous with up to four wives), in four districts in Oromia and the SNNP Regions (Holden and Tefera, 2008a, b). This survey focused explicitly on the initial effects of joint certification on husbands and wives in the two regions and included detailed data collection for all land parcels of households and separate interviews with husbands and wives on their knowledge of the land laws, perceptions of their land rights, the division of labor within households and their opinions and expectations regarding the effects of joint land certification. In polygamous households, separate interviews were conducted for each of the wives. However, in this study we only focus on the monogamous households. The interviews included specific questions about who was responsible for a range of land-related decisions, whether the spouse was consulted and whether decisions were joint decisions. Other questions were related to how land had been divided upon divorce or the death of the husband in the past.

Separate village level survey instruments were also used to collect information from each village regarding how land registration and certification were implemented (Holden and Tefera, 2008a). Separate survey instruments were also used to interview local conflict mediators to identify how women were treated in land-related disputes. At the time of the 2007 survey, the land of 80 percent of households had been registered, and 60 percent of households had received their land certificates. These detailed baseline data provide a unique opportunity to identify effects, using a new survey of the same households and individuals in 2012. Empowerment and attitude variables were constructed (see details below) based on stated responses.

4.3. Construction of variables

The following approaches are used to construct variables to measure empowerment and attitudes towards the new land rights that aim to strengthen women's position within households:

4.3.1. Measurements of empowerment

We assess in 2012 the extent of participation in a set of land management decisions, including crop choice and land renting decisions, and whether participation has led to changes in such decisions. Our measurements are constructed from the responses to the following questions:

i) Are you involved in land investment and production decisions with respect to any of the plots? 1=Yes, 0=No

ii) Have any of these discussions resulted in changes in how the household makes decisions or manages its land resources? 1=Yes, 0=No

iii) The wife's name on the land certificate affects her power over the land = 1 if any of codes 2, 3, 4, 5, and 6 below apply; = 0 otherwise.

1=Has no effect; 2=She would have a stronger position in case of divorce or husband's death; 3=She would be more involved in land-related decisions within marriage (e.g., crop choice and input use); 4=She would control more of the income from production on the land; 5=She would be more involved in land-renting decisions; 6=She would perform more work on the land; 7=It depends on the family,

An indicator variable for degree of empowerment with values from 0 to 3 was constructed based on responses to these three questions. A value of 1 was given to wives who responded positively to each question. The number of positive responses (out of 3) then determines the degree of perceived empowerment.

4.3.2. Wives' stated preferences for strengthened women's land rights

An index was generated by summing the responses to three questions based on interviews in 2007 and 2012:

i) The wife can deny a husband the right to rent out land = 1, = 0 otherwise;

ii) A wife expects a joint land certificate = 1, = 0 otherwise;

iii) A wife expects equal land sharing upon divorce = 1, = 0 otherwise.

4.3.3. Husbands' preference for the traditional position of women

An index was generated from responses to three questions based on interviews in 2012:

i) A widow should not be allowed to marry outside the family of the late husband = 1, = 0 otherwise;

ii) A widow should marry the brother of the late husband = 1; = 0 otherwise

iii) The husband decides when there is disagreement between husband and wife = 1, = 0 otherwise.

The index was generated by summing the responses to these three questions.

4.4. Descriptive statistics

We provide a brief review of some descriptive statistics in this section to clarify important contextual conditions. The share of households in our survey sample that had received a land certificate increased from 61.7 percent in 2007 to 82.4 percent in 2012 out of a total sample of 615 households. Only 5.8 percent of households perceived that tenure security had decreased during this period, while 57 percent perceived that tenure security had increased.

Perceptions of the effects of land certification on within-household discussions of land-related decisions were elicited. Crop choice and land renting emerged as the two most commonly discussed types of decisions following the reform and were mentioned by more than 60 percent of households. Other issues identified as more subject to discussion between spouses after land certification included division of labor, investment decisions regarding land, house construction and allocation of land to children.

Of those that indicated that there had been more discussion, 53.7 percent stated that there had been changes in decision-making. The most important types of issues regarding which changes in decisions had occurred, as perceived by spouses, were crop choice, improved land management, productivity and income generation.

Approximately 6.5 percent of the sample of married couples stated that they have faced land management issues that they have failed to agree upon. Again, crop choice, land management and income management emerged as common issues upon which spouses had difficulty obtaining agreement, as did the issue of land renting. We asked who decides when spouses cannot agree, and it appears that in most cases, the husband decides or that the decision is postponed. This may be the kind of non-cooperative outcome within families that the Lundberg and Pollak (1993) model allows for.

The distribution of wives' land-related empowerment index variable is presented in Table 1. Female-headed and polygamous households are dropped from the sample, as we are primarily interested in the responses of male-headed monogamous households with land certificates. The index shows that 55 percent of the respondents are at index levels 2 and 3, indicating substantial levels of empowerment.

The distribution of wives' land rights attitude index is presented in Table 2. For this index, we also have responses from 2007 and can determine whether there is a change in attitudes from 2007 to 2012. A chi-square test demonstrates that there has been a highly significant change in the attitude index from 2007 to 2012, with wives becoming more conscious of their land rights over time.

Table 1. Distribution of wives' land-related empowerment indicator

Indicator level	Freq.	Percent	Cum.
0	20	6.2	6.2
1	126	39.3	45.5
2	93	29.0	74.5
3	82	25.6	100.0
Total	321	100.0	

Source: Own survey data.

Table 2. "Wives' land rights attitudes"- index distribution by year for wives in monogamous households with land certificates

Index score	Stats	2007	2012	Total
0	Freq.	38	24	62
	Percent	11.3	7.5	9.4
1	Freq.	43	7	50
	Percent	12.8	2.2	7.6
2	Freq.	117	58	175
	Percent	34.7	18.1	26.6
3	Freq.	139	232	371
	Percent	41.3	72.3	56.4
Total	Freq.	337	321	658

Note: Pearson chi2(3) = 71.9 Pr = 0.000 for difference in distribution from 2007 to 2012.
Source: Own survey data.

The distribution of husbands' preferences regarding the traditional position of women index is presented in Table 3 for husbands in monogamous households with land certificates. We find that approximately 64% of husbands favored at least one of the traditional positions regarding women.

Table 3. "Husbands' preference for traditional position of women"- index in 2012

Index score	Freq.	Percent	Cum.
0	115	35.8	35.8
1	122	38.0	73.8
2	70	21.8	95.6
3	14	4.4	100
Total	321	100	

Source: Own survey data

Table 4 provides overview statistics for additional variables used in the econometric analysis.

Table 4. Descriptive statistics for male-headed monogamous households and individual data

	Mean	Median	St. Dev.	N
Wives' empowerment index	1.74	2	0.92	404
Age of household head	45.46	45	13.54	404
Household size	7.54	7	3.18	404
Average education level in household	2.96	2.86	1.84	399
Male work force	2.02	2	1.38	404
Female work force	1.95	2	1.26	404
Land certificate dummy	0.82	1		404
Share of households with land certificate in kebelle	0.82	0.83	0.13	404
Farm size, ha	0.85	0.625	0.032	491
Wives' land rights attitude index	2.59	3	0.81	404
Husbands' preference for traditional position of women index	0.95	1	0.85	404

Source: Own survey and experimental data from 2012.

The share of households within communities with land certificate varied from 0.36 to 1.00 across the communities.

4.5. Estimation strategy

The dependent variables are count variables for the number of rights that are claimed by wives out of three. We use poisson and negative binomial models to capture this specific structural characteristics of the dependent variables in our models. The models are also known as exponential conditional mean models; $E(y|x)=\exp(x'\beta)$. We do the estimation is steps:

4.5.1. Parsimonious models

We estimate the following parsimonious negative binomial regression models to assess whether we face an overdispersion problem. These models are more general than the poisson models which assume that the mean and the variance are of equal size:

a) Model for women's land rights attitude index, with data from 2007 and 2012:

3) $$AttitudeWLR_{ht}^{f} = NB\left(\beta_0 + \beta_1 Landreformmeet_h + \beta_2 Landcertificate_h + \beta_3 Year_t + c_v + e_{ht}, \alpha_1\right)$$

where we for simplicity use *NB* for the functional form of the negative binomial model[2] with quadratic variance function that allows testing for overdispersion with the α_1 parameter capturing the degree of overdispersion. With $\alpha_1=0$ there is no overdispersion problem and a poisson model may be an adequate representation of the count model.

[2] We refer to e.g. Cameron and Trivedi (2013, p.80-89) for the full specification and derivation of the negative binomial model.

$AttitudeWLR_{ht}^{f}$ is the latent index variable for the wife's attitude towards strengthened land rights for women in household *h*, $Year_t$ is a dummy for year=2012, c_v represents community fixed effects, and e_{ht} is the normally distributed error term. The index variable takes values from 0 to 3 (see Table 2). We assume that the land certificate variable is exogenous but will test this in the next step.

b) Model for men's preferences regarding women's traditional weak position, with data from 2012:

4) $$AttitudeWTradP_h^m = NB\left(\mu_0 + \mu_1 Landreformmeet_h + \mu_2 Landcertificate_h + c_v + u_h, \alpha_2\right)$$

with a specification similar to equation 3) above except that we were unable to construct this variable for the baseline data from 2007. Also here the dependent index variable ranges from 0 to 3 (see Table 3). The overdispersion parameter is α_2.

c) Model for women's participation in land-related decisions (empowerment indicator), with data from 2012. This is the main model of interest to us.

5) $$N_h = NB\left(\gamma_0 + \gamma_1 AttitudeWLR_h^f + \gamma_2 AttitudeWTradP_h^m + \gamma_3 Landreformmeet_h + c_v + v_h, \alpha_3\right)$$

where N_h is the latent index for the wife's participation in land-related decisions in household *h* as a function of the attitude index variables (represented in linear form in the parsimonious model), the land reform meeting participation dummy, the community dummy variables and the overdispersion parameter. The model was run only for households that had received land certificates.

Poisson and negative binomial regressions were tested in the analysis of the three models in equations 3) - 5) and gave almost identical solutions, indicating that overdispersion is not a problem. The more restrictive assumptions of poisson models that the conditional mean and variance of the distribution are equal are not a problem in our case. Still, we have preferred to use the less restrictive negative binomial models which include the statistics for the overdispersion parameter stated as "Ln alpha constant" in Table 5. The results, in the form of average marginal effects with cluster robust standard errors and clustering at the community (*kebelle*) level, are presented for the parsimonious models in Table 5. The alpha constants are not significantly different from zero.

4.5.2. Instrumental variable Poisson models

Instrumental variable Poisson models with control function approach were used to test for endogeneity of land certification and thus for robustness checks of models 3) and 4). The IV

Poisson model with control function estimates the following augmented model which is estimated using GMM with Stata 13 (Wooldridge 2010):

3a) $AttitudeWLR_{ht}^{f} = \exp\left(\beta_0^{'} + \beta_1^{'} Landreformmeet_{ht} + \beta_2^{'} Landcertificate_{ht} + \beta_3^{'} Year_t + \beta_4^{'} v_{ht} + c_i\right)$

3b) $p\left(Landcertificate_{ht}\right) = \Phi\left(\delta_0 + \delta_1 z_{ht} + \delta_2 Landreformmeet_{ht} + \delta_3 Year_t + c_v + v_{ht}\right)$

The parameter $\beta_4^{'}$ controls for endogeneity of land certificate. The same approach was used for equation 4):

4a) $AttitudeWTradP_h^{m} = \exp\left(\mu_0^{'} + \mu_1^{'} Landreformmeet_h + \mu_2^{'} Landcertificate_h + \mu_3^{'} \varepsilon_h + c_i\right)$

4b) $p\left(Landcertificate_h\right) = \Phi\left(\lambda_0 + \lambda_1 z_h + \lambda_2 Landreformmeet_h + c_v + \varepsilon_h\right)$

The instrument (z) used is household size in both cases. The instrument should affect the probability of receiving land certificate but should not affect the outcome variable. We see no reason that household size should affect the attitudes of husbands and wives towards wives' land rights. The instrument is significant in both models. The coefficients for the error terms from 3b) and 4b) in 3a) and 4a) were significant and this represents a Wald test of the hypothesis of exogeneity (Cameron and Trivedi 2010) which implies that exogeneity of certificate is rejected in both models. We also tested for exogeneity of the *Landreformmeet* variable but were unable to reject its exogeneity.

4.5.3. Empowerment models

We implemented a sensitivity analysis of the land-related empowerment models using negative binomial models using cluster robust standard errors, with clustering at community level. First, we introduced the wives' land rights attitude index and the index for husbands' preference for the traditional weak position of women as step functions to test for nonlinearities in these count variables. Second, to assess the possible effect of the land certification process we included the share of households with land certificate within each community (linear and squared terms). Third, to assess potential selection bias related to land certification and since the model only includes households with certificates, we included the inverse probability weights for households having a land certificate (*IPW Certificate*) as an additional control for sample selection. We needed to use district fixed effects (w_j) in these models as the share of households with land certificate does not vary within communities. This allows us also to study the variation across districts (equation 5a).

5a) $N_h = NB\left(\begin{array}{l}\gamma_1 AttitudeWLR_h^{f} + \gamma_2 AttitudeWTradP_h^{m} + \gamma_3 Landreformmeet_h \\ +\gamma_4 Certshare_v + \gamma_5 IPWCertificate_h + w_j + v_h, \alpha_5\end{array}\right)$

While the attitude variables also may be considered endogeneous, we are not aware of any good way to control for this endogeneity as linear 2SLS models gave vary poor predictions and did not give any meaningful results. We consider our implemented approach to be our best option given

the nature of our data and interpret the results with caution. The results are presented in Table 7 as a sequence of models adding the *Certshare* and *IPWCertificate* variables sequentially to allow inspection of the stability of other parameters in the models across the specifications.

5. Results and Discussion

5.1. Parsimonious models

We first present a set of parsimonious models to assess the relationship between the land certification reform, women's land rights attitudes, men's attitudes regarding the traditional position of women, and women's empowerment in land-related decisions, see Table 5. We use attendance in land registration and certification meetings to capture exposure to the reform (dummy variable) together with a dummy for having received a land certificate. We use the constructed index variables to capture women's land rights attitudes, men's attitudes regarding women's traditional position, and women's empowerment in land-related decisions. In the first model, the dependent variable is the women's land rights attitude index. We collected the data for this variable both in 2007 and 2012 and have therefore also included a year dummy (=1 for 2012) in this model. In the second model, the dependent variable is men's attitudes regarding women's traditional position (index) in 2012, with attendance at meetings and receipt of land certificates as explanatory variables. In the third model, the dependent variable is the empowerment in land-related decisions index variable in 2012, and again, attendance at meetings and the attitude variables are used as explanatory variables. This model applies only to households that have received land certificates, due to the way the dependent variable is constructed. It is possible that the empowerment effect exerts its influence primarily through the attitude variables, but we do not rule out that attendance in meetings may directly affect involvement in land-related decisions. All models have limited dependent (count) variables, and we have therefore used negative binomial models. We use community (*kebelle*) fixed effects to control for local unobservables.

We observe that the women's attitudes index has increased significantly (at the 0.1 percent level) from 2007 to 2012 and that attendance at land reform meetings is strongly positively related to women's attitude index, while having received a joint land certificate has no direct significant effect on the index level. This indicates that the reform has raised general awareness among women regarding their land rights.

Husbands' preferences for the traditional position of women are negatively associated with their participation in land reform meetings (significant at the 10 percent level). This may imply that the informational meetings have encouraged positive attitudes among men regarding stronger land rights for women.

Women's land-related empowerment index is strongly positively associated with women's land rights attitude index (significant at the 0.1 percent level) and is negatively related with men's

preferences for the traditional position of women index (significant at the 10 percent level). The relatively stronger effect of the women's land rights index implies that increased awareness among women may have contributed most to increased involvement of women in land-related decisions.

Table 5. The relation between land certification reform, wives' land rights attitude index, husbands' attitude towards women's tradition position, and women's involvement in land-related decisions.

	Wives' land rights attitude index		Husbands' preference for traditional position of women index		Wives' land-related empowerment index	
	dy/dx	P>z	dy/dx	P>z	dy/dx	P>z
Attended land reform meeting	0.178	0.000	-0.135	0.051	0.159	0.061
Land certificate, dummy	-0.076	0.191	0.046	0.653		
Year dummy, =1 for 2012	0.497	0.000				
Wives' land rights attitude index					0.271	0.000
Husbands' pref. for trad. pos. of women					-0.135	0.016
Community FE	Yes		Yes		Yes	
Constant	0.686	0.000	-0.373	0.003	0.238	0.003
Ln alpha constant	-65.597		-35.519		-27.077	
Number of observations	1166		617		400	

Note: Negative binomial models with cluster robust standard errors, clustering on community (*kebelle*). The table presents average marginal effects and P-values. The models for wives' land related empowerment index is for male-headed households with land certificate.

5.2. Instrumental variable poisson models for attitude variables

The results from the instrumental variable poisson models for wives' land rights awareness and husbands' preference for traditional weak rights of wives variables are presented in Table 6. The models in Table 5 indicated that there is no problem with overdispersion such that poisson models may fit the data well. This facilitates use of the *ivpoisson* command in Stata 13 to handle the potential endogeneity of land certification[3]. Household size was used as instrument for possession of land certificate in these models.

[3] A similar command for negative binomial models has to our knowledge not yet been developed.

Table 6 shows that attendance in land reform meetings and the year dummy variable are positively and highly significantly correlated (at 0.1 percent levels) with wives' land rights attitude index. The instrument (household size) in the first stage regression and the land certificate variable are significant at 5 percent levels and so is the error term from the first stage regression.

The husbands' preference model has attendance in land reform meetings as significant at 10 percent level and with a negative sign while certificate was significance at 10 percent level and with a positive sign based on a highly significant instrumental variable and an error term significant at the 10 percent level. The effects of the reform on husbands' preferences are therefore weaker and mixed.

Table 6. Instrumental variable poisson models for the gendered preference models.

	Wives' land rights attitude index		Husbands' preference for traditional position of women index	
	dy/dx	P>z	dy/dx	P>z
Attended land reform meeting	0.177	0.000	-0.145	0.080
Year dummy, =1 for 2012	0.544	0.000		
Land certificate, dummy	2.007	0.048	4.654	0.062
Community FE	Yes		Yes	
Constant	-0.044	0.898	-4.501	0.047
/C_certificate	-0.884	0.044	-5.279	0.059
First stage results for instruments:				
Household size	0.024	0.023	0.042	0.000
Number of observations	1143		602	

Note: The /C_certificate ancillary parameters corresponds to the estimates of α_4 and γ_3 in equations 3a) and 4a), the coefficients on the residual variables included to control for the endogeneity of certificate. The table shows average marginal effects and P-values. The models use community fixed effects (FE).

5.3. Empowerment models

We implemented a sensitivity analysis of the land-related empowerment models as negative binomial models with cluster robust standard errors[4]. The results are presented in Table 7.

First we introduced the wives' land rights attitude index and the index for husbands' preference for the traditional weak position of women as step functions to test for nonlinearities. Second we introduced a variable for the share of the households in each community that have land certificate. Third, we included the inverse probability weight for having land certificate as a control for sample selection based on a probit model with community fixed effects presented in Appendix Table A1. We were unable to use community fixed effects due to the introduction of the "share with certificate" variable and used district (*woreda*) fixed effects instead in these

[4] While we also tested poisson models they did not perform properly in Stata with our data. The more flexible functional form that the negative binomial models offer appeared to have an advantage.

models. The probit model with a broader set of household characteristics was used than in the earlier IV models and showed a positive significant correlation between land certificate and male and female labor force as variables that were excluded in the empowerment models. In addition many of the community dummy variables were highly significant, revealing administrative variation in distribution of certificates.

Table 7 shows that wives' empowerment (involvement in land-related decisions) is strongly positively correlated with the wives' land rights attitude index, a correlation that is significant at the 0.1 percent level when switching from count level one to two and from count level two to three for the attitude index in all models. This constitutes strong evidence that women who are more aware of and emphasize their rights are also able to become more involved in household decision-making regarding land.

However, the husbands' preferences for the traditional position of women index was also significant and negative for switching from level zero to level one and from level one to level two, indicating that women become less involved in land-related decisions in households where husbands resist acceptance of women's land rights, favoring women's traditional weak position.

The share of households with certificate is positively correlated with the degree of empowerment and the effect becomes stronger after controlling for sample selection with the inverse probability weighting approach. The degree of empowerment is strongest in Arsi Negelle district, an area with relatively good market access along the road towards Addis Ababa. The degree of empowerment is weakest in Wollaita the most remotely located area where also poverty and land scarcity is most severe. It is also weaker in Wondo Genet, the cash-cropping area where more modern land registration and certification has been implemented.

Overall, the relatively large change in involvement of wives in land-related decisions compared to their expectations five years earlier (Holden and Tefera 2008) seems to be a combined effect of joint registration and certification, participation in related information meetings, and changes in awareness and preferences of husbands and wives. Also, we cannot rule out that legal changes that favor women such as the revised Family Code that was issued in 2000 (FDRE 2000), and social influences through education, media, market integration and women's associations also have contributed to the empowerment process but we are unable to test this.

5.4. Discussion of hypotheses

We now discuss our results in relation to the key hypotheses that we aimed to test.

Hypothesis H1 states that the joint land certification reform has strengthened wives' awareness of their land rights. We find strong evidence in support of this hypothesis, as women's favorable attitudes towards women's land rights are significantly strengthened between 2007 and 2012, the early period after receiving the joint land certificates (Tables 2 and 5). There is a strong positive

and significant (at 0.1 percent level) correlation between participation in meetings during the reform process and awareness among women of their land rights (Tables 5 and 6). While the land certificate variable is not significantly correlated with women's awareness of their land rights in the parsimonious model in Table 5, it becomes significant (at 5 percent level) and positive after controlling for endogeneity of land certification in the IV poisson model in Table 6. We interpret this as an awareness effect of joint land certification.

Hypothesis H2 states that the land certification reform aiming to strengthen women's land rights within households is blocked by men/husbands who prefer that women retain their traditional weak land rights. We find only partial support for this hypothesis. Table 3 shows that 36 percent of the husbands claim none of the traditional weak rights of women, 38 percent claim one out of three and only four percent claim all the three weak rights. We find a negative and significant correlation between attendance in land reform meetings and preference for the traditional weak rights, possibly indicating that husbands are changing their attitudes towards accepting stronger land rights to women, even though here could also be some reverse causality. After controlling for endogeneity of land certification in Table 6, the land certificate variable becomes positive and significant (at 10 percent level). This may be a sign that land certification has resulted in protest reactions among some men such that they may try to cling to their power and further suppress the rights of their wives. Overall, this shows variation among men in their attitudes and Hypothesis H2 can partly be rejected. Some men try to cling to the traditional positions while others are open towards sharing more equal land rights with their wives.

Hypothesis H3 states that wives' preferences for strengthened land rights of wives positively influence, and husbands' preferences for the traditional position of wives negatively influence, the degree of involvement of women in land-related decisions. We find a significant positive correlation between women's positive attitudes towards women's land rights and their involvement in land-related decisions (Tables 5 and 7). We also find a significant negative correlation between husbands' preferences for the traditional position of women and wives' participation in land-related decisions. Both of these variables are highly significant in the third model in Table 5 where the preference variables are represented in linear form. For the non-linear models in Table 7, changes in wives' attitudes from level one to levels two and three are highly significant and likewise are changes from level zero to levels one and two for the male preference variable. These results are very stable across models also after controlling for the degree of land certification in the community and sample selection into certification for households with land certificate using inverse probability weighting. We therefore cannot reject hypothesis H3. We see significant bargaining effects and that women gradually get more involved as their awareness has increased.

Hypothesis H4 states that the within-community extent of joint land certification influences the within-household involvement in land-related decisions (social process hypothesis). This

hypothesis is tested by the inclusion of the share of households with land certificate within the community (in linear and quadratic form) in models two and three in Table 7. We see that both the linear and quadratic terms are significant in both models with a positive coefficient for the linear effect and a negative coefficient for the quadratic effect. The variable has share values between zero and one and with the coefficients on the linear effect having larger absolute values than the coefficients on the quadratic effect in both models this implies that the extent of participation in land-related decisions is increasing at a diminishing rate with the share of households with land certificate in the community. Joint land certification therefore seems to have initiated a social process in the communities towards more involvement of wives in land-related decisions and the extent of certification in the community matters for such involvement. This effect appears stronger after controlling for sample selection by use of inverse probability weights for land certification. We therefore cannot reject the social process effect hypothesis.

6. Conclusions

We conclude that the joint land certification reform in Southern Ethiopia has positively affected women's favorable attitudes towards strengthened land rights of women and that this development has contributed to increased involvement of women in land-related decision-making. Our study provides evidence of awareness effects, intra-household bargaining effects and intra-village social process effects that jointly have contributed to strengthen the involvement of women in land-related decision beyond the expectations of the respondents five year earlier. Issuance of joint land certificates appears therefore to have been a useful policy tool to promote more equal land rights and has increased the involvement of women in land-related decisions within households. Our study covers very diverse farming systems and different ethnic groups in Ethiopia, indicating that our findings are applicable to diverse socio-economic conditions. The findings may therefore be generalizable to other areas in Ethiopia and perhaps other parts of Africa. The low-cost land registration and certification approach in Ethiopia can provide useful insights for other African countries, although it is always important to design reforms that fit local contexts, as there is no guarantee that success in one location can be replicated elsewhere. However, patrilineal inheritance systems and virilocal marriage systems are also dominating in other African countries where women are in a weak bargaining position over land within households. Our findings should therefore be of more general relevance. Piloting and adjusting designs of tenure reforms in a step-wise fashion is in any case important to increase the chances of success and prevent large-scale failures.

Future research should focus more heavily on the welfare outcomes of the reform, how the intra-household climate for collaboration affects the efficiency of household production and the distribution of welfare within households. In Ethiopia, it will be important to integrate joint land certification with second stage land certification that is currently underway (Bezu and Holden 2014). Another priority should be the relationship between the reform and the extent of increased involvement of women in decision-making and organization of activities at the community level.

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Table 7. Factors associated with wives' participation in land-related decisions (empowerment indicator) in monogamous male-headed households with land certificates.

	Wives' land-related empowerment index, Model 1		Wives' land-related empowerment index, Model 2		Wives' land-related empowerment index, Model 3	
	dy/dx	P>z	dy/dx	P>z	dy/dx	P>z
Attended land reform meeting	0.151	0.047	0.162	0.034	0.308	0.000
Wives' land rights attitude index=1	0.580	0.157	0.597	0.153	0.598	0.153
Wives' land rights attitude index=2	0.816	0.001	0.797	0.001	0.817	0.001
Wives' land rights attitude index=3	0.949	0.000	0.958	0.000	0.985	0.000
Husbands' pref. for traditional position of women=1	-0.285	0.000	-0.294	0.000	-0.291	0.000
Husbands' pref. for traditional position of women=2	-0.354	0.003	-0.348	0.004	-0.348	0.008
Husbands' pref. for traditional position of women=3	-0.310	0.285	-0.320	0.267	-0.322	0.257
Share of households with certificate in *kebelle*			2.788	0.044	6.439	0.001
Share of households with certificate in *kebelle*, squared			-2.133	0.007	-4.034	0.000
IPW land certificate[a]					0.710	0.009
District dummies, Baseline=Sashemene						
Arsi Negelle	0.135	0.024	0.281	0.000	0.283	0.000
Wondo Genet	-0.257	0.048	-0.367	0.028	-0.314	0.028
Wollaita	-0.469	0.000	-0.482	0.000	-0.501	0.000
Wondo Oromia	0.128	0.529	0.051	0.770	0.018	0.919
Ln alpha constant	-27.077		-27.077		-27.214	
Prob > chi2	0.000		0.000		0.000	
Number of observations	400		400		395	

Note: Negative binomial models with cluster robust standard errors, clustering on community (*kebelle*) level. The table presents average marginal effects and P-values. The models are for male-headed households with land certificate. [a] IPW Land certificate is the inverse probability of households having received land certificate as a control for sample selection.

9. Appendix

Table A1. Factors associated with possession of land certificate, probit models

	Model 1	Model 2
Household size	0.062**	-0.013
Year dummy, 2012=1	0.034	
Attended land reform meeting	0.402****	0.436***
Sex of household head		0.021
Age of household head		-0.002
Average education of hh members		-0.017
Male work force		0.123*
Female work force		0.123*
Polygamous household, dummy		0.121
Farm size, ha		0.252
Community fixed effects		
3.kebelle	-0.405****	-0.525****
4.kebelle	-0.198****	-0.488****
5.kebelle	0.324****	0.265***
6.kebelle	1.113****	0.697****
7.kebelle	0.838****	0.673****
8.kebelle	.	.
9.kebelle	-0.084	-0.214*
10.kebelle	-0.063	-0.135
11.kebelle	0.065	0.027
12.kebelle	0.176**	0.216**
13.kebelle	-0.371****	-0.453****
14.kebelle	-0.635****	-0.773****
16.kebelle	-1.205****	-1.228****
17.kebelle	0.011	-0.048
18.kebelle	-0.313****	-0.367***
19.kebelle	-0.001	-0.022
20.kebelle	-0.435****	-0.536****
21.kebelle	.	.
22.kebelle	-0.013	-0.061
Constant	0.322	0.481
Number of observations	1041	537

Note: Results from probit models. Two communities (*kebelles*) were dropped because they predicted certification perfectly. Cluster robust standard errors with clustering at community level. Significance levels: *: 10%, **: 5%, ***: 1%, ****: 0.1%.