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Gender aspects in action- and outcome-based payments for ecosystem services—A tree planting field trial in Kenya

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ABSTRACT

Payments for ecosystem services (PES) schemes have been increasingly implemented in developing countries where gender-related inequalities are generally prevalent. A randomized field trial in Kenya revealed the impacts of participants' gender in conservation auctions and in environmental performance of action- and outcome-based PES schemes and provided evidence for associations between the gender effects and traditional gender roles. First, we identified differences between men and women in the utilities of the contract and relative risk aversion as potential drivers of the decrease in bids by women compared to men in the auction for action-based contracts. Second, we observed a gender-specific difference in perceptions of risk in the outcome-based approach when women increased their bids. Third, women achieved lower tree survival than men, despite women providing more effort. In this context, we identified the inequality in reciprocal labor for male and female contract holders as a possible source of the gendered tree survival. This case study showed that targeting women improves gender equity in terms of access to project decision-making, trainings and cash, and can significantly improve the effectiveness of the PES scheme.

1. Introduction

Market-based policy instruments have been increasingly applied to procure ecosystem services in the past three decades, whereas payments for ecosystem services (PES) represent the mostly used mechanism (Schilizzi and Latacz-Lohmann, 2016). Conservation payments convert "external, non-market environmental values into financial incentives" for private landholders (Engel et al., 2008, p. 664), as they offer payments/compensate for their provision of ecosystem services (Pagiola et al., 2005; Wunder, 2005). PES have been extensively applied to watershed protection, addressing conflicts between up-stream landholders who impact the water quality and quantity and downstream water users (Escobar et al., 2013; Richards et al., 2017).

In terms of PES contracts, two approaches have emerged, namely, outcome- and action-based conservation payments. In the context of enhancing PES performance, linking payments to outcomes is argued to boost PES effectiveness, as opposed to conservation payments for compliance with action prescriptions. The outcome-based contract design gives landholders the flexibility to achieve the desired environmental outcome and is expected to increase intrinsic motivation, resulting in increased environmental performance but decreased private compliance costs (Holm-Müller et al., 2006; Latacz-Lohmann and Schilizzi, 2005; Matzdorf and Lorenz, 2010; Schwarz et al., 2008). However, outcome-based approaches impose the additional risk of not achieving the desired goals, so they may induce participants to request risk premiums (Latacz-Lohmann and Schilizzi, 2005; Schwarz et al., 2008; Wätzold and Schwerdtner, 2005; Zabel and Roe, 2009).

A major challenge in PES schemes is how to select the contracts under a budget constraint (Hajkowicz et al., 2007). Additionally, asymmetric information exists between landowners and the conservation agency, which can limit the effectiveness of PES programs (Ferraro, 2008). Procurement auctions among suppliers of ecosystem services reveal their opportunity costs, as the participants compete for a limited number of conservation contracts. The bids, however, also contain bidder's expectations about the maximum payment; thus, they do not represent true opportunity costs (Ferraro, 2008; Latacz-Lohmann and

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Schilizzi, 2005; Latacz-Lohmann and Van der Hamsvoort, 1997).

Linking the two above contexts, the outcome-based approach and tendering contracts could improve PES effectiveness. However, theoretical predictions on allocating outcome-based contracts via an auction are ambiguous. Specifically, while auctions are expected to decrease the informational rents, linking payments to outcomes increases risk for participants (Schilizzi et al., 2011; Schilizzi and Latacz-Lohmann, 2016). Moreover, specific opportunities and challenges exist for tendering conservation contracts in low-income countries (Wünscher and Wunder, 2017). Field trials in Indonesia and Malawi contributed to the little evidence on the performance of tendering in developing countries (Ajayi et al., 2012; Jack, 2010, 2013; Jack et al., 2009). This case study directly compares the auctions for action- and outcome-based conservation contracts in Kenya. Because we have reason to believe that a participant's gender might influence bidding behavior and PES schemes in general, we also examine gendered impacts on the two contract types.

1.1. Gender and PES

PES schemes have been increasingly implemented in developing countries, which represent important suppliers of ecosystem services (Kerr et al., 2012; Swallow et al., 2009; Wunder et al., 2008). In developing countries, despite some progress over the past two decades, gender-related inequalities are prevalent, wherein in agriculture women have limited access to productive resources, grow less profitable crops and women's rights to land often depend on their marital status (FAO, 2011; GEF, 2013; Kiptot and Franzel, 2011; World Bank, 2012). In Africa, despite being recognized as key actors in agriculture, women face difficulties accessing financial credits, appropriate technology and extension services and are more labor constrained (Kiptot and Franzel, 2011; Kiptot et al., 2014). Eliminating the gender imbalance would lead to higher agricultural productivity (FAO, 2011; Murage et al., 2015).

While gender impacts have been sufficiently investigated with respect to agricultural production, limited evidence exists for gender impacts in food security (Kiptot et al., 2014), in forestry and conservation (Colfer and Minarchek, 2013) and for PES in particular. Kiptot et al. (2014) argue that addressing gender gaps in Africa will potentially reduce poverty and improve food security, provision of ecosystem services, as well as climate change mitigation. However, the few studies on gender and conservation show ambivalent results. On the one hand, mixed-gender decision-making is shown to possibly improve environmental outcomes and food security (Villamor et al., 2014b) and to result in the maintenance of protection forests and agroforestry (Villamor et al., 2017), while on the other hand, women react more positively than men to logging and oil palm conversion (Villamor et al., 2014a, p. 752).

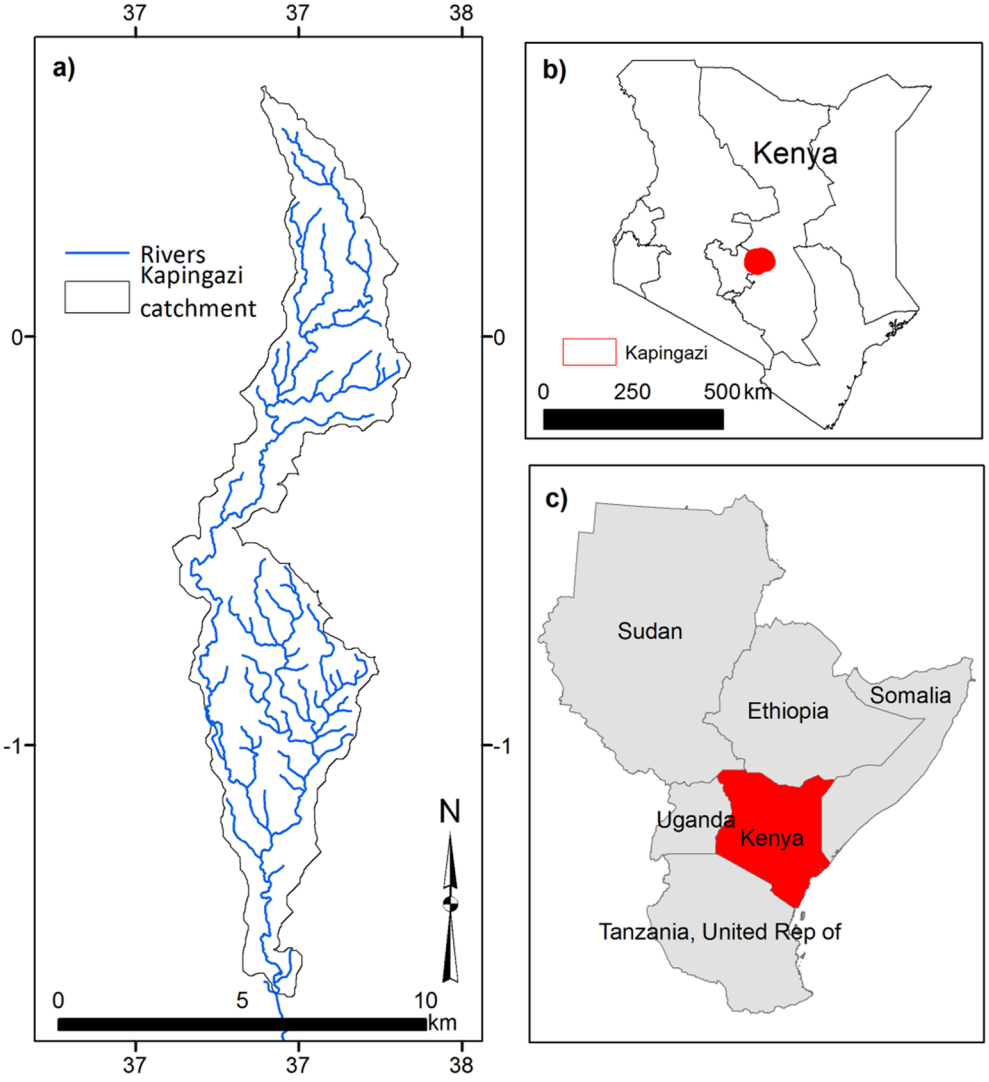

Fig. 1. Study area: a) Kapingazi River catchment, b) Study area in Kenya, c) Kenya in East Africa.

Hence, in this study, we were interested in exploring gendered performance in PES contracts, given the notion of differential land rights and thus, decision-making powers not only to generate insights on how a gender-responsive PES scheme might be developed but also to contribute to the literature on gender and PES. Without undermining family labor's contribution to the delivery of PES contracts, our focus was on the behavior of men (usually the husband and household head) and women (the wife, and in some cases, the household head) towards PES contracts. We argue that traditional gender roles imply gender differences in the willingness to accept PES contracts and in environmental performance. Moreover, we hypothesize that men and women might react differently to the incentives given in the action- and outcome-based PES schemes. With respect to the latter, studies show that the decisions on agroforestry and other livelihood opportunities reflect gender differences in "exposure to and perceptions of risks" (Villamor et al., 2014b, p. 128) and that "men and women may differ in their willingness to assume risks with respect to the provision of ecosystem services" (Villamor and van Noordwijk, 2016, p. 77). The objectives of this study were (i) to compare the performance of auctions for action- and outcome-based contracts and to examine the impacts of gender on the PES schemes as well as (ii) to explore the relationships between gender impacts on PES and gender roles and behavior.

2. Materials and methods

2.1. Study area

We conducted the study in the Kapingazi River catchment of the Upper Tana River watershed in Kenya (Fig. 1), where intensive agricultural land use and deforestation have resulted in severe soil erosion and stream siltation and where there is a high potential for conservation payments to reverse the degradation (Balana et al., 2011; Hoang et al., 2014; PRESA, 2010). The Kapingazi River begins at the Mt. Kenya forest boundary at approximately 2000 meters above sea level and joins the larger Rupingazi River 750 meters lower, near Embu Town. At about 1000 meters above sea level, the Rupingazi flows into the Kamburu reservoir, the second biggest of six reservoirs along the Tana River (Balana et al., 2011, p. 2636; Mbugua, 2009).

The Kapingazi catchment was one of the research sites of the PRESA (Pro-Poor Rewards for Environmental Services in Africa) project of the World Agroforestry Centre (ICRAF). In addition, the Upper Tana Natural Resources Management Project (UTaNRMP), supported by the International Fund for Agricultural Development (IFAD) and the Global Environmental Facility (GEF), has been active in the study area.[3] The Kapingazi catchment covers an area of 62 km^2 and the bounding coordinates of the catchment are approximately 37°27′ 37°31′E and 0°20′ 0°34′S (Balana et al., 2011, p. 2636; Firmian et al., 2011). The research site lies between 37°27′E to 37°29′E and 0°25′S to 0°33′S and covers middle part of the catchment where both coffee and tea prevail, coffee zones in the lower parts and areas with dominant subsistence farming in the lowest parts of the catchment.

2.2. Study sample and data collection

The research team approached all households on both the right and left riverbanks of the Kapingazi River within the demarcated research sites to invite study participants and conduct a baseline survey from October to November 2011. Aiming at a more gender-balanced study, we randomly sampled male or female household representatives, providing both genders with equal opportunity to participate in the auctions and allowing an assessment of gender behaviors. As a result, our sample included 190 men (44.5%) and 237 women (55.5%). The prevalence of women is because 20% of the households permanently lacked a male representative and a female representative was directly approached.

In the sampled population, 62% were cash crop farmers who planted mainly coffee (96%) or tea (3%). The remaining 38% of the farmers planted food crops, with mainly maize (77%) followed by beans (15%). We describe the latter as subsistence farmers since they produce predominantly for their own consumption and only partly sell their production at local markets. Further, the average yearly gross household income was 208,087 KSh (2,365 USD), with a standard deviation of 368,781 KSh (4191 USD). In this regard, the household income of subsistence farmers was 31% lower compared to cash crop farmers, which qualifies the farm type as a proxy for low or high income.[4] The average age of the respondents was 54 years, the average schooling represented 8 years, and the main ethnic group was Kiembu (93%). Finally, the study area was characterized by small land holdings with an average household land size of 3 acres and an average land strip along the river of 65 meters.

All surveyed landholders were invited to a workshop where the study was introduced. We organized nine workshops in the nearby coffee collection centers and schools. Discussions with landholders helped to fine-tune the design of the PES scheme, narrowing the contract to planting indigenous trees on riparian areas. Given our limited timeframe and challenges in measurability of watershed services, partly due to activities of non-participants, we used tree survival as the proxy for environmental performance. No specific information was provided at this stage, and conservation contracts and tender procedure were explained in detail on the auction day.

We allocated tree planting contracts through auctions in December 2011. After contract signing, training on tree planting was offered to all PES participants, and free tree seedlings were delivered by mid December 2011. A base payment (10% of the bid) was paid at the beginning of the contract period. We inspected the implementation of tree planting activities in February 2012 and monitored the tree watering requirements of the action-based contracts in February and March 2012. We assessed tree survival after the sixth month contract period, in June 2012. We awarded conservation payments and conducted a project evaluation survey in July 2012.

2.3. Contract allocation and PES design

To our knowledge, this study is the first to compare auctions for action- and outcome-based contracts in a field experiment. One hundred and twelve men and one hundred and twenty-two women participated in the auctions, which are 59 and 52% of the sampled population of men and women, respectively. We stratified the auction participants by household income and gender prior to assigning them randomly to one of the two contract treatments.

Each contract holder planted 30 indigenous trees on their riparian areas at the beginning of the contract. The riparian area was defined according to Kenya's law on riverbank protection, which determines 30 meters from the middle of the river as riparian land.[5] There were no limitations on the land use. The action-based contract then required landholders to water trees, and payments were conditional on sufficient levels of soil moisture around the trees at the time of monitoring. Under the outcome-based contracts the payments depended on the tree survival after the six-month contract period, independent of the actions taken. Despite differences in the incentives given, the contract costs consisted largely of opportunity costs of labor in both treatments. Because the tree seedlings were delivered to the farmers in a dry season

[3] Mount Kenya East Pilot Project for Natural Resources Management (MKEPP-NRM) preceded this project.

[4] Two-sample t-test with equal variances (n = 407): diff = 0.311, p = 0.001.

[5] Environmental Management and Coordination, (Water Quality) Regulations 2006. Legal notice No. 120, Legislative supplement No. 36, September 29, 2006. Republic of Kenya.

(December), intensive tree watering was crucial for the tree seedlings to survive, considerably increasing the cost of labor.

A budget-constrained discriminative price rule was used in both auctions, in which the participants were asked to bid for a limited number of contracts, and selected bidders were paid the exact amount of their bid. Sixty contracts were selected in each auction and the farmers finally signed 44 action-based and 54 outcome-based contracts. In terms of gender, 43 contract holders were men and 55 were women. Predominantly in the action-based treatment a number of bidders requested very low bids, wherein only few of them later also signed the offered contract. This led us to hypothesize on the winneŕs curse, when the willingness to accept of the selected bidder is lower than the opportunity costs. This was confirmed when the landholders reasoned the contract rejection by the payment being insufficient.

2.4. Data analysis

The advantage of conservation auctions over posted offers is their cost-revelation property, when individual bids should reflect characteristics that determine the opportunity costs of participating in the conservation contracts (Ferraro, 2008; Jack, 2010; Latacz-Lohmann and Schilizzi, 2005; Latacz-Lohmann and Van der Hamsvoort, 1997). The outcome-based approach then imposes the additional risk of not achieving the desired goals, which might induce the participants to increase bids (Latacz-Lohmann and Schilizzi, 2005; Schwarz et al., 2008; Wätzold and Schwerdtner, 2005; Zabel and Roe, 2009). In addition, we hypothesize gender differences in bidding behavior and reactions to the outcome-based risk. Consequently, we regress the logarithm bids on the treatment and gender dummies and their pairwise interactions and on the opportunity cost characteristics and control for personal characteristics as follows:

$$log\ (bid_i) = \beta_0 + \beta_1 T + \beta_2 G + \beta_3 (T{*}G) + \beta_4 x_i + \beta_5 y_i + \varepsilon_i$$

T denotes treatment, taking 0 when tendering outcome-based and 1 when tendering action-based contracts. G denotes gender, taking 0 for female and 1 for male bidders. x_i represents household characteristics that determine opportunity costs, and y_i stands for personal characteristics that might also influence the bids. In all OLS models reported in this paper, we applied the variance-inflation factor (VIF) to assure that multicollinearity was not an issue.

Opportunity cost and personal characteristics were elicited from the baseline survey. Total yearly income corresponds to participants' estimations of household yearly incomes (transformed into a logarithm). Subsistence farm refers to the farm type with food crop production only and represents a proxy for low income as opposed to the cash crop farm type with coffee and/or tea production. The survey participants also reported their land size and whether they face labor constraints and use river irrigation technology. Personal characteristics included age and years of education. Further, group participation refers to local groups such as self-help groups, women and youth groups, while organizational involvement refers to prior exposure to agricultural extensions, water resource associations and conservation initiatives. Higher general satisfaction corresponds to greater life satisfaction. Risk attitudes were assessed using the question "Are you generally a person who is fully prepared to take risks, or do you try to avoid taking risks?", providing a scale between 0 and 10, where 0 means "unwilling to take risks" and 10 means "fully prepared to take risks". Thus, a higher risk attitude refers to higher risk seeking. Finally, higher trust level refers to higher trust towards people in the local area, while higher discount rate refers to lower time preference. In addition to household characteristics, the baseline survey also collected gender-disaggregated data. For 20 bidders, the baseline information was not fully provided. The project evaluation survey provided information on the efforts of men and women in contract implementation and on the contract benefits.

3. Results and discussion

3.1. Gender and PES

3.1.1. Gender and conservation auctions

We analyzed the bids submitted in the two conservation auctions (treatments) to examine men and women's willingness to accept the action- and outcome-based contracts. The mean bid was 334 USD (29,406 KSh) in the auction for action-based contracts and 297 USD (26,126 KSh) in the auction for outcome-based contracts.[6] The standard deviations were 369 USD and 145 USD, respectively. The minimum and maximum bids were 2 USD and 2727 USD in the action-based and 23 USD and 1023 USD in the outcome-based treatment. In addition, almost 90% of bids were lower (71%) or equal to (16%) a wage-based amount of 409 USD (36,000 KSh), suggesting that for most bidders this amount was either the maximum expected opportunity cost or the maximum expected payment we would offer.[7] The latter would suggest strategic behavior in the bid formation.

Table 1 reports the results of the ordinary least squares (OLS) regression of logarithm bids on the main characteristics. We transformed the original metric state of bid into natural logarithms, to account for the non-linearity in the relationship between the bid amount and the predictors. Consequently, the coefficients on explanatory variables can be interpreted as percentage changes in bids (Jack, 2010, p.15; Wooldridge, 2003, p. 42–43). The regression results showed that men submitted between 18 and 26% higher bids than women. Furthermore, testing for combined effects revealed a statistically significant interaction between gender and treatment/contract type. This result implies that ignoring the interaction would result to a narrow conclusion that the bid was significantly impacted only by contract type or participant's gender. The bid was however determined by the combined effects of the contract type and gender. At the same time, testing for the interaction of the treatment with the farm type and risk-averse behavior did not reveal significant effects or change the model parameters.

Displaying the margins clearly shows differences in bids between men and women across and within the two treatments (Fig. 2). Table 2 reports the pairwise comparisons of the predictive margins. The reported contrasts (i.e., differences) decompose the effects of the treatments and gender on the bids into comparisons against reference categories (StataCorp, 2013, p.323). We show the differences in Kenyan Shillings and percentages. In particular, the action-based treatment had a 55% increase in men's bids as opposed to women's bids (row 4), and women submitted 23% lower bids in the action-based compared to the outcome-based treatment (row 2). For a different basis of comparison, women's action-based bids decreased 36% versus men's, and in women's bids, the outcome-based treatment increased 30% compared to the action-based treatment. In the auction for outcome-based contracts, women's and men's bids were statistically indistinguishable (row 1), and there was no significant difference in action-based and outcome-based bids for men (row 3).

In addition, three other variables were significantly associated with the bids, namely, risk attitudes, trust behavior and life satisfaction (Table 1). The increase in bids with increasing risk seeking corresponds to the theoretical prediction that risk-averse participants lower their bids to increase the probability of winning a conservation contract. The rationale behind this process could be that the conservation payment decreases landholders' income uncertainty (Latacz-Lohmann and Van der Hamsvoort, 1997). The drop in bids with increasing levels of trust towards locals is perhaps due to the lower possibility of conflict when implementing the contract. Life satisfaction was positively correlated with household income; thus, it can likely be interpreted in terms of

[6] The exchange rate at the time of the auction (14 December 2011) was: 1 US $ = 88 KSh (www.oanda.com).

[7] 200 KSh per day over 180 days = 36,000 KSh.

Table 1
Bid determinants.

Bid (in log)	(1) OLS		(2) OLS		(3) OLS	
Gender & Treatment & Interaction						
Male (0/1)	0.183*	(0.080)	0.260**	(0.091)	0.102	(0.112)
Action-based treatment (0/1)			−0.091	(0.081)	−0.261*	(0.110)
Interaction term[a]			–		0.338*	(0.164)
Opportunity costs characteristics						
Income & Land						
Total yearly income (in log)			0.029	(0.050)	0.019	(0.050)
Subsistence farm (0/1)			−0.042	(0.088)	−0.041	(0.095)
Total land (acres)			0.022	(0.015)	0.02	(0.015)
Labor & Technology						
Stated labor constraints (0/1)			−0.057	(0.074)	−0.075	(0.078)
Irrigation technology (0/1)			−0.016	(0.131)	−0.013	(0.131)
Personal characteristics						
Age (years)			0.004	(0.004)	0.004	(0.003)
Education (years)			−0.005	(0.013)	−0.005	(0.013)
Group participation (0/1)			0.015	(0.094)	0.038	(0.094)
Organization involvement (0/1)			0.054	(0.081)	0.051	(0.079)
General life satisfaction (0–3)			0.100*	(0.045)	0.110*	(0.044)
Risk attitudes (0–10)			0.051**	(0.019)	0.052**	(0.018)
Trust to locals (0–3)			−0.099*	(0.046)	−0.107*	(0.045)
Discount rate (0–2)			−0.013	(0.047)	−0.026	(0.047)
Constant	9.954***	(0.053)	9.169***	(0.553)	9.358***	(0.560)
Observations	221		203		203	
Wald chi-squared	5.21*		37.91***		45.67***	
R-squared	0.025		0.154		0.175	
Adjusted R-squared	0.021		0.086		0.104	

Notes: [a] Interaction term for the treatment and gender. Bootstrapped VCE errors (1,000 replications) are in parentheses. P-values: + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Influential observations excluded based on Cook's D. Dummy variables are described as (0/1), with "no" coded as 0 and "yes" coded as 1. The range for categorical variables is provided in parentheses. For description of variables, see Data analysis.

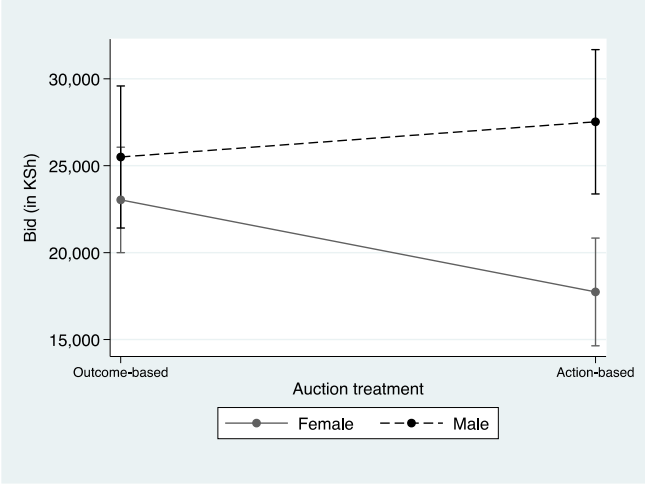

Fig. 2. Predictive margins of the bids for the treatment-gender interaction calculated from predictions of the OLS regression in Table 1: column 3. 95% confidence intervals.

contract utility decreasing as wealth increases. Contrary to our expectations, neither the reported labor constraints nor the availability of irrigation technology significantly impacted the bids. Finally, including a dummy for female headship in the regression models did not reveal a statistically significant effect, and the model's parameters remained unchanged.

Although the bids might also contain strategic elements and miscalculations, a fraction of the variation in bids could be explained and statistically significant and consistent effects revealed. At the same time, the results show that rather than opportunity cost observables, the personal characteristics determined the bidding behavior. Regarding the main hypothesis, in our study gender significantly impacted the willingness to accept in conservation auctions, and the effects differed between the action-based and outcome-based contract types. This finding corroborates with Jindal et al. (2013, p.76) in a study in Tanzania wherein a significant gender effect was found on bids for tree planting, with male bids being on average 18% higher. The authors did not, however, elaborate on the result, mentioning "higher opportunity costs of labor for men, greater demand for trees by women, or some other difference between the genders" to potentially explain the gendered bids. Based on the optimal bidding model developed by Latacz-

Table 2
Pairwise comparisons of predictive margins of the bids for the treatment-gender interaction term.

Treatment interaction with	Effect	Contrast (KSh)		Contrast (%)
Gender				
(1) Outcome-based#Male vs. Outcome-based#Female	Within subject	2,468	(2,745)	10.7
(2) Action-based#Female vs. Outcome-based#Female	Treatment effect	-5,297*	(2,180)	–23.0
(3) Action-based#Male vs. Outcome-based#Male	Treatment effect	2,024	(2,984)	7.9
(4) Action-based#Male vs. Action-based#Female	Within subject	9,789***	(2,781)	55.2
Observations		203		

Notes: Calculated from predictions of the OLS regression in Table 1: column 3. P-values: + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Bootstrapped VCE errors are in parentheses.

Table 3
Tree survival determinants.

Number of surviving trees	(1) OLS		(2) OLS		(3) OLS	
Gender & Treatment						
Male (0/1)	2.086*	(0.965)	2.134*	(1.030)	2.067*	(1.001)
Action-based treatment (0/1)	−0.381	(1.118)	−0.498	(1.128)	−0.075	(1.057)
Conservation payment						
Payment in units of 10,000 KSh					2,108+	(1.121)
Opportunity costs characteristics						
Income & Land						
Total yearly income (in log)			0.774	(0.592)	0.728	(0.643)
Subsistence farm (0/1)			1.197	(1.207)	1.386	(1.219)
Total land (acres)			−0.346	(0.294)	−0.360	(0.279)
Labor & Technology						
Stated labor constraints (0/1)			−0.642	(1.141)	−0.469	(1.098)
Irrigation technology (0/1)			1.701	(1.523)	2.032	(1.760)
Personal characteristics						
Age (years)	−0.037	(0.047)	−0.004	(0.054)	−0.011	(0.053)
Education (years)	−0.287*	(0.138)	−0.249+	(0.150)	−0.249+	(0.145)
Group participation (0/1)	2.790*	(1.358)	2.688+	(1.567)	2.402+	(1.428)
Organization involvement (0/1)	1.453	(1.024)	1.211	(1.050)	0.483	(1.034)
General life satisfaction (0–3)	0.093	(0.686)	−0.168	(0.762)	−0.160	(0.698)
Risk attitudes (0–10)	−0.094	(0.206)	−0.120	(0.231)	−0.089	(0.223)
Trust in locals (0–3)	−0.038	(0.583)	−0.039	(0.647)	−0.028	(0.609)
Discount rate (0–2)	0.512	(0.643)	0.600	(0.638)	0.515	(0.598)
Constant	26.105***	(3.541)	16.141*	(7.680)	13.608+	(7.671)
Observations	95		95		95	
Wald chi-squared	21.75*		24.67+		26.46*	
R-squared	0.202		0.248		0.295	
Adjusted R-squared	0.107		0.105		0.150	

Notes: Bootstrapped VCE errors (1,000 replications) are in parentheses. P-values: + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. For description of variables, see Data analysis.

Lohmann and Van der Hamsvoort (1997), we posit that the decrease in female bids in the action-based treatment might be explained by gender differences in (i) opportunity costs, (ii) contract utility, and (iii) risk aversion. In addition, we suggest that gender differences in risk behavior resulted into the gendered treatment effect. We analyze the relevant factors and test the hypotheses in the Sub-sections 3.2.1 and 3.2.2.

3.1.2. Gender and environmental performance

On average, 25 (84%) and 26 trees (85%) survived out of 30 seedlings planted in the action-based and outcome-based treatments, respectively. Examining the tree survival determinants in an OLS regression framework (Table 3) shows men achieved approximately two (7%) more surviving trees than women. Further, the tree survival increased with participation in a local group and with the conservation payment amount; conversely, it decreased with years of education. Two observations are not included in the tree survival analysis due to flood damage that could not be controlled by contract holders. The regression results then remain consistent when accounting for the count nature of the outcome variable (negative binomial regression) and when censoring for the maximum number of trees (Tobit regression, right-censored at 30).[8]

Education's negative effect might be because education increases the alternative livelihood options; thus, educated people tend to more precisely consider opportunity costs when taking decisions or actions related to their livelihoods. Social network benefits in terms of labor sharing and conflict prevention might explain the positive effect of group participation. The revealed association between the payment and tree survival suggests that the environmental performance increased with payment amounts. Contrary to our expectations, tree survival did not differ for the action-based and outcome-based treatments.

Including the interaction of the treatment with gender did not change the model's parameters, and the interaction is not statistically significant. Further, including the variable for female headship did not show a significant effect on tree survival; neither did it change the model's parameters. Consequently, with respect to the main hypothesis, we conclude that in our study gender impacted the environmental performance, regardless of contract type or household headship. Three explanations are possible for the gender difference in tree survival. First, environmental performance might be influenced by natural conditions. Second, a gender difference existed in tree planting knowledge, which we consider key for the effort to translate into the desired environmental outcome. Third, differences in tree survival were linked to gender differences in invested effort. In our study, the natural conditions for tree planting were fairly equal, where the same mix of indigenous trees had to be planted on riparian land. Consequently, we narrow our focus to men and women's tree planting knowledge and efforts in contract implementation as possible drivers of the significantly higher tree survival for male participants (see Sub-section 3.2.3).

3.2. Gender roles, behavior and knowledge, and impacts on PES

3.2.1. Gender roles and behavior

Land tenure was found to be traditionally associated with males, with men being perceived as the household heads. Based on workshop discussions and a report of the Upper Tana Natural Resources Management Project (UTaNRMP, 2012), we found men to be the main decision-makers and payout recipients from cash crops. The intra-household analysis in Table 4 shows that men were also dominant in tree management, being the decision-makers in 50% of the households, as opposed to 15% of women. Exotic commercial tree species such as *Eucalyptus* and *Grevillea robusta* dominate our study area (Hoang et al., 2014; UTaNRMP, 2012), and the authority of men over tea and coffee production and tree management reflects the trend in other studies across Africa that show men's concentration in wholesale trade and high-value crop trees (Kiptot and Franzel, 2011; Rocheleau and Edmunds, 1997). The observed dominance of women in subsistence farming is also consistent with other studies from Sub-Saharan Africa

[8] Procedure used in Jack (2010).

Table 4
Intra-household decision-making and labor division in male-headed households.

	Male	Female	Jointly	N	Male	Female	Jointly	N
	Who decides on these activities?				Who performs these activities?			
Agricultural production & farm labor								
Crop planting	27	27	46	327	14	37	49	309
Crop harvesting	15	32	53	325	14	37	49	308
Weeding	13	37	50	327	13	44	43	307
Mulching	22	28	50	237	20	38	42	218
Labor hiring	26	28	46	275	35	35	30	267
Tree management								
Tree planting	50	15	35	315	48	20	32	301
Tree pruning	50	18	32	291	57	18	25	264
Resource allocation & produce marketing								
Household expenses & savings	21	21	58	322	22	26	52	317
Inputs purchase & use	33	17	50	324	42	28	30	318
Sell of farm produce	25	25	50	317	24	46	30	312
Consumption of farm produce	17	35	48	316	-	-	-	
Family care								
Children's education	37	11	52	246	43	21	36	244
Caretaking of relatives	15	18	67	272	11	34	55	268

Notes: The figures in the table are indicated in percent, that is, of the number of households taking decisions on/performing the activity (denoted as N), what was the share in percent decided/performed solely by men, solely by women, or jointly by men and women. Female-headed households (N = 82) are excluded from the analysis, resulting in the total number of 327 observations.

(Kiptot and Franzel, 2011; Meijer et al., 2015; Rocheleau and Edmunds, 1997), wherein we found women to have greater stakes than men in decisions related to harvesting, weeding, and crop consumption.

Further, we assessed gender income by disaggregating the reported yearly income of the household into the shares generated by men and women and revealed gender differences in income, which are linked to the above evidence that men dominated in the higher end of the value chain. The female-dominated food crop sector yields significantly lower incomes compared to the male-controlled cash crop and timber production. Men on average generated 20% more income than women, or women contributed 17% less to household income. Excluding the female-headed households from the analysis, the gender gap becomes much more remarkable, with a 75% increase in men's versus women's income; conversely, the results show a 43% decrease in women's versus men's income.

The labor division, to a great extent, reflects decision-making roles in which men invest the most labor in tree management and joint and women's labor dominate in food crop production. Moreover, in several areas of joint and men's decision-making, women invest more labor than men. In particular, while marketing produce involves joint decision-making, the women mainly sell the produce. Further, although decisions on caretaking of relatives are taken jointly, more women than men assume the responsibility (Table 4). Similarly, while men take over decision rights and earnings from cash crops, women are the main collectors of tea leaves and coffee beans (UTaNRMP, 2012). The findings concur with the literature showing that although women perform most of the labor in agricultural production, they have limited rights over the produce, are prevented from decision-making on cash crops, and normally have obligations to provide labor for male-controlled fields, while the men bear no reciprocal responsibility (Kiptot and Franzel, 2011; Colfer and Minarchek, 2013).

Our study also presents a special case in which women assumed headship, mostly due to the husband's urban labor migration or the female's status as a widower. A separate analysis shows that women, in the absence of their husbands, perform men's tasks, even if 80% of the female-headed households have other male household members. Thus, the labor burden of female heads is particularly high. As mentioned above, 20% of our sampled households were female-headed, and 21% of the auction participants and 18% of the contract holders were women who assumed household headship.

3.2.2. *Gender impacts on bids*

The evidence on gender roles and behavior allows us to prove potential sources of gender heterogeneity in bids, as hypothesized above (see sub-section 3.1.1). First, the gendered income suggests lower returns for female labor when the contract costs covered mainly the opportunity costs of labor. Nevertheless, women's opportunity costs in the conservation contract were not necessarily lower because women faced higher labor constraints than men. Gendered income might play a crucial role because it defines the utility of conservation contracts. Hence, the optimal bidding behavior of auction participants is to submit a bid amount "if the expected utility in case of participation exceeds the reservation utility" (Latacz-Lohmann and Van der Hamsvoort, 1997, p. 410), and the decrease in women's bids might be explained by women's lower reservation utility. For women the expected utility of a low-price conservation contract might still be higher than the utility without the contract, given that women generate significantly lower income than men and lack alternative livelihood options.

The evaluation survey supports the second hypothesis. Most participants were willing to accept a tree planting contract at the same price, showing that both men and women were satisfied with the payments received. Further, women were more likely than men to decide alone on the use of the payment, with 67% of men but only 44% of women deciding jointly with their spouses. Moreover, 64% of women but only 51% of men stated the payment had contributed "much" to their livelihood, while for 36% of women and 44% of men, the improvement was only "little", and two men (5%) stated they observed no improvement at all.

The third hypothesis is that the decrease in bids made by women could also be explained by an increase in women's risk aversion, in that risk aversion is predicted to decrease the willingness to accept in conservation auctions (Latacz-Lohmann and Van der Hamsvoort, 1997). First, assessing risk attitudes of the sample population does not reveal women being generally more risk averse than men. The Arrow-Pratt measure of relative risk aversion however predicts people are generally more risk taking with greater assets (Pratt, 1964); relative risk aversion is specified as the percentage value of wealth one "is willing to put at risk" (Tobler and Weber, 2014, p. 155). Applying this concept to our study, the risk aversion of women was proportionally higher as a result of gendered income; thus, it might induce women to further lower their bids.

Further, given that the randomized treatment assignment allows for isolation of the effect of the contract type on the bidding behavior, the significant increase in female bids in the outcome-based compared to action-based treatment leads us to hypothesize that women, in contrast to men, have requested risk premiums. The gendered treatment effect, thus, suggests that women perceived higher risk in the outcome-based approach than men. This finding can be best explained within the risk-return framework that interprets differences in risk taking as "differences in the perception of the riskiness of the choice options rather than from differences in attitude towards perceived risk" (Weber, 1999; p.61). Risky preferences have been empirically proven to concur with perceptions of the riskiness of the choices (Weber and Milliman, 1997), and obvious cultural differences in risk behavior relate to different perceptions of the risk rather than to different attitudes towards the (perceived) risk (Weber and Hsee, 1998).

Moreover, while sufficient evidence shows that women are generally more risk averse in their decisions (Charness and Gneezy, 2012; Eckel and Grossman, 2008; Hersch, 1996), other investigations of gender differences in risk behavior show that this tendency derives from the tendency of women to perceive the same risks to be greater than men do (Weber, 1999). Schubert et al. (1999, 2000) found that women are not generally less risk taking in their financial choices than men, but that the gender differences in risky decisions coincide with gender perceptions of riskiness. Similarly, Slovic (1999) show that gender differences in risk taking originate in women consistently perceiving higher riskiness across a set of choices than men. Additionally, a study by Harris et al. (2006) reveals that mostly, women perceived probabilities of negative outcomes from risky choices significantly higher than men did. We found evidence that women expected significantly fewer trees to survive than men. In the baseline survey, out of 30 trees planted in December, men on average expected 28, but women only 27, trees to survive for six months.[9]

3.2.3. Tree planting knowledge and male and female efforts in PES schemes

We addressed a potential gender gap in tree planting knowledge by the training offered to all contract holders prior to delivering the tree seedlings. Subsequently, an inspection at the beginning of the contract period revealed all tree seedlings to be appropriately planted. This finding implies that the difference in tree survival did not result from an insufficient tree planting knowledge that was crucial for the up-take of the tree seedlings. In this respect, we examined whether differences in male and female effort during the contract period were responsible for the variation in tree survival.

In the evaluation survey, the PES participants specified the amount of time they spent caring for trees by season. The contract holders were also asked to rank the most important activities they performed to maintain the 30 trees in the last 6 months and to indicate who conducted the activities. First, men allocated less time to tree care than women. In the dry season, on average, men invested 5.6 hours and women 7.7 hours a week to tree care. In the rainy season, the weekly time spent was 5.2 hours for men and 6.9 hours for women. Second, we regressed the binary conduct of implemented tree care activities on the set of regressors that we used in the bid and tree survival analyses (using probit regressions). We found that female contract holders were more likely to weed and fertilize, the two most frequent tree care activities, after watering. We also revealed that outcome-based contract holders were more likely to implement all the tree-caring practices in addition to watering, which is consistent with the theoretical prediction on the incentive effect of the outcome-based approach to enhance the choice of actions expected to achieve the desired environmental performance. Discovering that female contract holders provide more effort than males is, however, counterintuitive in explaining the decrease in tree survival for women. Hence, we further examined the potential differences in the reciprocal support of husbands and wives in implementing the contract.

[9] Two-sample t-test with equal variances (n = 407): diff. 0.992, p = 0.010.

Table 5
Labor division for tree care activities in male-headed households.

	Contract holder	Spouse	Jointly	N^b
Male contract holder (N^a = 33)				
Watering	67	0	33	33
Weeding	64	22	14	28
Fertilizing	82	11	7	28
Guarding from people	85	0	15	26
Guarding from animals	84	8	8	13
Insecticides/Pesticides	100	0	0	14
Female contract holder (N^a = 33)				
Watering	76	0	24	33
Weeding	81	9	10	31
Fertilizing	93	7	0	27
Guarding from people	85	0	15	20
Guarding from animals	87	6	7	15
Insecticides/Pesticides	50	42	8	12

Notes: The figures in the table are indicated in percent, that is, of the number of (male or female) contract holders implementing the activity (denoted as N^b), what was the share in percent conducted solely by the contract holder, the spouse, or jointly by the contract holder and the spouse. Of the 98 contracts, 33 men and 33 women were interviewed on labor division under the conservation contracts (denoted as N^a). Eighteen female-headed households were excluded from the analysis, and fourteen surveys lacked data (the missing numbers are random).

The gender-disaggregated data for male-headed households revealed that more women than men provided labor support to their spouses who were awarded the contract (Table 5). In the case of watering, 76% of female contract holders provided their own labor while only 67% of the male contract holders did so. The gender gap was even more remarkable in weeding, which is also a regular and labor-intensive activity. In particular, for 22% of male contract holders, their wives did the weeding while only 9% of female participants received support from their spouses. For fertilizing, the increase in female individual labor was 11%. Applying insecticides and pesticides was the only activity dominated by male labor. This fact might relate to the traditionally prevalent role of men in the purchase of inputs, whereas the activity was marginally implemented compared to activities in which women played a considerable role. In addition, contract holders regardless of gender predominantly protected the trees from being damaged by people and strayed animals. The substantial support of women to their husbands in the most frequent tree care practices is consistent with the above findings that women invest labor into men's activities while benefiting rather sporadically from men's labor. Moreover, in the 18 female-headed households that were awarded contracts, women alone performed all tree-caring activities.

3.2.4. Gender impacts on tree survival

Although women provided more effort than men in the contract implementation, the latter achieved 7% higher tree survival. Several issues can be linked to the gender differences in environmental performance. First, trees were rather men's domain; thus, men might have more knowledge on tree planting. We however found that all participants, both men and women, planted the trees in an appropriate way. Second, the better performance of men might result from the fact that more women than men provided labor support in the three main tree care activities to their spouses who were awarded the contract.

To explore the statistical effects of labor reciprocity on tree survivals, we included binary variables on reciprocal labor into the above tree survival analysis. Here, the number of observations decreases to 79 because 14 surveys lacked labor data. For the two most common practices, watering and weeding, the coefficients suggests that more trees on average survived if the spouse provided labor, compared to labor of the contract holder only. The effects are however not

statistically significant. Although not proving statistically significant effects in terms of labor reciprocity on tree survival, the gender-disaggregated data on tree care provide an important insight on unequal labor division in PES contracts that might, in addition to the generally large labor constraints for women, drive gendered performance, and we encourage considering it in PES studies.

In this respect, the question arises as to whether awarding PES contracts to women is a good idea because doing so exposes them to an even higher labor burden. In the evaluation survey, the female participants were, however, willing to accept a tree planting contract for the same price again. This finding suggests that women prefer to fully provide labor and receive the contract payment because they have to contribute labor regardless, without being rewarded, if their husbands were to receive the contract, in addition to the fact that any PES contract would present additional income for them.

Moreover, the 36% decrease in women's versus men's bids for action-based contracts implies that despite the 7% decline in women's tree survival, allocating the action-based contract to women was highly cost-effective. Thus, we found evidence that involving women in conservation projects might decrease overall costs, and the effectiveness gain of awarding contracts to women can be neutralized if tendering contracts were tied to the outcome. Our study did not discuss ethical considerations of whether the gender gap should be addressed in payments, but it illustrates the importance of considering both gender aspects and the effectiveness of a PES scheme. As mentioned above, our study did not focus on the family unit to analyze labor allocation in tree care activities; rather, we observed the behavior of men and women (husband and wife) in PES contracts to discover insights on how a PES scheme might be designed in a gender-responsive way.

4. Conclusion

The randomized field trial revealed that participants' genders significantly impacted the willingness to accept and environmental performances in the action- and outcome-based tree planting PES schemes. We found associations between gender effects and men's and women's traditional roles and risk behaviors.

First, we found differences in contract utilities and relative risk aversion to provide possible explanations for the 36% decrease in women's compared to men's bids in the auction for action-based contracts. We argue that women derive higher utilities from the conservation contract, because for women who traditionally depend on subsistence farming, the payment represents an important cash income opportunity. Moreover, women's significantly lower income compared to men's indicates the former's proportionally higher risk aversion, which might provide a complementary explanation for the gender effect in the action-based auction. Second, we found that the 30% increase in female bids in the outcome-based compared to action-based treatment reflects that women perceive higher risk in the outcome-based approach.

Third, we found that although women provided more effort than men in the contract implementation, the latter achieved a 7% higher tree survival. Our study did not deeply examine underlying factors for gender differentials in PES contracts, but as the data have shown, intra-household dynamics manifested in decision-making, traditional roles, and inequality in reciprocal labor provide plausible explanations why the environmental performances of men and women differed, despite the revealed uniform performance at the contract's start. Clearly, this finding points to the significant and important role women play in conservation activities; thus they should be empowered to take an active part and benefit equitably from PES contracts. Our study findings reinforced our approach to providing equal opportunity for men and women to participate in the auctions and align with the general interest of recognizing and harnessing women's potential role in conservation.

Finally, to the best of our knowledge this is the first time that intra-household gender differences and gendered risk behavior are argued to determine the bids and that men and women are shown to react differently to outcome-based PES. Moreover, the findings confirm many of the concerns raised in the PES literature, namely, that tree planting, tree care, and conservation in general might expose women to additional costs without gaining corresponding benefits if gender is not considered in contract allocation specifically and in PES designs generally. As the study has shown, targeting women improves gender equity in terms of access to project decision-making, trainings and cash and can significantly improve the effectiveness of the PES schemes. However, because women might be more averse to risks associated with PES schemes and because evidence shows that conservation programs can negatively affect women's land rights (Jindal et al., 2013), PES designs should always be tailored to local conditions, bearing in mind both gender equity and conservation goals.

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References

Ajayi, O.C., Jack, B.K., Leimona, B., 2012. Auction design for the private provision of public goods in developing countries: lessons from payments for environmental services in Malawi and Indonesia. World Dev. 40 (6), 1213–1223.

Balana, B.B., Yatich, T., Mäkelä, M., 2011. A conjoint analysis of landholder preferences for reward-based land-management contracts in Kapingazi watershed, Eastern Mount Kenya. J. Environ. Manage. 92, 2634–2646.

Charness, G., Gneezy, U., 2012. Strong evidence for gender differences in risk taking. J. Econ. Behav. Organ. 83, 50–58.

Colfer, C.J.P., Minarchek, R.D., 2013. Introducing 'the gender box': a framework for analyzing gender roles in forest management. Int. Forestry Rev. 15 (4).

Escobar, M.M., Hollaender, R., Weffer, C.P., 2013. Institutional durability of payments for watershed ecosystem services: Lessons from two case studies from Colombia and Germany. Ecosyst. Serv. 6, 46–53.

FAO, 2011. The State of Food and Agriculture in the World. Women in Agriculture. Closing the Gender Gap for Development. Rome.

Eckel, C.C., Grossman, P.J., 2008. Men, women and risk aversion: experimental evidence. In: In: Plott, C., Smith, V. (Eds.), Handbook of Experimental Economics Results, vol. 1. Elsevier, New York, pp. 1061–1073 Chapter 113.

Engel, S., Pagiola, S., Wunder, S., 2008. Designing payments for environmental services in theory and practise: an overview of the issues. Ecol. Econ. 65 (4), 663–674.

Ferraro, P.J., 2008. Asymmetric information and contract design for payments for environmental services. Ecol. Econ. 65 (4), 810–821.

Firmian, I., Catacutan, D., Gatenya, J., Namirembe, S., 2011. PES and Eco-certification in the Kapingazi Watershed, Kenya. Working Papers. World Agroforestry Centre, Library Department. https://EconPapers.repec.org/RePEc:raf:wpaper:2011071.

GEF, 2013. Mainstreaming Gender at the GEF, pp. 1–57.

Harris, C.R., Jenkins, M., Glaser, D., 2006. Gender Differences in Risk Assessment: Why do Women Take Fewer Risks than Men? Judgment Decision Making 1 (1), 48–63.

Hajkowicz, S., Higgins, A., Williams, K., Faith, D.P., Burton, M., 2007. Optimization and the Selection of Conservation Contracts. Aust. J. Agric. Resour. Econ. 51 (1), 39–56.
Hersch, J., 1996. Smoking, Seat Belts, and Other Risky Consumer Decisions: Differences by Gender and Race. Manag. Decis. Econ. 17 (5), 471–481.
Hoang, M.H., Namirembe, S., van Noordwijk, M., Catacutan, D., Öborn, I., Perez-Teran, A.S., Nguyen, H.Q., Dumas-Johansen, M.K., 2014. Farmer portfolios, strategic diversity management and climate-change adaptation – implications for policy in Vietnam and Kenya. Clim. Dev. 6 (3), 216–225.
Holm-Müller, K., Henseleit, M., Möseler, B. M., Vollmer, I., 2006. Honorierung ökologischer Leistungen der Landwirtschaft: Einführung ergebnisorientierter Komponenten in das Kulturlandschaftsprogramm NRW. Landwirtschaftliche Fakultät der Universität Bonn, Schriftenreihe des Lehr- und Forschungsschwerpunktes USL, Nr. 141 (Teil 1), p. 247.
Jack, B.K., 2010. Allocation in Environmental Markets: A Field Experiment with Tree Planting Contracts in Malawi, SSRN Working Paper Series.
Jack, B.K., 2013. Private information and the allocation of land use subsidies in Malawi. Am. Econ. J. Appl. Econ. 5 (3), 113–135.
Jack, B.K., Leimona, B., Ferraro, P., 2009. A revealed preference approach to estimating suppy curves for ecosystem services: use of auctions to set payments for soil erosion control in Indonesia. Conserv. Biol. 23 (2), 358–367.
Jindal, R., Kerr, J.M., Ferraro, P.J., Swallow, B.M., 2013. Social dimensions of procurement auctions for environmental service contracts: Evaluating tradeoffs between cost-effectiveness and participation by the poor in rural Tanzania. Land Use Policy 31, 71–80.
Kerr, J., Vardhan, M., Jindal, R., 2012. Prosocial behavior and incentives: Evidence from field experiments in rural Mexico and Tanzania. Ecol. Econ. 73, 220–227.
Kiptot, E., Franzel, S., 2011. Gender and agroforestry in Africa: Are women participating? ICRAF Occasional Paper 13. World Agroforestry Centre, Nairobi.
Kiptot, E., Franzel, S., Degrande, A., 2014. Gender, agroforestry and food security in Africa. Curr. Opin. Environ. Sustain. 6, 104–109.
Latacz-Lohmann, U., Schilizzi, S. (2005). Auctions for conservation contracts: A review of the theoretical and empirical literature. Technical Report, Scottish Executive Environment and Rural Affairs Department.
Latacz-Lohmann, U., Van der Hamsvoort, C., 1997. Auctioning Conservation Contracts: A Theoretical Analysis and an Application. Am. J. Agric. Econ. 79, 407–418.
Matzdorf, B., Lorenz, J., 2010. How cost-effective are result-oriented agri-environmental measures? An empirical analysis in Germany. Land Use Policy 27, 535–544.
Mbugua, W.E., 2009. Using GIS techniques to determine rusle's 'r' and 'ls' factors for Kapingazi river catchment. Master of Science Research Project Report. Jomo Kenyatta University of Agriculture and Technology.
Meijer, S.S., Sileshi, G.W., Kundhlande, G., Catacutan, D., Nieuwenhuis, M., 2015. The Role of Gender and Kinship Structure in Household Decision-Making for Agriculture and Tree Planting in Malawi. J. Gender Agric. Food Security 1 (1), 54–76.
Murage, A.W., Pittchar, J.O., Midega, C.A.O., Onyango, C.O., Khan, Z.R., 2015. Gender specific perceptions and adoption of the climate-smart push-pull technology in eastern Africa. Crop Prot. 76, 83–91.
Pagiola, S., Arcenas, A., Platais, G., 2005. Can payments for environmental services help reduce poverty? An exploration of the issues and the evidence to date from Latin America. World Dev. 33 (2), 237–253.
Pratt, J.W., 1964. Risk Aversion in the Small and in the Large. Econometrica 32 (1–2), 122–136.
PRESA, 2010. Assessing landholder preferences for alternative land management schemes and willingness to accept rewards for watershed services provision: the case of Kapingazi River basin, Mt. Kenya East. Project Report.
Richards, R.C., Kennedy, C.J., Lovejoy, T.E., Brancalion, P.H.S., 2017. Considering farmer land use decisions in efforts to 'scale up' Payments for Watershed Services. Ecosyst. Serv. 23, 238–247.
Rocheleau, D., Edmunds, D., 1997. Women, Men and Trees: Gender, Power and Property in Forest and Agrarian Landscapes. World Dev. 25 (8), 1351–1371.
Schilizzi, S., Breustedt, G., Latacz-Lohmann, U. (2011). Does Tendering Conservation Contracts With Performance Payments Generate Additional Benefits? Working Paper 1102. School of Agricultural and Resource Economics, University of Western Australia, pp. 1–39.
Schilizzi, S., Latacz-Lohmann, U., 2016. Incentivizing and Tendering Conservation Contracts: The Trade-off between Participation and Effort Provision. Land Econ. 92, 273–291.
Schubert, R., Gysler, M., Brown, M., Brachinger, H., 1999. Financial decision-making: are women really more risk averse? American Economic Review Papers and Proceedings 89: 381–385.
Schubert, R., Gysler, M., Brown, M., Brachinger, H., 2000. Gender Specific Attitudes Towards Risk and Ambiguity: An Experimental Investigation. Mimeo Center for Economic Research, Swiss Federal Institute of Technology.
Schwarz, G., Moxey, A., McCracken, D., Huband, S., Cummins, R., 2008. An analysis of the potential effectiveness of a payment-by-results approach to the delivery of environmental public goods and services supplied by Agri-Environment Schemes. Report to the Land Use Policy Group, UK. Macaulay Institute, Pareto Consulting and Scottish Agricultural College, pp. 108.
Slovic, P., 1999. Trust, Emotion, Sex, Politics, and Science: Surveying The Risk-Assessment Battlefield. Risk Anal. 19 (4), 689–701.
StataCorp, 2013. STATA Base Reference Manual: Release 14. STATA Press, College Station, TX: StataCorp LP, pp. 2556.
Swallow, B., Kallesoe, M., Iftikhar, U., Van Noordwijk, M., Bracer, C., Scherr, S., Raju, K.V., Poats, S., Duraiappah, A., Ochieng, B., Mallee, H., Rumley, R., 2009. Compensation and rewards for environmental services in the developing world: framing pantropical analysis and comparison. Ecol. Soc. 14 (2), 26.
Tobler, P.N., Weber, E.U., 2014. Valuation for Risky and Uncertain Choices. In: Glimcher, P.W., Fehr, E. (Eds.), Neuroeconomics. Decision Making and the Brain. Second Edition. Elsevier, pp. 149–172 Chapter 9.
UTaNRMP, 2012. Upper Tana Natural Resources Management Project (UTaNRMP). Strategic environmental assessment draft report. UTaNRMP/IFAD Kenya County Office, August 2012, p. 132.
Villamor, G.B., Catacutan, D.C., Truong, V.A.T., Thi, L.D., 2017. Tree-cover transition in Northern Vietnam from a gender-specific land-use preferences perspective. Land Use Policy 61, 53–62.
Villamor, G.B., Desrianti, F., Akiefnawati, R., Amaruzaman, S., van Noordwijk, M., 2014a. Gender influences decisions to change land use practices in the tropical forest margins of Jambi, Indonesia. Mitig. Adapt. Strat. Glob. Change 19, 733–755.
Villamor, G.B., van Noordwijk, M., 2016. Gender specific land-use decisions and implications for ecosystem services in semi-matrilineal Sumatra. Global Environ. Change 39, 69–80.
Villamor, G.B., van Noordwijk, M., Djanibekov, U., Chiong-Javier, M.E., Catacutan, D., 2014b. Gender differences in land-use decisions: shaping multifunctional landscapes? Curr. Opin. Environ. Sustain. 6, 128–133.
Wätzold, F., Schwerdtner, K., 2005. Why being wasteful when preserving a valuable resource? A review article on the cost-effectiveness of European biodiversity policy. Biol. Conserv. 123, 227–338.
Weber, E.U., 1999. Who's afraid of a little risk? New evidence for general risk aversion. In: Shanteau, J., Mellers, B.A., Schum, D. (Eds.), Decision Research from Bayesian Approaches to Normative Systems: Reflections on the Contributions of Ward Edwards. Kluwer Academic Press, Norwell, MA, pp. 53–64.
Weber, E.U., Hsee, C.K., 1998. Cross-cultural differences in risk perception but cross-cultural similarities in attitudes towards risk. Manag. Sci. 44, 1205–1217.
Weber, E.U., Milliman, R., 1997. Perceived risk attitudes: Relating risk perception to risky choice. Manag. Sci. 43, 122–143.
Wooldridge, J.M., 2003. Introductory Econometrics: A Modern Approach, second ed. pp. 863.
Wunder, S., 2005. Payments for environmental services: some nuts and bolts. CIFOR, Ocassional Paper, pp. 42.
World Bank, World Development Report 2012: Gender Equality and Development, 458 p.
Wunder, S., Engel, S., Pagiola, S., 2008. Taking stock: a comparative analysis of payments for environmental services programs in developed and developing countries. Ecol. Econ. 65, 834–852.
Wünscher, T., Wunder, S., 2017. Conservation tenders in low-income countries: Opportunities and challenges. Land Use Policy 63, 672–678.
Zabel, A., Roe, B., 2009. Optimal design of pro-conservation incentives. Ecol. Econ. 69 (1), 126–134.