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Action-based and outcome-based payments for environmental services

An experimental auction for tree planting contracts in Kenya

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Abstract

The dissertation represents a first randomized field experiment that compares action-based and outcome-based payments for environmental services (PES). The main aim of the study was to investigate the effect of the outcome-based contracts in conservation auctions, and to prove the theoretical prediction on their improved environmental performance. In addition, the study uses a gender sensitive approach to examine gendered behavior. Tree planting contracts were allocated via conservation auctions in Central Kenya, one making final payments dependent on actions (keeping the soil around the trees moist) and the other on outcomes (tree survivals). The results show (i) a significant increase in women´s bids in the outcome-based versus action-based treatment, suggesting women to react more averse to the outcome-based approach than men. Also, (ii) women submitted significantly lower bids compared to men in the action-based treatment, wherein gendered differences in opportunity costs and cash constrains were identified as potential drivers. Further, (iii) there was no significant difference in budget effectiveness between the auctions for action- and outcome-based contracts. Moreover, (iv) tree survivals were statistically undistinguishable for the action-based and outcome-based treatments, whereas (v) the type of contract, however, played a role in defining care taking actions, with outcome-based contract holders being more likely to conduct conservation activities that are expected to improve tree survivals. Furthermore, (vi) women achieved significantly less surviving trees than men, wherein gender imbalance in mutual labor support in the contract implementation was identified as potential driver for the lower performance. In this respect, despite the decline in women's tree survivals, the contract allocation to women was still highly cost-effective. In addition, (vii) tree survivals were increasing with the payment amount, implying that decreasing the gap between informational rents and true opportunity costs might negatively affect the environmental performance. Finally, (viii) the overall high tree survivals might be in the first place motivated by the payments and expected future tree benefits, wherein a number of factors also suggest on intrinsic motivation for tree survivals.

Zusammenfassung

Die Dissertation präsentiert die erste randomisierte Feldstudie die handlungs- und ergebnisorientierte Zahlungen für Umweltleistungen (PES) vergleicht. Ziel dieser Studie ist es, den Effekt eines ergebnisorientierten Vertrages in Umweltauktionen zu untersuchen, sowie die theoretischen Voraussetzungen für deren erhöhte Umweltperformance zu prüfen. Des Weiteren untersucht die Studie das genderspezifische Verhalten. Verträge für Baumpflanzung wurden mittels Umweltauktionen in Zentralkenia verteilt, wobei der eine Vertrag für Handlungen (Erhalt der Bodenfeuchtigkeit) und der andere für Ergebnisse (Überlebensraten der Bäume) vergütete. Die Ergebnisse zeigen (i) einen signifikanten Anstieg in Geboten von Frauen in der ergebnisorientierten Auktion, welcher auf eine erhöhte Aversion der Frauen gegenüber dem ergebnisorientierten Ansatz hinweist. Darüber hinaus (ii) haben Frauen in der handlungsorientierten Auktion signifikant niedrigere Gebote abgegeben als Männer, wobei die genderspezifischen Opportunitätskosten sowie finanziellen Bedingungen mögliche Erklärungen darstellen. Ferner (iii) wurden keine signifikanten Differenzen in der Budget-Effektivität zwischen den Vertragsarten festgestellt. Außerdem (iv) waren die Überlebensraten der Bäume unter den handlungs- und ergebnisorientierten Verträgen nicht signifikant unterschiedlich, wobei (v) die Vertragsart eine Rolle in der Baumpflege spielte. Die Teilnehmer mit ergebnisorientierten Verträgen haben eher zusätzliche Aktivitäten zur Erhaltung der Bäume umgesetzt. Des Weiteren, (vi) haben Frauen signifikant weniger überlebende Bäume erzielt als Männer, wobei geschlechtsspezifisches Ungleichgewicht in der gegenseitigen Unterstützung bei der Vertragsimplementierung als Einflussfaktor für die niedrigere Performance identifiziert wurde. Trotz der Senkung der Überlebensraten, war die Vergabe der Verträge an Frauen immer noch sehr kosteneffizient. Außerdem (vii) sind die Überlebensraten der Bäume mit den Zahlungsbeträgen gestiegen, was darauf hindeutet, dass eine Reduzierung der Differenz zwischen den Opportunitätskosten und den Geboten negative Effekte auf die Umweltperformance auswirkt. Zuletzt, (viii) die generell hohe Überlebensraten der Bäume könnten durch die Zahlungen und zukünftige Leistungen der Bäume motiviert worden sein, wobei einige Faktoren auch für eine intrinsische Motivation für das Überleben der Bäume sprechen.

1. Introduction

1.1. Motivation for the dissertation

Concept of payments for environmental services

Biodiversity and ecosystems provide environmental services of direct value to people such as food, clean water, and fuel, but also many indirect services including water filtration, climate regulation, flood protection, nutrient cycling and pollination. Environmental services are therefore extremely valuable in terms of economic, social and cultural aspects, and are being increasingly demanded due to rapid world population growth. However, a high degradation is changing the capability of ecosystems to meet these demands (OECD, 2010, 2013).

From an economic perspective, the degradation of ecosystems results from the public good nature of environmental services. In this respect, market-based policy instruments have become increasingly applied to procure environmental services from private landholders in the last three decades, whereas payments for environmental services (PES) represent the most commonly used policy instrument (Engel et al., 2008; Schilizzi et al., 2011; Swallow et al., 2009). The conservation payments convert external, non-market environmental values into financial incentives for the landholders (Engel et al., 2008). The rationale behind is to encourage people to voluntarily preserve ecosystems by compensating the opportunity costs of sustainable land-uses and the costs of actions required to provide environmental services (García-Amado et al., 2011; Pagiola et al., 2005; Wunder, 2005; Wünscher et al., 2008).

The direct nature of PES is argued to offer potentially large savings as well as to be more effective in delivering environmental goals than indirect or regulatory conservation approaches. Consequently, the research on how to advance the effectiveness gains of PES is of particular importance, whereas it is argued that the contract design, the contract allocation mechanism, targeting, and the acceptance of

PES program determine how effective the PES scheme is (Engel et al., 2008; Ferraro & Simpson, 2002; Schomers & Matzdorf, 2013; Wunder, 2005; Wunder et al. 2008)

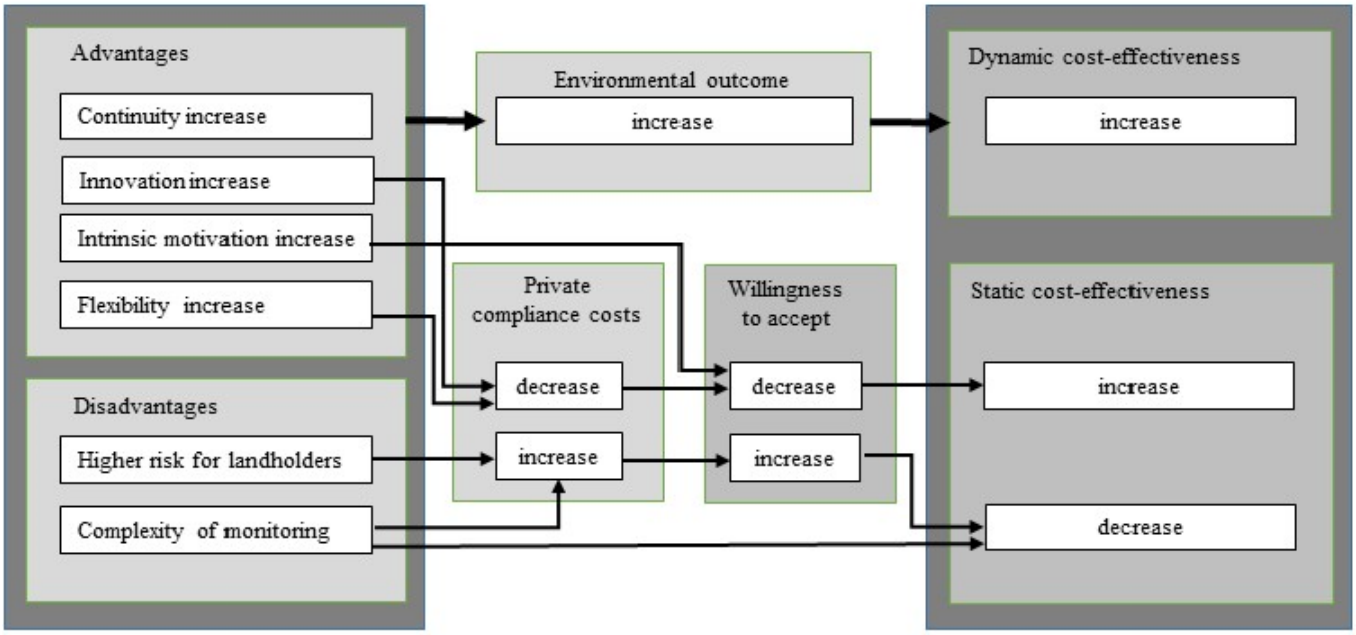
Outcome-based conservation contracts

In the context of enhancing PES performance, linking payments to outcomes is argued to boost PES effectiveness. It remains, however, the norm to offer a uniform conservation payment for compliance with action prescriptions that are expected to deliver the desired outcome (Holm-Müller et al., 2006; Latacz-Lohmann & Schilizzi, 2005; Schilizzi et al., 2011; Schwarz et al., 2008). I refer to these two approaches as to outcome-based and action-based conservation payments, respectively.[1]

The outcome-based contract design gives landholders the flexibility in how to achieve the desired environmental outcome, it allows for an efficient use of their resources and knowledge, provides incentives for innovations, and is expected to increase intrinsic motivation. As result the environmental performance should increase and the private compliance costs decrease. Nevertheless, as outcome-based approaches impose the additional risk of not achieving the desired goals, it might induce participants to request risk premiums (Latacz-Lohmann & Schilizzi, 2005; Matzdorf, 2004; Matzdorf & Lorenz, 2010; Schilizzi et al., 2011; Schilizzi & Latacz-Lohmann, 2016; Schwarz et al., 2008; Wätzold & Schwerdtner, 2005; Zabel & Roe, 2009). Figure 1 visualizes the predicted effects of the outcome-based payments on the environmental performance (denoted as dynamic cost-effectiveness), and on the willingness to accept (denoted as static cost-effectiveness).

[1] Other terms used for action-based conservation payments: Input-based payments, payments prescribing specified activities, payments tied to actions. Other terms used for outcome-based conservation payments: Result-oriented payments, performance-based payments, payments tied to outcomes.

Figure 1 The predicted effects of outcome-based payments



Adapted from Matzdorf & Lorenz (2010)

Conservation auctions

One of the major challenges for the PES schemes refers to how to optimally select the contracts (Hajkowicz et al., 2007), wherein asymmetric information between landowners and the conservation agency can limit the effectiveness of PES programs (Ferraro, 2008). In this context, procurement auctions among suppliers of environmental services are argued to more truly reveal the opportunity costs, as the participants bid competitively for a limited number of conservation contracts. The bidders thus face a trade-off between a higher informational rent and a reduced chance of winning, which decreases the incentive to inflate their willingness to accept. Consequently, the cost revelation property of conservation auctions is expected to provide budget effectiveness gains (Engel & Palmer 2008; Ferraro, 2008; Latacz-Lohmann & Schilizzi, 2005; Latacz-Lohmann & Van der Hamsvoort, 1997), and auctions are thus gaining increasing interest as alternative to the flat-rate payments (Burton & Schwarz, 2013; Schwarz et al., 2008).

Moreover, risk aversion - as compared to risk neutrality - is predicted to decrease the willingness to accept in auctions. The rationale behind is that if the income from the conservation contract reduces landholders´ income uncertainty, risk averse bidders lower their bids in order to increase the probability of being awarded the conservation payment (Jack, 2010; Latacz-Lohmann & Van der Hamsvoort, 1997).

At the same time, it is also claimed that a trade-off exists between payment savings and environmental performance. According to Latacz-Lohmann & Schilizzi (2005, p.39) "extracting a higher share of information rents from bidders, by itself, achieves little in promoting efficient use of resources"; while Jack (2010, p.27) states that "the compliance is increasing in the difference between the price and minimum willingness to accept." Payment surplus thus might increase the contract compliance.

Tendering outcome-based contracts

The above argumentation suggests that allocating outcome-based contracts via an auction has the potential to further improve PES effectiveness. However, theoretical predictions on linking the two – the result-oriented approach and the tender – are far from clear. Specifically, while auctions are expected to decrease the informational rents, linking payments to outcomes might result into risk premiums. Hence, the potential effectiveness gains of tendering outcome-based payments depend on whether the incentive effect - related to improved environmental performance - outweighs the risk effect (Schilizzi et al., 2011; Schilizzi & Latacz-Lohmann, 2016).

Gender aspects

PES schemes have been increasingly implemented in developing countries that represent important suppliers of environmental services (Jindal et al., 2013; Kerr et al., 2012; Swallow et al., 2009; Wunder et al., 2008). In this context, gender related inequalities are generally prevalent in the developing world (Colfer et al., 2013; FAO, 2011; GEF, 2013), wherein women's rights to land are often secured through their ties to husbands, women face difficulties in accessing financial credits, appropriate

technology and extension service, and are more labor constrained (Kiptot & Franzel, 2011; Kiptot et al., 2014). Thus, despite of women being key actors in African agriculture they have limited access to resources, whereas it is argued that eliminating the gender imbalance would lead to higher agricultural productivity (FAO, 2011; Murage et al., 2015). There is, however, only little evidence on gender with respect to conservation (Colfer et al., 2013; Villamor et al., 2013), wherein it is argued that addressing the gender gap also holds potential for improved provision of environmental services (Kiptot et al., 2014). In the context of PES, we argue that traditional gender roles might imply gendered differences in willingness to accept and in environmental performance, and moreover, we suppose that men and women might react differently to the incentives given by the action- and outcome-based approaches.

1.2. Previous studies

A theoretical model on applying auctions to conservation contracts has been developed (Latacz-Lohmann & Van der Hamsvoort, 1997) and different auction designs tested in laboratory experiments (Cason et al., 2003; Cummings et al., 2002; Hailu & Schilizzi, 2004). Conservation auctions have been implemented in the US (Baylis et al., 2008; Connor et al., 2008) and Australia (Rolfe & Windle, 2011; Stoneham et al., 2003; Windle & Rolfe, 2008) and tested in Germany (Bertke et al., 2008; Groth, 2005, 2008), while field trials in Indonesia and Malawi contributed to the little empirical evidence on the performance of tendering in developing countries (Ajayi et al., 2012; Jack, 2010, 2013; Jack et al. 2009).

Further, while the experience in the US and Australia highlights the drawbacks of paying landholders on actions, there is only limited empirical evidence on the performance of outcome-based contracts (Schilizzi & Latacz-Lohmann, 2016). An overview of such programs in Europe (Burton & Schwarz, 2013; Schwarz et al., 2008) reveals that few schemes have been purely outcome-based, with most combining action-based and outcome-based contract features. In this regard, Zabel and Holm-Müller (2008) have reviewed a truly outcome-based scheme for conserving carnivores

in Sweden, showing that compared to the traditional ex-post damage compensations the result-oriented payments were successful in addressing the moral hazard problem and removing the high transaction costs to the landholders. Further, de Saint Marie (2014) discusses the use of an outcome-based approach to the delivery of species-rich grasslands in France, concluding that the approach would allow farmers to adapt their management practices according to the plot vegetation and changing conditions, while it would challenge the conventional principal of agro-environmental policies on costs compensation.

The combination of auctions and outcome-based contracting has been only recently initiated. A pilot project in Germany has examined two outcome-based conservation auctions, but the database was not sufficient to make a conclusive statement as to whether auctioning result-oriented contracts induced more efficiency gains than a fixed price scheme (Bertke et al., 2008; Groth, 2005, 2008). Tendering outcome-based contracts for ground-nesting birds in Australia (Goddard et al., 2008; Whitten et al., 2008) reveals cost savings of around 30 percent, as compared to tendering of ex ante action-based payments. Yet, also in this case the analysis is limited by a small sample. Further, a forest enrichment field trial in Kenya has shown the auction mechanism to reduce provision costs, and the outcome-based payments to provide additional incentives to improve the environmental service provision, however, again the small number of contracts did not allow for statistical tests (Khalumba et al., 2014). On the contrary, robust results of laboratory experiments conducted in Australia and Germany (Schilizzi et al., 2011; Schilizzi & Latacz-Lohmann, 2016) show that combining auctions with outcome-based payments can be counterproductive in terms of the environmental output.

The few studies on gender in conservation show ambivalent results, wherein on one hand, mixed-gender decision-making is shown to possibly improve environmental outcomes and food security (Villamor et al., 2014b) and to result in maintenance of protection forests together with agroforestry systems (Villamor et al., 2017), while on the other hand, women react more positively than men to logging or oil palm

conversion (Villamor et al., 2014a).

1.3. Research gaps, objectives, and outline of the dissertation

Research gaps

While both the auction allocation and linking conservation payments to outcomes have potential to improve PES effectiveness, there are only few studies examining the combined effect of tendering outcome-based contracts. Similarly, whereas the conservation community is increasingly acknowledging the importance of gender aspects, empirical results on gendered impacts in conservation, and PES schemes in particular, are relatively scarce. I have attempted to fill the research gaps by carrying out a field experiment in Kenya. To my knowledge, this PES study is the first one to compare auctions for action- and outcome-based contracts in a randomized field trial setting, and is also novel in that it applies a gender-sensitive approach that allows for assessment of gendered behavior.

Objectives

The objective of the dissertation is to examine following hypotheses:

1. Tendering outcome-based contracts results in risk premiums and thus higher bid values (risk effect), compared to the action-based treatment; wherein
2. Auction for action-based contracts results into higher budgetary effectiveness.
3. Outcome-based contracts, compared to action-based contracts, achieve better environmental performance; wherein
4. Outcome-based approach incentivizes a choice of tree care actions expected to lead to the desired outcome (incentive effect), and enhances intrinsic motivation.
5. Participant´s gender impacts PES schemes in terms of willingness to accept and environmental performance; wherein
6. There is a relationship between gender impacts on PES and gender roles and attitudes.

Outline

The dissertation is organized as a monograph. After the Introduction chapter (1) the Methodology chapter (2) follows, describing the study area and experimental design. Chapter 3 represents results of conservation auctions (hypotheses 1 & 2). Chapter 4 assesses the environmental performance (hypotheses 3 & 4). Gender impacts on PES and the relationship to gender roles and attitudes (hypotheses 5 & 6) are explored in Chapter 5. Conclusion (6) summarizes key findings and contribution of the study and outlines policy recommendations.

2. Methodology

2.1. Study area and sample

Study area

I conducted the study in the Upper Tana River watershed along the Kapingazi River catchment, on the South Eastern slope of Mount Kenya. Here intensive agricultural land use and deforestation result in severe soil erosion and siltation of streams, representing major threat for hydropower and irrigation use downstream the Tana River, the Kenya´s largest river of crucial economic importance. An increased population with decreasing land sizes, lack of firewood and alternative energy sources resulted in deforestation and high pressure on riparian lands, wetlands and forests. Consequently, tree cover is low in the farming zones of the Kapingazi catchment, wherein there is high potential for conservation payments to reverse the degradation (Balana et al., 2011; Hoang et al., 2014; PRESA, 2010).

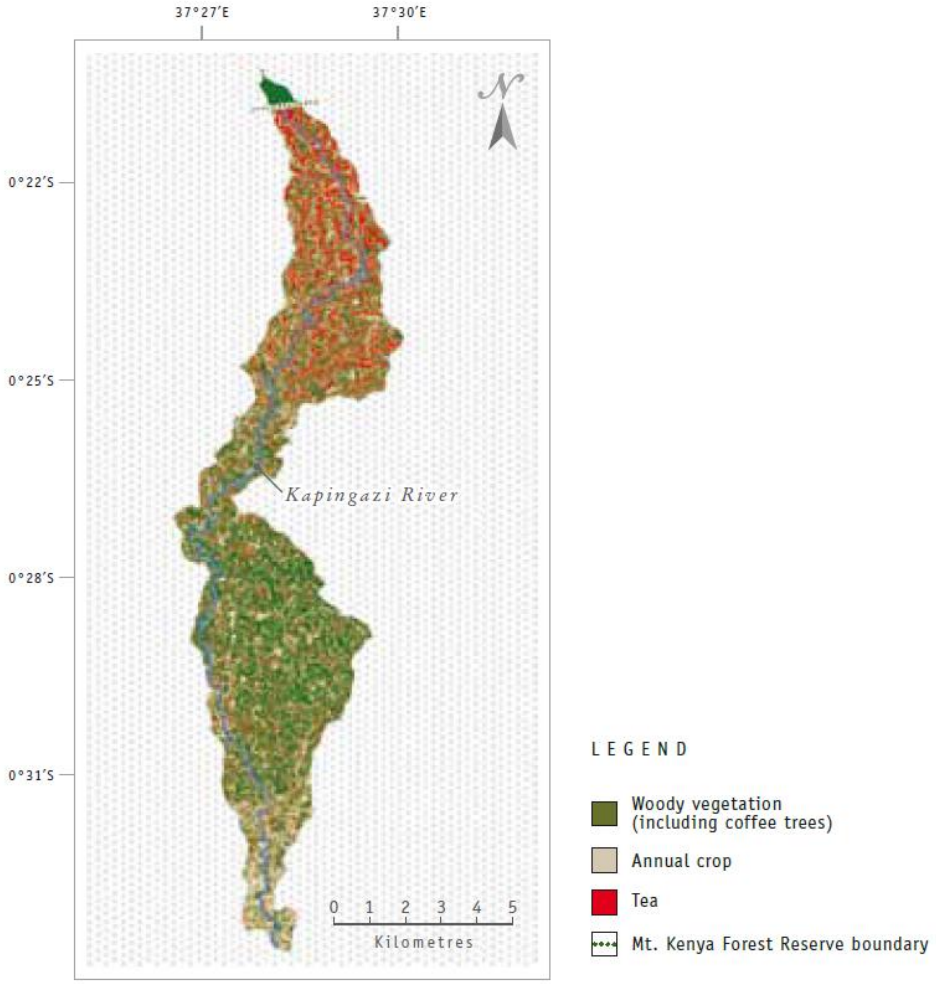
Figure 2 Study area

Source: Firmian et al., 2011

The Kapingazi catchment´s total area is 62 km^2 and it is located in the Embu County, formerly the Eastern Kenya Province. The Kapingazi River begins at the Mt. Kenya

forest boundary at approximately 2,000 meters above the sea level (m.a.s.l.) and joins the larger Rupingazi River 750 meters lower near the Embu Town (Mbugua, 2009). Accordingly, the cropping patterns in the Kapingazi watershed vary along the elevation, with a tea zone in the upper part, a transition zone with mixed tea and coffee plantation in the middle part, and a coffee zone in the upper lower part of the catchment. Subsistence farming – mostly maize and beans - is performed in the entire catchment and prevails in the lowest parts. Land scarcity results in zero grazing being the main livestock practice in all zones (Balana et al., 2011; Mbugua, 2009; PRESA 2010).

Figure 3 Predominant land-use classes in the Kapingazi River catchment



Source: Firmian et al., 2011. The figure was adapted from original map by Miika Mäkelä (ICRAF), and data corresponds to year 2005.

Study sample

Three administration units - called Focal Development Areas (FDA) - of the lower and middle parts of the Kapingazi River catchment, namely Muthatari, Mutunduri and Kairuri, were targeted for this study. The study sites were selected according to their contribution to the environmental degradation of the Kapingazi River, wherein in the targeted subsistence and coffee zones the silt contribution is greatly above the silt levels of the upper tea zone (Figure 4).

Figure 4 Silt distribution by sources of silt and zones in the Upper Tana catchment

Source of sediments	Main issue	Percentage silt contribution by zone (whole catchment)					Estimated silt by zone (tons/yr)-whole catchment				
		Forest zone	Tea zone	Coffee zone	Lower zone	ASAL zone	Forest zone 1,925 km²	Tea zone 1,367 km²	Coffee zone 2,545 km²	Lower zone 1,012 km²	ASAL zone 2,574 km²
1. *Roads*	Uncontrolled run-off along roads, loosened earthworks and culvert discharge into unprotected lands	2%	8%	30%	10%	50%	6,387	25,550	95,811	31,937	159,685
2. *River banks*	Collapsing of unprotected and encroached river banks	1%	10%	35%	15%	39%	1,988	19,882	69,586	29,823	77,539
3. *Farms*	Inadequate soil conservation measures, especially due to low economic prospects on subsistence farms.	0%	5%	35%	15%	45%	0	19,162	134,136	57,487	172,460
4. Forests and *degraded catchments*	Inadequate soil conservation measures, especially due to low economic prospects on subsistence farms.	11%	11%	13%	10%	55%	10,935	10,935	12,923	9,941	54,675
5. *Unprotected areas around impervious surfaces*	Rainwater run-off from urban centres, institutions and homesteads without rainwater harvesting structures or soil and water conservation systems.	0%	10%	35%	20%	35%	0	21,277	74,469	42,553	74,469
6. *Footpaths and Tracks*	Downhill alignment of footpaths on farm boundaries, which have increased due to excessive land sub-division.	0%	10%	30%	18%	42%	0	4,966	14,898	8,939	20,857
7. *Quarry sites*	Loosened soils, high run-off from exposed quarried rock surfaces and sand mines.	0%	5%	40%	10%	45%	0	711	5,685	1,421	6,396
TOTAL	COMBINATION OF ISSUES	14%	59%	218%	98%	311%	19,310	102,482	407,508	182,101	566,080
	Rank	5	4	2	3	1	1,277,481				

Source: UTaNRMP/IFAD, 2012b. Notes: In the Kapingazi catchment the coffee zone stretches from the middle up to the upper lower parts of the catchment. Arid and semi-arid lands (ASAL) that qualified as the highest silt contributors are not represented in the Kapingazi catchment.

Kairuri represents the central part of the Kapingazi watershed where both tea and coffee were prevailing. It is located between 1,700 and 1,500 m.a.s.l., and with an area of 7.7 km^2 it is the smallest FDA of the catchment. Kairuri is followed by Mutunduri, which represents the upper lower part of the catchment and is dominated by coffee. Finally, Muthatari is the lowest and greatest community area. It accounts for approximately 20 percent of the Kapingazi catchment and the altitude falls up to 1,200 m.a.s.l. Here subsistence farming is dominant, with only few landholders growing coffee (Firmian et al., 2011; PRESA, 2010).

All households at both right and left riverbanks of the Kapingazi River, in the demarcated research sites (Figure 5), were targeted for the study. In total 427 households received invitation to participate in our study, out of which 411 provided data for an extensive baseline survey. Aiming at a gender-balanced study, a random draw was used to determine whether a male or female household representative is to be approached. Subsequently, 190 men and 237 women represented the targeted suppliers of environmental services. The prevalence of women is to be explained by the fact that about 20 percent of the households lack a male representative, making a random draw impossible.

2.2. Experimental design

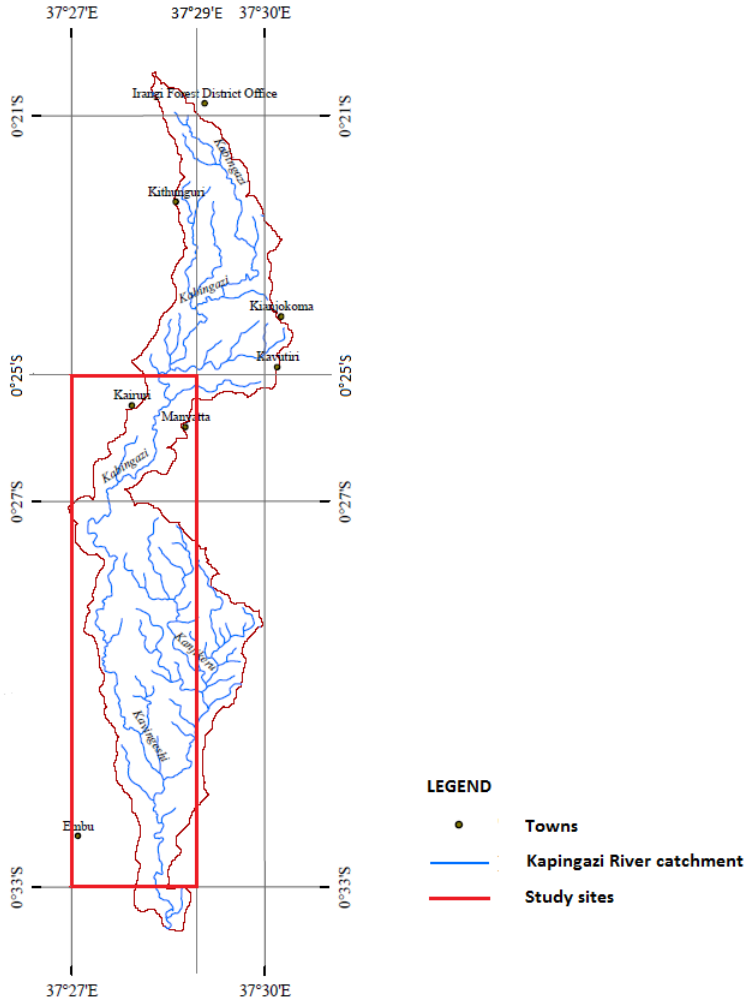
Contract design

As the baseline survey showed that over half of the targeted population was fully using their riparian area for food crop production, I abandoned the initial idea of the contract requesting the removal of agricultural production from the riverbanks. In the first place, I had food security concerns since there is the possibility that farmers underestimate their opportunity costs. Second, there were also budget reasons, when the request of setting land aside would greatly increase the contract prices.

Consequently, the conservation contracts requested to plant 30 indigenous trees on the riparian area, without any further limitations on the land use. The riparian area was

defined according to Kenya´s law on the riverbanks protection, which determines 30 meters from the middle of the river as riparian land.[2] Further, as the measurability of the watershed services outcomes might be problematic, in particular with respect to the short contract period and the activities of non-participants, tree survival was used as measurement of the environmental performance. The contract period represented six months, which were crucial for the up-take and survival of the tree seedlings, particularly when the seedlings were distributed in the dry season (December).

Figure 5 Study sites of the Kapingazi River catchment



Adapted from: Mbugua, 2009

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

Contract types

In the action-based contract the payments were conditional on finding the soil around the trees to have sufficient levels of soil moisture at the time of monitoring. Under the outcome-based contracts the payments depended on the tree survival after the six-month period, independently of the actions taken. Consequently, despite the differences in the incentives given under the action- and outcome-based contracts, in both treatments the compliance costs consisted mainly of opportunity costs of labor.

Further, the contracts exempted flooding and other natural disasters from landholders´ liability. It was not only impossible for landholders to prevent flash floods during the rainy season, but also the aim was to explore the impact of risk due to farmers´ full responsibility for the outcome, and not due to the exposure to extreme events. Damages resulting from human adverse interventions, on the other hand, were not a priori excluded from landholders´ liability, as these might be prevented by watchfulness (Jack, 2010).

Under the action-based contracts the landholders might be monitored several times, with the exact frequency and time of monitoring not being revealed. This prevented the landholders from deliberately watering the trees only on the days of monitoring, and from stopping watering after the last announced monitoring. Payments were reduced by one percent for each tree that was not kept moist. Thus, three monitoring rounds could have reduced the payment by a maximum of 90 percent. On the contrary, under the outcome-based contracts the payments reduced by four percent for each non-surviving tree. Up to four deceased trees were then tolerated without sanctions, a number agreed upon by landholders and experts to decease even if good care was taken. Further, regardless of the monitoring results and the contract type, all farmers were guaranteed 10 percent of their bids as a base payment, which was paid at the beginning of the contract period. Consequently, the maximum sanctions for both treatments corresponded to 90 percent of the contract payments.

Conservation auctions

The auctions took place on December 14, 2011. In total, 234 landholders (112 men and 122 women) participated in the conservation auctions, representing 55 percent of the targeted population. The participants were stratified upon income level and gender, and from each stratum the farmers were randomly assigned to one of the two treatments - either the auction for action- or outcome-based contracts.[3]

Notes: Auction participants draw lots for the treatment assignment. Photo taken by ICRAF.

In order to avoid information spillovers both auctions were conducted simultaneously, in separate rooms. In the auctions the landholders submitted price offers – bids - at which they were willing to accept the PES contract. A discriminative price rule was used in both auctions, paying selected bidders the exact amount of their bid. The auction was announced as one-shot budget constrained while the information on budget was hidden.

Communication was not allowed during the auction, wherein the participants were encouraged to write their bid in a way that the figure is not seen, and subsequently place the bid sheet in the obtained envelope. It is, however, possible that the participants did occasionally see the bid values of the neighbors, as it was the case in the auction study in Malawi (Jack, 2010), with bids of nearest neighbors being marginally correlated. Further, the facilitators helped farmers who needed assistance in writing.

[3] The income level was divided into low and high based on the baseline survey.

The total budget for both auctions was approximately 1,770,000 KES (around 20,000 US$),[4] whereas I additionally aimed at an equal number of contracts for each treatment (also this information was hidden). Consequently, I was able to offer 60 contracts in each of the two auctions. Due to number of farmers opting for drop-out, 44 action-based and 54 outcome-based contracts were finally signed. Training on tree planting was offered to all contract holders, prior delivering free tree seedlings mid of December 2011.

Notes: Auction participants assigned to one of the two treatments at the start of the auction. Photo taken by ICRAF.

Monitoring

Monitoring on the contract compliance was carried out by the research team in collaboration with the Kenya Forest Service (KFS), and in presence of the landholders. In February 2012, all participants were monitored on whether they had planted the trees at their riparian area. The landholders with action-based contracts were additionally monitored on the compliance with the tree-watering requirement. Second monitoring followed in March 2012, wherein further monitoring on the soil moisture

[4] I use the exchange rate from 14 December 2011: 1 US$ = 88 KSh (www.oanda.com)

did not take place due to the rain start. Farmers with the outcome-based contracts were monitored on the tree survivals at the end of the contract period, in June 2012. At the same time, tree survival rates of the action-based PES scheme were recorded for the research purpose (Table 1).

Table 1 Monitoring

Type of monitoring	Trees planted	Soil kept moist around trees		Tree survival
	Feb 2012	Feb 2012	March 2012	June 2012
Action-based contracts				
On contract compliance	✓	✓	✓	×
For research purpose	×	×	×	✓
Outcome-based contracts				
On contract compliance	✓	×	×	✓
For research purpose	×	×	×	×

Pay-offs and evaluation

The conservation payments were awarded in July 2012, and subsequently an evaluation survey with the contract holders was conducted. There was no further obligation for the participants to keep the trees standing or to take care of them. Whether the participants received the whole or reduced conservation payment was conditional on the above contract type conditions and monitoring results. Regardless of the monitoring results all farmers were guaranteed 10 percent of their bids as a base payment, which was paid at the beginning of the contract period.

3. Action- and outcome-based payments for environmental services: An experimental auction for tree planting contracts in Kenya

3.1. Objectives and hypotheses

Auctions are argued to improve the cost-effectiveness of conservation contracts, with the competitive selection to reveal the private opportunity costs much more closely than posted offer mechanisms (Rolfe & Windle, 2011). However, while auctions are expected to reduce the informational rents, linking payments to outcomes might result into risk premiums (Goddard et al., 2008; Schilizzi & Latacz-Lohmann, 2016). The main aim of this chapter is to examine the treatment effect of the performance-based approach on the bid formation, wherein I analyze bids for action- and outcome-based contracts. Further, I compare the budgetary effectiveness of the two treatments.

The chapter examines the first and second hypotheses of the dissertation:

1. Tendering outcome-based contracts results in risk premiums and thus higher bid values (risk effect), compared to the action-based treatment; wherein

2. Auction for action-based contracts results into higher budgetary effectiveness.

3.2. Results

3.3. Conservation auction

Socio-economic context

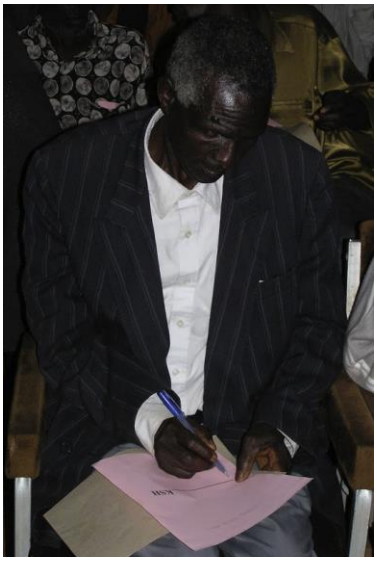
In the targeted population 62 percent were cash crop farmers who planted mainly coffee (96 percent) or tea (3 percent)[5]. The remaining 38 percent of the farmers planted food crops, with mainly maize (77 percent) followed by beans (15 percent).[6] We describe the latter as subsistence farmers, since they produce predominantly for their own consumption and only partly sell their production at local markets.

[5] Macadamia nuts are also considered as a cash crop (about one percent).

[6] Further food crops in descending order by frequency: Fruits, leaves vegetables, arrow roots, tomatoes, napier grass

Subsistence farmers then dominate in the lower altitudes, and cash crop farmers in the higher altitudes that provide suitable climate for coffee and/or tea. Further, the average yearly gross household´s income was 208,087 KSh (2,365 USD), with standard deviation of 368,781 KSh (4,191 USD). In this regard, the household's income of subsistence farmers was 31 percent lower, compared to cash crop farmers, which has qualified the farm type as proxy for low or high income.[7] The average schooling represented 7.9 years, with standard deviation of 4.7 year, and the main ethnic group was Kiembu (92.5 percent). Finally, the study area was characterized by small land holdings, with an average household´s land size of 2.9 acres, and standard deviation of 4.6 acres. The average land strip along the river – riparian area - in the study area has 65 meters, with standard deviation of 87 meters.

Summary statistics



Notes: Participant indicates his bid on the bidding sheet. Photo by ICRAF.

117 landholders submitted their bids in each of the two auction treatments. The density estimates of bids show that in both treatments there is a great variation in the bids that range from 200 KSh to 240,000 KSh (Figure 6). Further, both distributions are positively skewed,[8] with higher skewness and bid variation under the action-based treatment.[9] In the action-based auction the mean bid is 29,406 KSh and the median is 25,000 KSh, compared to the mean of 26,126 KSh and the median of 26,000 KSh in the outcome-based auction. Neither the means nor the distributions of bids are significantly different.[10]

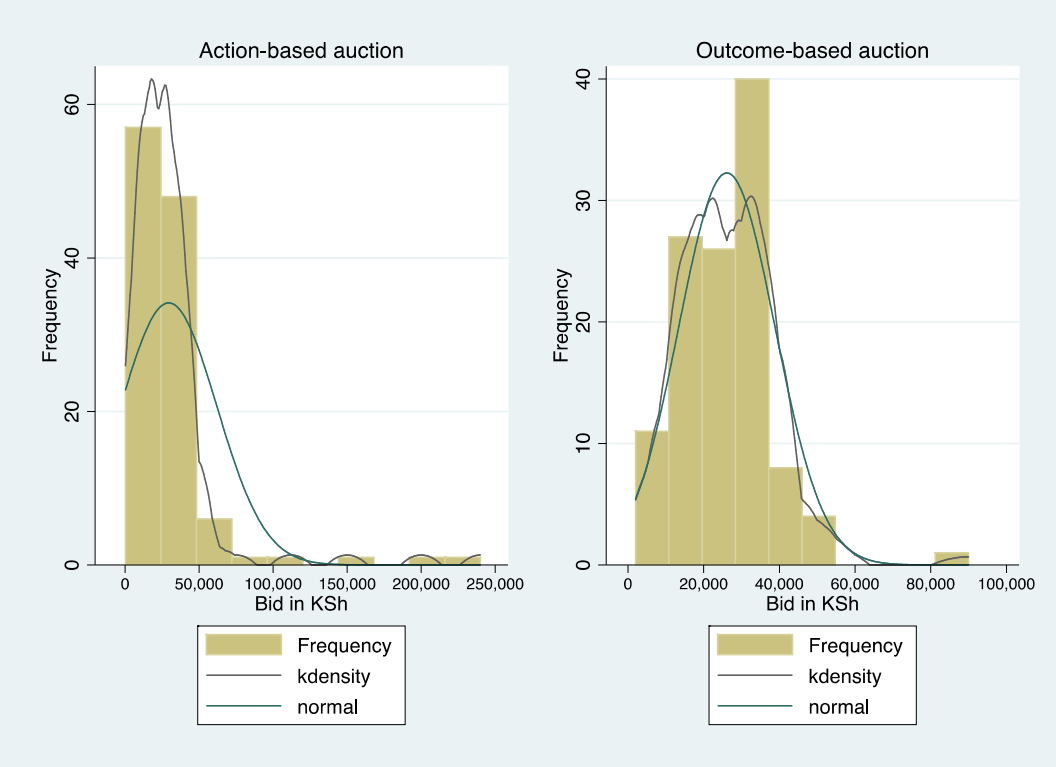
[7] Two-sample t-test with equal variances of log total income on subsistence farm type (0/1): diff=0.311, p=0.001.

[8] Skewness/Kurtosis: action-based (4.177/24.281), outcome-based (1.072/7.077).

[9] Coefficients of variation [(standard deviation/mean)*100]: Action-based (1.10), outcome-based (0.49).

[10] A two sample t-test for equal means by auction treatment (action-based 0/1): -3,280 (p=0.311). A two-sample Kolmogorov-Smirnov test for equality of distribution: p=0.125.

Figure 6 Bid distributions by auction treatment



Notes: Density estimates of bids with underlying histograms for the action- and outcome-based auction treatments. One action-based bid of 10,000,000 KSh represents an outlier and is excluded from the bid analyses.

Regression analysis

I transformed the original metric state of bid into natural logarithm, in order 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 percent changes in bids. First, regressing bids (in logs) on the treatment, gender, and farm type – the income level proxy - shows a statistically significant gender effect, with men submitting 24 percent higher bids than women, and no treatment effect (Table 2: column 1). Testing for combined effects then reveals statistically significant treatment interactions, which proposes that a treatment effect depends on participant´s gender (Table 2: columns 2) and farm type (Table 2: columns 3), or conversely, the associations between the bids and gender and the bids and farm type depend on the treatment.

Table 2 Treatment effect

	(1) OLS		(2) OLS		(3) OLS	
Action-based treat. (0/1)	-0.196	(0.124)	-0.444*	(0.174)	-0.425*	(0.165)
Male (0/1)	0.244+	(0.124)	-0.006	(0.117)		
Subsistence farm (0/1)	0.130	(0.125)			-0.160	(0.121)
Interaction[a]			0.510*	(0.245)		
Interaction[b]					0.592*	(0.247)
Constant	9.843***	(0.085)	10.013***	(0.062)	10.070***	(0.071)
Observations	218		218		218	
Joint F-statistic	2.17+		2.40+		3.04*	
R-squared	0.034		0.048		0.041	
Adjusted R-squared	0.020		0.035		0.027	

Notes: (1) OLS regression of logarithm bid on the treatment type, gender, and farm type. (2) OLS regression of logarithm bid on the treatment type and the treatment interaction with gender. (3) OLS regression of logarithm bid on the treatment type and the treatment interaction with farm type. Robust standard errors are in parentheses (Breusch-Pagan/Cook-Weisberg test for heteroskedasticity in (1) - (3) regression models: p<0.01). P-values: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001. [a] Interaction term for the treatment and gender. [b] Interaction term for the treatment and farm type. Dummy variables are described as (0/1), with "no" coded as 0, and "yes" coded as 1. The variable "subsistence farm" refers to the farm type with food crop production only, as opposed to the cash crop farm type with coffee and/or tea production. For 15 bidders out of 234 (seven in the action-based and eight in the outcome-based treatment) the baseline information is not provided. One bid of 10,000,000 KSh represents an outlier and is excluded from the analysis.

Further, accounting for influential observations shows that, while the treatment-gender interaction effect remains statistically significant (Table 3: column 1), the model regressing bids on the treatment-farm type interaction term is jointly insignificant (Table 3: column 2). To explain this I further examine the influential bids that might result from strategic bidding or cost miscalculation.

Table 3 Treatment effect - Influential observations omitted

	(1) OLS		(2) OLS	
Action-based treatment (0/1)	-0.164	(0.109)	-0.136	(0.102)
Male (0/1)	0.085	(0.108)		
Subsistence farm (0/1)			-0.136	(0.114)
Interaction[a]	0.259+	(0.156)		
Interaction[b]			0.260	(0.162)
Constant	10.013***	(0.075)	10.105***	(0.070)
Observations	207		207	
Joint F-statistic	3.43*		0.92	
R-squared	0.048		0.013	
Adjusted R-squared	0.034		-0.001	

Notes: (1) OLS regression of logarithm bid on treatment type and the treatment interaction with gender. Influential observations excluded based on Cook´s D>4/218. (Breusch-Pagan/Cook-Weisberg test for heteroskedasticity: 0.526). (2) OLS regression of logarithm bid on treatment type and the treatment interaction with the farm type. Standard errors are in parentheses. Influential observations excluded based on Cook´s D>4/218. P-values: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001. [a] Interaction term for the treatment and gender. [b] Interaction term for the treatment and the farm type. For description of variables see Table 2.

Particularly, using the Cook´s D procedure, nine extremely low and two extremely high bids were identified as influential observations (Table 4). Cash crop farmers then mainly submitted the extremely low bids, wherein subsistence farmers requested the two extremely high bids. At the same time, the extreme bid values have been submitted almost exclusively in the action-based treatment. Hence, this combination seems to explain the excessive influence that was exerted on the interaction term coefficient. Further, the comparisons of the single and combined effects models via likelihood ratio test suggest including the treatment interaction with gender into the regression models, but dropping the treatment-farm type interaction term.

Table 4 Influential bids

Bid (in KSh)	Treatment	Contract signed	Gender	Farm type
200	Action-based	No	Female	Cash crop
200	Action-based	No	Female	Subsistence
500	Action-based	Yes	Female	Cash crop
600	Action-based	No	Male	Cash crop
900	Action-based	No	Male	Cash crop
1,000	Action-based	No	Male	Cash crop
1,800	Action-based	No	Female	Cash crop
2,000	Outcome-based	Yes	Male	Subsistence
2,400	Outcome-based	Yes	Male	Cash crop
150,000	Action-based	No	Male	Subsistence
240,000	Action-based	No	Male	Subsistence

Notes: Observations with Cook´s D value above 4/218. Based on regression model in Table 3 (column 2).

Further, the treatment-gender interaction term remains statistically significant when including additional explanatory variables (Table 5). Simultaneously, while the inclusion of personal characteristics increases model´s predictive ability and shows other significant bid determinants (Table 5: column 2), the model regressing bids on opportunity costs variables is, however, jointly insignificant (Table 5: column 1). Finally, the interaction and bid determinants parameters stay stable in the full model that involves all regressors (Table 5: column 3).

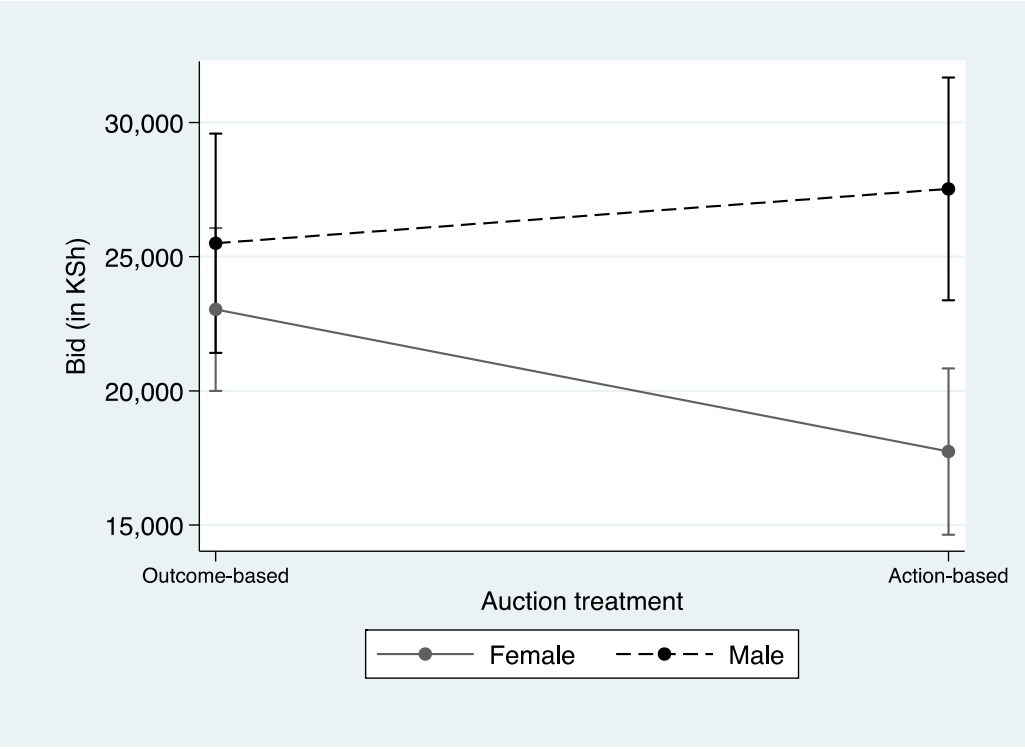
Table 5 Treatment effect and bid determinants

	(1) OLS		(2) OLS		(3) OLS	
Treatment & Gender & Interaction						
Action-based treatment (0/1)	-0.151	(0.111)	-0.275**	(0.104)	-0.261*	(0.110)
Male (0/1)	0.080	(0.105)	0.103	(0.101)	0.102	(0.112)
Interaction term [a]	0.271+	(0.162)	0.343*	(0.147)	0.338*	(0.164)
Opportunity costs characteristics						
Income & Land						
Total yearly income (in log)	0.011	(0.048)			0.019	(0.050)
Subsistence farm (0/1)	0.003	(0.095)			-0.041	(0.095)
Total land (acres)	0.018	(0.020)			0.02	(0.015)
Labor & Technology						
Stated labor constrains (0/1)	0.033	(0.077)			-0.075	(0.078)
Irrigation technology (0/1)	-0.026	(0.115)			-0.013	(0.131)
Personal characteristics						
Age (years)			0.006+	(0.003)	0.004	(0.003)
Education (years)			-0.001	(0.010)	-0.005	(0.013)
Group participation (0/1)			0.053	(0.088)	0.038	(0.094)
Organization involvement (0/1)			0.050	(0.078)	0.051	(0.079)
General life satisfaction (0-3)			0.099*	(0.042)	0.110*	(0.044)
Risk attitudes (0-10)			0.049**	(0.018)	0.052**	(0.018)
Trust to locals (0-3)			-0.103*	(0.044)	-0.107*	(0.045)
Discount rate (0-2)			-0.021	(0.046)	-0.026	(0.047)
Constant	9.825***	(0.570)	9.465***	(0.242)	9.358***	(0.560)
Observations	207		203		203	
Wald chi-squared	10.27		39.50***		45.67***	
R-squared	0.055		0.163		0.175	
Adjusted R-squared	0.017		0.115		0.104	

Notes: (1) OLS regression of logarithm bid on the treatment, participant´s gender, the treatment interaction with gender, and opportunity costs characteristics. Influential observations excluded based on Cook´s D>4/218. (2) OLS regression of logarithm bid on the treatment, participant´s gender, the treatment interaction with gender, and personal characteristics. Influential observations excluded based on Cook´s D>4/214. (3) OLS regression of logarithm bid on the treatment, participant´s gender, the treatment interaction with gender, and the opportunity costs and personal characteristics. Influential observations excluded based on Cook´s D>4/214. Bootstrapped VCE errors (1,000 replications) are in parentheses. P-values: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001. For 20 bidders the baseline information is not fully provided, resulting in 214 observations. [a] Interaction term for the treatment and gender. The counterfactual for action-based treatment is outcome-based treatment. 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. Subsistence farm refers to the farm type with food crop production only, as opposed to the cash crop farm type with coffee and/or tea production. Irrigation technology means the use of river irrigation. Group participation refers to community groups such as self-help groups, women´s and youth groups. Organization involvement refers to prior exposure to agricultural extensions, water resource associations, and conservation initiatives. Higher general satisfaction corresponds to greater life satisfaction. Higher trust level corresponds to higher trust towards people in the local area. Higher discount rate corresponds to lower time preference. Higher risk attitude corresponds to higher risk seeking (see p.71).

Displaying the margins of the interaction term then clearly shows differences in men´s and women´s bids across and within the two treatments (Figure 7). Using the pairwise comparisons of predictive margins we reveal a significant treatment effect, with women submitting 23 percent lower bids in the action-based compared to the outcome-based treatment (Table 6: row 2). Furthermore, there is a significant gender effect within the action-based treatment, with increase in men´s opposed to women´s bids by 55 percent (Table 6: row 4). Changing the base of comparison, there is 30 percent increase in female bids in the outcome-based compared to the action-based treatment, and 36 percent decrease in women´s versus men´s action-based bids. On the contrary, there is no statistically significant difference in men´s action-based and outcome-based bids (Table 6: row 3), and women´s and men´s bids are statistically undistinguishable in the auction for outcome-based contracts (Table 6: row 1).

Figure 7 Predictive margins of the bids for the treatment-gender interaction



Notes: Predictive margins of the bids for the treatment-gender interaction term with 95% confidence intervals, calculated from predictions of the OLS regression of logarithm bid on gender of the auction participant, the treatment and the treatment interaction with gender, and the opportunity costs and personal characteristics (Table 5: column 3). Influential observations excluded based on Cook´s D>4/214. As in the regression model the bid is transformed into natural logarithm, the predictions are exponentiated in order to show the effects in KSh.

Three additional variables were significantly associated with the bids - life satisfaction, risk attitudes, and trust behavior (Table 5: columns 2-3). Life satisfaction was positively correlated with household´s income, and thus can be probably interpreted in terms of opportunity costs increasing with the wealth.[11] The increase in bids with increasing risk seeking is consistent with the prediction on risk aversion to reduce willingness to accept (see 1.1). The drop in bids with increasing level of trust towards locals lead us to speculate on the farmers to expect less conflicts and more support when implementing the contract. On the contrary, none of the opportunity costs variables – neither the income, farm type, land size nor the reported labor constraints or the availability of irrigation technology - have significantly determined the bids.

Table 6 Pairwise comparisons of predictive margins

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

Notes: Pairwise comparisons of predictive margins of the bids for the treatment-gender interaction term, calculated from predictions of the OLS regression of logarithm bid on gender of the auction participant, the treatment and the treatment interaction with gender, and the opportunity costs and personal characteristics (Table 5: column 3). Influential observations excluded based on Cook´s D>4/214. P-values: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001. Bootstrapped VCE errors are in parentheses. [a] Contrast decomposes the effects of the treatments and gender on the bids into comparisons against reference categories. As in the regression model the bid is transformed into natural logarithm, I exponentiated the predictive margins in order to show the effects in KSh. [b] The effects of the treatment and gender on the bids expressed in percentages, with predictive margins (Figure 7) as reference categories: [1] 2,467.911/23,034.59=0.107; [2] -5,296.783/23,034.59=-0.230; [3] 2,024.316/25,502.5=0.079; [4] 9,789.011/17,737.81=0.552.

Finally, replacing the bid amount by the bid rank provided a robustness check of the bid analysis, wherein "the ranking preserves the ascending sorting of the bids while eliminating outliers" (Jack, 2010, p. 15). Particularly, the variable parameters in the bid

[11] Ordered logistic regression of satisfaction levels (0-3) on the household´s income (in log): coefficient=0.232; p=0.017.

rank regressions – in terms of coefficient signs and significance levels – are consistent with the foregoing bid amount analysis that excluded influential bids (Table 7).

Table 7 Bid rank robustness check

	(1) OLS		(2) OLS		(3) OLS	
Treatment & Gender & Interaction						
Action-based treatment (0/1)	-20.938+	(12.660)	-31.836**	(11.074)	-31.591*	(12.451)
Male (0/1)	8.140	(11.675)	6.080	(12.144)	5.751	(12.374)
Interaction[a]	32.819+	(17.380)	45.607*	(17.734)	45.246*	(18.408)
Opportunity costs characteristics						
Income & Land						
Total yearly income (in log)	3.291	(6.510)			3.344	(6.883)
Subsistence farm (0/1)	3.617	10.098			1.522	10.783
Total land (acres)	0.243	(2.301)			0.490	(2.326)
Labor & Technology						
Stated labor constrains (0/1)	3.536	(9.027)			-1.228	(9.048)
Irrigation technology (0/1)	-1.596	(13.221)			2.056	(15.057)
Personal characteristics						
Age (years)			0.417	(0.384)	0.398	(0.443)
Education (years)			-0.444	(1.144)	-0.711	(1.400)
Group participation (0/1)			-1.412	(9.931)	-3.008	(10.132)
Organization involvement (0/1)			7.388	(9.664)	7.792	(9.991)
General satisfaction (0-3)			8.800+	(4.855)	9.325+	(4.852)
Risk attitudes (0-10)			4.162*	(2.111)	4.211+	(2.206)
Trust to locals (0-3)			-10.806+	(5.928)	-10.764+	(5.936)
Discount rate (0-2)			-2.752	(5.311)	-2.819	(5.361)
Constant	72.934	(78.682)	80.431*	(31.143)	45.543	(89.273)
Observations	218		214		214	
Wald chi-squared	12.15		29.62**		28.99*	
R-squared	0.057		0.116		0.118	
Adjusted R-squared	0.012		0.068		0.037	

Notes: (1) OLS regression of bid rank (in ascending order) on the treatment, participant´s gender, the treatment interaction with gender, and opportunity costs characteristics. (2) OLS regression of bid rank on the treatment, participant´s gender, the treatment interaction with gender, and personal characteristics. (3) OLS regression of bid rank on the treatment type and the treatment interaction with gender, and opportunity costs and personal characteristics. Bootstrapped VCE errors (1,000 replications) are in parentheses. P-values: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001. [a] Interaction term for the treatment and gender. The counterfactual for action-based treatment is outcome-based treatment. Dummy variables are described as (0/1). For description of variables see Table 5.

Overall, the predictive ability of the regression models is rather low when it explains at most 18 percent of the variation in the bids; if considering the adjusted R-squared then the predictive power does not exceed 12 percent (Table 5). This can be partly explained by the binary and categorical variables explaining a scale dependent variable. It might, however, also imply that though controlling for a set of variables a part of the bid formation remains unobserved. Nonetheless, despite of the noise a fraction of the variation in bids could be explained, and highly significant and consistent effects could be revealed. Moreover, I found that participant´s gender and other personal characteristics rather than opportunity costs observables determined the bids. Chapter 5 provides possible explanations for the gendered impacts on bids.

Notes: Auction participants submit their bidding sheets in sealed envelopes. Photo taken by ICRAF.

Strategic bidding and winner´s curse

Ideally, the bid would reveal the landholder´s opportunity costs of implementing the conservation contract; however, „the bid curves contain an element of strategic overbidding and thus do not represent true opportunity costs" (Latacz-Lohmann & Schilizzi, 2005, p. 52). In other words, besides the opportunity costs the bids contain bidder´s expectations about the maximum payment (Latacz-Lohmann & Schilizzi, 2005; Latacz-Lohmann & van der Hamsvoort, 1997). In the field trial, the most frequent bid value in the auction (36,000 KSh) corresponded to an average daily wage times the contract period.[12] Moreover, 87 percent of bids were lower (71 percent) or equal (16 percent) to this wage-based amount, suggesting that for most landholders 36,000 KSh was either the maximum expected opportunity cost, or the maximum expected payment we would offer. The latter would suggest strategic behavior in the bid formation.

At the same time, „a risk of losing a contract at a favorable price can also lead to downward bid shading", and thus the direction of the strategic bidding is potentially ambiguous (Jack, 2010, p. 25). Also, the bidders may underestimate their opportunity costs as result of incorrectly formed expectations, ex post shocks or misunderstanding of the valuation task (Jack, 2010, p. 7). In this regard, if the willingness to accept of the selected bidder is lower than the opportunity costs, then, he or she faces the winner´s curse. Stoneham et al. (2003, p. 484) generally define the winner´s curse as "the situation where an item is allocated to the most optimistic bidder (in this study the bidder with the lowest valuation), rather than the bidder whose valuation is closest to the true valuation." 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 me to hypothesize on the winner´s curse, which was later confirmed by the exit interviews, when the landholders reasoned the contract rejection by the payment being insufficient.

[12] 200 KSh per day over 180 days = 36,000 KSh.

In summary, the consistent and highly significant bid effects show that the bids reflected landholders´ characteristics, though the observed strategic elements in bidding suggest that the opportunity costs were not fully disclosed. In this context, the uniform price auction increases the incentive to reveal costs. However, as all bidders receive the same payment, especially low cost bidders are overpaid, which may or may not, subject to the extent of costs revelation, lead to lower budgetary effectiveness compared to discriminative bidding (Cason & Gangadharan, 2004; Stoneham et al., 2003). Further, multiple auction rounds would allow the participants to "get a better sense of the true contract value" of the contract, and thus mitigate the winner´s curse (Stoneham et al., 2003, p. 484); however, they also increase administration costs when after each round bids have to be evaluated (Cason & Gangadharan, 2004), and might lead to the effectiveness eroding learning effect (Hailu & Schilizzi, 2004). Finally, another important consideration beyond my preference for the one-shot discriminatory price auction was that both uniform pricing and multiple rounds are more complex and might represent a barrier in comprehending the auction allocation (Ayaji et al., 2012; Latacz-Lohmann & Schilizzi, 2005, p. 25).

Comparison to contingent valuation

The baseline survey, conducted prior the auction, has contained following contingent valuation question: If you were offered a payment for planting 30 tree seedlings in December at your riparian area, and for the subsequent care for the trees for six months, what would be the amount of payment you would accept?

First, though a direct comparison of contingent valuation to the bids has its limitation, given the former was a hypothetical question and the latter a real stake experiment, the results let me suggest that – against the expectations - the competitive bidding has not reduced the willingness to accept. Particularly, comparing the means of contingent values and bid offers show statistically undistinguishable results (Table 8). Consequently, using an experimental setting would enable a more reliable comparison of the different willingness to accept elicitation methods; which is beyond the scope of this study, but might be of interest for further research.

Table 8 Means of contingent valuation and bids

	N	Mean		Median
(1) Paired t-test				
Bid	209	27,143	(22,721)	-
Contingent valuation	209	25,180	(19,601)	-
Difference	1,963			
(2) Two-sample t-test with equal variances				
Bid	233	27,759	(24,643)	25,200
Contingent valuation	372	25,588	(22,960)	20,000
Difference	2,171			

Notes: Means and medians of bid amounts (treatments combined) and willingness to accept in contingent valuation (in KSh). Standard deviations are in parentheses. (1) Difference in means using paired t-test: p=0.282. (2) Difference in means using two-sample t-test with equal variances: p=0.272. 55 landholders, 24 of them auction participants, have not provided answer to the contingent valuation question, resulting into 372 observations in the two-sample t-test, and 209 observations in the paired t-test.

Second, regressing the contingent values on observable variables shows that there is consistency in the significant effects of gender and risk attitudes between the auction and contingent valuation (Table 9). This provides further robustness check of the bid analysis, and suggests that the landholders reflected well-defined cost and risk expectations into their willingness to accept. The possible drivers for the gendered heterogeneity in willingness to accept are analyzed below in Chapter 5. Finally, neither trust nor life satisfaction - the other bid determinants - have impacted the contingent valuation, whilst the hypothetical values are additionally determined by the farm type and respondent´s age.

Table 9 Contingent valuation determinants

	(1) OLS		(2) OLS		(3) OLS	
Opportunity costs characteristics						
Income & Land						
Total yearly income (in log)	0.090+	(0.048)			0.041	(0.055)
Subsistence farm (0/1)	0.222*	(0.094)			0.210*	(0.097)
Total land (acres)	0.004	(0.017)			0.026	(0.015)
Labor & Technology						
Stated labor constrains (0/1)	-0.067	(0.085)			-0.117	(0.087)
Irrigation technology (0/1)	0.120	(0.119)			-0.002	(0.012)
Personal characteristics						
Male (0/1)			0.160+	(0.083)	0.194*	(0.083)
Age (years)			-0.005+	(0.003)	-0.007*	(0.003)
Education (years)			-0.009	(0.011)	-0.009	(0.012)
Group participation (0/1)			0.090	(0.092)	0.017	(0.096)
Organization involvement (0/1)			-0.143	(0.090)	-0.153+	(0.090)
General satisfaction (0-3)			-0.002	(0.040)	-0.016	(0.041)
Risk attitudes (0-10)			0.071***	(0.017)	0.088***	(0.018)
Trust to locals (0-3)			0.022	(0.049)	-0.013	(0.050)
Discount rate (0-2)			-0.085+	(0.049)	-0.064	(0.047)
Constant	8.699***	(0.566)	9.770***	(0.223)	9.304***	(0.620)
Observations	352		346		344	
Wald chi-squared	11.62*		31.56***		54.36***	
R-squared	0.029		0.070		0.124	
Adjusted R-squared	0.015		0.045		0.087	

Notes: In order to account for the non-linearity in the relationship between the contingent values and the explanatory variables the original metric state is transformed into natural logarithm. (1) OLS regression of willingness to accept (log-transformed) on opportunity costs characteristics. Influential observations excluded based on Cook´s D>4/371. (2) OLS regression of willingness to accept (log-transformed) on personal characteristics. Influential observations excluded based on Cook´s D>4/366. (3) OLS regression of willingness to accept (log-transformed) on opportunity costs and personal characteristics. Influential observations excluded based on Cook´s D>4/365. Bootstrapped VCE errors (1,000 replications) are in parentheses. P-values: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001. 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 Table 5. 55 landholders have not provided answer to the contingent valuation question, resulting into (at most) 372 observations. The contingent valuation question: If you were offered a payment for planting 30 tree seedlings in December at your riparian area, and for the subsequent care for the trees for six months, what would be the amount of payment you would accept?

3.4. Budgetary effectiveness

Effectiveness of PES schemes can be defined as the achievement of a specific environmental outcome at the least possible costs, or as the maximum environmental benefit achievable for a given budget. Since most conservation agencies are budget constrained I use the latter definition; that of the maximum outcome for money spent, and refer to it as to budgetary effectiveness.

Figure 8 Individual bids and allocation by auction treatment (in log scale)

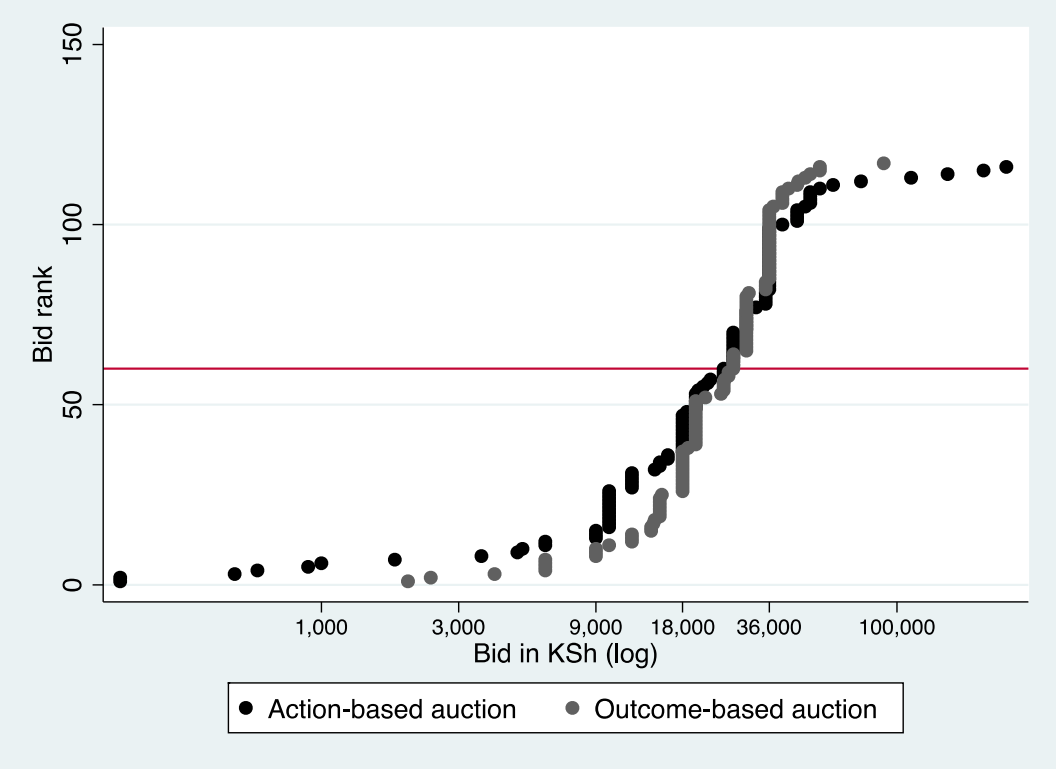


Figure 8 presents the bids as cumulative distribution functions when the horizontal axis illustrates submitted bids sorted in an ascending price order, and the vertical axis the corresponding bid ranks. The horizontal line at the 60th bid rank represents the number of selected conservation contracts, resulting in the bid caps of 25,000 KSh for

the action-based, and 27,000 KSh for the outcome-based treatment.[13] The graphical depiction shows (i) a considerably steeper action-based curve in the bid range from 9,000 KSh to 18,000 KSh, and (ii) a number of extremely low action-based bids.

Given that the bid curves differed in the first quartile, when the bids were selected in the ascending order, the winning bids were significantly lower for action-based than outcome-based contracts (Table 10: row 2). However, the effectiveness gain of the selected bids in the action-based versus outcome-based auction has been lost due to drop-outs, wherein the means for contracts that were finally signed are statistically undistinguishable (Table 10: row 3). Particularly, eleven bidders in the action-based, and one bidder in the outcome-based auction opted not to sign the contract, with the mean bid of the rejected contract offers being significantly lower compared to the contracts that were finally signed.[14]. Consequently, the second hypothesis on increased budget effectiveness of the auction for action-based contracts could not be confirmed, wherein the most of the low cost bidders opted for not signing the contract (see p.39).

In addition, there were barriers in the contract allocation, wherein in each treatment five selected participants could not be contacted for contract signing.[15] However, as this happened randomly, these bids do not significantly differ from the signed bids. Finally, out of 60 contract offers 44 were successfully concluded in the action-based, and 54 in the outcome-based treatment. The mean payment for a planted tree was then 501 KSh in the action-based, and 554 KSh in the outcome-based treatment.

[13] Given the budget constraint only one bid of 27,000 KSh could be accepted in the outcome-based treatment, wherein we used lottery to select one out of three bids of this value.

[14] Two-sample t-test with equal variances of bid on whether the selected bidder dropped out (0/1): difference=10,575; p=0.000; n=120.

[15] The selected bidders were contacted via cell phones, wherein for these participants the phone numbers did not go through, neither the village elders could successfully contact them.

Table 10 Means of submitted, selected, and contracted bids

	N	Mean		Median
(1) Submitted bids				
Action-based contract	116	29,406	(32,499)	25,000
Outcome-based contract	117	26,126	(12,729)	26,000
(2) Selected bids				
Action-based contract	60	13,028*	(6,923)	12,000
Outcome-based contract	60	16,456*	(6,077)	18,000
(3) Contracted bids				
Action-based contract	44	15,027	(5,915)	17,000
Outcome-based contract	54	16,618	(5,900)	18,000

Notes: Means and medians of bid amounts (in KSh) for submitted, selected, and contracted bids are reported for action- and outcome-based treatments. Standard deviations are in parentheses. Difference in means using two-sample t-test with equal variances. P-values: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001.

At the end of the contract period the PES participants were asked to estimate their "tree-planting cost for the six months period considering all costs, including leisure time, labor re-allocation, input costs, and other costs". The estimates show 10,563 KSh to be the average realized cost in the action-based, and 10,736 KSh in the outcome-based treatment (Table 11: row 1). Consequently, comparing the costs estimates to actual pay-offs suggests that the PES participants on average received payments above the realized costs (Table 11: row 2). Moreover, the contingent valuation assessed at the contract end fairly corresponds with the actual pay-offs (Table 11: row 3), suggesting that the PES participants considered the received payments as sufficient, but also that they were not willing to accept payments closer to the realized costs.[16] The mean pay-off for a surviving tree then was 573 KSh in the action-based, and 623 KSh in the outcome-based treatment (for tree survivals see Chapter 4).[17]

[16] Evaluation survey question (n=98): What would be the lowest payment that would still encourage you to participate in the project?

[17] Two outcome-based contracts with flood damage excluded (see Table 12: row 2).

Table 11 Realized costs, pay-offs, and ex-post contingent valuation

	Obs.	Mean		Median	Min	Max
(1) Realized costs						
Action-based contract	44	10,563	(10,315)	7,000	1,000	50,000
Outcome-based contract	54	10,736	(8,324)	9,000	1,250	43,680
(2) Pay-offs						
Action-based contract	44	14,422	(6,535)	16,820	350	25,000
Outcome-based contract	54	15,919	(6,106)	17,800	1,280	26,000
(3) Ex post contingent valuation						
Action-based contract	44	13,180	(7,001)	13,200	2,000	25,000
Outcome-based contract	54	15,449	(6,518)	15,000	2,400	30,000

Notes: Summary statistics of (1) realized opportunity costs of the tree planting contract estimated by the PES participants at the end of the contract period, (2) actual pay-offs awarded to the PES participants (i.e. bids deducted by sanctions), and (3) minimum willingness to accept of PES participants stated at the end of the contract period. All figures are in KSh. Standard deviations are in parentheses.

3.5. Discussion and conclusion

The hypothesis on the risk effect to increase the bids for outcome-based contracts could be confirmed for female bidders. In particular, I found (i) women to submit 23 percent lower bids in the action-based versus outcome-based treatment, and conversely 30 percent higher bids in the outcome-based versus action-based treatment. At the same time, men did not react differently to the two treatments. In addition, the comparison within the treatments reveals (ii) a statistically significant decrease of 36 percent in women´s versus men´s bids, or conversely an increase of 55 percent in men´s versus women´s bids, in the action-based treatment.

Further, there is evidence on the willingness to accept to contain strategic elements, when bidders bid above, but also below their true opportunity costs. While overbidding resulted in contract prices being on average higher than the realized costs, the winner´s curse led to contract drop-outs. Nonetheless, despite of the strategic behavior a fraction of the variation in bids could be explained, and highly significant and consistent effects could be revealed.

In this context, I found that - besides the participant´s gender - personal characteristics, such as life satisfaction, risk attitudes and trust behavior, rather than opportunity costs observables determined the bids. Moreover, I found the impacts of gender and risk behavior to be consistent with a contingent valuation elicitation, conducted prior the auction. This suggests that the landholders reflected well-defined cost and risk expectations into their willingness to accept. At the same time, however, I revealed that the competitive bidding has not reduced the willingness to accept, as proposed by the auction literature. In addition, the contingent valuation assessed at the contract end suggests that the PES participants were not willing to accept payments closer to the realized costs.

Finally, the average bid selected in the action-based treatment was significantly lower, compared to the outcome-based treatment. However, the potentially high effectiveness gains of the action-based auction have been neutralized due to a high drop-out rate of the low-cost bidders. Consequently, I could not confirm the second hypothesis on increased budgetary effectiveness of the auction for action-based contracts. The revealed gender effects, however, imply that it might be cheaper and thus more effective for the conservation agency to award action-based contracts to women. However, the increase in women´s bids in the outcome-based treatment shows that tendering outcome-based contracts might neutralize the potential effectiveness gains of targeting women. Thus, I found that the choice of the contract type might – as result of gendered bidding behavior - define the budgetary effectiveness. Possible explanations for the gendered impacts on bids are provided in Chapter 5.

4. Action- and outcome-based payments for environmental services: Environmental performance of tree planting contracts in Kenya

4.1. Objectives and hypotheses

Notes: The farmer inter-planted the tree seedlings with the agricultural produce at his riparian bank. September 2013, one year after the project end.

Most conservation payments are linked to actions that are expected to lead to the desired outcome (Latacz-Lohmann & Schilizzi, 2005). It is, however, argued that increasing the degree of conditionality is desirable, as outcome-based payments in contrast to the standard prescription approach are expected to increase the environmental outcome. Particularly, they offer flexibility to choose how to achieve the targeted outcome, and are expected to enhance intrinsic motivation (Holm-Müller et al., 2006; Matzdorf & Lorenz, 2010; Schwarz et al., 2008; Zabel & Roe, 2009).

The chapter examines the third and fourth hypotheses of the dissertation:

3. Outcome-based contracts, compared to action-based contracts, achieve better environmental performance; wherein

4. Outcome-based approach incentivizes a choice of tree care actions expected to lead to the desired outcome (incentive effect), and enhances intrinsic motivation.

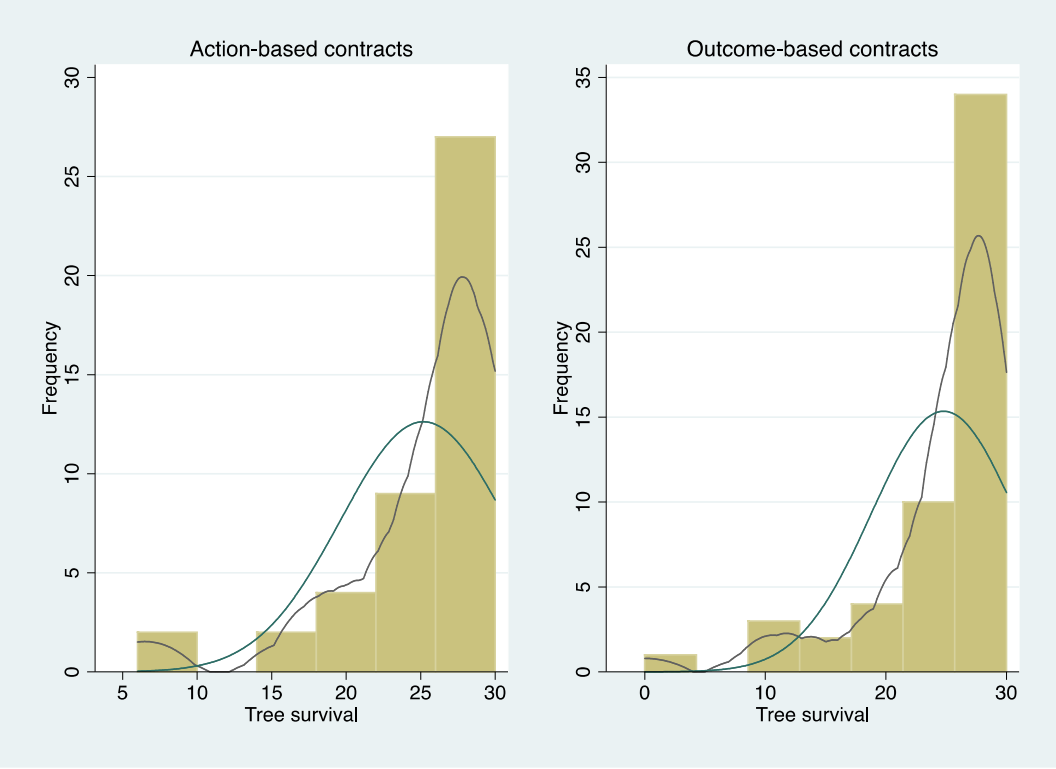
4.2. Results

4.3. Environmental performance

Summary statistics

The environmental performance is measured as the number of surviving trees, out of thirty, at the end of the six months contract period. The density estimates of the tree survivals with underlying histograms show left skewed distributions, when in both treatments there is high density of high values (Figure 9). Particularly, 16 and 15 percent of participants with action- and outcome-based contracts, respectively, achieved the maximum survival rate of 30 trees, and in both treatments about 55 percent of participants achieved tree survival rate of at least 90 percent (27 trees).

Figure 9 Tree survival by contract type/treatment



The mean survival was 25.18 trees in the action-based, and 24.80 trees in the outcome-based treatment (Table 12: row 1). Excluding two cases of immense flood damage from

the analysis - when the landholders could not prevent it – then increases the mean in the outcome-based treatment to 25.54 trees (Table 12: row 2). Further, neither the means nor the distributions of the tree survivals reveal statistically significant differences between the treatments.[18]

Table 12 Summary statistics of tree survivals

	Obs.	Mean		Median	Min	Max
(1) Tree survivals						
Action-based contract	44	25.18	(5.56)	27	6	30
Outcome-based contract	54	24.80	(6.02)	27	0	30
(2) Tree survivals – excluding flood damage						
Action-based contract	44	25.18	(5.56)	27	6	30
Outcome-based contract	52	25.54	(4.61)	27	9	30

Notes: (1) Summary statistics including means of tree survivals for action-based and outcome-based contracts. (2) Summary statistics including means of tree survivals for action-based and outcome-based contracts, when two observations (both in the outcome-based treatment) were dropped from the analysis due to flood damage (with 19 and 30 trees swept away). Standard deviations are in parentheses.

Regression analysis

Examining the tree survival determinants in OLS regression framework shows men to achieve about 2.1 trees (7 percent) more surviving trees than women. Further, the tree survival was increasing with participation in a community group and the conservation payment amount, and conversely, decreasing with years of education (Table 13: columns 1-3). On the contrary, the tree survivals did not differ for the action- and outcome-based treatments, nor there was significant interaction of the treatment with gender. In addition, I examined differences in tree survivals at the village level, as there might be village-based differences such as climate and soil conditions. This was, however, not confirmed, as controlling for the village or area effects has not revealed statistically significant differences.[19]

[18] (1) All contracts: A two sample t-test for equal means: difference=-0.386; p=0.745; n=98. A two-sample Kolmogorov-Smirnov test for equality of distribution: p=0.938. (2) Excluding two contracts with flood damage: A two sample t-test for equal means: difference=0.357; p=0.732; n=96. A two-sample Kolmogorov-Smirnov test for equality of distribution: p=0.985.

[19] Likelihood ratio test of mixed effects ML regression with village as group variable: p=1.000. Likelihood ratio test of mixed effects ML regression with area (FDA) as group variable: p=1.000.

Table 13 Tree survival determinants

	(1) OLS		(2) OLS		(3) OLS	
Treatment & Gender						
Action-based treatment (0/1)	-0.381	(1.118)	-0.498	(1.128)	-0.075	(1.057)
Male (0/1)	2.086*	(0.965)	2.134*	(1.030)	2.067*	(1.001)
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 constrains (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 to 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: (1) OLS regression of the tree survivals on the treatment, gender, and the personal characteristics. (2) OLS regression of the tree survivals on the treatment, gender, and the opportunity costs and personal characteristics. (3) OLS regression of the number of surviving trees on the treatment, gender, the conservation payment amount, and the opportunity costs and personal characteristics. Bootstrapped VCE errors (1,000 replications) are in parentheses. P-values: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001. Two observations were dropped from the analyses due to flood damage (with 19 and 30 trees swept away), and one respondent did not provide answer on risk attitudes; resulting in 95 observations. 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 Table 5.

Further, the negative effect of education might be possibly clarified by the opportunity costs being increasing with the education level. Social network benefits in terms of labor sharing and conflict prevention might perhaps explain the positive effect of group participation. The revealed association between the variations in the tree survivals and the payment amounts shows that the environmental performance was increasing with payment surpluses. In particular, disaggregating the payment levels discloses the performance to be gradually increasing with the payment amount, when the tree survival increases by 2.31 trees (insignificant) for payments of the second quantile, by 3.86 trees (at $p<0.05$) for payments of the third quantile, and by 3.31 trees (at $p<0.05$) for payments of the fourth quantile (Table 14).

Table 14 Tree survival and payments

	(1) OLS	
Conservation payment		
Payment in units of 10,000 KSh	-	
Payment in quantiles		
1st quantile (up to 12,000 KSh)		
2nd quantile (above 12,000 - 18,000 KSh)	2.313	(1.625)
3rd quantile (above 18,000 - 20,000 KSh)	3.862*	(1.753)
4th quantile (above 20,000 KSh)	3.310*	(1.673)
Treatment & Gender		
Action-based treatment (0/1)	0.156	(1.121)
Male (0/1)	1.886+	(1.087)
Opportunity costs characteristics		
Income & Land		
Total yearly income (in log)	0.823	(0.627)
Subsistence farm (0/1)	1.097	(1.226)
Total land (acres)	-0.342	(0.278)
Labor & Technology		
Stated labor constrains (0/1)	-0.300	(1.193)
Irrigation technology (0/1)	2.321	(1.770)

Personal characteristics		
Age (years)	-0.014	(0.050)
Education (years)	-0.247+	(0.146)
Group participation (0/1)	2.133	(1.415)
Organization involvement (0/1)	0.545	(1.005)
General satisfaction (0-3)	-0.335	(0.738)
Risk attitudes (0-10)	-0.107	(0.220)
Trust to locals (0-3)	-0.171	(0.697)
Discount rate (0-2)	0.643	(0.612)
Constant	14.459+	(8.043)
Observations	95	
Wald chi-squared	26.71+	
R-squared	0.311	
Adjusted R-squared	0.148	

Notes: (1) OLS regression of the number of surviving trees on the conservation payment levels (in quantiles), the treatment type and gender, and opportunity costs and personal characteristics. Bootstrapped VCE errors (1,000 replications) are in parentheses. P-values: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001. The contract payment is categorized into four quantiles, which are denoted by the 25th, the 50th (i.e. median), and the 75th percentiles. Two observations were dropped from the analyses due to flood damage (with 19 and 30 trees swept away), and one respondent did not provide answer on risk attitudes; resulting in 95 observations. The counterfactual for action-based treatment is outcome-based treatment. For description of variables see Table 5.

Further, the OLS regression results remain consistent when accounting for the count nature of the outcome variable (Table 15: column 1), and censoring for the maximum number of trees (Table 15: column 2).[20] Overall, given the very small variation in the tree survivals, with standard deviation of 5.05 trees, the magnitudes of the above revealed significant effects are fairly high. With respect to the main hypothesis, I conclude that the outcome-based approach did not result into higher environmental performance than the action-based contracts.

[20] Given the significant over-dispersion in the data (Likelihood-ratio test of alpha=0: p=0.027), I select the negative binomial regression that accommodates the non-linearity of the count data and relaxes the assumption of equal variance of the Poisson regression (Long & Freese, 2006).

Table 15 Negative binomial and censored regressions

	(1) NB		Marginal effects	(2) Tobit	
Conservation payment					
Payment in units of 10,000 KSh	0.086*	(0.044)	2.185	2.173+	(1.189)
Treatment & Gender					
Action-based treatment (0/1)	-0.002	(0.038)	-0.060	-0.272	(1.210)
Male (0/1)	0.080*	(0.036)	2.035	2.394*	(1.132)
Opportunity costs characteristics					
Income & Land					
Total yearly income (in log)	0.028	(0.021)	0.707	1.063	(0.696)
Subsistence farm (0/1)	0.055	(0.043)	1.384	1.270	(1.325)
Total land (acres)	-0.014	(0.009)	-0.349	-0.450	(0.304)
Labor & Technology					
Stated labor constrains (0/1)	-0.015	(0.041)	-0.385	-0.258	(1.285)
Irrigation equipment (0/1)	0.073	(0.056)	1.839	2.886	(2.232)
Personal characteristics					
Age (years)	-0.001	(0.002)	-0.014	-0.004	(0.057)
Education (years)	-0.010*	(0.005)	-0.258	-0.296+	(0.169)
Group participation (0/1)	0.100+	(0.055)	2.527	2.514	(1.551)
Organization involvement (0/1)	0.018	(0.036)	0.452	0.918	(1.182)
General satisfaction (0-3)	-0.007	(0.026)	-0.180	0.021	(0.748)
Risk attitudes (0-10)	-0.003	(0.008)	-0.086	-0.185	(0.269)
Trust to locals (0-3)	0.000	(0.022)	-0.008	0.220	(0.754)
Discount rate (0-2)	0.021	(0.021)	0.523	0.504	(0.680)
Constant	2.775***	(0.258)		9.816	(8.807)
Observations	95			95	
Wald chi-squared	30.87*			23.78+	
Pseudo R-squared	-			0.063	

Notes: (1) Negative binomial regression of the number of surviving trees on the conservation payment, treatment type and gender, and the opportunity costs and personal characteristics. Robust standard errors are in parentheses. (2) Tobit regression of the number of surviving trees on the conservation payment, treatment type and gender, and the opportunity costs and personal characteristics. Right-censored at 30. Bootstrapped VCE errors (1,000 replications) are in parentheses. P-values: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001. Two observations were dropped from the analyses due to flood damage (with 19 and 30 trees swept away), and one respondent did not provide answer on risk attitudes; resulting in 95 observations. The counterfactual for action-based treatment is outcome-based treatment. For description of variables see Table 5.

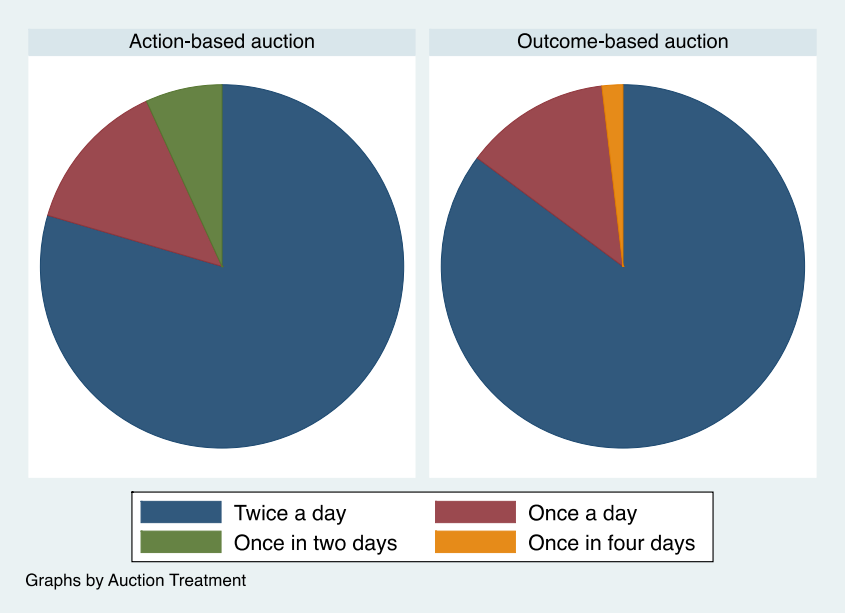
4.4. Tree care

Summary statistics

Using the evaluation survey I collected information on the tree care PES participants conducted during the contract period, which allows me to examine the hypothesis on the outcome-based approach to incentivize a choice of actions expected to lead to the desired outcome (incentive effect). Particularly, the PES participants were requested to specify the tree watering intensity, time spent on the tree care by seasons, and all activities performed to maintain the trees.

In the dry season intensive tree watering was required under both contracts. Particularly, while under the action-based contract watering was necessary to comply with the requirement on keeping the soil moist, under the outcome-based contract watering was crucial for the tree seedlings to establish. Consequently, there was not much flexibility in how often to water the trees. This resulted in similar watering intensity, with 80 percent of participants under the action-based and 85 percent under the outcome-based contract watering the trees twice a day (Figure 10).

Figure 10 Watering intensity by contract type



Given that intensive watering was required in the dry season, I collected separate data on tree care time for the dry and rainy seasons. The estimates confirm that the PES participants invested more labor in the dry season, and disclose only a little, statistically insignificant, variation between the two contract types in the dry season, and equal working hours in the rainy season.

Table 16 Weekly time spent on tree care by seasons and contract types

	Obs.	Mean		Median	Min	Max
(1) Hours a week in dry season						
Action-based contract	44	19.25	(10.31)	14	3	45
Outcome-based contract	54	16.82	(8.89)	14	6	42
(2) Hours a week in rainy season						
Action-based contract	44	6.36	(5.60)	4	0	24
Outcome-based contract	54	6.02	(5.55)	4	0.5	28

Notes: Summary statistics of weekly hours spent on tree care by the seasons and contract types. (1) Time in hours per week spent on the contract implementation in the dry season. (2) Time in hours per week spent on the contract implementation in the rainy season. Standard deviations are in parentheses. Difference in means using two-sample t-test with equal variances. P-values: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001.

Finally, the PES participants implemented on average four activities to maintain the trees, wherein the most common practices – in descending order - were: watering, weeding, fertilizing, guarding trees from damage by people and animals, and use of insecticides and pesticides (Table 17).

Table 17 Tree care activities

	N	Percent
Watering	98	100
Weeding	88	90
Fertilizing	79	81
Guarding from people	64	65
Guarding from animals	40	41
Insecticides/Pesticides	38	39

Notes: Tree care activities conducted during the contract period, sorted in descending order by the number of contract holders implementing the activity (denoted as N). The share out of 98 contract holders conducting the activity is indicated in percent. The activities were assessed using following question: Rank the most important activities that you have done to maintain the contract trees in the last six months.

Regression analysis

First, regressing the time estimates for the dry season reveals that the time allocated to tree care increases with household's income, and decreases with male gender, years of education, and prior exposure to a conservation organization. On the contrary, neither the contract type, nor the payments have revealed significant effects (Table 18: column 1). At the same time, for the rainy season the variables are not jointly significant when predicting the tree care time (Table 18: column 2).

Table 18 Weekly time spent on contract implementation by seasons

	(1) NB		**Marginal effects**	**(2) NB**		**Marginal effects**
Conservation payment						
Payment in units of 10,000 KSh	0.084	(0.096)	1.513	0.203	(0.135)	1.258
Treatment & Gender						
Action-based treatment (0/1)	0.129	(0.101)	2.326	0.083	(0.170)	0.515
Male (0/1)	-0.177+	(0.103)	-3.178	-0.192	(0.168)	-1.191
Opportunity costs characteristics						
Income & Land						
Total yearly income (in log)	0.176**	(0.053)	3.157	0.054	(0.106)	0.336
Subsistence farm (0/1)	0.013	(0.110)	0.234	0.197	(0.184)	1.218
Total land (acres)	-0.025	(0.018)	-0.458	-0.068*	(0.032)	-0.420
Labor & Technology						
Stated labor constrains (0/1)	0.103	(0.107)	1.846	-0.149	(0.162)	-0.923
Irrigation technology (0/1)	0.245	(0.168)	4.412	-0.107	(0.246)	-0.664
Personal characteristics						
Age (years)	0.001	(0.004)	0.012	-0.010	(0.020)	-0.038
Education (years)	-0.037**	(0.013)	-0.660	-0.008	(0.021)	-0.060
Group participation (0/1)	-0.086	(0.137)	-1.549	0.199	(0.205)	1.235
Organization involvement (0/1)	-0.214*	(0.104)	-3.849	-0.443*	(0.191)	-2.744
General satisfaction (0-3)	0.016	(0.049)	0.283	-0.028	(0.087)	-0.175
Risk attitudes (0-10)	-0.001	(0.027)	-0.008	0.005	(0.039)	0.028
Trust to locals (0-3)	-0.017	(0.057)	-0.297	-0.088	(0.094)	-0.542
Discount rate (0-2)	-0.042	(0.059)	-0.763	0.042	(0.098)	0.262

Constant	1.141	1.586	(1.259)
Observations	97	97	
Wald chi-squared	48.51***	22.03	

Notes: (1) Negative binomial regression of self-estimated time (in hours per week) spent on contract implementation in the dry season on the payment, treatment type and gender, and the household and personal characteristics. (2) Negative binomial regression of self-estimated time (in hours per week) spent on contract implementation in the rainy season on the payment, treatment type and gender, and the household and personal characteristics. Robust standard errors are in parentheses. P-values: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001. The counterfactual for action-based treatment is outcome-based treatment. For description of variables see Table 5.

Second, the treatment is the only variable consistently signed across the tree care activities, while gender and discount rate show consistent parameters for all but one activity. None of the other significant determinants were consistently signed, and therefore their interpretation is rather difficult. Further, since regular watering was prescribed for the action-based contracts as well as was crucial for the tree survivals, there was no significant difference in the watering intensity by the contract type or gender (Table 19).

Consequently, the outcome-based contract holders were more likely to implement the entire tree caring practices additional to watering, which is consistent with the theoretical prediction on the outcome-based approach to enhance choice of actions that is expected to achieve the desired environmental performance. The indifferent tree survivals between the action- and outcome-based contracts, however, suggest that the incentive effect did not translate into a better performance.

Table 19 Conservation activities

	(1) Probit Watering	(2) Probit Weeding	(3) Probit Fertilizing	(4) Probit Guarding	(5) Probit Insect/Pest.
Treatment & Gender					
Action-based treatment (0/1)	-0.513	-0.947+	-0.801*	-1.359***	-0.604*
	(0.351)	(0.512)	(0.380)	(0.323)	(0.295)
Male (0/1)	-0.094	-1.963***	-0.712*	-0.341	0.311
	(0.364)	(0.510)	(0.362)	(0.311)	(0.299)
Opportunity costs characteristics					
Income & Land					
Total yearly income (in log)	1.013***	-0.773*	0.602*	-0.579**	0.065
	(0.267)	(0.376)	(0.298)	(0.195)	(0.179)
Subsistence farm (0/1)	-0.410	1.506+	-0.491	-0.837*	-0.442
	(0.377)	(0.788)	(0.349)	(0.342)	(0.335)
Total land (acres)	0.028	0.239*	0.114	-0.062	0.033
	(0.065)	(0.099)	(0.114)	(0.071)	(0.068)
Labor & Technology					
Stated labor constrains (0/1)	0.322	-0.044	0.294	0.313	0.906**
	(0.404)	(0.502)	(0.378)	(0.291)	(0.314)
Irrigation technology (0/1)	-1.121*	-1.259+	1.955**	0.665	1.134*
	(0.533)	(0.643)	(0.620)	(0.540)	(0.486)
Personal characteristics					
Age (years)	0.026+	0.031	-0.008	0.002	-0.028*
	(0.015)	(0.021)	(0.015)	(0.013)	(0.013)
Education (years)	-0.115+	-0.020	0.088+	0.046	-0.038
	(0.060)	(0.059)	(0.046)	(0.039)	(0.036)
Group participation (0/1)	-0.723	1.238*	-0.189	0.147	-0.291
	(0.449)	(0.626)	(0.404)	(0.384)	(0.390)
Organization involvement (0/1)	0.098	0.666	-0.104	0.521	0.534+
	(0.429)	(0.509)	(0.386)	(0.343)	(0.304)
General life satisfaction (0-3)	0.516**	0.546*	-0.490**	-0.152	-0.212
	(0.197)	(0.269)	(0.188)	(0.170)	(0.170)
Risk attitudes (0-10)	0.141	0.104	-0.094	-0.096	0.037
	(0.094)	(0.102)	(0.093)	(0.070)	(0.073)

Trust to locals (0-3)	-0.376	0.171	0.400	-0.257	-0.262
	(0.240)	(0.328)	(0.246)	(0.183)	(0.189)
Discount rate (0-2)	-0.377	-0.910*	-0.475*	-0.076	0.031
	(0.275)	(0.365)	(0.235)	(0.184)	(0.190)
Constant	-10.314**	8.962*	-4.513	7.757**	0.632
	(3.008)	(4.262)	(3.533)	(2.536)	(2.320)
Observations	97	97	97	97	97
Wald chi-squared	32.95**	35.44**	33.43**	29.32*	30.22*
Pseudo R-squared	0.345	0.469	0.307	0.225	0.223

Notes: (1) Probit regression with the binary conduct of intense watering (1-twice a day, 0-less than twice a day) as the outcome variable, and the treatment, gender, and opportunity costs and personal characteristics as explanatory variables. (2) Probit regression with the binary conduct of weeding as the outcome variable, and the treatment, gender, and opportunity costs and personal characteristics as explanatory variables. (3) Probit regression with the binary conduct of fertilizing as the outcome variable, and the treatment, gender, and opportunity costs and personal characteristics as explanatory variables. (4) Probit regression with the binary conduct of guarding from animals as the outcome variable, and the treatment, gender, and opportunity costs and personal characteristics as explanatory variables. (5) Probit regression with the binary conduct of use of insecticides or pesticides as the outcome variable, and the treatment, gender, and opportunity costs and personal characteristics as explanatory variables. Robust standard errors are in parentheses. P-values: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001. 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 Table 5. The regression model explaining the variation in the conduct of guarding trees from people was not statistically significant.

In this regard, I could prove a significant association between the tree survivals and the watering intensity in the action-based treatment where monitoring data is available. Particularly, I found between 0.49 and 0.65 more trees surviving with one more tree watered in the first monitoring round (Table 20: columns 1-2), and between 0.29 and 0.33 more trees surviving with one more tree watered in the second monitoring round (Table 20: columns 3-4).

This suggests that watering was the main action ensuring the tree survivals, which - given the indifferent watering intensity between the contract types – might explain why the differences in the additional tree care did not translate into different tree survivals. At the same time, the extent to which all contract holders implemented a wide range of tree care activities is in the contradiction to the expectation that participants under action-based contracts solely meet the contract requirements (Matzdorf & Lorenz, 2010; Zabel & Holm-Müller, 2008).

Table 20 Tree survival and watering compliance under action-based contract

	(1) OLS	(2) Marginal effect (NB)	(3) OLS	(4) Marginal effect (NB)
No. of watered trees in:				
1st monitoring round	0.494*	0.651*	-	-
	(0.201)	(0.330)		
2nd monitoring round	-	-	0.289**	0.329*
			(0.098)	(0.128)
Constant	11.184+	-	18.098***	-
	(5.997)		(2.897)	
Observations	44	44	44	44
F-statistics/Wald chi-squared	6.05*	3.73+	8.67**	6.03*
R-squared	0.268	-	0.369	-
Adjusted R-squared	0.250	-	0.354	-

Notes: (1) OLS regression of the number of surviving trees on the number of watered trees in the first monitoring round (2) Marginal effect of negative binomial (NB) regression regressing the number of surviving trees on the number of watered trees in the first monitoring round. (3) OLS regression of the number of surviving trees on the number of watered trees in the second monitoring round (4) Marginal effect of negative binomial (NB) regression regressing the number of surviving trees on the number of watered trees in the second monitoring round. Robust standard errors are in parentheses. P-values: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001.

4.5. Intrinsic motivation

The concept of payments for environmental services is based on a voluntary conduct, which can be differentiated on the basis of extrinsic and intrinsic motivation. Extrinsic motivation then refers to the payment to incentivize the compliance with the conservation contract, and intrinsic motivation to the inner commitment to the environmental outcome. In this context, the outcome-based approach compared to the action-based payments is expected to enhance intrinsic motivation (Matzdorf & Lorenz, 2010). This is an open-ended discussion when I present some thoughts on the roles of intrinsic and extrinsic motivation, and potential differences in motivations between the contract types.

First, I suggest that the high environmental performance under the two PES schemes might result from the design of contracts, when the action-based contracts required intensive watering that was significantly associated with tree survivals, and the outcome-based contracts paid according to the number of surviving trees. In this respect, I was interested whether under the action-based treatment the trees were watered for the sake of monitoring, which would indicate extrinsic rather than intrinsic motivation.

Indeed, I found that the compliance with the watering requirement significantly dropped after the first monitoring. In this regard, it is important to mention that the farmers expected the first monitoring with high probability, whilst the timing of the second monitoring was rather surprising for them. Thus, the significant decrease by 3.84 trees in the number of the watered trees in the second monitoring round shows that the compliance under the action-based contracts was decreasing with decrease in the expected probability of monitoring.[21] Moreover, regressing the monitoring results on the conservation payment reveals increase in the number of watered trees between 3.3 and 3.4 trees in the first monitoring round (Table 21: columns 1-2), and between 10.6 and 13.4 trees in the second monitoring round (Table 21: columns 3-4), for 10,000 KSh increase in the payment. Hence, the contract compliance being increasing with the payment amounts also indicates on external motivation under the action-based contracts.

[21] Paired t-test of numbers of watered trees, out of 30, in the first and second monitoring rounds: difference=3.84; p=0.019; n=44.

Table 21 Watering compliance under action-based contracts

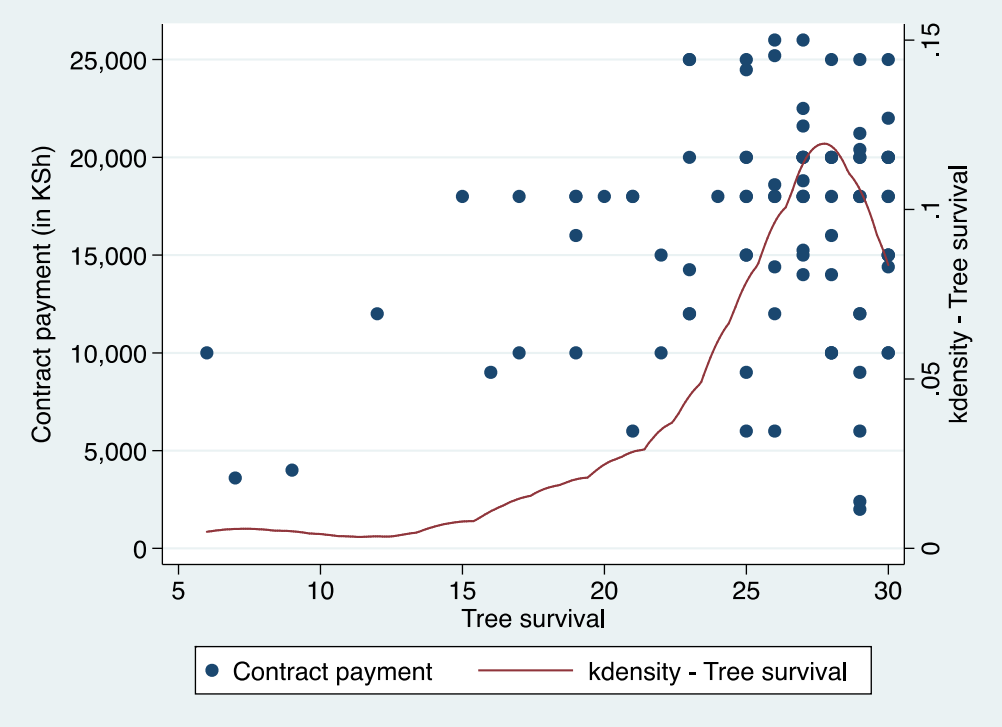
	(1) OLS	(2) Marginal effect (NB)	(3) OLS	(4) Marginal effect (NB)
	1st monitoring round		2nd monitoring round	
Conservation payment				
Payment in units of 10,000 KSh	3.329+	3.374+	10.612***	13.373**
	(1.819)	(1.930)	(2.655)	(5.141)
Constant	23.316***	-	8.529	-
	(3.498)		(5.239)	
Observations	44	44	44	44
F-statistics/Wald chi-squared	3.35+	2.79+	15.98***	5.82*
R-squared	0.114	-	0.289	-
Adjusted R-squared	0.093	-	0.272	-

Notes: (1) OLS regression of the number of watered trees in the first monitoring round on the conservation payment (in units of 10,000 KSh). (2) Marginal effect of negative binomial regression regressing the number of watered trees in the first monitoring round on the conservation payment (in units of 10,000 KSh). (3) OLS regression of the number of watered trees in the second monitoring round on the conservation payment (in units of 10,000 KSh). (4) Marginal effect of negative binomial regression regressing the number of watered trees in the second monitoring round on the conservation payment (in units of 10,000 KSh). Robust standard errors are in parentheses. P-values: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001. Controlling for the other variables (for description of the variables see Table 5) does not change the payment variable parameters.

At the same time, the tree care assessment disclosed landholders with result-oriented contracts to be more likely to conduct tree-care activities additional to watering. This, together with the above evidence on watering requirement compliance seems to indicate that the outcome-based compared to the action-based contract indeed enhanced intrinsic motivation towards tree survivals. However, though the extent of the implementation was significantly lower compared to the outcome-based treatment, the landholders with action-based contracts did not just follow the contract requirement on keeping the soil around the trees moist, but also them conducted weeding and fertilizing, guarded trees from people and animals, and applied insecticides and pesticides. Also, the specified motivation of more than half of action-based farmers to care for seedlings was based on tree survival, and not soil moisture and the payment alone (Table 22). This, actually, suggests that also the action-based contract holders were to some extent aiming at tree survivals.

Further, the finding on the environmental performance being increasing with payment surpluses indicates that the payments, in general, provided incentive for better care taking. At the same time, however, a number of low payments also resulted in high tree survivals (Figure 11).

Figure 11 Contract payments and tree survivals



This lets me hypothesize that the low cost participants might be either intrinsically motivated, or might expect future tree benefits, which would refer to rather extrinsic motivation. Regarding the latter, the evaluation survey reveals participants being largely satisfied with the tree species (94 percent), and all being expecting tree benefits such as firewood, fodder or leaves for mulching. There are, however, time lags between planting the trees and the benefit provision, when the participants expected some benefits and substantial benefits in five and ten years from the project start.

Table 22 Responses to questions assessing intrinsic motivation

	Targeted farmers (n=411), Affirmative answers	
More trees lead to a better water quality	378 (92.0%)	
More trees increase the water quantity	392 (95.4%)	
Conservation plays an important role in the society	405 (98.5%)	
I feel obliged to conserve the environment	389 (94.6%)	
I am willing to protect water in my area	408 (99.3%)	
People in this area are generally concerned with conservation	287 (69.8%)	
Farming at the riparian banks affects water quality	320 (77.9%)	
My water quality is affected by activities of people upstream	322 (78.3%)	
There is a relationship between my farming activities and the water quality in the area	240 (58.4%)	
	Contracted farmers (n=98) Farmers who 'very much agreed'[a]	
	Action-based (n=44)	**Outcome-based (n=54)**
A good farmer cares for plants on his farm	37 (84.1%)	47 (87.0%)
I feel obliged to plant a tree once receiving a seedling	38 (86.4%)	49 (90.7%)
I feel obliged to take good care of a tree once planted	40 (90.9%)	50 (92.6%)
Planting trees is a responsibility	34 (77.3%)	48 (88.9%)
The importance of tree planting increased with being selected in a competitive tender	35 (79.5%)	37 (68.5%)
The importance of tree planting increased with the signing of a contract	29 (65.9%)	38 (70.4%)
How would you feel about a tree you planted dying: i. nothing, ii. disappointed (incurred cost), iii. sad?	i. 0, ii. 21 (47.7%), iii. 23 (52.3%)	i. 0, ii. 27 (50%), iii.27 (50%)
Did you aim at i. tree survival, ii. moist soil, or iii. both i. and ii.?	i. 26 (59.1%), ii. 1 (2.3%), iii. 17 (38.6%)	-
What was your main motivation for tree watering: i. tree survival, ii. payment, iii. both?	i. 25 (56.8%), ii.0, iii. 18 (40.9%), 1 missing	-

[a] The questions used a scale from 1 to 5, where 1 corresponds to "I agree very much" and 5 to "I very much disagree".

With respect to the former suggestion on the PES participants being intrinsically motivated, the targeted population and the contract holders indeed showed high intrinsic motivation towards conservation and trees. Environmental awareness and general willingness to contribute to conservation was very high, with values close to 100 percent. The awareness slightly drops to 78 percent when it comes to farming effects along the river bank on water in general, and further falls to 58 percent when prompted to judge one's own farming effects on water. In addition, the auction allocation mechanism and the contract signing procedure appear to increase the PES participants´ motivation towards tree planting. In particular, between 74 percent and 68 percent of participants very much agreed that the importance of tree planting was increased by being selected in a competitive tender and by the signing of a contract, as opposed to a situation without a tender or contract (Table 22).

Moreover, the participants showed largely satisfaction with the participation in the tree planting project, wherein 75 percent appreciated the participation in the field trial due to gain of knowledge on tree benefits and skills on tree planting and management, while other appreciated the project participation to establish a sense for responsibility, commitment and time planning.[22] Also, 80 percent of the participants were trusting they would receive the payment.[23] For comparison, only 9 percent of the participants stated that people could be generally trusted. Yet the participants' statements indicate that the PES schemes could promote intrinsic motivation, 61 percent of the contract holders still stated that without the payment most people would not perform tree care as the contracts required.[24]

Finally, though the landholders were not obliged to keep the planted trees after the PES scheme end, I discovered average survival rates of 20.6 trees, and median of 22

[22] The question was open, asking, „What lessons did you learn from the project?"

[23] How much did you trust that you would receive the payment for tree planting after the six month period? Answers on a scale between 1 and 5, when 1 denotes trusted very much and 5 is did not trust at all.

[24] Do you agree or disagree that most people would breach the conservation contract, that is would not be fulfilling the requirements, if there were no payment? Answers on a scale between 1 and 5, when 1 denotes agree very much and 5 disagree very much.

trees, by the tree survivals assessment one year after the project end, in August 2013. These are about five trees less, compared to the tree survivals in June 2012, without significant difference between the former treatments.[25] The high survivals show on continuous care taking for the planted trees after the one-shot conservation payments. According to the interviewed farmers they expected long-term tree benefits, but also generally took more care of trees since their participation in the PES scheme. The continuity results thus suggest that while the conservation payments helped to overcome the initial costs of the most labor intensive phase, the participants continued with the tree care after the six months period, being driven by expected tree benefits and enhanced intrinsic motivation.

4.6. Discussion and conclusion

The hypothesis on the outcome-based approach to achieve better environmental performance could not be confirmed, with the tree survivals being statistically undistinguishable for the action-based and outcome-based contracts. On the other hand, the field trial disclosed participant´s gender, education, group participation, and the payment amount to impact the tree survivals.

In this regard, the significant association between the tree survivals and payments provides supporting evidence on the argumentation that decreasing the gap between informational rents and true opportunity costs might negatively affect the environmental performance, as suggested in the PES literature. The negative effect of education might be possibly clarified by the opportunity costs being increasing with the education level. Social network benefits in terms of labor sharing and conflict prevention might then perhaps explain the positive effect of group participation. The gender effects are discussed in Chapter 5.

Further, I found the type of contract to play a role in defining tree care, with outcome-based contract holders being more likely to conduct entire care taking actions,

[25] Two-sample t-test with equal variances (p=0.300).

conducted in addition to watering. Thus, I could confirm the hypothesis that the outcome-based treatment has incentivized a choice of activities that is expected to lead to the desired outcome. Nevertheless, the observed additional tree care under outcome-based contract holders did not translate into higher tree survivals. In this respect, I found the watering intensity under the action-based contracts to be positively correlated with the tree survivals, which leads me to speculate that, given the indifferent watering intensity between the contract types, the treatment difference in the additional tree care alone could not significantly influence the environmental performance. Perhaps, if formulating the watering requirement as less demanding I might find more variation in the tree survivals of the action-based contracts.

Finally, the considerations on intrinsic and extrinsic motivations are end-open. The farmers clearly had intrinsic motivation from the outset of the study; however surpluses in the conservation payments led to higher tree survivals and higher compliance with the watering requirement. Monitoring also played a crucial role in the watering intensity under action-based contracts. High performance of participants who received low payments and the continuity results might refer to intrinsic motivation and/or expected future tree benefits.

5. Action- and outcome-based payments for environmental services: Gender aspects in tree planting contracts in Kenya

5.1. Objectives and hypotheses

In the foregoing bid and tree survivals analyses statistically significant gender effects were revealed. Hence, I can fully confirm the fifth hypothesis of the dissertation on participant´s gender to impact PES schemes in terms of willingness to accept and environmental performance. The main aim of this chapter is to examine gender roles and attitudes, and their implications in the implementation of action-based and outcome-based PES schemes.

Notes: Former contract holder with a project tree. September 2013, one year after the project end.

Based on the above evidence (Chapters 3 & 4) I confirm the fifth hypothesis:

5. Participant´s gender impacts PES schemes in terms of willingness to accept and environmental performance.

In this chapter I examine the last sixth hypothesis of the dissertation:

6. There is a relationship between gender impacts on PES and gender roles and attitudes.

5.2. Conceptual framework

I adapted the "Gender Box" framework of Colfer & Minarchek (2013) to analyze gender aspects that I consider of importance with respect to the implementation of PES schemes. The framework was originally developed for identifying gender issues relevant to forestry, assigning them to macro, meso, or micro scale. The scales are rather flexible when each issue has some relevance across all scales, while the micro-level is considered as the most powerful in determining the main drivers.

The data of my study predominantly refer to the micro scale. At the meso and macro scale, I compare my findings to other regions in Kenya and Sub-Saharan Africa. I did not analyze all the listed factors, but rather focus on those, which I consider most relevant for the tree planting PES schemes. Additionally, as I deal with conservation payments and thus, economic decisions, I add risk attitudes to the relevant factors at the micro scale (Table 23).

Table 23 Framework for analyzing gender implications in PES schemes

Gender-specific factors that might impact PES schemes
Macro scale (global to national level)
Laws & policies (e.g. conservation, rural development & land tenure)
Cultural & religious trends
Meso scale (regional to landscape level)
Resource allocation (e.g. customary land and tree tenure, inheritance & residence)
Norms of behavior in conservation, forestry & agriculture
Access to education & trainings
Importance of cash activities (e.g. cash crops, salaried work & remittances)
Micro scale (village/community to intra-household level)
Intra-household decision-making and power dynamics (also in terms of conservation, forestry & agriculture)
Labor division (also in terms of conservation, forestry & agriculture)
Economic roles & Risk attitudes
Demographic issues (e.g. migration, population changes & density)
Alternative economic strategies (e.g. livelihood diversification, time constrains & distribution of benefits)

Notes: The framework is adapted from Colfer & Minarchek (2013: p. 412-413, Tables I & II).

5.3. Results

5.4. Gender and conservation auction

I proved gender to significantly impact the willingness to accept in conservation auctions, and the effects to differ for the action-based and outcome-based contract types. In particular, I found (i) women to submit 23 percent lower bids in the action-based versus outcome-based treatment, and conversely 30 percent higher bids in the outcome-based versus action-based treatment, whilst men did not react differently to the two treatments. In addition, there was (ii) a statistically significant decrease of 36 percent in women´s versus men´s bids, or conversely an increase of 55 percent in men´s versus women´s bids, in the action-based treatment (Chapter 3).

Using the gender-disaggregated data analysis, I examine the relationship between the revealed gendered treatment effect on bids and risk behavior of men and women, and subsequently explore potential links between the gender differences in bids and gender roles.

Risk attitudes

I elicited risk behavior of the targeted population using a general risk question "Are you generally a person who is fully prepared to take risks, or do you try to avoid taking risks?" and providing a scale between 0 and 10, where the value 0 means "unwilling to take risks" and the value 10 means "fully prepared to take risks". In the conservation auctions (Table 5) the bids were increasing with increasing risk seeking, which is in accordance with the theoretical prediction that risk averse participants lower their bids in order to increase the probability of winning a conservation contract. Particularly, the rationale behind is that the conservation payment decreases landholders´ income uncertainty (Latacz-Lohmann & Van der Hamsvoort, 1997).

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 me to hypothesize that women in contrast to men have requested risk premiums. This is in line with the arguments that the adoption of agroforestry and other investment opportunities reflects gendered differences in exposure to and perceptions of risk (Villamor et al., 2014b), and that "men and women may differ in their willingness to assume risks with respect to the provision of ecosystem services" (Villamor & van Noordwijk, 2016; p. 77).

However, the elicited risk behavior does not reveal women being more risk averse than men.[26] This is not only untypical for a development country setting, but also means that the higher aversion of women to the outcome-based approach was not predicted by the elicited risk attitudes. This is consistent with the study of Dohmen et al. (2011) who found the general risk question as the best overall predictor, but proposes that context specific questions might provide better measures on risk attitudes within their particular domain. In this case it would imply to additionally examine specific risk questions concerning the outcome-based approach.

Gender roles

I explore the intra-household decision-making, labor division, and income generation of the target population in order to provide answer on the ways traditional gender roles might impact the conservation auctions, and PES schemes in general.

The baseline survey revealed men to be traditionally perceived as the household head. In 20 percent of the surveyed households, women assumed headship, mostly due to husband´s urban labor migration or their status as widowers. The shift in headship is even more remarkable in Western Kenya, but also other African countries such as Zimbabwe, where over fifty percent of the households were found to be female-headed

[26] Multinomial logistic regression of general risk attitudes (scale 0-10) on gender (n=407).

(Kiptot & Franzel, 2011). Land tenure in the study area is also associated with the male household representatives (Bedru et al., 2011). This shows that even if the 2010 adopted Constitution of Kenya eliminated gender discrimination related to land and property in land,[27] traditional rules still prevent women from possession of land. Expressing it in the terminology of Colfer & Minarchek (2013), a change at the macro level has not (yet) been translated into changes at the micro level. A similar situation is reported in Tanzania where by law, men and women are granted equal land ownership and inheritance rights, nevertheless customary laws still exclude women (Kiptot et al., 2014).

More importantly, men hold exclusive rights in high value sectors. Particularly, men are the main decision-takers and payout recipients from cash crops (UTaNRMP/IFADb, 2012). Further, the intra-household analysis - of male-headed households - shows that men are also dominant in the tree management, being the only decision-takers in 50 percent of households, as opposed to 15 percent for women (Table 24). In this regard, exotic tree species of high economic value such as Eucalyptus and Grevillea robusta dominate in the study area (Hoang et al., 2014; UTaNRMP/IFAD, 2012a). Consequently, the men´s authority over tea and coffee production and tree management matches studies across Africa that show men´s concentration on the wholesale trade and high-value crop trees such as cocoa, coffee, and oil palm (Kiptot & Franzel, 2011; Rocheleau & Edmunds, 1997). Moreover, with respect to the men´s dominance in tree management, cultural beliefs might additionally prevent women from tree planting (Kiptot & Franzel, 2011; Franzel et al., 2007).

Similarly, the observed dominance of women in subsistence farming is also consistent with other studies from Sub-Sahara Africa (Kiptot & Franzel, 2011; Meijer et al., 2015; Rocheleau & Edmunds, 1997), wherein I find women to have greater stakes than men in decisions related to harvesting, weeding, and crop consumption. At the same time, men more frequently make individual decisions on the purchase of inputs and

[27] Constitution of Kenya, 2010. Chapter 5-Land and Environment. Part 1 – Land. 60(1): (f).

children´s education while gender roles are balanced in decisions on what crops to plant, whether to hire labor, what produce to sell, on overall household´s expenses and savings, and on caretaking for relatives (Table 24).

Table 24 Intra-household decision-making in male-headed households

	Male only	Female only	Jointly	N
Agricultural production & Farm labor				
Crops to plant	27	27	46	327
Crop harvest	15	32	53	325
Weeding	13	37	50	327
Mulching	22	28	50	237
Labor to hire	26	28	46	275
Tree management				
Trees to plant	50	15	35	315
Tree pruning	50	18	32	291
Resource allocation & Produce marketing				
Household expenses & savings	21	21	58	322
Inputs to purchase	33	17	50	324
Farm produce to sell	25	25	50	317
Farm produce to keep for consumption	17	35	48	316
Family care				
Children´s education	37	11	52	246
Caretaking of relatives	15	18	67	272

Notes: The table is based on the following question from the baseline survey: Who among the household members serves as the decision-maker for the following activities, and who performs the activities? The gender roles were assessed from following options: (i) Male household member only, (ii) Female household member only, (iii) Both male and female household members. The figures in the table are indicated in percent, that is of the number of households taking decisions on the activity (denoted as N), what was the share in percent conducted solely by men (denoted as male only), solely by women (denoted as female only), or jointly by men and women (denoted as jointly). Female-headed households (N=82) are excluded from the analysis, resulting in the total number of 327 observations.

Further, the labor division and resource allocation - in male-headed households - to a great extent reflect the decision-making roles, wherein men invest most labor in tree management, and joint and women´s labor dominate in food crop production. Similarly, men are more frequently responsible for the purchase of inputs, and assisting children with school. On the other hand, whereas labor hiring and conduct of household expenditures remain a joint task, in several areas of joint and men´s decision-making women invest more labor than men. In particular, while there is joint decision-making on marketing produce, it is the women who are mainly selling the produce to the market. Further, although decisions on caretaking of relatives are taken jointly, more women than men do assume the responsibility (Table 25). Similarly, while men dispose over decision rights and earnings from the cash crops, women are the main collectors of tea leaves and coffee beans (UTaNRMP/IFAD, 2012b).

The findings concur with the literature showing that although women perform most of the labor in agricultural production, women have limited rights over produce, are prevented from decision-making on cash crops, and normally have obligations to provide labor for male controlled fields while there is no reciprocal responsibility for the men (Kiptot & Franzel, 2011; Kiptot et al., 2014). Simultaneously, a special case represents households where women assumed headship, wherein a separate analysis of female-headed households shows that women, in the absence of their husbands, additionally perform the men´s tasks; and that despite of 80 percent of the female-headed households do include male representatives, being it adult sons or other relatives.

Table 25 Labor division and resource allocation in male-headed households

	Male only	Female only	Jointly	N
Agricultural production & Farm labor				
Planting crops	14	37	49	309
Harvesting crops	14	37	49	308
Weeding	13	44	43	307
Mulching	20	38	42	218
Hiring of labor	35	35	30	267
Tree management				
Planting trees	48	20	32	301
Pruning trees	57	18	25	264
Resource allocation & Produce marketing				
Making expenditures	22	26	52	317
Inputs purchase and use	42	28	30	318
Farm produce retailing	24	46	30	312
Family care				
Assisting children with school performance	43	21	36	244
Caregiving to relatives	11	34	55	268

Notes: For details on the assessment see notes of Table 24. The number of the observations (demoted as N) shows the number of households performing the activity. Female-headed households (N=82) are excluded from the analysis, resulting in the total number of 327 observations.

Next, the comparison of the household´s income shares generated by men and women reveals that traditionally men are the key earner in the household, while women assume the main income generation role only in the absence of the husband. Specifically, men represented the main cash income generator, contributing over 60 percent of the household´s main income, in 45 percent of the targeted households; while the women that mainly contribute to household's income accounts to 35 percent of the households. Moreover, considering the male-headed households only, the proportion of women who provide most of the household´s income further drops from

35 to 20 percent, and accordingly, the share of men being the main earner increases from 45 to 55 percent. In the remaining households, both male and female household´s representatives contributed between 41 and 59 percent to the main income.

In total, men on average generated about 20 percent more income than women, or women contributed 17 percent less to household´s income than men (Table 26: column 1). Again, excluding the female-headed households from the analysis, the gender gap becomes much more remarkable, with 75 percent increase in men´s versus women´s income, or conversely, 43 percent decrease in women´s versus men´s income (Table 26: column 2). The gendered incomes are consistent with the above evidence that men hold rights in the upper end of the value chain, in that, the female dominated food crop sector yields significantly lower incomes, compared to the men-controlled cash crop and timber production.

Further, yet women´s income in female-headed households almost double compared to women in male-headed households (Table 26: column 3), overall, male-headed households still generate 45 percent more income than households with female heads. This shows that despite women's assumption of income-generating activities due to absence of men, they could not fully earn the same level of income as men, suggesting that female-headed households are especially cash constrained. In this regard, in our study 20 percent of the targeted households were female headed, and 21 percent of the auction participants and 18 percent of the contract holders were women who assumed household´s headship.

Moreover, men´s income sources were far more diversified, when over 30 percent of men derived their income from business and salaried work that generate up to 50 percent higher incomes compared to the female dominated crop production.

Table 26 Gendered incomes

	(1)		(2)		(3)	
	All households		**Male-headed**		**Female-headed**	
Male	71,827	(6,336)	89,399	(7,619)	1,752	(1,006)
Female	59,857	(6,074)	51,066	(6,535)	94,914	(14,912)
Difference	11,970+	(6,607)	38,333***	(6,599)	-93,162***	(15,071)
N	409		327		82	

Notes: (1) Means of main household´s income in KSh generated by men and women for all surveyed households. (2) Means of main household´s income in KSh generated by men and women in male-headed households. (3) Means of main household´s income in KSh generated by men and women in female-headed households. Standard errors are in parentheses. Differences in means using paired t-test. + p<0.1, * p<0.05, ** p<0.01, *** p<0.001. The analysis is based on following survey questions: (i) What is the household´s total yearly gross income in KSh? (ii) What is the percentage of the main income on the total household´s income? (iii) Indicate in percentages how much of the household´s main income is earned by (a) male (b) female (c) both.

From the foregoing discussion I hypothesize on two potential drivers of the gender effects on bids. First, the gendered incomes suggest on lower returns to female labor. Consequently, as auction bids should be related to compliance costs, the lower female bids could be a result of lower opportunity costs of women. At the same time, however, the labor division analysis shows women to face higher labor constraints than men. In this regard, I posit a second complementary hypothesis that for women the cash income from conservation payments was of higher importance than for men. The reasoning beyond is that, as presented above, women compared to men face increased cash constrains and lack alternative income opportunities, which might lead them to reduce their bids in order to increase their chance of receiving the contract.

The evaluation survey then provides additional supportive evidence on the latter hypothesis. First, most women alike men were willing to accept a tree planting contract at the same price again, showing women were satisfied with the received payments. Second, women more than men used the chance to decide alone on the use of the conservation payment, with 67 percent of men, but only 44 percent of women deciding jointly with their spouses. Third, for women the conservation payment represented more improvement in their livelihoods than for men. Particularly, 64 percent of

women, but only 51 percent of men stated the conservation payment "much" improved their livelihood, while for 36 percent of women and 44 percent of men the improvement was only "little", and two men (5 percent) stated no improvement at all. Overall, this leads me to suggest that the gender roles impact opportunity costs and access to cash of men and women, and accordingly provided source of the gendered heterogeneity in bids.

5.5. Gender and environmental performance

The tree survival analysis proved men to achieve about 7 percent higher tree survivals than women (Chapter 4), wherein there were no significant differences in tree survivals between the treatments. Since in the study the natural conditions for tree planting were fairly equal, wherein the same mix of indigenous trees had to be planted on riparian land, I narrow my focus on the tree care as possible driver of the gendered differences in tree survivals. I explore first conservation knowledge of men and women, which I consider key for the tree care to translate into the desired environmental outcome, and continue with the assessment of the tree care provided by male and female PES participants.

Conservation knowledge

The baseline assessment of the conservation knowledge reaffirms tree planting as a predominantly male task, while men´s labor also prevails in erosion-abatement practices such as terraces building and grass strips planting. Similarly to tree planting, the men´s dominance over grass strips and napier grass might be explained by their commercial value as fodder (UTaNRMP/IFAD, 2012b). Women are then mainly conducting soil improvement practices such as crop rotation, cover cropping and mixed cropping, and use of drought resistant crops; thus confirming women´s prevalence in the food crop sector. Also, the traditional women´s responsibility for domestic water supply has been confirmed by their prevailing responsibility for roof water harvesting. The only practice conducted fairly equally by both male and female household members is contour ploughing (Table 27).

Table 27 Labor division for conservation practices in male-headed households

	Male only	Female only	Jointly	N
Tree planting	48	18	34	297
Erosion terracing	70	19	11	228
Contour ploughing	37	31	32	132
Grass strips	61	23	16	129
Napier grass	44	26	30	308
Crop rotation	19	42	39	203
Cover cropping	22	54	24	140
Mixed cropping	12	44	44	291
Drought resistant crop	31	49	20	224
Roof water harvest	26	61	13	174

Notes: The table is based on the following question from the baseline survey: Do you practice any of the following soil and water conservation methods, and who is performing the methods? The gender roles were assessed from following options: (i) Conduct of the activity by the male household member only. (ii) Conduct of the activity by the female household member only. (iii) Joint conduct of the activity by both male and female household members. The figures in the table are indicated in percent, that is of the number of respondents practicing the activity (denoted as N), what was the share in percent conducted solely by men (denoted as male only), solely by women (denoted as female only), or jointly by men and women (denoted as jointly). Female-headed households (N=82) are excluded from the analysis, resulting in the total number of 327 observations.

Therefore, gendered roles in conservation can be posited, which corroborates other study findings highlighting gendered decision-making as an important determinant of the adoption of tree planting and agroforestry technologies (Kiptot & Franzel, 2011; Meijer et al., 2015). Given that men were considered traditional decision-makers on trees, I addressed potential gender gap in tree planting knowledge by the training that were offered to all contract holders in their vicinity prior delivering the tree seedlings. Moreover, an inspection at the beginning of the contract period revealed all tree seedlings to be appropriately planted. Hence, better tree planting knowledge of men does not appear as the actual reasoning beyond the increase in men´s environmental performance. In this respect, I further scrutinize whether differences in the tree care might be responsible for the variation in the tree survivals.

Tree care

The tree care analysis has revealed that men allocated significantly less time to tree care than women, and that women were more likely to conduct the two most frequent tree care activities after watering, that are weeding and fertilizing (see 4.4). Aiming at explaining the decrease in tree survivals for women, discovering female contract holders to provide more effort than men is actually contra-intuitive. Therefore, in the next step I examine whether there were differences in the reciprocal support of husbands and wives in implementing the conservation contract.

Particularly, the gender-disaggregated data reveal that more women than men have provided labor support in the three main tree management activities to their spouses who were awarded the contract. For the case of watering - the most frequent and labor intensive activity – female contract holders provided own labor in 76 percent, but men only in 67 percent. The gender gap is even more remarkable for weeding, which is also a regular and labor intensive practice, where the increase in provision of own labor for contracts being awarded to women represents 17 percent. In other words, for 22 percent of male contract holders their wives conducted the weeding labor, but only 9 percent of female participants received reciprocate support from their spouses. Next, for fertilizing - the third most frequently conducted tree care action - the increase in female individual labor represents 11 percent. On the other hand, use of insecticides and pesticides was the only activity dominated by male labor, with men being almost exclusively responsible in case they were the contract holders while also providing great support to their wives. This might relate to the traditionally prevalent role of men in the purchase of inputs, whereas the activity was marginally implemented compared to the activities with considerable role of women. In addition, the contract holders - regardless of gender - were predominantly protecting trees from damage by people and strayed animals (Table 28).

Table 28 Labor division for tree planting contracts in male-headed households

	Contract holder only	Spouse only	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 table is based on the following open question from the evaluation survey: Rank the most important activities that you have done to maintain the 30 trees in the last 6 months, and indicate who was conducting the activities. The gender roles were assessed from following options: (i) Conduct of the activity by the male household member only. (ii) Conduct of the activity by the female household member only. (iii) Joint conduct of the activity by both male and female household members. 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 (denoted as contract holder only), solely by the spouse of the contract holder (denoted as spouse only), or jointly by the contract holder and the spouse (denoted as jointly). N[a] In total 98 contracts were awarded, 43 to men, and 55 to women. Female-headed households (N=18) are excluded from the analysis, resulting in 43 male and 37 female contract holders of male-headed households. Out of these, 33 men and 33 women were interviewed on labor division under the conservation contracts, wherein the missing interviews (10 for male and 4 for female contract holders) are random.

Hence, the substantial support of women to their husbands in the most frequent tree care practices is consistent with the above finding that women are investing labor into men´s activities while benefiting rather sporadically from men's labor. The unequal labor support is also in line with other studies in Sub-Sahara Africa, showing that women normally have obligations to provide labor for male controlled fields while there is not such a responsibility for the men. Moreover, the labor provision to men´s fields is even considered superior over women´s own labor (Kiptot & Franzel, 2011; Kiptot et al., 2014). In addition, 18 of the total of 98 contracts were awarded to female-headed households, in which basically women alone performed all tree caring activities (Table 29).

The findings thus show that not only the gender roles, but also the traditionally rooted inequality in mutual labor support translated into the PES schemes; with the latter providing a possible explanation for male contract holders - despite of investing less effort - to achieve significantly higher tree survivals than women.

Table 29 Labor division for tree planting contracts in female-headed households

	Female contract holder only	Male household´s member only	Jointly	N
Watering	87	6.5	6.5	15
Weeding	87	6.5	6.5	15
Fertilizing	92	7	-	13
Guarding from people	89	11	-	9
Guarding from animals	100	-	-	5
Insecticides/Pesticides	67	33	-	3

Notes: The table is based on the question described in Table 28, and assesses exclusively the female-headed households (N=18) that were excluded from the former labor division analysis. Of the 18 female-headed households 15 contract holders were interviewed on gender-disaggregated labor division under the conservation contracts, wherein the three missing interviews are random.

5.6. Barriers to women´s participation

In addition, based on the above gender-disaggregated analysis, I identified following potential barriers for women to participate in PES schemes: (i) men´s supremacy in high-value fields, (ii) the prevailing male land tenure when tree planting and conservation practices are conducted on men´s land, (iii) male dominance over tree management and erosion abatement practices, (iv) high labor constrains for women, in general and in female-headed households in particular, (v) men´s experience with negotiations given their role as registered producers with tea and coffee factories, and (vi) cultural beliefs that might exclude women from certain activities, including tree planting or use of certain tree species.

In response to women´s barriers to participation, I applied a gender sensitive design that has resulted in desired participation rates of men and women (see 2.1). Comparing to other studies that sampled at the household level, I have achieved higher participation rates of women. Specifically, a previous study in the same area had 61 percent male and 39 percent female survey respondents, explaining the gender distribution as result of the male-dominated culture (Bedru et al., 2011). Also, in the auction study in Malawi, participants were less frequently female, compared with non-participants (Jack 2009, p. 10). However, I cannot conclude on a significant relationship between the sampling approach I used and the participation level of women, as the study design does not include a counterfactual to compare participation rates. Rather, I state that the stratified sampling by gender was successful in achieving a gender balanced study.

5.7. Discussion and conclusion

The randomized field trial revealed the participants´ gender to significantly impact the willingness to accept and environmental performance of the action-based and outcome-based tree planting PES schemes, wherein we found evidence on associations between the gender effects and traditional roles of men and women.

First, I identified lower opportunity costs, in terms of returns to labor, and increased cash constrains for women as potential drivers for the 36 percent decrease in women´s compared to men´s bids in the action-based treatment. I argue that women not only earn less cash income than men, but also for women – who traditionally depend on the subsistence farming - the conservation payment represents a very important cash income opportunity. This is a completely new insight, as it suggests that beside the household´s opportunity costs also the intra-household differences determine the bids.

Second, I suggest that the 30 percent increase in female bids in the outcome-based compared to action-based treatment reflects higher aversion of women than men to the risk of not achieving the desired outcome. Thus, while in the action-based treatment women´s bids - compared to men - were significantly lower, tendering outcome-based contracts shows statistically undistinguishable bids for men and women. In trying to link the gendered treatment effect to general risk behavior I realized that the gender specific difference in perceptions of risk in the outcome-based approach was not predicted by the elicited risk attitudes. The findings highlight that risk behavior is context specific, and that gendered responses should be considered in the PES design.

Third, aiming at explaining the gender differences in the environmental performance I could prove that all participants - men and women - planted trees in appropriate way, and that women provided more effort than men in the contract implementation. And yet, men achieved 7 percent higher tree survivals than women. Again, the intra-household differences provided possible answer, when I revealed inequality in reciprocal labor. More women than men have provided labor support in the three main

tree care activities to their spouses who were awarded the contract, and in the 18 female-headed households - out of 98 - women did not receive any support at all.

Additionally, in this respect, the question arises whether awarding contracts to women is a good idea, as this exposes them to even higher labor burden. The female participants were, however, willing to accept a tree-planting contract, at the same price, again. This suggests that women prefer to fully provide labor and receive the contract payment, as they will have to contribute to labor anyway without being awarded if their husbands were to receive the contract. Moreover, the 30 percent decrease in women´s bids for action-based contracts implies that, despite of the 7 percent decline in women's tree survivals, allocating the action-based contract to women was highly cost-effective. The effectiveness gain of awarding contracts to women was, however, neutralized when tendering contracts tied to outcome.

Finally, I outline some considerations in the design of gender sensitive PES schemes:

- Examine men´s and women´s roles, risk behavior, preferences, and constrains at the initial stage of PES scheme planning.
- Apply gender sensitive participatory approaches to increase women´s participation and generate gendered perspectives on environmental issues and possible solutions. Special attention has to be paid to marginalized female-headed households, in particular if greater gender equity is the goal.
- PES policies should match preferences of men and women into the PES design. These include among others, decisions on conservation practices, environmental outcomes, tree and shrubs species, contract design, conservation payment, and non-financial benefits.
- Integrate gender aspects into the evaluation and revision of PES schemes, with respect to both equity and effectiveness.

6. Conclusion

6.1. Main findings and contribution of the dissertation

Theory predicts that outcome-based payments, relative to action-based payments, offer more flexibility in the choice of relevant conservation actions, and can improve a landholder's intrinsic motivation for the actual conservation outcome. On the other hand, the result-oriented approach is also associated with risk, which might prompt landholders to ask for higher payments. As these factors are expected to act in opposite directions, it is an empirical question, whether the incentive effect or the risk effect prevails. While both the auction allocation and linking conservation payments to outcomes have potential to improve PES effectiveness, there are only few studies examining the combined effect of tendering outcome-based contracts. Similarly, whereas the conservation community is increasingly acknowledging the importance of gender aspects, empirical results on gendered impacts in conservation, and PES schemes in particular, are relatively scarce. I have attempted to fill the research gaps by carrying out a field experiment in Kenya. To my knowledge, this PES study is the first one to compare auctions for action- and outcome-based contracts in a randomized field trial setting, and is also novel in that it applies a gender-sensitive approach that allows for assessment of gendered behavior.

Conservation auction

The first hypothesis on the risk effect to increase the bids for outcome-based contracts could be confirmed for female bidders. In particular, I found (i) women to submit 23 percent lower bids in the action-based versus outcome-based treatment, and conversely 30 percent higher bids in the outcome-based versus action-based treatment. At the same time, men did not react differently to the two treatments. In addition, the comparison within the treatments reveals (ii) a statistically significant decrease of 36 percent in women´s versus men´s bids, or conversely an increase of 55 percent in men´s versus women´s bids, in the action-based treatment.

Further, there is evidence on the willingness to accept to contain strategic elements, when bidders bid above, but also below their true opportunity costs. While overbidding resulted in contract prices being on average higher than the realized costs, the winner´s curse lead to contract drop-outs. Nonetheless, despite of the strategic behavior a fraction of the variation in bids could be explained, and highly significant and consistent effects were revealed.

In this context, I found that - besides the participant´s gender - personal characteristics, such as life satisfaction, risk attitudes and trust behavior, rather than opportunity costs observables determined the bids. Moreover, the impacts of gender and risk behavior were consistent with a contingent valuation elicitation, conducted prior the auction. While this suggests that the landholders reflected well-defined cost and risk expectations into their willingness to accept, the competitive bidding - in contradiction to the expectations - has not reduced the willingness to accept.

The average bid selected in the action-based treatment was significantly lower, compared to the outcome-based treatment. However, the potentially high effectiveness gains of the action-based auction have been neutralized due to a high drop-out rate of the low-cost bidders. Consequently, I could not confirm the second hypothesis on increased budgetary effectiveness of the auction for action-based contracts. At the same time, the revealed gender effects imply that it might be cheaper and thus more effective for the conservation agency to award action-based contracts to women. However, the increase in women´s bids in the outcome-based treatment shows that tendering outcome-based contracts might neutralize the potential effectiveness gains of targeting women. Thus, I found that the choice of the contract type might – as result of gendered bidding behavior - define the budgetary effectiveness.

Environmental performance

The third hypothesis on the outcome-based approach to achieve better environmental performance could not be confirmed, with the tree survivals being statistically undistinguishable for the action-based and outcome-based contracts. Consequently, the incentive effect did not outweigh the risk effect revealed for female bidders while there was no impact of the contract type for men. Moreover, the field trial disclosed participant´s gender, education, group participation, and the payment amount to impact the tree survivals. In this regard, the significant association between the tree survivals and payments provides supporting evidence on the argumentation that decreasing the gap between informational rents and true opportunity costs might negatively affect the environmental performance.

Further, I found the type of contract to play a role in defining tree care, with outcome-based contract holders being more likely to implement care taking actions conducted in addition to watering. Thus, I could confirm the fourth hypothesis that the outcome-based treatment has incentivized a choice of activities that is expected to lead to the desired outcome. Nevertheless, the observed additional tree care of outcome-based contract holders did not translate into higher tree survivals. Perhaps, if formulating the action-based contract requirement in the way that it does not correlate with the tree survivals, I might find more variation in the environmental performance of the two contract types.

The considerations on intrinsic and extrinsic motivations are then end-open. The farmers clearly had intrinsic motivation from the outset of the study; however surpluses in the conservation payments lead to higher tree survivals and higher compliance with the watering requirement. Monitoring also played a crucial role in the watering intensity under action-based contracts. High performance of participants who received low payments and the continuity results might refer to intrinsic motivation and/or expected future tree benefits. The mixed evidence suggests that considering long-term perspective in terms of behavioral change rather than short-term

achievement of conservation goals might relativize the effectiveness of budgetary savings, but also that there might be danger of conservation payments to crowd out intrinsic motivation. Consequently, careful considerations in general on the choice of conservation mechanism, and on the PES design in particular are essential.

Gender aspects

With respect to the fifth and sixth hypotheses the study revealed the participants´ gender to significantly impact the willingness to accept and environmental performance of the action-based and outcome-based tree planting PES schemes, while providing evidence on associations between the gender effects and traditional roles of men and women.

First, I identified lower opportunity costs, in terms of returns to labor, and increased cash constrains for women as potential drivers for the decrease in women´s compared to men´s bids in the action-based treatment. I argue that women not only earn less cash income than men, but also for women – who traditionally depend on the subsistence farming - the conservation payment represents a very important cash income opportunity. This is a completely new insight, as it suggests that beside the household´s opportunity costs also the intra-household differences determine the bids. Second, I suggest that the increase in female bids in the outcome-based compared to action-based treatment reflects higher aversion of women than men to the risk of not achieving the desired outcome. The findings highlight that risk behavior is context specific, and that gendered responses should be considered in the PES design.

Third, aiming at explaining the gender differences in the environmental performance I could prove that all participants - men and women - planted trees in appropriate way, and that women provided more effort than men in the contract implementation. And yet, men achieved higher tree survivals than women. Again, the intra-household differences provided possible answer, when I revealed inequality in reciprocal labor.

The study further suggests that women prefer to fully provide labor and receive the contract payment, as they will have to contribute to labor anyway without being awarded if their husbands were to receive the contract. Moreover, the 30 percent decrease in women´s bids for action-based contracts implies that, despite of the 7 percent decline in women's tree survivals, allocating the action-based contract to women was highly cost-effective. The effectiveness gain of awarding contracts to women was, however, neutralized when tendering contracts tied to outcome.

Finally, the findings not only confirm many of the concerns raised in the PES literature that tree planting, tree care, and conservation in general, might expose women to additional costs without gaining corresponding benefits if gender is not considered specifically in contract allocation and generally in PES designs. The study also shows that while targeting women improves gendered equity in terms of access to project decision-making, trainings and cash, it can also significantly improve the effectiveness of the PES scheme. However, as women might be more averse to risk associated with PES schemes, or – as the study by Villamor et al. (2014a) show - might react less positively to conservation than men, the PES scheme design should always be fine tailored to the local conditions, bearing in mind both the gender equity and conservation goals. Moreover, as Colfer & Minarchek's (2013) suggest the conservation agency has to consider whether to put effort into improvement within existing gendered roles and behavior, or to apply more powerful approaches to effectively balance men´s and women´s roles.

Contribution of the dissertation

The empirical study contributes to the priority topics of current PES literature – that is the effectiveness enhancement through the use of auctions and outcome-based payments (Schomers & Matzdorf, 2013). In a broader context the findings are also important in the light of carbon projects under the Reducing emissions from deforestation and forest degradation (REDD+) mechanism, developed by Parties to the United Nations Framework Convention on Climate Change (UNFCCC). Particularly, the

mechanism is usually assumed as performance based, when communities in developing countries would receive results-based payments for their actions (Skutsch et al., 2011). Moreover, the use of auctions is also considered, for instance for carbon payment schemes in the Amazon (Börner et al., 2010). Furthermore, at time of an increasing acknowledgment of gender aspects by the conservation community (Colfer & Minarchek, 2013), and of GEF´s commitment to enhancing the degree of gender mainstreaming, the dissertation represents a key contribution to the scarce evidence on gendered implications in the PES. Additionally, the study findings on gendered impacts on effectiveness might be key for motivating the conservation agencies to consider gender in environmental projects.

Further research

Further experiments on the action-based and outcome-based contracts would provide supplementary evidence with respect to budgetary and environmental effectiveness. Lessons learnt from this study, on the issue of how to define prescribed actions and desired outcomes, or the challenge of winner´s curse and strategic bidding, provide a base for further improvement of the experimental design. In addition, possible crowd out effects of introducing conservation payments on intrinsic motivation, and the impacts on non-participants remain open for further research.

6.2. Policy recommendations

Based on the above findings, I outline some considerations and policy recommendations for improved PES design and implementation:

- The decision on the action-based versus outcome-based approach has to be considered carefully, as I proved that the contract type has significantly impacted the bidding behavior.
- As women have shown to bid about 30 percent lower for action-based contracts than men, offering conservation payments to women might foster considerable effectiveness gains. These might be, however, neutralized if payments are fully tied to outcomes.
- The outcome-based approach incentivizes the choice of actions that is expected to deliver the desired outcome. However, if the desired conservation activities are known to the conservation agency, action-based contracts with monitoring might achieve the same outcome.
- The conservation agency should bear in mind that what is gained in budgetary effectiveness might get lost at the environmental performance. Also, in a long-term perspective a behavioral change is more effective than short-term achievement of conservation goals.
- From the initial stage of PES schemes gender roles and attitudes should be taken into account, and PES policies should match gendered perspectives on conservation into the PES design.

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 Development 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. Journal of Environmental Management 92: 2634-2646.

Baylis, K., Peplow, S., Rausser, G., Simon, L. (2008). Agri-environmental policies in the EU and United States: A comparison. Ecological Economics 65 (4): 753-764.

Bertke, E., Gerowitt, B., Hespelt, S.K., Isselstein, J., Marggraf, R., Tute, C. (2005). An outcome-based payment scheme for the promotion of biodiversity in the cultural landscape. Integrating Efficient Grassland Farming and Biodiversity (10): 36–39.

Bertke, E., Klimek, S., Wittig, B. (2008). Developing result-oriented payment schemes for environmental services in grasslands: results from two cases studies in North-Western Germany. Biodiversity 9: 91–95.

Börner, J., Wunder, S., Wertz-Kanounnikoff, S., Tito, M.R., Pereira, L., Nascimento, N. (2010). Direct conservation payments in the Brazilian Amazon: scope and equity implications. Ecological Economics 69: 1272–1282.

Burton, R. J. F., Schwarz, G. (2013). Result- Oriented Agri-environmental Schemes in Europe and Their Potential for Promoting Behavioural Change. Land Use Policy 30 (1): 628–41.

Cason, T., Gangadharan, L., Duke, C. (2003). A Laboratory Study of Auctions for Reducing Non-point Source Pollution. Journal of Environmental Economics and Management 46: 446-471.

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

Connor, J. D., Ward, J. R., Bryan, B. (2008). Exploring the Cost-effectiveness of Land Conservation Auctions and Payment Policies. Agricultural and Resource Economics 51 (3): 303–19.

Cummings, R., Holt, C., Laury, S. (2002). Using laboratory experiments for policymaking: an example from the Georgia irrigation reduction auction. Working paper of the Georgia Water Planning and Policy Center, 46 pp.

de Saint Marie, C. (2014). Rethinking agri-environmental schemes. A result-oriented approach to the management of species-rich grasslands in France. Journal of Environmental Planning and Management 57 (5): 704-719.

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., Wagner G.G. (2011). Individual risk attitudes: Measurement, determinants, and behavioral consequences. Journal of the European Economic Association 9 (3): 522–550.

Engel, S., Pagiola, S., Wunder, S. (2008). Designing payments for environmental services

in theory and practice: An overview of the issues. Ecological Economics 65 (4): 663 - 674.

Engel, S., Palmer, C. (2008). Payments for environmental services as an alternative to logging under weak property rights: The case of Indonesia. Ecological Economics 65 (4): 799-809.

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

Ferraro, P. J. (2008). Asymmetric information and contract design for payments for environmental services. Ecological Economics 65 (4): 810-821.

Ferraro, P. J., Simpson, R.D. (2002). The Cost-Effectiveness of Conservation Payments. Land Economics 78 (3): 339-353.

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.

García-Amado, L.R., Pérez, M.R., Escutia, F.R., García, S.B., Mejía, E. C. (2011). Efficiency of Payments for Environmental Services: Equity and additionality in a case study from a Biosphere Reserve in Chiapas, Mexico. Ecological Economics 70: 2361–2368.

GEF (2013). Mainstreaming Gender at the GEF, pp. 57.

Goddard, R., Whitten, S., Reeson, A. (2008). When should biodiversity tenders contract on outcomes? Paper presented at the 52nd Annual conference of the Australian Agricultural and Resource Economics Society. Canberra 6-8 February 2008. 1-20 pp.

Groth, M. (2005). Ausschreibungen in einem Konzept zur ergebnisorientierten Honorierung ökologischer Leistungen – Eine Transaktionskostenökonomische Analyse. Paper at the 45th annual conference of the German Agricultural Economics Society (GEWISOLA), Göttingen, Germany, October 2005.

Groth, M. (2008). Kosteneffizienter und effektiver Biodiversitätsschutz durch Ausschreibungen und eine ergebnisorientierte Honorierung: das Modellprojekt Blühendes Steinburg. No. 105. University of Lüneburg Working Paper Series in Economics.

Hailu, A., Schilizzi, S. (2004). Are auctions more efficient than fixed price schemes when bidders learn? Australian Journal of Management, 29(2): 147-168.

Hajkowicz, S., Higgins, A., Williams, K., Faith, D.P., Burton, M. (2007). Optimization and the Selection of Conservation Contracts. Australian Journal of Agricultural and Resource Economics 51 (1): 39–56.

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, Climate and Development 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): 247 p.

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. American Economic Journal: Applied Economics 5 (3): 113–35.

Jack, B. K., Leimona, B., Ferraro, P. (2009). A revealed preference approach to estimating supply curves for ecosystem services: use of auctions to set payments for soil erosion control in Indonesia, Conservation Biology 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 Ecological Economics 73: 220–227.

Khalumba, M., Wünscher, T., Wunder, S., Büdenbender, M., Holm-Müller, K. (2014). Combining Auctions and Performance-Based Payments in a Forest Enrichment Field Trial in Western Kenya. Conservation Biology 28 (3): 861–866.

Kiptot, E., Franzel, S. (2011). Gender and agroforestry in Africa: Are women participating? ICRAF Occasional Paper 13. Nairobi: World Agroforestry Centre.

Kiptot, E., Franzel, S., Degrande, A. (2014). Gender, agroforestry and food security in Africa. Current Opinion in Environmental Sustainability 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., Schilizzi, S. Breustedt, G. (2011). Auctioning Outcome-Based Conservation Contracts. 51st Annual Conference, Halle, Germany, September 28-30, 2011. No. 114523. German Association of Agricultural Economists (GEWISOLA).

Latacz-Lohmann, U., Van der Hamsvoort, C. (1997). Auctioning Conservation Contracts: A Theoretical Analysis and an Application. American Journal of Agricultural Economics 79: 407-418.

Long, J.S., Freese, J. (2006). Regression Models for Categorical Dependent Variables Using Stata. 2nd ed. College Station, TX: Stata Press.

Martin, A., Gross-Camp, N., Kebede, B., McGuire, S. (2014). Measuring effectiveness, efficiency and equity in an experimental Payments for Ecosystem Services trial. Global Environmental Change 28: 216–226.

Matzdorf, B. (2004). Ergebnisorientierte Honorierung ökologischer Leistungen der Landwirtschaft, Vorteile, Voraussetzungen und Grenzen des Instrumentes. Umweltwissenschaften und Schadstoff-Forschung–Zeitschrift für Umweltchemie und Ökotoxikologie, Ecomed 16 (2): 125–133.

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. EN 382-0069/2008, 64p.

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. Journal of Gender, Agriculture and 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 Protection 76: 83-91.

OECD (2010). Paying for biodiversity. Enhancing the cost-effectiveness of payments for ecosystem services. OECD Publishing.

OECD (2013). Scaling-up Finance Mechanisms for Biodiversity, OECD Publishing.

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 development 33 (2): 237-253.

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, World Agroforestry Centre.

Rocheleau, D., Edmunds, D. (1997). Women, Men and Trees: Gender, Power and Property in Forest and Agrarian Landscapes. World Development 25 (8): 1351-1371.

Rolfe, J., Windle, J. (2011). Using auction mechanisms to reveal costs for water quality improvements in Great Barrier Reef catchments in Australia. Agricultural Water Management 98 (4): 493-501.

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 Economics (92): 273-291.

Schomers, S., Matzdorf, B. (2013). Payments for ecosystem services: A review and comparison of developing and industrialized countries. Ecosystem services (6): 16-30.

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, 108pp.

Skutsch, M.,Vickers, B., Georgiadou,Y., McCall, M. (2011). Alternative models for carbon payments to communities under REDD+: a comparison using the Polis model of actor inducements. Environment Science and Policy (14): 140–151.

Stoneham, G., Chaudhri, V., Ha, A., Strappazzon, L. (2003). Auctions for conservation contracts: an empirical examination of Victoria's BushTender trial. Australian Journal of Agricultural and Resource Economics (47): 477–500.

Swallow, B. M., Kallesoe, M.F., Iftikhar, U. A., van Noordwijk, M., Bracer, C., Scherr, S.J., Raju, K.V., Poats, S.V., Duraiappah, A.K., Ochieng, B.O., Mallee, H., Rumley, R. (2009). Compensation and Rewards for Environmental Services in the Developing World: Framing Pan-Tropical Analysis and Comparison, Ecology and Society 14 (2): 26.

UTaNRMP/IFAD (2012a). Kenya: Upper Tana Catchment Natural Resource Management Project (UTaNRMP) Project Design Report – Main Report. Document of the International Fund for Agricultural Development. East and Southern Africa Division, Project Management Department, IFAD, pp.36.

UTaNRMP/IFAD (2012b). Upper Tana Natural Resources Management Project (UTaNRMP). Strategic environmental assessment draft report. UTaNRMP/IFAD Kenya County Office, August 2012, pp. 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. Mitigation and Adaptation Strategies for Global 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 Environmental 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? Current Opinion in Environmental Sustainability 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. Biological Conservation 123: 227-338.

White, B., Sadler, R. Williams, K., Prober, S., Smith, P., Latacz-Lohmann, U., Schilizzi, S., Burton, M., Curry, J. (2009). Auction for Landscape Recovery under Uncertainty (ALRUU). Technical Report, Department of Agriculture, Fisheries and Forestry, Round 2 National Market-Based Instruments Pilot Programme. Canberra: Australian Government.

Whitten, S., Goddard, R., Knight, A., Reeson, A., Stevens, D. (2008). Designing and testing an outcome focused conservation auction: evidence from a field trial targeting ground nesting birds. Draft paper. CSIRO Sustainable Ecosystems.

Windle, J., Rolfe, J. (2008). Exploring the efficiencies of using competitive tenders over fixed price grants to protect biodiversity in Australian rangelands. Land Use Policy (25): 388–398.

Wunder, S. (2005). Payments for environmental services: some nuts and bolts, CIFOR, Ocassional Paper 42.

Wunder, S., Engel, S., Pagiola, S. (2008). Taking stock: A comparative analysis of payments for environmental services programs in developed and developing countries Ecological Economics 65: 834-852.

Wünscher, T., Engel, S., Wunder, S. (2008). Spatial targeting of payments for environmental services: a tool for boosting conservation benefits. Ecological Economics 65: 822–833.

Zabel, A., Holm-Müller, K. (2008). Conservation performance payments for carnivore conservation in Sweden. Conservation Biology 22: 247-251.

Zabel, A., Roe, B. (2009). Optimal design of pro-conservation incentives. Ecological Economics 69 (1): 126–134.

Annex 1

Baseline survey of landholders along the Kapingazi River and its tributaries, Mt. East Kenya

October – November 2011

ENU: Ask the household head or the female spouse depending on who is about to receive the invitation for the informational workshop!

We are conducting a study on conservation in the Kapingazi Catchment in Kenya. The study is conducted by a researcher from University of Bonn, Germany, in cooperation with the World Agroforestry Centre (ICRAF), Nairobi. We appreciate your VOLUNTARY participation in this survey. The information you disclose will be completely CONFIDENTIAL and your opinion will be combined with those of others to give a general view. Your privacy will be protected to the maximum.

Enumerator _____ Altitude_____

Respondent's name_____ Longitude_____

FDA_____ Latitude_____

Village_____ Date_____

Cell phone number_____ Start time_____ End time_____

Workshop date_____

I. RESPONDENT'S DEMOGRAPHICS AND OCCUPATION

1) What is the tenure of the household head over the farmland? tenure [____]
1= Owned with title deed 2=Owned without title deed 3=Rented 4=Borrowed 5=Workers on the farm 100=Others_____

ENU: Stop the interview if the answer is not 1 or 2.

2) We would like to ask you some personal questions. What is…?
ENU: Proceed the interview if the respondent is a household head, the spouse or a son/daughter who is in charge of the farm.

Relation to household head*	**Sex** 1=Male 2=Female	**Age (yr)**	**Main activity****	**Education (number of years completed)**	**Ethnic affiliation**	**Household size**		
						Adult Male (>=15)	**Adult Female**	**Children (<15)**
relathead	sex	age	activity	edu	ethnic	nrhhmale	nrhhfem	nrchildhh

*1=Household head 2=Spouse 3=Son/Daughter 4=Others_____
**1=Farmer 2=Off-farm 3=Self-employed 4=Public sector employee 5=Private sector employee 6=Disable/unable to work 100=Others _____

3) Can you make decisions on what and when to plant on the farm? candecide[_____]
1=Yes 2=I do decisions together with my spouse 3=No

II. LAND-USE AND CROPS

4) What is the household's total land owned (in acres)? totland[_____]

5) What is the household's total riparian land owned (in sqm?)

ripariland[_____x30]

ENU: Explain riparian land as land along the river by 30 meters from the middle of the river into the farm land

6) What are the main crops planted on your farmland?
ENU: List crops starting with the one being planted on the greatest area, followed by second greatest area etc.

Crop ENU: Use codes	**Crop type** 1=cash crop 2=food crop	**Cropping season** 1=Long rain 2=Short rain 3=Permanent

1=Coffee 2=Tea 3=Maize
4=Beans 5=Arrow roots
6=Leaves vegetables 7=Sweet potatoes
8=Irish potatoes 9=Sorghum
10=Wheat 11=Tomatoes
12=Cabbage 13=Cassava
14=Fruits (bananas, mango, passion fruits, avocado etc.) 15=Sugarcane
100=Others_____

7) Do you irrigate your crops or trees using water from the river? irrigation[_____]
1=Yes 2=No

ENU: Skip if answer 2

8) How much of your crop production is irrigated in a dry season (in %)? acresirrig[_____]

9) Do you have livestock? livestock[_____]
1=Yes 2=No

ENU: Ask only if answer 1

10) If yes, would you tell us your herd of livestock at present?

Type of livestock	**Animal Code**	**Number owned (present at your farm and away)**
Oxen/bulls	ani01	
Cows/heifer	ani02	
Horses/mules	ani03	
Calves	ani04	
Donkeys	ani05	
Sheep	ani06	
Goats	ani07	
Chicken	ani09	
Pigs	ani10	
Rabbit	ani11	
Others_____	ani100	

11) Which year did you start farming? farmstat [_____]

12) What is the average daily wage for general farm work in this area? wage[_____]

13) What are the challenges you face if you wished to hire a labour? labchall[_____]
1=I don't need hiring labour 2= There are no challenges 3= I cannot afford it/it's too expensive
4=There is lack of labour in rainy seasons 5=There is lack of labour the whole year through
100=Others_____

III. INCOME, UNCERTAINTY, WELFARE PERCEPTIONS, AND OPPORTUNITY COSTS

14) What is your household **total yearly gross income** in KES? totalincome[_____]

ENU: We ask about income that includes everything – farming, business, off-farm work, pensions etc. It is the total income before deducting any cost.

15) What are your household **total yearly expenses** in KES? totalexpens[_____]

ENU: We ask about all expenses –on farming activities such as paying for inputs and off-farm labour, on school fees, food, health, transport etc.

16) What is the **yearly gross income** from the **riparian area <u>only</u>**? incomeripar[_____]
ENU: Explain that riparian land is the land along the river by 30 meters from the middle of the river into the farm.

17) Do you have a loan or do you get any support? loansupp[_____]

1=No 2=Yes, loan from a bank 3=Yes, loan from neighbours or friends
4=Yes, money from merry go rounds 100=Others_____

18) Please answer following questions regarding the household's income:

ENU: Make sure that the income percentages add to 100%!

What is/are the household's …	Code	Income type ENU: Use codes	What is the % out of the total income?	Who earns the income? 1=Male, 2=Female, 3= Both - indicate %
main source of income?	income1			
2nd main source of income?	income2			
3rd main source of income?	income3			
other sources of income?	income100			

1=Cropping activities 2=Livestock activities 3=Business 4=Salaried work 5=Off-farm work
6=Renting land/house 7=Pensions 8=Remittances 100=Others_____

19) Please answer following questions regarding the household's expenses:

ENU: Make sure that the income percentages add to 100%!

What are the household's …	Code	Expenses type ENU: Use codes	What is the % out of the total expenses?	Who decides on the expenses? 1=Male, 2=Female, 3= Both - indicate %
main expenses?	expens1			
2nd main expenses?	expens2			
3rd main expenses?	expens3			
other expenses?	expens100			

1=Food 2=Clothing 3=Electricity 4=Water 5=School fees 6=Health care 7=Transport
8=Farm inputs 9=Hiring off-farm labour 10=Paying rent for land/house 100=Others_____

20) What would be the **yearly rent** you would expect if renting out the **riparian area**? opripariarent[_____]

ENU: Show the farmer what is the distance of 30 meters (use steps) and make sure that he/she understands what land size are you asking about.

21) What was the trend in the household total gross income in last 5 years? incometrend[_____]
1=Highly decreasing 2=Slightly decreasing 3=The same 4=Slightly increasing 5=Highly increasing

22) How likely is your household's income going to change in next 12 months compared to last year?
chnginc[_____]
1=Very likely 2=Somewhat likely 3=Will be the same
ENU:Skip if answer 3

23) What are the main causes of change in your household yearly gross income? ENU: Rank 1-3
estimincdiff1[_____] estimincdiff2[_____] estimincdiff3[_____]
1=Change in crop market prices 2=Change in yields 3=Change in wages obtained from off-farm labour
4=Change in income from salaried work 5=Possible shocks (illness, death) 6=Natural disasters (droughts, storm, pest) 7=Climate variability/change 100=Others_____

24) All things considered, how satisfied are you with your life over the past 12 months? gensatisfac[_____]
1=unsatisfied 2=rather unsatisfied 3=rather satisfied 4=satisfied

25) Has the household's income over the past 12 months been sufficient to cover what you consider to be the needs of the household? incomesatisfac[_____]
1=yes 2=reasonable (just about sufficient) 3=no

26) Compared with other households in the village, how well-off is your household? welloffvill[_____]
1=better-off 2=about average 3=worse-off

27) Has the household's food production over the past 12 months been sufficient to cover what you consider to be the needs of the household? foodenough[_____]
1=yes 2=reasonable (just about sufficient) 3=no

28) How many months in a year do you have to purchase your main food (maize, beans, potatoes etc.)
foodpurch[_____]
1=Don´t buy 2=Buy_____
Skip if answer 1

29) Does this number of months vary year to year? foodvary[_____]
1=Yes, it varies a lot (by more than one month) 2=It somewhat varies (by several weeks) 3=No, it's almost the same

IV. OTHER ASSETS AND INFRASTRUCTURE

ENU: Fill in following information on the housing conditions in questions 30) and 31)

30) Roofing type: roof[_____]

1=Grass 2=Iron sheet 3=Bricks 100=Others_____

31) Type of wall: wall [_____]

1=Stone 2=Mud 3=Timber 4=Iron Sheets 5=Bricks 100=Others_____

32) What is the main source of water for the household? watersource[_____]
1=River 2=Tap water 3=Community wells 4=Bore holes 5=Rainwater 6=Spring water
100= Others_____

33) Do you have electricity at your homestead? electricity[_____]
1=Yes 2=No

34) Please indicate which items are owned by the household:

Item	**Item code**	**Owned** ENU: Tag items that are owned by the household
	nritem[_	
Car/Truck/Tractor	item01	
Motorcycle	item02	
Bicycle	item03	
Cell phone	item04	
TV	item05	
Radio	item06	
Stove for cooking/gas cooker	item07	
Refrigerator	item08	
Wheel barrow	item09	
Ox cart	item10	
Ox plough	item11	
Water tank	item12	
Food storage	item13	
Irrigation equipment/pump	item14	
Posho mill	item15	
Sprayer (hand/ox/tractor drawn)	item16	
Sofa set	item17	
Wall unit	item18	
Computer	item10	
Others with value over 5000 KES _____	item100	

35) What is the distance from your home to the nearest tarmac road? disttmk[_____]

36) What is the distance from your home to the nearest health centre? disthc [_____]

37) What is the distance from your home to the main market? distmarkt[_____]

38) What is the distance from your home to the collection centre of your produce (coffee, tea)? distcoll[_____]

39) What is the distance from your home to the nearest input store? distinput[_____]

V. PLANTING TREES, USE OF WATER AND SOIL, AND ECOLOGICAL KNOWLEDGE

40) If you would plant 30 tree seedlings at the riparian area in December, in your opinion, how many out of 30 would survive for six months if you don't take care of them after planting, i.e. if you would leave them the given the natural conditions?
treenatsurv[_____]

41) If you would plant 30 tree seedlings at the riparian area in December, in your opinion, how many out of 30 would survive for six months if you take a good care of them?
treecaresurv[_____]

42) What do you understand by "good care"? _____

43) In your opinion what can make the tree die or to be in a poor condition? treedeath[_____]
ENU: Indicate all reasons
1=droughts 2=inappropriate soil conditions 3=inappropriate planting of the seedling 4=disease
5=termites 6=weeds 7=other people cutting/destroying 100=Others_____

44) If you would be offered a payment for (i) **planting 30 tree seedlings** at your **riparian area,** and (ii) for the **subsequent care** for the trees **for six months**, what **would be the amount of payment you would accept**?

WTA[_____]
1=I would not plant the trees for any payment 2=I would accept following payment_____

45) In your assessment, what has been the general trend in the average yearly quantity of water from the Kapingazi River and its tributaries in this area in the last 10 years? waterquantity[_____]
1=Decreased 2=Increased 3=Remained the same 4=Don't know

46) In your assessment, what has been the general trend in the average yearly quality of water available from the Kapingazi River and its tributaries in this area in the last 10 years? waterquality[_____]
1=Decreased 2=Increased 3=Remained the same 4=Don't know

47) Do you experience any form of soil erosion in your farm? erosion[_____]
1=Yes 2=No

48) What do you usually use for cooking? fuelcook[_____]
ENU: Indicate all
1=Firewood 2=Kerosene 3=Gas 4=Charcoal 5=Crop residue
6=Animal dung 7=Electricity 100=Others_____

49) Where do you get the above fuel used? wherefuel[_____]
ENU: Indicate all
1=Own farm 2=Own trees 3=Forest 4=Purchased from market/shop 5=Purchased from villagers
100=Others_____

50) In your assessment, what has been the general trend in the quantity of firewood available in your village in the last 10 years? firewoodquant[_____]
1=Decreased 2=Increased 3=Remained the same 4=Don't know

ENU: Ask only if answer 1

51) If the availability of firewood decrease, how do you cope with it? _____

52) Do you think climate change affects the current land use and farming practices in the area? climatech[_____]
1=Yes 2=No

ENU: Explain climate change as variability in rains or unexpected events such as extreme droughts.

ENU: Ask only if answer 1

53) If you experience climate change, how is your farm affected? _____
ENU: Ask only if by question 52 answer 1

54) If you experience climate change, how do you cope with it? _____

55) Do you practice any of the following soil and water conservation methods and who is performing the methods?
ENU: Go column by column.

Conservation methods ENU: Tag the methods in use	**Who is performing the conservation methods?** 1=Male 2=Female 3=Both – indicate %_____
consmeth	consmethgen
1. Tree planting	
2.Napier grass	
3.Other grass strips	
4.Terracing[a]	
5.Contour ploughing[b]	
6.Crop rotation[c]	
7.Cover cropping[d]	
8. Mixed cropping[e]	
9. Roof rainwater harvesting	
10. Drought resistant crop varieties	
100. Others_____	

[a]Terraces consist of ridges and channels constructed across-the-slope.
[b]Contour ploughing is the farming practice of ploughing across a slope following its elevation contour lines while in the case of contour bounding stones are placed around the contours of slopes.
[c]Crop rotation is practice of growing a series of dissimilar types of in the same area in sequential seasons.
[d]Cover crops to be planted at the end of the growing season in order to protect the soil surface from wind and water erosion and maintain the soil quality.
[e]Mixed cropping is practise of sowing two or more crops together on the same land area, one being the main crop and the others the subsidiaries.

VI. GENDER

56) Who among the household members serves as the decision-maker for the following activities and who performs the activities? ENU: Ask row by row

ENU: Following questions are on labour division within the household only and do not include off-farm labour. If no household member is conducting a particular task fill dash. If only one household member is making decisions and performing the activities indicate why this is the case under the table.

Farm related activities	**Decision-maker** 1=male, 2=female, 3=both	**Code**	**Who performs the agreed actions/activities?** 1=male, 2=female, 3=both	**Code**
Attendance in community meetings		attpolmeet		perfpolmeet
Attendance in farm-related training/seminars/field days		atttrain		perftrain
Farm management decisions				
What crop where to plant		decplant		makeplant
Whether plant trees/what trees/where to plant		dectree		maketreeplant
What/how much /where to buy inputs (seeds, fertilizer)		decinput		useinput
Whom to hire		dechire		hirepaylab
When to harvest		decharvest		makeharvest
Weeding		decweed		makeweed
Pruning		decprun		makeprun
Mulching		decmulch		makemulch

Marketing produce				
What/when/where to sell produce		decsell		makesell
Manage money from sell	xxxxxxxxxx	xxxxxxxxx		mngmoney
What to keep for consumption		deccons	xxxxxxxxxxxxxxxxx	xxxxxxxxx
Others				
Children's education		decchildedu		learnchild
Household expenses/saving incomes		decexpen		makeexp
Taking care of relatives		deccare		makecare
Others		decother2		makeother2

VII. SOCIAL CAPITAL, TRUST, AND RISK BEHAVIOUR

57) Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks? Please decide for a number on a scale between 0 and 10, where the value 0 means: 'unwilling to take risks' and the value 10 means: 'fully prepared to take risks'. genrisk[_____]

58) Would you prefer to get 100 KES or a lottery ticket with a 50% chance of winning 400 KES? risklottery[_____]
1=Get 100 KES 2=Go for lottery with 50% chance of winning 400 KES

59) What would you prefer? discountrate[_____]
1=100 KES today 2=300 KES in a week 3=1000 KES in a month

60) Do you participate in any group, association, committee or community activities? grouppart[_____]
1=Yes 2=No

ENU: Skip if answer 2

61) Please indicate:

Name of the group/association/activity you participate in	**Who participated?***	**Major activities**

*1=Male in the household 2=Female in the household 3=Both

ENU: Skip if by question 60 answer 1:

62) If you are no member to any group/association, why? _____

63) Have you had a problem with one of your neighbours/village members in the last 3 years? probnghbr[_____]
1=Yes 2=No

ENU: Skip if answer 2

64) What kind of problem have you had with one of your neighbours/village members in the last 3 years?

kindprobnghbr[_____]
1=boundaries of the farm (property rights) 2=damage to my crops by neighbours´ animals
3=damage to neighbours´ crops by my animals 4=conflicts among mine and neighbours´ children
100=Others_____

65) Have you had a problem with any stranger in the last 3 year? problstrngr[_____]
1=Yes 2=No

ENU: Skip if answer 2

66) What kind of problem have you had with strangers in the last 3 year? kindproblstrng[_____]
1=Land property rights 100=Others_____

67) Generally speaking, do you think that most people can be trusted, or you have to be careful when dealing with people? generaltrust[_____]
1=Most people can be trusted 2=You have to be careful when dealing with people

ENU: Immediately following this trust question, respondents should answer following question:

a) In answering the last question, who came to your mind when you were thinking about ''most people''? _____

ENU: Respondents should indicate all people that came into their mind – ask "Who else?"

68) How much do you trust people in your local area? localtrust [_____]
1=A lot 2=A fair amount 3=Not very much 4=Not at all

ENU: Immediately following this trust question, respondents should answer following question:

b) In answering the last question, who came to mind when you were thinking about ''people in your local area''? _____

ENU: Respondents should indicate all people that came into their mind – ask "Who else?"

69) Have you ever borrowed money - from somebody or a bank or other institution? loaned[_____]
1=Yes 2=No

70) Have you ever loaned money to someone? giveloan[_____]
1=Yes 2=No
ENU: Skip if answer 2

71) Did the person pay on time? giveloanexp[_____]
1=Yes 2=Paid beyond the term 3=Failed to pay

72) Have you ever spontaneously benefited from a person you did not know before? benefitstrngr[_____]
1=Yes 2=No

73) If you lost a wallet or a purse including your identity card, how likely is it to be returned with the money in it if it was found by someone who lives close by? walletlocal[_____]
1=Very likely 2=Somewhat likely 3=Not likely at all

74) If you lost a wallet or a purse including your identity card, how likely is it to be returned with the money in it if it was found by a complete stranger? walletstrngr[_____]
1=Very likely 2=Somewhat likely 3=Not likely at all

75) Have you been involved with any organization promoting **conservation or development** in this area?
Examples of conservation activities-tree planting, water or soil conservation, trainings
involvedcons[_____]
1=Yes 2=No

ENU: Skip if answer 2

76) Provide names of the organizations: _____

ENU: Skip if by question 75 answer 2

77) How was your experience with the conservation organization? exprncconsorg[_____]
1=Very good 2=Good 3=Not very good 4=Not good at all

ENU: Skip if by question 75 answer 2

78) Why? _____

79) Imagine a situation when your community will be given a certain amount of funds for conservation. Whom would you choose for managing these funds? oldorgtrst [_____]
1=Current organisations in place 2=A new organisation

ENU: Immediately following this question, respondents should answer following question:

a) In answering the last question on managing the conservation funds, what organization or institution came to your mind when you were thinking of **"current organisations in place"**?
_____

ENU: If respondent has chosen answer 2 in 79), he should answer following question (otherwise skip):

b) In answering the question on managing of conservation funds, what organization or institution came to your mind when you were thinking about **"a new organisation"**?
_____

80) Who do you trust most to give advices on agricultural practices and conservation?
_____

VIII. CONSERVATION ATTITUDES AND ASPIRATIONS

81) Tell me if you agree or disagree with the following statements:

Statement	Code	**Agree**	**Disagree**
There is a relationship between my individual farming activities and the water quality in my area.	relfarm		
Tree planting is labour intensive.	treelab		
Conservation plays an important role in society today.	consrole		
I would be willing to protect water resources in my area for the sake of everybody.	protectwat		
Research organizations have played an important role in conservation issues.	rsrchrole		
There is enough firewood for the next generation.	woodnext		
Water quality is a major problem.	wqualprob		
The farming activities at the riparian banks affect water quality.	ripactwqual		
More trees lead to increased water quantity.	treeswquant		
I can count on government officials to act in my best interest.	trustgovern		

A bad health condition of me or the family members does not allow us to take a good care of the farm.	healthfarm		
I feel obliged to conserve the environment.	obligedenv		
The quality of the water I get is affected by the activities of the people who are living or farming upstream.	upstrmwqual		
Water scarcity is a major problem affecting crop production in this area.	wscarc		
The riparian land is the most productive.	riparprod		
More trees lead to better water quality.	treeswqual		
People in this area are generally concerned with conservation.	peoplecons		

82) What would you like to achieve or get improved in the next five years? ENU: Rank 1-5

Aspiration 1 _____

Aspiration 2 _____

Aspiration 3 _____

Aspiration 4 _____

Aspiration 5 _____

IX. RIPARIAN AREA

83) Go to the river and measure (using GPS and measuring tape):
ENU: Riparian land is the land along the river by 30 meters from the middle of the river into the farm.

Riparian land buffer width (in meters) – ENU: Control the figure of 5) and correct		
Riparian land under crops (in sqm)	ripcropland	
Not usable/idle riparian land (in sqm)	ripidleland	
Riparian woodlot – land purely occupied by trees (in sqm)	riptreeland	
Number of trees at the riparian land (number)	riptrees	

Annex 2

Evaluation Survey

July 2012

For farmers with conservation contracts.

Respondent's name_____ ID_____

Contract type: (tag one of the two options) (1) Action-based (2) Outcome-based

FDA_____ Village_____

Cell phone number_____ Date _____

Instruction for the enumerator: IF NO OTHER INSTRUCTION THEN READ THE OPTIONS TO THE FARMER AND TAG THE PARTICULAR ANSWER.

Opportunity costs vs. Benefits and Pro-poor effect

1. Would you participate in the project again given the same payment?
   1-Yes 2-No

2. What would be the lowest payment that would still encourage you to participate in the project?
   _____Ksh for six months tree planting project

3. If you didn't participate in the contract, what would you have been doing at the time when you were caring for the trees planted in your riparian? _____

4. Aside from the payment, what benefit did you get from participating in the tree-planting contract?
   _____

5. Were you satisfied with the tree species you received from the project?
   1-Yes 2-No

6. What benefits do you expect the trees to give you in the future?
   Instructions: Let the farmer tell you all benefits and tag them. Ask "What else?"

   0-None 1-Firewood 2-Timber 3-Fodder 4-Leaves as mulch 5-Improved soil

   6- Help reduce erosion 7-Retaining water – soil keeps moisture 8-Shade-good for other plants 9-Pollination 10-Medical use 11-Improved water quality in the river
   100-Others_____

7. How important are these tree benefits to you?
   1- Benefits important, but the payment more important 2-Benefits and the payment both equally important
   3-Benefits more important than the payment

8. How much in terms of time and money do you expect to gain from the firewood given by the project trees in five/ten years from now?
   Weekly time saved on firewood collection_____hours (after 5 years),_____hours (after 10 years)
   Annual income saved on firewood purchase_____Ksh (after 5 years), _____Ksh (after 10 years)
   Annual income from firewood sale_____Ksh (after 5 years), _____Ksh (after10 years)

9. How much money do you expect to gain from fodder given by the project trees in five/ten years from now?
   Weekly time saved on fodder collection_____hours (after 5 years),_____hours (after 10 years)
   Annual income saved on fodder purchase_____Ksh (after 5 years), _____Ksh (after 10 years)
   Annual income from fodder sale_____Ksh (after 5 years), _____Ksh (after 10 years)

10. How much money do you expect to gain from improved soil conditions and decreased erosion in five/ten years from now?
    Increase in annual income by_____Ksh (after 5 years), by_____Ksh (after 10 years)

11. How much money do you expect to gain from increased agricultural productivity as result of leaves mulching, shade conditions and pollination in five/ten years from now?
    Increase in annual income by_____Ksh (after 5 years), by_____Ksh (after 10 years)

12. How much money do you expect to gain from improved water quality and medical use of the project trees in five/ten years from now?
    Increase in annual income by_____Ksh (after 5 years), by_____Ksh (after 10 years)

13. How much money do you expect to gain from timber from the project trees in five/ten years from now?
    Total income from timber sale (number of trees cut*timer sale price for a tree)_____Ksh (after 5 years)
    Total income from timber sale (number of trees cut*timer sale price for a tree)_____Ksh (after 10 years)

14. How much money do you expect to be the total gain from the project trees in five/ten years from now?
    _____Ksh (for 5 years), _____Ksh (for 10 years)

15. What was the tree-planting cost considering all expenses - time, productive land loss due to tree planting, input and travel cots, etc.? _____Ksh (for the six-month period)

16. How much do you expect to be the total cost of the trees planted considering all expenses - time, productive land loss due to tree planting, inputs etc. in five/ten years from now?
    Total cost _____Ksh (for 5 years), _____Ksh (for 10 years)

17. Did the conservation payment help your household to improve the current livelihood?

    1-Not at all 2-A little 3-Much

18. Who makes decisions on how the payment is going to be used for?

    1-Male household member only 2-Female household member only 3-Both male and female household members: Male_____% , Female_____%

19. What is the conservation payment going to be used for?

    1-Food 2-Health 3-Education/school fees 4-Agricultural inputs 5-Cover debits 6-Transport
    7-Business activities 100-Others_____

Comparison Action-based vs. Outcome-based conservation contracts activities

20. Rank the most important activities that you have done to maintain your trees in the last 6-months and indicate who was mainly conducting the activities:

    Instruction for the enumerator: Let the farmer tell you the main activity and then tag the particular code. DO NOT READ THE OPTIONS TO THE FARMER!

    Main Activity: _____ Conducted by:_____
    Second Activity: _____ Conducted by:_____
    Third Activity: _____ Conducted by:_____
    Fourth Activity:_____ Conducted by:_____
    Fifth Activity:_____ Conducted by:_____

Codes on activities: 0-None 1-Watering 2-Weeding 3-Fencing 4-Fertilizing/Mulching 5-Guarding from animals 6-Guarding from people 7-Use of insecticides/pesticides 100-Others_____

Codes on gender roles: 1-Male household member only 2-Female household member only 3-Both male and female household members: Male_____% , Female_____% 4-Male child only (<15 years) 5-Female child only (<15years) 6-Both male and female children (<15 years): Male child:_____%, Female child:_____% 7- Adult household members and children: Adults_____%, Children:_____% 8-Off-farm labour: Male 9-Off-farm labour: Female 10-Off-farm labour: Both male and female: Male____%, Female_____%

21. How often did you water the trees (if no rain)?

    Instruction for the enumerator: Let the farmer tell you the main activity and then tag the particular code. DO NOT READ THE OPTIONS TO THE FARMER!

    0-Never 1- Twice a day 2-Once a day 3-Once in two days 4-Once in three days 5-Once in four days 6-Once in five days 7-Once in six days 8- Once in a week (seven days) 9-Drip irrigation using bottles – frequency of re-filling_____ 10-Drip irrigation using tap-frequency_____ 100-Others_____

22. How many hours a week, on average, did you spend for caring for the 30 trees planted at your riparian land – in the dry season (January-March)?
    _____hours/week

23. How many hours a week, on average, did you spend for caring for the 30 trees planted at your riparian land – in the rainy season (April-June)?

    _____hours/week

Conservation attitudes and social norms – both contract types

24. What was your main goal during the six-month tree-planting project?
    1-To keep soil around the trees moist (i.e. fulfilling watering requirement) 2-To keep the planted trees surviving 3-Both, to keep soil moist and the trees surviving

25. How would you feel about a tree you planted dying (general question not in relation with the project!)?
    Instruction for the enumerator: Read the options to the farmer and tag the particular answer.

    1-No special feeling, it just happens 2-I would feel sad as I want the tree to survive (intrinsic value)
    3-I would feel disappointed as I spent time on caring for the tree (opportunity cost-intrinsic value)

26. Do you expect your children to benefit from trees you plant?
    1-Yes 2-No

27. Do you agree or disagree that a good farmer is caring for plants on his farm on a scale from 1 to 5 (when 1 is agree very much, and 5 is very much disagree)?
    Agree ( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 Disagree

28. Do you agree or disagree that you feel obliged to plant a tree once you receive a seedling on a scale from 1 to 5 (when 1 is agree very much, and 5 is very much disagree)?
    Agree ( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 Disagree

29. Do you agree or disagree that you feel obliged to take good care of a tree once planted on a scale from 1 to 5 (when 1 is agree very much, and 5 is very much disagree)?
    Agree ( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 Disagree

30. Do you agree or disagree that planting trees is a responsibility/obligation on a scale from 1 to 5 (when 1 is agree very much, and 5 is very much disagree)?
    Agree ( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 Disagree

31. Do you agree or disagree that the fact you were among the farmers selected in a conservation tender increased the importance of the tree planting on your farm as compared to a situation without a tender where everybody could participate, on a scale from 1 to 5 (when 1 is agree very much, and 5 is very much disagree)?
    Agree ( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 Disagree

32. Do you agree or disagree that the act of signing a conservation contract increased the importance of the tree planting on your farm as compared to a situation without a contract?
    Agree ( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 Disagree

33. Do you agree or disagree that most people would breach the conservation contract, i.e. would not be fulfilling the requirements, if there were no payment, on a scale from 1 to 5 (when 1 is agree very much, and 5 is very much disagree)?
    Agree ( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 Disagree

34. What was in your opinion the main aim of the project you participated in?

    Instruction for the enumerator: Read the options to the farmer and tag the particular answer.

    1-To monitor the contract requirements, i.e. if soil is kept moist by action-based, and if trees survive by outcome-based contracts 2-To reward farmers for tree planting 3-To plant trees and assure their survival

35. How do you feel about sanctions in this project?

    Instruction for the enumerator: According to the contract type read only one of the options to the farmer and tag the particular answer.

    1-Sanctions are necessary in order to keep the trees alive (conservation) 2-Sanctions are necessary in order to make the project conditions the same for everybody (fairness) 3-Sanctions are not good

36. How fair did you find that everybody got different payment on a scale from 1 to 5 (when 1 is not fair at all, and 5 is very fair)?
    Not fair at all ( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 very fair

37. Please tell us why did you find the different payment fair/unfair (depending on the previous answer!)?
    _____

38. Do you think it would be better if everybody got the same initial payment (that would be reduced in case of non-compliance with the contract conditions)?
    1-Yes 2-No

39. Why do you think it would be/it would not be better if everybody got the same initial payment?
    _____

Conservation attitudes and social norms – Action-based contracts specifically

Questions 38, 39, and 40 only for ACTION-BASED farmers:

40. How often would you water the trees (if no rain) if your payment would depend on the tree survival rates, and not on the watering requirement – as compared to what you did?

    1-The same 2-More 3-Less

41. If you were not paid for keeping the soil moist but tree survival, what actions would you have done to take care of the trees? Instruction for the enumerator: If the farmers were conducting different actions, let him tell you ALL the activities he would have done.

    1-The same 2-Different_____

---

42. What was your main motivation to water the trees?

    1. Get the payment 2. Make the tree survive 3. Get the payment and make the tree survive

Future trees survival and Additionality

43. Would you plant 30 trees at your riparian area if given free seedlings and no payment?
    1-Yes 2-No 3-I would plant less_____

44. Would you give the trees the same care as you did in this project?
    1-The same care 2-Less care 3-More care

45. If we would give you tree seedlings only, without the payment, how many of the 30 tree seedlings you would plant do you think would survive?
    Instruction for enumerator: If in Q.41 answer 3, i.e. the farmer would plant less trees, ask how many of those trees he would plant would then survive and indicate the whole answer: E.g. 15 out of 20 trees.
    _____

46. If no payment were offered, what alternative reward would encourage you to conduct the tree-planting?

    Instructions to enumerator: Distinguish between "There is no alternative to payment" and "Don't know which alternative", or list all alternatives that were given.

    1- There is no alternative to payment 2-Don´t know which alternative
    3-Alternatives_____

47. How many more trees than those in the agreement did you care for in the last six months? _____

48. What are your plans with the trees in the next year:

    1-Keep watering them and support survival 2-Uproot and use area for other purposes
    3-Do nothing. If tree survives it's OK

49. How many trees – out of 30 you planted at the riparian area - do you expect to survive in 5 years?
    _____

50. Do you agree or disagree that participation in this project will encourage you to plant more trees in the future (being your own decision, i.e. that is without a project participation)?
    1-Agree 2-Disagree

51. How many additional trees do you plan to plant on your farm in next twelve months? _____

Transaction costs

52. How many hours did you spent on participation in the survey and all the meetings required to participate in this program (including transport time)?
    _____hours

53. What would you use the time for instead of participating in the survey and the meetings?
    1-Farming activities 2-Collecting water 3-Collecting firewood 4-Taking care of children
    5-Sale on the market 6-Leisure 100-Others_____

Project challenges and lessons learnt

54. What were the challenges you encountered during the six-month tree-planting project?

    _____

55. How would you improve the project?

    _____

56. What lessons did you learn from the project?

    _____

57. How much did you trust that you would receive the payment for tree-planting after the six month period on a scale from 1 to 5 (when 1 is trusted very much, and 5 is did not trust at all)?

    Trusted very much ( ) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5 Did not trust at all

58. Why did you have this trust/mistrust as indicated in the previous question?

    _____

Annex 3

Action-Based Tree Planting Research Agreement

Relating to the implementation of land-use change leading to enhanced supply of watershed and carbon sequestration services

Between

ZEF-University of Bonn/ICRAF

And

Name:_____

Year of Birth:_____

Address/Village:_____

Identification Number_____

This agreement ("**this Agreement**") is made on December, 14th 2011 ("Execution of this Agreement").

between

(1) ZEF/University of Bonn with registered office at Walter-Flex-Str. 3, 53113 Bonn, Germany, and the **World Agroforestry Centre – ICRAF** with registered office at P.O. Box 30677-00100, Nairobi, Kenya (the "**Buyers**")

(2) _____ with identification number _____ (the "**Seller**")

Whereas:

A. The Seller agrees to implement "Tree Planting" as defined below;

B. The Buyer agrees to make payment to the Seller ("Conservation Payment") subject to the "Monitoring Requirements, Conditions and Sanctions" and "Payment Conditions";

C. The Buyer agrees to procure for the Seller the tree seedlings necessary to implement the Tree Planting.

It is agreed as follows:

1. Definitions

"Riparian Land" means the land along the river 30 meters from the middle of the river into the farm land.

"Riparian Land Width" means the width of the land along the river.

2. Payment Conditions

2.1 90% of the "Conservation Payment" of _____ KES will be made by the Buyer to the Seller once the Buyer has verified that Tree Planting is implemented and maintained in accordance with the "Tree Planting Requirements" and the "Monitoring Requirements, Conditions and Sanctions".

2.2 The verification of the Conservation Payments will be conducted within one month after the Expire Term of this Agreement (i.e. from June, 22nd, 2012 to July, 21st, 2012).

2.3 10% of the Conservation Payment will be made by the Buyer to the Seller at the day of the Execution of this Agreement (i.e. December, 14th, 2011).

2.4 All Riparian Land subject to Seller's control or ownership is eligible for implementation of Tree Planting under the terms of this Agreement.

3. Seller's Warranties

3.1 The Seller warrants to the Buyer that he owns a Riparian Land at the Kapingazi River or its tributaries;

3.2 The Seller warrants to the Buyer that he owns Riparian Land with a minimum of 12 meters width along the river.

4. Dispute Resolution

4.1 In the event there is any dispute in respect of the terms of this Agreement between Buyer and Seller, this dispute shall be referred to the "Dispute Resolution Committee", the decision of which shall be binding upon both the Buyer and the Seller.

4.2 The Dispute Resolution Committee consists of representatives of the local administration (chiefs and assistance chiefs) and representatives of the Kenya Forest Service (KFS).

5. Term

5.1 This Agreement will expire on June, 22nd 2012 ("Expire Term").

6. Force Majeure

6.1 Neither Buyer nor Seller shall be liable for any failure to perform its obligations where such failure is as a result of acts of nature (including fire, flood, storm or other natural disaster).

6.2 Either Buyer or Seller asserting acts of nature as an excuse shall have the burden of proving that reasonable steps were taken (under the circumstances) to minimise damages caused by unexpected events, and that the other party was timely notified of the occurrence of the unexpected events.

In witness whereof this Agreement has been duly executed.

Date: December, 14th, 2011

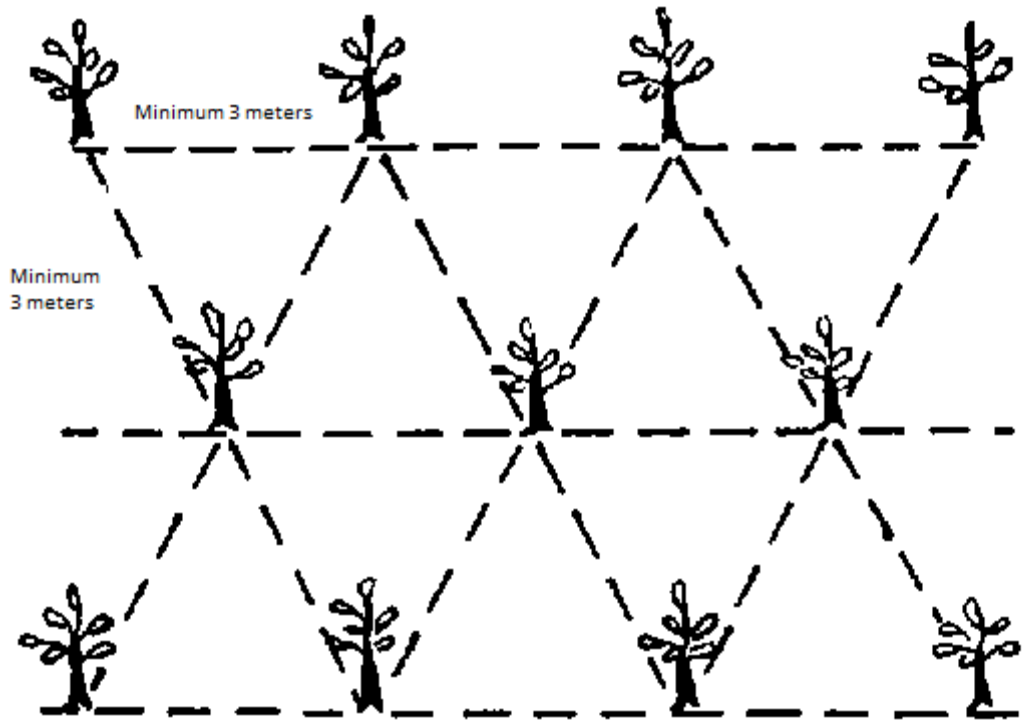
Authorised Buyer Signatories	**Authorised Seller Signatories**
Lucie Andeltova	
ZEF-University of Bonn/ICRAF	

Schedule 1

Tree Planting Requirements

I. The Seller shall:

1. Plant 30 tree seedlings provided by the Buyer on the Riparian Land (i.e. within 30 meters from the middle of the river into the farm land) according to the following instructions:
   1.1. The trees shall be planted in rows - minimum of two rows and maximum of eight rows;
   1.2. The minimum distance between the trees shall be three meters;
   1.3. The maximum distance between the rows shall be six meters;
   1.4. The maximum distance of the first row of trees from the middle of the river should be five meters;
   1.5. Trees that were at the Riparian Land before this Agreement can be interplanted within the rows of the tree seedlings subject to the minimum distance of three meters;
   1.6. The trees shall be planted in rows as shown in the following illustration:



2. Compliance on Tree Planting Requirements will be monitored within first month after Execution of this Agreement;

II. The Seller shall not:

1. Replace tree seedlings procured by the Buyer by new seedlings.

III. Sanctions

1. Any violation of the Tree Planting Requirements can result in rejection of the Conservation Payment.

Schedule 2

Monitoring Requirements, Conditions and Sanctions

I. The Seller shall:

1. Make sure that the soil around the tree is kept moist;
2. This will be monitored by testing the soil moisture in a depth of five centimetres near the rootball.

II. Monitoring Conditions

1. Monitoring can be done any day within the term of this Agreement;
2. The Seller can be monitored more than once;
3. The monitoring will be conducted together by the authorised representatives of the Buyer and the representatives of the Kenya Forest Service (KFS).

III. Sanctions:

1. The Conservation Payment will be reduced by 1% for each tree that was not kept moist on the day of the monitoring, according to the following schedule:

Number of trees with soil kept moist	**Conservation Payment in percent (including the Base Payment)**
30	100
29	99
28	98
27	97
26	96
25	95
24	94
23	93
22	92
21	91
20	90
19	89
18	88
17	87
16	86
15	85
14	84
13	83
12	82
11	81
10	80
9	79
8	78
7	77
6	76
5	75
4	74
3	73
2	72
1	71
0	70

Schedule 3

Seller´s Land

Location:_____

Sub-Location:_____

Village:_____

FDA:_____

Land size:_____Acres

Annex 4

Outcome-Based Tree Planting Research Agreement

Relating to the implementation of land-use change leading to enhanced supply of watershed and carbon sequestration services

Between

ZEF-University of Bonn/ICRAF

And

Name:_____

Year of Birth:_____

Address/Village:_____

Identification Number_____

This agreement ("**this Agreement**") is made on December, 14th 2011 ("Execution of this Agreement").

between

(3) ZEF/University of Bonn with registered office at Walter-Flex-Str. 3, 53113 Bonn, Germany, and the **World Agroforestry Centre – ICRAF** with registered office at P.O. Box 30677-00100, Nairobi, Kenya (the "**Buyers**")

(4) _____ with identification number _____ (the "**Seller**")

Whereas:

D. The Seller agrees to implement "Tree Planting" as defined below;

E. The Buyer agrees to make payment to the Seller ("Conservation Payment") subject to the "Monitoring Requirements, Conditions and Sanctions" and "Payment Conditions";

F. The Buyer agrees to procure for the Seller the tree seedlings necessary to implement the Tree Planting.

It is agreed as follows:

1. Definitions

"Riparian Land" means the land along the river 30 meters from the middle of the river into the farm land.

"Riparian Land Width" means the width of the land along the river.

2. Payment Conditions

2.1 90% of the "Conservation Payment" of _____ KES will be made by the Buyer to the Seller once the Buyer has verified that Tree Planting is implemented and maintained in accordance with the "Tree Planting Requirements" and the "Monitoring Requirements, Conditions and Sanctions".

2.2 The verification of the Conservation Payments will be conducted within one month after the Expire Term of this Agreement (i.e. from June, 22nd, 2012 to July, 21st, 2012).

2.3 10% of the Conservation Payment will be made by the Buyer to the Seller at the day of the Execution of this Agreement (i.e. December, 14th, 2011).

2.4 All Riparian Land subject to Seller's control or ownership is eligible for implementation of Tree Planting under the terms of this Agreement.

3. Seller's Warranties

3.1 The Seller warrants to the Buyer that he owns a Riparian Land at the Kapingazi River or its tributaries;

3.2 The Seller warrants to the Buyer that he owns Riparian Land with a minimum of 12 meters width along the river.

4. Dispute Resolution

4.1 In the event there is any dispute in respect of the terms of this Agreement between Buyer and Seller, this dispute shall be referred to the "Dispute Resolution Committee", the decision of which shall be binding upon both the Buyer and the Seller.

4.2 The Dispute Resolution Committee consists of representatives of the local administration (chiefs and assistance chiefs) and representatives of the Kenya Forest Service (KFS).

5. Term

5.1 This Agreement will expire on June, 22nd 2012 ("Expire Term").

6. Force Majeure

6.1 Neither Buyer nor Seller shall be liable for any failure to perform its obligations where such failure is as a result of acts of nature (including fire, flood, storm or other natural disaster).

6.2 Either Buyer or Seller asserting acts of nature as an excuse shall have the burden of proving that reasonable steps were taken (under the circumstances) to minimise damages caused by unexpected events, and that the other party was timely notified of the occurrence of the unexpected events.

In witness whereof this Agreement has been duly executed.

Date: December, 14th, 2011

Authorised Buyer Signatories	**Authorised Seller Signatories**
Lucie Andeltova	
ZEF-University of Bonn/ICRAF	

Schedule 1

Tree Planting Requirements

I. The Seller shall:

1. Plant 30 tree seedlings provided by the Buyer on the Riparian Land (i.e. within 30 meters from the middle of the river into the farm land) according to the following instructions:

1.1 The trees shall be planted in rows - minimum of two rows and maximum of eight rows;

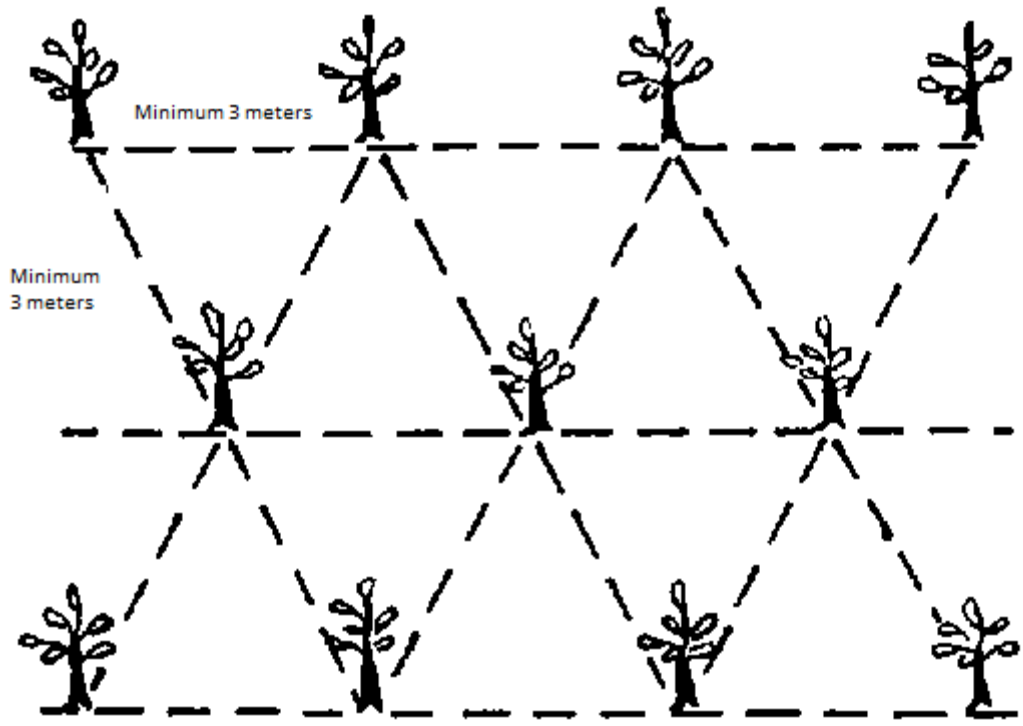
1.2 The minimum distance between the trees shall be three meters;

1.3 The maximum distance between the rows shall be six meters;

1.4 The maximum distance of the first row of trees from the middle of the river should be five meters;

1.5 Trees that were at the Riparian Land before this Agreement can be interplanted within the rows of the tree seedlings subject to the minimum distance of three meters;

1.6 The trees shall be planted in rows as shown in the following illustration:



2. Compliance on Tree Planting Requirements will be monitored within first month after Execution of this Agreement;

II. The Seller shall not:

1. Replace tree seedlings procured by the Buyer by new seedlings.

III. Sanctions

1. Any violation of the Tree Planting Requirements can result in rejection of the Conservation Payment.

Schedule 2

Monitoring Requirements, Conditions and Sanctions

I. Monitoring Conditions

1. Monitoring on the survival rate of the tree seedlings will be conducted after six months from the Execution of this Agreement;
2. The monitoring will be conducted together by the authorised representatives of the Buyer and the representatives of the Kenya Forest Service (KFS).

II. Sanctions:

1. If the survival rate is less than 26 trees then the Conservation Payment will be reduced by 4% for each additional tree that did not survive, according to the following schedule:

Number of trees that survived	Conservation Payment in percent (including the Base Payment)
30	100
29	100
28	100
27	100
26	100
25	96
24	92
23	88
22	84
21	80
20	76
19	72
18	68
17	64
16	60
15	56
14	52
13	48
12	44
11	40
10	36
9	32
8	28
7	24
6	20
5	16
4	12
3	10
2	10
1	10
0	10

Schedule 3

Seller´s Land

Location:_____

Sub-Location:_____

Village:_____

FDA:_____

Land size:_____Acres