The Cost-Effectiveness of Combining Conservation Auctions with Performance Based Payments – A Field Trial in rural Kenya

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Word Count: 6732

Abstract

The increased interest and application of payments for ecosystem services calls for mechanisms with a high cost-effectiveness. In participatory field trials with communities in Western Kenya, we combined procurement auctions for reforestation contracts with payments based on contractor performance measured as number of survived seedlings. We compared the cost-effectiveness of this approach to a baseline approach that is currently applied by the Kenyan Forest Services and found our approach to return a considerably higher cost-effectiveness. The increase in cost-effectiveness is partly due to lower contracting costs as a result of competitive bidding, but even more so to improved seedling survival as a result of the incentives of outcome oriented payments. These led to a monitoring intensity which significantly reduced seedling destruction through cattle grazing, one of the major causes of seedling loss. Seedling care, however, also appeared to have been motivated by factors other than performance based payments including i. monitoring costs, ii. community benefits from the reforested areas, and iii. the size of the investment. With respect to equity, participation of poor community members was disproportionately high. We acknowledge the limitation of this study in lacking statistical evidence but find our results to indicate clear trends.

1. Introduction

Interest in payments for ecosystem services (PES) or PES-like schemes has grown considerably in recent years (Pattanayak *et al.* 2010) and have become one of the most prominent approaches to environmental conservation in the last decades (Gómez-Baggethun *et al.* 2010). PES constitutes a clear market transaction in which the different interests of two market agents (supplier and buyer of ecosystem services) are recognized and openly dealt with through agreements on supply and remuneration (Wunder *et al.* 2008). As Ferrarro and Simpson (2002) point out direct payments tend to be more cost effective in achieving conservation goals than indirect strategies such as the promotion of commercial enterprises intended to generate local incentives for conservation. Cost effectiveness is defined here as the ratio of environmental benefits to program costs.

Information asymmetry over the cost of service provision is one of the major challenges of PES design. Service providers know more about costs of contractual compliance than service buyers which usually puts the latter in a disadvantaged bargaining position (Ferraro 2008). This may entail high surpluses for service providers both in individual negotiations and where schemes use fixed payments that are made independent of individual provision costs (Wünscher *et al.* 2008). Conservation auctions are one viable way to overcome or at least mitigate the problem of informational rent. Conservation auctions are multi-item procurement auctions in which governments (or private actors) purchase (instead of sell) multiple units (rather than one unit) of the conservation good (Latacz-Lohmann & Schilizzi 2005). Competitive bidding under certain conditions can reduce overcompensation and increase cost-effectiveness by revealing the 'real' opportunity cost of service provision (Engel & Palmer 2008). Auctions thus constitute an interesting instrument to circumvent the issue of informational rent (Latacz-Lohmann & Schilizzi 2007). While the interest in conservation auctions has grown in recent times, and most studies have indicated gains from conservation auctions relative to fixed payments, there have been great deviations in gains which made a robust assessment of the cost effectiveness of conservation auctions difficult (Hailu & Schilizzi 2004).

In order to ensure that desired services are delivered and to further increase cost effectiveness, the use of performance based PES approaches has been suggested (Ferraro 2007). Other than action-based approaches which pay for the implementation of defined conservation actions, performance payments are made on a strict outcome oriented basis, and the paid amount depends on the level of services produced. The actions that lead to the conservation outcome are not relevant (Zabel & Holm-Müller 2008). Performance based payments give maximum flexibility and room for innovations for the scheme participants regarding the choice of methods to achieve the desired environmental outcome (Zabel & Roe 2009). Performance based payments also offer participants an incentive to guard the respective areas and therefore provide a solution where monitoring is otherwise costly to achieve.

Up to date there is little empirical evidence for conservation auctions and performance based payments and most of them stem from high income countries. The objective of this study is therefore to test the general functioning and cost-effectiveness of auctions and performance based payments in a developing country, here in the specific case of Western Kenya. The innovative methodological element of our study is the combination of conservation auctions with performance based payments. In addition, we contribute to fill the empirical gap regarding the implementation of such approaches in low income countries. The use of PES faces certain obstacles that are particularly pronounced in developing countries with weak institutional settings which make its implementation and enforcement more difficult.

In our approach, we auction afforestation contracts to members of forest adjacent communities in Western Kenya. The payments are made conditional on survived seedlings, although, following Ferraro (2007), a ‘base payment’ is made immediately after planting. Base payments may further increase the cost effectiveness because they attract risk-averse service providers into the program who are otherwise deterred by the uncertainty associated with performance based payments in which the eventual pay-off can depend on factors outside the providers control, for example due to unexpected weather events. The outcomes are compared to fixed payment afforestation activities led by the Kenyan Forest Service in the same area.

The paper follows a conventional structure. In section 2 we describe the applied methodologies including a description of the study area. This is followed by the results which are presented in section 3, and discussed in section 4. We conclude in section 5.

2 Methodology

Study area

The trials were conducted in communities adjacent to Kakamega forest in Western Kenya. Kakamega forest is the last remaining rainforest in Kenya and home to a large number of endemic species (Müller & Mburu, 2008). Its rich biodiversity makes Kakamega Forest a high priority area for conservation both nationally and globally. Within Kenya it was ranked the third highest priority for conservation in 1995 (Guthiga *et al.* 2008). Globally, Kakamega forest is significant also as a carbon sink (Glenday 2006). Like in many other parts of the world the forest is subject to deforestation and forest degradation. While the forest was subject to farmland conversion in the pre-colonial era, and gold mining and large scale logging in the colonial period (Mitchell 2004), today’s degradation is mainly attributed to the extraction of forest products such as firewood and livestock feed by the people who live in and around the forest in one of the most densely populated areas in Africa (Guthiga 2007). Today, the forest covers an area of about 240 km^2 with 10% being forest plantation and the rest being natural forest (Glenday 2006). Lung and Schaab (2004) estimated that approximately 20% of the forest cover was lost in the last three decades. Complementary to activities aimed at halting further forest loss, the Kenyan government finances reforestation in and around the forest with mixed indigenous species. Our study is an attempt to find ways to increase the cost-effectiveness of these reforestation activities, and thus increase the impact of limited reforestation budgets.

The conservation auctions were implemented in three villages adjacent to Kakamega forest, namely Isecheno and Cheroban, bordering Kakamega forest station in Kakamega South District, and Kamlembe bordering Kibiri forest station in Hamisi District. With approximately 900 households Kamlembe was the biggest community, followed by Cheroban and Isecheno with 475 and 470 households, respectively. With the assistance of the Kenyan Forest Service (KFS) which manages the largest part of Kakamega Forest, communities with a strong utilization link to the forest were selected from a list of 57 villages, all bordering the forest. Communities with a high record of forest offences and conflicts with neighbouring communities were excluded to minimize disturbance effects.

Selection of afforestation sites

The sites for afforestation in the communities were selected by the local KFS forester and elected community leaders of each respective village, in February 2009. All community members, however, had the possibility to join and influence the selection process by attending the community meetings that were organized to facilitate the process.

The identification of afforestation sites centred on the areas outlined in the KFS planting plan, which is developed on an annual basis and which indicates areas for afforestation. For Kamlembe a suitable site of one hectare was found close to the community. Reforestation on that site was beneficial to the community as it could help protect a river bank. For Isecheno and Cheroban the only suitable site was relatively far away from both communities, eleven and six kilometres, respectively. The site was 3.5 hectares in size and was situated in the Tisain forest block, an open area of the natural forest that had been prone to forest fires. The plots close to the entrance of this forest site were given to Isecheno and the plots located deeper inside the site were assigned to the Cheroban community.

After the two sites had been selected, one for Kamlembe and one for Isecheno and Cheroban together, they were split up into plots, which was the unit in which they were put on auction. The 3.5 ha site of the Isecheno and Cheroban community was divided into three plots of one hectare for Isecheno, and two plots of 0.25 hectares for Cheroban. The one hectare site in Kamlembe was split up into two plots of 0.5 hectares (Table 1). The sizes of the plots and total reforestation area followed the available funding which came from the sale of community owned forest use rights to community members.

[Insert about here Table 1 (Reforestation plots by village)]

Timing, set up and auction setting

After consultations with the community leaders and the Kenyan Forest Service, the conservation auctions were announced in December 2008 in community meetings. A few months later, in February 2009, a planning workshop was organized in which the auction type and payment modalities were agreed upon, planting standards were presented, and the sites were chosen. The conservation performance auctions were held in April 2009. The actual planting was also scheduled for April following the onset of the rainy season. Survival rates for tree seedlings were assessed five months after planting, in August 2009. In the same month the small questionnaire was administered to auction participants.

Modalities

The modalities that were discussed and determined in the February planning workshop included the design of the auction. The majority of the people attending the meeting voted for a simultaneous descending multiple round (seven rounds) single stage bidding auction with discriminatory first price open bid payment. This means that for each round all participants would present a price for which they were willing to complete the environmental service on the plot which was on vote. As it was a descending auction, bid values would be successively reduced until the last round. It was determined that for the first three rounds bidders would be allowed to bid for a maximum of two plots, but after the third round they were restricted to one plot only. This had the purpose to increase the competition in the first rounds but at the same time to prevent one bidder from wining more than one plot to allow more community members to win a bid.

The February workshop also set the required planting standards. For example, 400 seedlings were to be planted per hectare. Planting rows were to be five meters apart. Using diagrams, it was explained how the sites were to be cleared and how the plants were to be planted. It was stressed to keep animals out of the reforestation area to avoid seedling damage. This was stressed also by putting up signs saying ‘BIOTA EA Forest Conservation Project. Animals are not allowed on the site’. People were informed that they would have to get in touch with the forester after the beginning of the rain to obtain the seedlings (the Kenyan Forest Service provided the seedlings for the afforestation for free).

Next, people were briefed on the payment modalities. 60% of the bid would be paid right after the auction but the remaining 40% were dependent on the performance after five months.

Performance was measured as a score. It was, however, not told how exactly the score would be calculated and of which components it would consist. People were also informed that any performance below 80% survival rate would be penalized with the bid winners having to re-plant all the failed seedlings, with the second rainy season beginning in August (the new seedlings would however still be provided by the forester). Our base payment is therefore somewhat conditional on a relatively good performance (above 80%) as part of it becomes eroded by opportunity costs of time in case of replanting. Participation in the auction was open to every household in the community. For the auction itself the households were asked to send their head to bid in the auction. The planting and monitoring of the plots could, however, be undertaken by the entire family.

Monitoring

Monitoring had the purpose to evaluate the seedling survival rate and other planting quality measures and consequently to calculate the conservation score of each plot. The monitoring followed a monitoring design, which captured 50% of all planted seedlings and was based on a selection of random control units of 10 seedlings each. For the time of monitoring, we chose the end of the initial growing phase of seedlings five months after planting because of its importance for long term survival of the trees.

Conservation score

The score which was to determine the height of the second bid payment to the winners, with a maximum of 40% of the total bid, was calculated on the basis of three performance criteria: i. seedling survival, ii. seedling damage, and iii. site preparation and planting quality. The first criterion was the seedling survival in percentage, 100% corresponding to a score of 5, meaning that all seedlings on a plot had survived. Less than 50% seedling survival meant a score of 0. The second criterion addressed grazing damage and was evaluated on a scale from zero to five points. This criterion was used to acknowledge differences in surviving quality. The seedlings that were destroyed by insects or other pests were counted as surviving. The rationale for this is that destruction of seedlings by pests was outside the control of the bid winners and was therefore not penalized. Damage therefore mainly referred to damage by cattle. Zero points meant that the plant had been completely uprooted by an animal while five points indicated no loss of vegetation due to grazing. Each single plant was examined and given a score from which a mean was calculated to determine the overall score of the plot for this criterion. As a final scoring criterion, the site preparation and planting quality was assessed. Although this criterion reminds of an action-based approach we decided to integrate planting quality into score because it served as a proxy for performance beyond the five-month monitoring period. Here again each single seedling was examined separately and categorized according to the following indicators: 1. clear area around the seedling, 2. staking is well done, 3. planting hole (45cm wide), 4. spacing done as per forester's directions, 5. seedlings upright. If all five of these indicators were met, the seedling would get a score of 5, if only four of the indicators were fulfilled a score of four was given, and so forth. Eventually, the mean score of all seedlings per plot was calculated.

Using the scores for all three criteria the overall conservation score for each plot i was derived by computing the sum (s_i) of the three criteria. The maximum achievable score was 15 (s_{max}). The performance based payment (P), that is 40% of the total bid b for plot i, was calculated as follows:

$$P = \frac{s_i}{s_{\max}}(0.4 b_i)$$

KFS reserve price

For the auctions we established a reserve price of Kshs 5500 per hectare, on the basis of planting costs by the Kenyan Forest Service (KFS). The auction participants were, however, not informed about the reserve price, in order not to drive up the bids. The KFS paid a daily wage of 240 Kenyan Shillings (3.33 US$) without food. On average, the reforestation of one hectare requires KFS to pay for 23 man days (Table 2) or the equivalent of 5520 Kenyan Shillings. Accordingly, the reserve price for the 0.5 ha and 0.25 ha plots were 2760 KSH and 1380 KSH, respectively.

[Insert about here: Table 2 (Reserve price per hectare)]

Surveys

We undertook two surveys to capture the socio economic characteristics of the three communities. One general questionnaire with 286 randomly selected inhabitants of the three villages, and one smaller survey only with the 114 participants of the conservation auction. The main survey was conducted in March 2009 before the implementation of the conservation auction. The second smaller survey was held in August 2009, five month after the auctions had taken place. The main questionnaire inquired general socio economic characteristics of the three communities, such as the gender of the household head, his/her occupation, forest product utilization. The smaller questionnaire included similar questions with the purpose to allow for an assessment of the socio economic state of the participants in contrast to their communities as a whole. In addition, it also contained more specific questions related to the auctions, as for instance the distance to the planting plot and the number of days people went to guard their site.

3. Results

Socio-economic characteristics of the communities

As expected the great majority of household heads are male (82%). Only 37% of Cheroban's household heads stated to have farming as their main occupation. With this Cheroban differs from Isecheno and even more so from Kamlembe where 52% and 81%, of household heads work mainly on-farm. The subsistence level is high with 80% of the interviewees indicating to grow crops mainly for household consumption. We used house types as an indicator of the economic faring of a household. A mud house with a grass roof was categorized as a poor household, a mud house with a tin roof indicated a middle income household, and a stone house with tin roof was an indicator for a high income family. Using these determinants our general survey showed that all of the three communities are relatively poor, with 88% of the respondents owning mud houses and 49% having grass roofs (Table 3). 78% of all respondents regularly grazed cattle in the forest indicating the forest's importance in the lives of most community members.

[Insert about here: Table 3 (Community characteristics in percentages ('main survey'))]

Time spent in education is slightly lower in Cheroban (five years) than in the other two communities with six and seven years. The sampled households can be classified as small-scale given the average size of the land with 0.64 hectares per household. The average household in Cheroban, however, owns only 0.20 hectares, compared to 0.89 ha in Isecheno and 0.52 in Kamlembe.

[Insert about here: Table 4 (Characteristics of the households (main survey))]

Participation

In Kamlembe 37 households participated in the auctions. In Cheroban and Isecheno the number of participants was 33 and 44, respectively. Taken together, 114 households participated in the conservation auctions. With respect to income 79%, 80%, and 74% of all the households that participated in the auction in Cheroban, Isecheno and Kamlembe, respectively, fall into the category of poor households (Table 5). Thus the participation rate of poor households is far above their proportion in the three communities (49%). This finding refutes fears that the poor are excluded from competitive mechanisms.

[Insert about here: Table 5 Income categories of participants ('small survey'), percentages in brackets]

The bidders initially asked for high remuneration for the afforestation service. With each round however, the amount of money for which the service was offered became reduced until they slightly fell below the reserve price, as shown for the example of Cheroban (Figure 1).

[Insert about here: Figure 1 Bids in auction rounds in Cheroban]

The time bidders took between the rounds varied depending on the perceived importance of the round (Table 6). Thus, the initial time taken was around seven minutes and became successively reduced to a mean of 3.6 minutes. Only before the final bid, participants spent again more time preparing with a mean of 4.7 minutes.

[Insert about here: Table 6 Mean time in minutes between auction rounds]

Auction outcomes

In Isecheno, where the land had been divided into three plots of 1 ha each, final bids resulted to be 4.500, 3.650, and 3.900 Kenyan Shillings for each one of the three 1 ha plots. Thus, in comparison to the fixed price established by the KFS (5.500 Kenyan Shillings), the payment had been reduced on average by 1.483 Kenyan Shillings per hectare. In Kamlembe, the auction on the two plots of 0.5 hectares went to bidders with final offers of Kshs 1.320 and 1.450. Here the savings that were made per hectare were Kshs 2.730. In Cheroban, the two 0.25 hectare plots went for the price of Kshs 794 and 690 saving Kshs 2532 per hectare (Table 7).

[Insert about here: Table 7 Conservation Auction, winning bids (in Kenyan Shillings)]

Guarding/protection of seedlings by bid winners

After planting, it was in the interest of the auction winners to ensure a high seedling survival rate as 40% of the payment depended on the conservation score achieved. In undertaking this task of guarding and protecting the planted seedlings, the three communities had to face fairly different circumstances. The distance from Isecheno to the forest plot was 11km. The remoteness of their plot attracted the participation of grass cutters who passed through the forest every day regardless of the reforestation service. Due to their occupation as grass cutters they had bicycles at their disposal which made it relatively easy for them to cover the distance. Travel time per visit was 70 minutes. All bid winners in Isecheno were grass cutters and they recorded to have controlled their plots 26 days per month. In addition, the surroundings of the Isecheno forest plots were accessed predominantly by Isecheno community members. The familiarity with the people enabled the auction winners to influence their behaviour towards protecting the reforested plot, for example by keeping their cattle out of the plot. Though closer to the forest plot (6 km), the Cheroban community members did not have bicycles at their disposal and needed to walk the distance which took an average of 60 minutes. Consequently, they only came two days a month to monitor their plots. In addition, they expressed concern with the fact that they were planting in an area which they did not belong to and where they did not know the people. Yet, considering that Cheroban shared its site with the Isecheno people, it also benefited from the latter's frequent visits and monitoring. The two winners from Kamlembe only had 0.15 km or nine minutes to walk to reach their forest plots. They controlled the development of their plots every single day of the month as they were so close that they could just quickly pass by during the day. It seems that the monitoring intensity is strongly linked to the distance and the ease with which the bid winners could reach their plots.

Survival rates

Five months after planting the Kamlembe site showed the highest number of seedling survival with 87% survival rate (Table 8). Isecheno noted a survival rate of 75%, whilst Cheroban accounted for the lowest rate with only 52%. Thus the community that was located the closest to its forest site, and that had monitored it daily had the highest survival rate. However, other factors might also have played a role. The Isecheno and Cheroban community did, for instance, complain about the bad quality of the seedlings they had received from the KFS forester. They argued that the forester had planted his own areas first and had given the 'leftovers' to the auction planting. We could not confirm this complaint, as we were informed of the grievance only after the planting had taken place and the accuracy of the charge could not be proven any more. At the same time Kamlembe was advantaged as the seedlings they were given came from tree nurseries on their own compounds. Due to this fact the seedlings were used to the soil conditions of that area, did not need to be transported over longer distances, and consequently were in a better state when planted. Another issue that seems to be of relevance is the varying sensitivity of different tree species. In all sites five different tree species had been planted, the mix was however determined by the KFS forester and differed from site to site. It appeared that *Prunus africana*, an indigenous species, was relatively more sensitive than the other tree species and died in much higher numbers. In Kamlembe, observations indicated that there were the smallest number of seedlings of *Prunus Africana*, although this was not confirmed quantitatively. Lastly, the Kamlembe community turned out more innovative than the other villages. They brought, inter alia, organic fertiliser to their plots to improve the seedlings' growth. Organic fertiliser is, however, not entirely uncritical as it can contain insects, such as cut worms and termites, that could in turn contribute to the seedling destruction. Whether this was the case in our study is difficult to prove, as we did not analyse the fertilizer, yet the high ratio of seedling destruction through pests in Kamlembe may indicate that organic fertiliser and pests are closely related.

The survival rate for the KFS sites was notably lower. The KFS scheme in Kibiri noted a survival rate of 57.8% and the site in Kakamega had the lowest rate with 48.4%.

[Insert about here: Table 8 Mean no of seedlings per control unit[a] after 5 months (SD in brackets)]

Cost effectiveness

In terms of cost effectiveness, that is cost per survived tree seedling, the conservation performance auction outperformed the baseline approach in all communities. The unit cost of surviving seedling of Kshs 5 (US$ 0.07) in Kamlembe, Kshs 8 (US$ 0.11) in Isecheno, and 14 (US$ 0.19) in Cheroban, was considerably lower than that of the KFS baseline approach with Kshs 26 (US$ 0.36) per surviving tree seedling.

Mode of destruction

The main factor leading to the destruction of the seedlings in the auctioned plots was the drying up of the intact seedlings with an overall mean of 53% (46% in Isecheno, 59% in Kamlembe, and 54% in Cheroban). In the KFS sites drying up accounted for considerably less seedling mortality than in the auctioned sites with a mean of 13.5%. Drying up was caused by poor planting leaving the soil around the seedling's roots either too loose or too compact. Although we observed adequate rainfall during the five months after planting, poor planting would not allow the roots to absorb sufficient amounts of moisture. Regarding the low seedling destruction through drying up in the KFS sites, it is possible that the people contracted with the KFS had better planting skills. This might be explained by the fact that they were preferably chosen from forest user groups and thus were already familiar with different planting methods.

The second most frequent cause of seedling mortality was the attack of seedlings by defoliators such as insects, cut worms and termites which accounted for 30.6% of seedling mortality. Although the destruction of seedlings by pests were not factored into the calculation of the conservation score it is, nevertheless, interesting to see that pest attacks accounted for considerably less seedling mortality on the KFS sites (14.5%) than on the auctioned sites (30.6%). Unfortunately, we have no explanation for what may have brought this about.

Lastly, the chewing of seedlings by animals/cattle accounted for a mean of 24.5% with large differences between sites. While the Kamlembe site saw cattle chew to have caused zero percent of the total seedling destruction, it was the highest factor of destruction at the KFS sites with 72%. The other auctioned sites (Cheroban and Isecheno) also stayed well below the KFS occurrence with 16% and 33%, respectively. The high rate of seedling destruction through grazing cattle at the KFS sites may be explained by the small number of forest ranchers to guard Kakamega forest. Thus, the likelihood of a rancher being around the KFS plots when cattle were grazing on them was rather small.

There seems to be a strong relation between frequent guarding of the plots and the prevention of seedling destruction through grazing animals/cattle. Cheroban appears to be an exception (little guarding, little cattle damage). But given that the Cheroban and Isecheno sites were in the same location, Cheroban benefit from the high monitoring intensity by the Isecheno bid winners and had the additional advantage to have been located at rear end of the forest site. Thus, cattle first entered the Isecheno plots before reaching the Cheroban plots. Overall, while cattle damage was the predominant source of seedling loss in the KFS sites, drying up was responsible for most losses in the auctioned sites. This invokes the question how to guarantee better planting, having controlled for the prevention of chewing already.

4. Discussion

In our study, the performance based auction approach showed considerably lower contract costs and substantially higher survival rates compared to the baseline approach. The findings concur with Latacz-Lohmann and van der Hamsvoort (1997 and 1998), and Latacz-Lohmann and Schilizzi (2005), who reported that competitive bidding performs better than fixed rate payment by significantly increasing the cost effectives. The findings are also in line with Ferraro (2007), and Zabel and Roe (2009), who state that performance based payments give an incentive to ensure the proper provision of the service, which consequently improves cost effectiveness, too. In practical terms and with regard to our study the incentive encouraged increased monitoring of the seedlings by the planters and therefore visibly reduced the predominant factor of seedling destruction that was identified on the ‘non-guarded’ KFS sites: the grazing of cattle.

It has to be noted though that due to the limited scope of our study the findings do not provide statistically relevant evidence. This makes it difficult to isolate the effects of the conservation auction and performance based payments from other influential factors. Nevertheless, with all the care that is necessary for the interpretation of results under these conditions, the results appear to show clear trends. Apart from the positive impact of auctions and performance based payments on the cost-effectiveness, other factors seem to play a crucial role. These include ‘sense of ownership’ and ‘monitoring costs’ and may explain the relatively low performance levels in Cheroban.

While we observed Kamlembe and Isecheno develop some kind of pride and ownership, this was not evident in Cheroban. Based on our observations, the degree to which a sense of ownership is developed may be linked to two factors: i. the benefit the community obtains from the reforested area, ii. the amount that the communities themselves pay for the reforestation. Given the distance, the lack of transport facilities and the small size of the reforested area, Cheroban clearly benefited least. For Kamlembe, on the other hand, it was easy to identify the reforestation to benefit the entire community as it was located right next to the village. The sense of ownership that was observed in Kamlembe is probably the driver for extra efforts that were made by bringing organic fertiliser to the plots.

Cheroban also put very few funds on the table for reforestation investment (the user right auctions had only generated a small overall amount). With little money invested costs of failure are low, hence reducing community interest and sense of ownership. The far distance and cost of transport also drive up monitoring costs in Cheroban reducing monitoring intensity and performance levels. In Kamlembe, it was possible to guard the plots throughout the day, as they were in range of sight.

A third aspect to be considered is the fact that the Cheroban community was least engaged in farming. Average land size was 0.2 hectares and only 37% of the population specified their principal occupation to be farming. This may have had some implications for the community's low performance in the sense that planting skills were low. Thus, the success of conservation auctions might also be dependent on pre-existing knowledge of agriculture and forestry.

The scale of the conservation auctions in our study was restricted to the community level. This raises the question to what extent the presented approach could be successfully applied at a larger scale. For our study we can confirm that the auction and the mediation of all related processes went smoothly and without any considerable problems. Much of this may have had to do with the participatory approach that was chosen to implement the schemes. Schemes that are rolled out on a larger scale, however, may not be able to maintain such a participatory undertaking. Roll out on a larger scale means potentially increasing heterogeneity of the participants with associated differences in culture, norms and hierarchies. On the one hand, this demands for well established rules, clear structures, and enforcement mechanisms. At the same time, an auction scheme with an extensive scope that is not adjusted to the particularities of the community members may invoke the issue of legitimacy or community acceptance. It is therefore important to consider community acceptance and the potentially increasing heterogeneity of the participants with a more extensive auction scheme.

The set up of the auctions and the mediation of all processes from the first meeting over the planting period until the final payment is relatively complex and is thus likely to impose higher transaction costs than an action based payment scheme with fixed rates. The question that remains to be answered and was not addressed by us is whether the effectiveness gains offset the higher associated transactions costs.

5. Conclusion

Using data from field trials in Western Kenya we found the combination of conservation auctions with performance based payments to return a considerably higher cost-effectiveness than the baseline approach that is currently applied by the Kenyan Forest Services. The increase in cost-effectiveness is partly due to lower contracting costs as a result of competitive bidding, but even more so to improved seedling survival as a result of the incentives of outcome oriented payments. This led to a monitoring intensity which significantly reduced seedling destruction through cattle grazing, one of the major causes of seedling loss. Seedling care, however, also appeared to have been motivated by factors other than performance based payments including i. monitoring costs, ii. the extent to which the community foresaw the reforested areas to provide them with direct benefits such as firewood, and iii. the level of reforestation investment that was made by the community. With respect to equity considerations, poor community members were represented disproportionately high in the auctions. We acknowledge the limitation of this study in lacking statistical evidence but find our results to indicate clear trends. Confirmation of our findings remains to be provided in studies with larger sample sizes.

Acknowledgements

We thank the Federal Ministry of Education and Research for the funding of this study within the BIOTA project (Biodiversity Monitoring Transect Analysis). We are grateful for the support that was given to us by Kenyan Forest Service and the community members.

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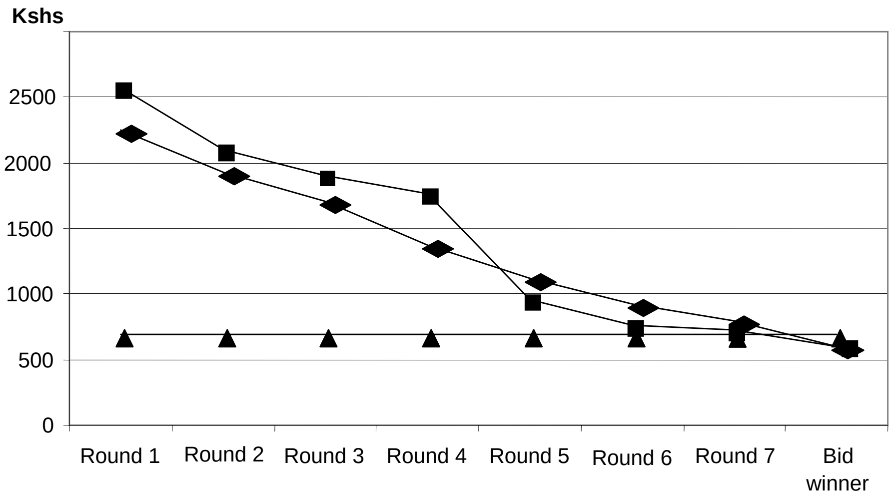
Figure 1 **Bids in auction rounds in Cheroban (in Kenyan Shillings, Kshs)**



Legend

Plot 1

Plot 2

Fixed rate

Table 1 **Reforestation plots by village**

Village	No of plots	Area per plot(ha)	Total area (ha)
Isecheno	3	1	3.0
Cheroban	2	0.25	0.5
Kamlembe	2	0.5	1.0
KFS Kakamega	3	1	3
KFS Kakamega	1	0.5	0.5
KFS Kibiri	1	1	1

Table 2 Reserve price per hectare

	Man days	Enrichment planting N= 400

Clearing	10	2400 (33.3)
Staking	3	720 (10)
Digging holes	6	1440 (20)
Planting	4	960 (13.3)
TOTAL	23	5520 (76.7)

US$ in brackets

Table 3 Community characteristics in percentages ('main survey')

Variable	Isecheno	Kamlembe	Cheroban	Overall
Gender of household head (male)	90	75	79	82
Main occupation of household head (farming)	52	81	37	58
Type of crops grown by the farmer (subsistence crops)	79	73	88	80
Type of houses owned by the household (mud house)	86	91	87	88
Type of roof (grass)	70	18	62	49
Household graze cattle in the forest	82	68	85	78

Table 4 Characteristics of the households (main survey)

	Characteristics of the households							
	Overall		Isecheno		Kamlembe		Cheroban	
	N=268		n=86		n=96		n=86	
Variable	Mean	SD	Mean	SD	Mean	SD	Mean	SD
No of cattle owned by HH	2.1	2.2	2.3	2.8	1.5	1.4	2.5	2.1
Age of household head in years	43.0	12.9	42.4	12.4	46.9	13.8	39.2	11.3
Years of formal education	6.1	4.0	6.9	4.6	6.0	3.4	5.3	4.0
Total land area in hectare	0.64	1.38	0.89	2.67	0.52	0.48	0.20	0.56
Average family size	5.7	2.3	5.7	2.5	5.9	2.4	5.6	2.2

Table 5 Income categories of participants ('small survey'), percentages in brackets

Income category	Cheroban	Isecheno	Kamlembe	TOTAL
Low	26 (79)	35 (80)	27 (74)	88 (77)
Middle	7 (21)	9 (20)	5 (13)	21 (18)
High	0 (0)	0 (0)	5 (13)	5 (4)
TOTAL	33 (100)	44 (100)	37 (100)	114 (100)

Table 6 Mean time in minutes between auction rounds

	Mean time in minutes between conservation auction rounds						
Village	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6	Round 7
Isecheno	6.6	6	5.4	4.9	3.8	2.9	4.2
Cheroban	7	7	6	5	5	4	5
Kamlembe	7	6	5	4	4	4	5

Table 7 Conservation Auction, winning bids (in Kenyan Shillings)

ID	Site	Plot	No of	Planting date	Tree species	Reserve	Cost
1	Isecheno	1	400	April 16, 2009	Assorted indigenous	5500	4500
2	Isecheno	1	400	16th April 2009	Assorted indigenous	5500	3650
3	Isecheno	1	400	16th April 2009	Assorted indigenous	5500	3900
4	Kamlembe	0.5	200	8th April 2009	*Croton megalocarpus*	2750	1320
5	Kamlembe	0.5	200	8th April 2009	*Croton megalocarpus*	2750	1450
6	Cheroban	0.25	100	16th April 2009	Assorted indigenous	1375	794
7	Cheroban	0.25	100	16th April 2009	Assorted indigenous	1375	690
8	Kakamega KFS	1	400		Assorted indigenous	n.a.	5500
9	Kibiri KFS	1	400		Assorted indigenous	n.a.	5500

Table 8 Mean no of seedlings per control unit[a] after 5 months (SD in brackets)

	Isecheno	Kamlembe	Cheroban	Kakamega (KFS)	Kibiri (KFS)	Total
n (no of control units)	60	31	30	90	31	242
No of seedlings	7.5 (1.5)	8.7 (0.45)	5.2 (1.4)	5.8 (2.0)	4.8 (1.4)	6.4 (2.0)

[a]Number of seedlings per control unit at time of planting