Self-selection into payments for ecosystem services programs

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Designers and funders of payments for ecosystem services (PES) programs have long worried that payments flow to landholders who would have conserved forests even without the program, undermining the environmental benefits ("additionality") and cost-effectiveness of PES. If landholders self-select into PES programs based on how much conservation they were going to undertake anyway, then those who were planning to conserve should always enroll. This paper discusses the less-appreciated fact that enrollment is often based on other factors too. The hassle of signing up or financial costs of enrollment (e.g., purchasing seedlings) can affect who participates in a PES program. These enrollment costs reduce overall take-up, and, importantly, they can also influence the composition of landholders who select into the program—and thereby the program's environmental benefits per enrollee. Enrollment costs can increase a program's benefits per enrollee if they are systematically higher for (and thus deter enrollment by) landholders who would have conserved anyway. Alternatively, enrollment costs can dampen per-enrollee benefits if their correlation with status-quo conservation is in the opposite direction. We illustrate these points with evidence from two studies of randomized trials of PES programs aimed at increasing forest cover in Uganda and Malawi. We also discuss how in other sectors, such as social welfare, policy designers have purposefully adjusted the costs of program enrollment to influence the composition of participants and improve cost-effectiveness. We propose that these ideas for targeting could be incorporated into the design of PES programs.

payments for ecosystem services | self-targeting | cost-effectiveness | avoided deforestation | afforestation/reforestation

Payments for ecosystem services (PES) is a type of conservation program in which individuals are offered payment in exchange for providing ecosystem or environmental services. For example, to promote forest cover, PES is used to compensate landholders for leaving forest intact or for planting new trees. PES is an especially popular approach in low-income countries where requiring landholders to conserve or asking them to do so without compensation could exacerbate poverty.

A core principle in PES programs is that participation is voluntary: A payment is offered for some environmental outcome, and a landholder chooses whether to participate. The voluntary nature of PES makes self-selection into a program one of the key factors determining its environmental benefits and cost-effectiveness.

Theoretically, PES programs will be more attractive for landholders who do not have to change their behavior (they were going to preserve their forest or plant trees anyway) to qualify for payment. Meanwhile, those who were not going to conserve incur a cost of conserving and complying with the program conditions (such as foregone income from deforesting or time and effort to plant and maintain seedlings).

This self-selection is central in the literature evaluating the impact of PES on conservation outcomes, where the objective is to measure the "additionality" of a PES program: How much of the conservation behavior is because of the program? Additional conservation is distinct from the observed level of conservation because some of the conservation among program participants might have happened anyway. Simply comparing those who enroll and those who do not leads to mismeasurement of the program's additionality; the two groups differ in their forest-cover outcomes both because of any impacts of the program and also because of what they would have done with their forest in the absence of the program. The challenge of isolating the counterfactual conservation (what would have happened in the absence of the program) has led to calls for randomized trials to better isolate causal program impacts (1–3) and to the use of matching and other program evaluation statistical techniques to adjust for self-selection using observable variables (4–8).

In this article, we use two recent randomized trials of PES, one that compensated avoided deforestation (DEFOR) in Uganda and one that compensated afforestation/reforestation (AFFOR) in Malawi, to show how counterfactual conservation varies across eligible landholders and affects enrollment (9, 10).

Our main goal, however, is to highlight that other factors affect the landholder's enrollment decision and may help determine a program's ultimate additionality. Programs often entail nonmonetary administrative burdens or financial costs to enroll, such as filling out paperwork, or buying seedlings or other inputs. These enrollment costs dampen take-up, but they also change the composition of who participates. This can improve the environmental benefits per dollar spent if enrollment costs are negatively correlated with additionality, or it can decrease the benefits if the correlation goes in the opposite direction. We lay out these ideas in a simple framework and then show evidence on these points using the same two randomized trials.

PES programs are not unique in that participation in them is shaped by numerous factors, which also influence overall program impacts. This is true for conservation programs other than PES, and for social programs more broadly. We conclude with examples of how policy makers could manipulate these administrative and financial costs of enrollment to improve program cost-effectiveness and discuss examples of policy makers doing this in the context of social programs outside of conservation.

Conceptual Framework

Our conceptual framework considers the goals of a program designer and the decisions of eligible landholders to illustrate three key points:

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i) There is heterogeneity across landholders in their cost of meeting the program's conservation target, and this conservation cost is relevant for enrollment decisions.

ii) There may also be other significant costs of enrolling in a PES program that affect both the number and composition of enrollees.

iii) The correlation between the cost of conserving and other enrollment costs affects the net conservation benefits and cost-effectiveness of a PES program.

A PES program designer wishes to maximize the ratio of total conservation benefits, B, to the sum of all payments made under the program, C. (We abstract from fixed costs of the program here, but this setup does allow for per-enrollee administrative costs; the benefit per enrollee can be thought of as net of these costs.) Participating in the program is voluntary. Thus, while the program designer can choose who is eligible for the program, eligible landholders then choose whether to enroll in the program.

We simplify the landholder's problem to consist of a single decision: whether to enroll in the program. In the absence of any uncertainty in the cost of complying with the contract, every landholder who enrolls should also comply. (As emphasized in ref. 11 but ignored in the current exercise, landholders may also face considerable uncertainty in both the costs and benefits of tree survival at the time they make their enrollment decision. We also assume that a landholder is only paid if she complies with the program, which may not be the case if monitoring or enforcement is imperfect.) We also abstract from heterogeneity across enrollees in the benefits they generate through conservation. (We treat the conservation behavior as binary, so the only heterogeneity in program benefits derives from whether the participant's activity is additional conservation or not. In practice, there is also heterogeneity in how much of the conservation is additional; in the case of avoided deforestation, more of the conservation is additional if the participant would have deforested 50% of her forest compared with 10%. In addition, there might be heterogeneity based on the species of trees on one landholder's plot contributing more to biodiversity or carbon storage. One could incorporate this latter type of heterogeneity into our framework by allowing the policy maker to set a landholder-specific payment level. See ref. 12 for a discussion of targeting on heterogeneity in environmental benefits.)

While there is also rich analysis one could do by incorporating these other features, the simplifications allow us to more concisely and clearly fulfill the goal of this conceptual framework: to highlight that, while the literature has focused on who would have conserved absent the program and how that shapes self-selection in to the program—in other words, how counterfactual conservation outcomes affect enrollment decisions—other determinants of take-up are also relevant for thinking about policy effectiveness and design.

Enrollment Based on Counterfactual Conservation. Assume each eligible landholder has a cost of conservation, such as foregone income from crops, which we will refer to as a, that determines her decision to enroll in the program. We introduce a numerical example to make our points concrete. We consider a population of landholders whose value of a is equally distributed at integer values between −5 and 10. Fig. 1 shows the aggregate supply of landholders willing to take up a PES contract at any payment level, p; the landholders enrolling are those for whom $p > a$. [We assume that indifferent landholders ($p = a$) do not enroll.]

Note that landholders with a negative cost (i.e., positive personal benefit or $a < 0$) of conservation will conserve even absent any payment. Thus, the amount of conservation they provide is not changed by the program. In the REDD (reducing emissions from deforestation and forest degradation) literature, these

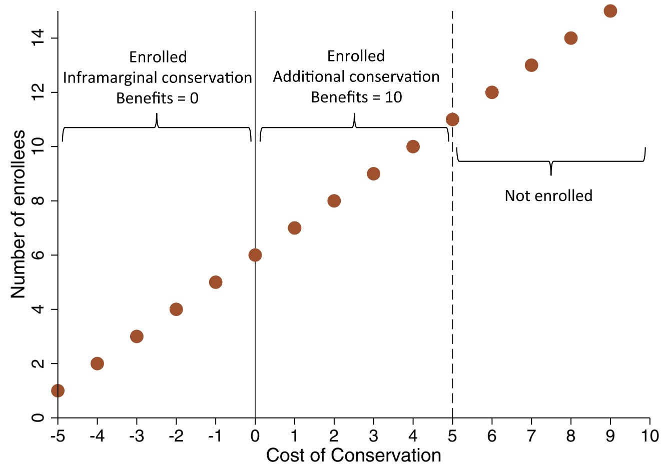

Fig. 1. Aggregate supply of PES contracts. Aggregate supply curve shows the number of enrollees for contract payments (vertical height of points) against the cost of conservation shown on the horizontal axis. The vertical line at zero separates nonadditional conservation, which generates a per-enrollee benefit of 0, from additional conservation, which generates a per-enrollee benefit that we set to 10 in our illustrative example. The dashed vertical line at 5 marks a hypothetical payment level; supply at this price is 10 landholders, namely the 10 landholders to the left, whose conservation cost is less than or equal to the payment level.

landholders and their conservation behavior are often referred to as "not additional."

We assume that for every landholder, achieving the program's conservation outcome generates conservation benefit of 10. However, for those who would have conserved even absent the program ($a < 0$), the conservation benefit due to the program is 0. Thus, the conservation benefit caused by the program is 10 for each landholder with a positive cost of conservation, and 0 otherwise.

A potentially important distinction between DEFOR and AFFOR programs is the proportion of the population whose conservation is additional. In DEFOR programs, particularly in settings with low baseline rates of deforestation, a substantial proportion of potential enrollees are likely to be nonadditional. In AFFOR programs, this may be less of a problem if tree planting is relatively uncommon in the absence of explicit incentives. We view this as a difference in degree rather than in kind.

From here forward, we consider a program offering a specific price, which we set at 5, marked by a dashed vertical line on Fig. 1. Facing this price, 10 out of the 15 eligible landholders, namely those with a cost of conservation less than 5, will enroll, as long as conservation costs are the only costs of enrollment.

Fig. 2*A* is restricted to participating landholders—those with $a < 5$—and highlights the problem of nonadditionality. For half of those landholders who enroll, their participation in the program creates zero conservation benefits.

In case A, total program benefits are equal to 50 because there are five new individuals conserving, each generating a conservation benefit of 10. The total program cost is $10 \times t = 50$ because 10 individuals each receive a payment of 5. Cost-effectiveness, which we define as the benefit–cost ratio B/C, therefore equals 1.

Cost-effectiveness may not be the only metric a program designer cares about, though. (In practice, many PES programs in developing countries have dual goals of cost-effectiveness and poverty alleviation; see refs. 6 and 13 for discussions of targeting on each.) The landholder's cost of conservation is a real cost. It might reflect effort or materials costs to plant and maintain trees

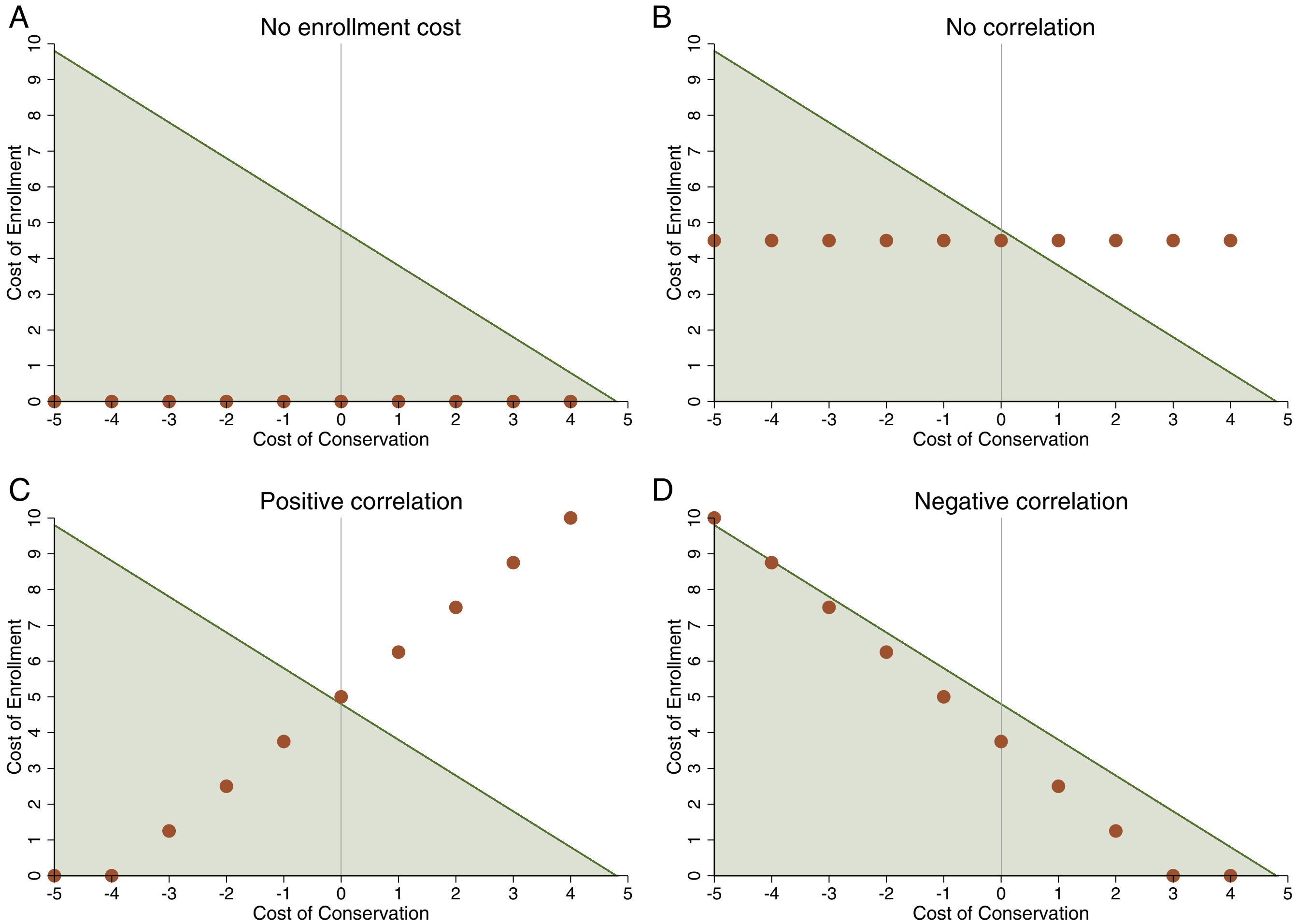

Fig. 2. Variation in PES enrollment as a function of conservation costs and other enrollment costs. Each panel is an illustrative case. The horizontal axis represents the opportunity costs of conservation and the vertical axis represents other PES enrollment costs. The PES program pays each contract a total of 5, and thus landholders will enroll when their costs fall in the shaded region: the area where the sum of both costs is less than 5. Each dot depicts the costs of 1 of 10 landholders. By construction, six have conservation costs less than or equal to zero and would conserve in the absence of the program. *A* depicts the case in which there are no costs of enrollment and corresponds to the 10 landholders who enroll at a price of 5 in Fig. 1. *B*–*D* focus on these same 10 landholders and depict different correlations between costs of conservation and other costs of enrollment, which yield different enrollment patterns. In each of cases *B*–*D*, the average enrollment cost among the 10 landholders is 4.5.

in the AFFOR case, or opportunity costs such as forgone timber or agricultural income in the DEFOR case. The landholder's surplus from participating in the program, and thus the total program surplus, also depends on these costs incurred by the landholder for conserving. The landholder's surplus from participating is $min(p - a, p - 0)$. The first argument in the *min* function applies for enrollees who are additional; their surplus is the payment minus their cost. The second argument applies for nonadditional enrollees; their surplus from the program is the payment, which is, in essence, just a pure transfer to them. (Nonadditional enrollees also earn surplus from conserving which is beneficial to them per se, but they would earn this component of the surplus with or without the PES program.) Because the program is voluntary, both types of enrollees obtain positive surplus; those with negative surplus will choose not to enroll. Enrolling landowners with negative conservation costs generates the most surplus for them, but enrolling those with positive costs generates the most conservation benefits. Putting these together, if the conservation benefits are homogeneous across potential participants, then enrolling those with positive but small costs of conservation creates the most total surplus; using incentives to get people for whom conservation is not too onerous to start conserving is a win–win. (Heterogeneity in how much individuals would conserve without the program alters this reasoning. If someone who would have cleared a large portion of her forest enrolls and complies, then compared with an enrollee who would have cleared a small portion, the first enrollee faces a higher cost of conservation, but also generates a larger environmental benefit if she participates.)

In the numerical example when conservation costs are the only cost of enrollment (case A), the surplus to landholders associated with the program, summing across the 10 enrollees, is 40. The total surplus, which is the conservation benefit net of payments plus the surplus to landholders, or equivalently $B - C$, is also 40 in this case. Note that total surplus is closely related to the cost–benefit ratio, B/C; the former will be positive if and only if the latter is greater than 1. The key distinction is that B/C is a per-enrollee metric, whereas $B - C$ is an aggregate metric, and at a given B/C the total surplus will increase as the enrollment rate rises and the program operates at larger scale. These metrics are summarized in Table 1.

Other Costs of Enrollment. The point we aim to highlight in this paper is that landholders may also incur other enrollment costs, which might vary across landholders. Examples of enrollment costs include costs of obtaining and understanding information

Table 1. The four cases corresponding to Fig. 2

	Case A: no enrollment cost	Case B: no correlation	Case C: positive correlation	Case D: negative correlation
Enrollment rate	100%	60%	50%	90%
Percent of enrollees whose conservation is additional	50%	17%	0%	56%
Conservation benefits (*B*)	50	10	0	50
Total program payments (*C*)	50	30	25	45
Cost-effectiveness (*B*/*C*)	1.0	0.3	0.0	1.1
Surplus to landholders	40	18	22	10
Total surplus	40	−3	−3	15

The set of potential enrollees being considered are the 10 landholders who take up under case A. Surplus to landholders is calculated as the payment net of costs, conditional on take-up: $min(p - (a + t), p - 0)$. The total surplus is the surplus to landholders plus the conservation benefits net of program payments ($B - C$).

about the program, time and effort to complete the application process, credit constraints that affect up-front conservation investments, and trust in the implementing organization. We discuss these in greater detail below. These enrollment costs often receive less attention from PES program designers, yet they play an important role in determining program's cost-effectiveness.

Assume that the total cost of take-up is the sum of the cost of conservation, a, and other enrollment costs, t. Now landholders will enroll in the program if $p > a + t$. This additional cost t of take-up has two main effects:

i) It lowers the overall amount of take-up relative to the case where take-up is determined solely by a.

ii) It affects the composition of those who take up. This affects the overall net benefits and cost-effectiveness of the program if it increases or decreases the average a of enrollees.

The first effect is intuitive: Some enrollees who would have enrolled in the absence of t will now not enroll because the additional cost t makes the program unattractive. (These are the cases where $a < p < a + t$.) The total number of enrollees (and hence total conservation benefits) will be lower.

The second effect depends on the correlation between a and t. If they are uncorrelated (case B, Fig. 2*B*)—so t is, on average, the same for landholders with different values of a—then the individuals whose decision will flip and who will no longer participate are the high-a landholders; their high a means that their surplus from participating is particularly small even when t is 0, so additional costs of enrollment can easily tip them to no longer having positive surplus from participating. Meanwhile, the low-a landholders' decision to participate is less likely to be changed by enrollment costs. Thus, the proportion of additional enrollees will be lower than in the absence of t. The surplus to landholders will also be lower because participating landholders now also incur the enrollment cost t.

If the correlation between a and t is positive (case C, Fig. 2*C*), then take-up among high-a landholders will be even lower than in case B, resulting in an even lower fraction of additional enrollees. The high-a individuals—who are more likely to generate additional conservation—now have a second reason they are especially unlikely to enroll, namely that they also have high t. Thus, a positive correlation between a and t exacerbates the problem that a PES program is making payments to landholders whose conservation is not additional. However, the landholders with a low conservation cost a are also likely to have low enrollment costs t, so the surplus to landholders will tend to be higher than in case B.

Finally, if the correlation between a and t is sufficiently negative (case D, Fig. 2*D*), then take-up among high-a landowners will be higher than in case A, resulting in a higher fraction of additional enrollees. (A necessary condition for a negative correlation to improve cost-effectiveness is that, on average, a one-unit increase in conservation costs is associated with a greater than one-unit decrease in enrollment costs.) Here the intuition is that the landholders who, based on their cost of conservation a are less likely to enroll, have an offsetting force, namely their low t, that makes them relatively more likely to enroll. The existence of other enrollment costs, t, serves the potentially useful function of "screening out" some nonadditional landholders who would have otherwise enrolled. (If a PES program entails high fixed administrative costs, then even though the composition of enrollees is preferable in case D than in case A, the higher number of enrollees in case A could imply that it has higher cost-effectiveness than case D because the fixed costs are spread over more enrollees.)

Table 1 summarizes these cases in terms of the total environmental benefits (or additionality), total program costs (payments to enrollees), cost-effectiveness (benefit–cost ratio), surplus to enrollees (transfers net of costs incurred), and total surplus. The following insights emerge from Table 1:

- First, enrollment costs that are uncorrelated with conservation costs lower the cost–benefit ratio and reduce total surplus. The program scale is smaller and the landholders deterred from enrolling due to the enrollment costs are disproportionately the ones that provide additionality (comparison of case B to case A).
- Second, when enrollment and conservation costs are positively correlated, the cost–benefit ratio falls even further (comparison of case C to case B).
- Finally, when the two types of costs that determine self-selection are negatively correlated, the cost–benefit ratio can rise relative to when enrollment is costless, but total surplus may be lower due to the dampened level of enrollment and extra costs incurred by enrollees (comparison of case D to case A).

We next use two PES programs in low-income countries to empirically demonstrate the main points made in this conceptual framework.

Background on PES Programs

In this section, we provide background on the two PES programs used to provide evidence on self-selection into PES programs.

Example 1: Avoided Deforestation in Uganda (DEFOR-Uganda).

Context. Jayachandran et al. (9) report on a randomized evaluation of an avoided deforestation PES program.* The PES program ran for 2 y in Hoima and northern Kibaale districts in

*Informed consent was obtained from all participants. The study was reviewed and approved by Northwestern University IRB under protocol STU00055401, Stanford University IRB under protocol 19468, and Uganda National Council for Science and Technology under protocol SS2234.

western Uganda. In addition to being valuable for carbon storage, the forest in this region promotes biodiversity, notably by providing habitat for chimpanzees. Much of the primary forest in this region is privately owned by households. The typical household enrolled in the study owned 2 ha of primary forest, and 10 ha of land overall.

Intervention. The program was implemented by a local conservation nonprofit, Chimpanzee Sanctuary and Wildlife Conservation Trust (CSWCT). Interested forest owners signed a contract which entitled them to US$28 (in 2012) per hectare of primary forest if they refrained from clearing trees in it. Whether they kept the forest intact was monitored via on-the-ground spot checks by CSWCT staff.

Study design. The program was implemented in 60 villages randomly selected from among the 121 study villages. The main outcome was the change in land area covered by trees, measured via analysis of high-resolution satellite imagery.

Cost of conservation. Before the study, many (but not all) forest owners were clearing some portion of their forest, mostly to use the land for subsistence agriculture and or to sell trees to timber and charcoal dealers. Complying with the program and fully conserving the forest entailed a loss of income from reduced area of cultivation or cultivation of second-choice land, as well as loss of income that would have been generated by selling trees.

Costs of program enrollment. To enroll in the program, a forest owner needed to be aware of the program, meet with CSWCT to allow her forest area to be measured, sign a contract that granted CSWCT rights to come onto her land to do spot checks, and then comply with the program. (The need to gain access to private land is why the program required active enrollment with a signed contract.) These steps introduced several sources of enrollment costs. First, forest owners needed to attend a meeting to learn about the program. Second, they needed to put in the effort to understand the contract and gather information on CSWCT to allay their possible fear that the program was a ploy to seize their land.

Example 2: Afforestation/Reforestation in Malawi (AFFOR-Malawi).

Context. Jack (10) reports on a randomized experiment embedded in an afforestation/reforestation program.[†] The PES program ran for 3 y in Ntchisi district in Central Malawi. The program encouraged planting of *Khaya anthotheca* (an endemic mahogany species, referred to locally as Mbawa), a species useful for carbon sequestration, in part due to its use for timber and construction. Most of the land in central Malawi was deforested decades ago and is used for agricultural production under customary land title. The typical household enrolled in the study cultivated three different crops on an average of 2 ha of land.

Intervention. The program was implemented by an international organization, the World Agroforestry Centre (ICRAF). Eligible households were given 50 seedlings if they chose to sign a contract. The contract paid per surviving tree at 6 mo and 1, 2, and 3 y, up to US$85 (in 2008) in total over 3 y if all trees survived for the duration of the contract.

Monitoring was conducted by ICRAF staff and local agricultural extension officers, who counted surviving trees and issued payments.

Study design. The 472 households from 27 villages were randomly assigned to participate in an auction or a lottery treatment. The auction elicited bids over how much a landholder would need to be compensated to be willing to enroll. The nongovernmental organization (NGO) had a budget cap that determined a single price to be offered to all accepted bids. A random sample of households in the lottery treatment was drawn and those households were offered the same contract. All accepted. (Because payments were per surviving tree, and no penalty was applied for zero tree survival, all landholders have an incentive to take up the contract.)

Cost of conservation. Around half of the sample reported some tree planting at baseline. Planting trees and ensuring their survival is time-consuming. Estimates suggested that the labor and material inputs necessary for full tree survival were worth around US$142 over the 3 y of the contract, if evaluated at market prices. Households with a higher per-tree cost of conservation should have kept fewer trees alive under the contract.

Costs of program enrollment. To enroll in the program, landholders needed to attend a training session and sign a contract. Attendance was nearly universal since ICRAF offered transportation and refreshments. Because seedlings were provided for free, many of the enrollment costs typical to an afforestation program were borne by ICRAF. That said, landholders may not have trusted the contract, particularly if they were illiterate. They also may have been concerned that the trees would have detrimental impacts on crop production.

Evidence from DEFOR-Uganda

Evidence on Heterogeneous Costs of Conservation. In the DEFOR-Uganda case, the cost of conservation is the amount (and value) of deforestation that a landholder would have undertaken absent the program. Because eligibility for the program was randomly assigned, the control group provides a measure of the treatment group's counterfactual deforestation; the control group is similar to the treatment group except for the key difference of not being eligible for the program.

Fig. 3 shows that there is a wide distribution of change in tree cover in the control group. Many forest owners are deforesting a lot (those on the left of the distribution with very negative tree cover change); inducing them to sign up and comply would yield large amounts of forest gain. However, a sizable proportion (about one-third) have no net deforestation, and in fact net positive tree gain. This figure lays bare the worst-case scenario of take-up. If these one-third of individuals and only these individuals enrolled, the program would be making payments to them but with no additional forest cover resulting from the program. The program's benefit–cost ratio would be 0.

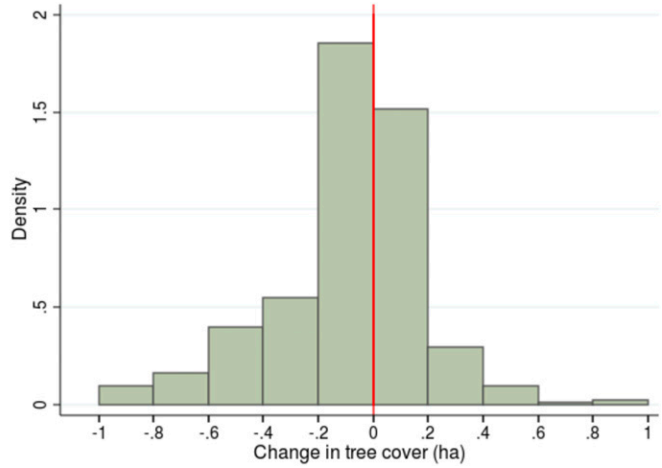

Fig. 3. DEFOR-Uganda: Change in tree cover, control group. Histogram of change in tree cover between baseline and endline among landholders in control villages.

[†]Informed consent was obtained from all participants. The study was reviewed and approved by Harvard University's Committee on the Use of Human Subjects under protocol F16307-101.

Evidence on Other Costs of Enrollment. In the DEFOR-Uganda case, one-third of eligible landholders enrolled. If enrollment were costless, then we would expect enrollment to be 100%. This is because the program offers option value if you enroll, with a weakly positive net benefit; noncompliers receive no payment while those who fulfill the program requirements receive payments.

In interviews of eligible landholders who chose not to enroll, several factors were cited. Many said they were not aware of the program and did not attend the informational session about it. Others stated that the contract they were asked to sign was too complicated, or they feared it was a ploy to gain property rights over their land.

Indeed, a measure of whether the landholder had prior experience signing a contract is a positive predictor of enrollment. For the 76% of eligible landowers with prior experience with written contracts, take-up likelihood was 10 percentage points higher than among those who had not signed a contract before ($P < 0.05$).

Evidence on How Enrollment Costs Affect Additionality. As shown in Fig. 3, with one-third of landholders enrolling, the worst-case scenario results in no additionality from the program. In fact, the program led to a sizable decline in deforestation. Tree loss in the treatment villages was 4.2% compared with 9.1% in the control villages. This implies that the selection into signup was not based solely on costs of conservation. The proportional decline in deforestation in the treatment groups is roughly similar to, and in fact somewhat larger than, the take-up rate, implying that those who enrolled had a similar average counterfactual deforestation as the eligible population as a whole.

We explore this pattern in the data by calculating a landholder-specific counterfactual change in tree cover for the treatment group. We run a regression model of deforestation in the control group with baseline variables such as initial tree density and demographic characteristics. The model estimates are then used to construct the predicted value for each treated landholder, for whom the counterfactual is not observed. The R^2 of the regression model we estimate with the control group is 0.28, implying that its predictive power for the ex ante similar treatment group should be good, though, of course, not perfect.

Fig. 4 plots the resulting distribution of predicted change in tree cover for the full treatment group and for the subset that enrolled. Under pure selection on costs of conservation, the enrollee distribution would be shifted to the right of the full distribution; enrollees would be drawn from the right-hand side of the full distribution (positive or small negative change in tree cover). In fact, the distributions are quite similar.

Returning to the example of prior experience signing contracts, this characteristic is predictive of a lower change in forest cover (correlation of −0.14, $P < 0.01$) or, in other words, of more deforestation. Speculatively, this could be because the prior contracts were with timber dealers or because certain traits of people make them both more likely to enter contracts and more likely to deforest. Regardless, this empirical pattern means that if lack of familiarity led some people to decline the PES contract, this fact inadvertently screened out landholders whose forest conservation would have been nonadditional, consistent with case D from our conceptual framework. Lack of familiarity with contracts acted as a source of enrollment costs that improved the average additionality among program enrollees.

Evidence from AFFOR-Malawi

Evidence on Heterogeneous Costs of Conservation. In the afforestation case (AFFOR-Malawi), the cost of conservation is the cost associated with planting and caring for trees above and beyond any trees that the landholder would have grown absent the program.

Because landholders were randomly assigned to bid over contracts in an auction or receive contract terms at random in a lottery, the distribution of tree survival under random contract

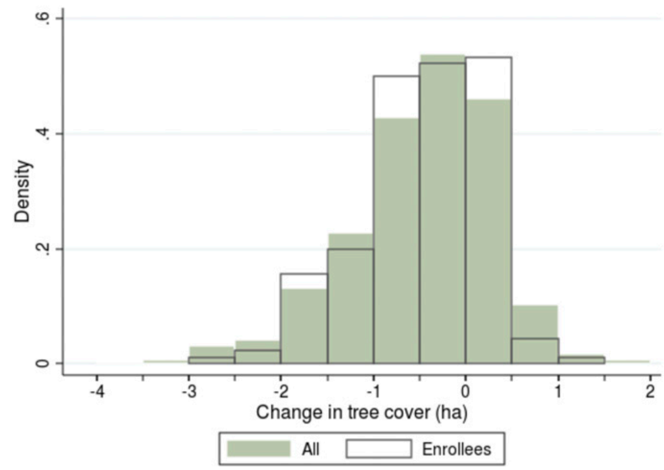

Fig. 4. DEFOR-Uganda: Predicted change in tree cover, treatment group. Histogram of predicted counterfactual change in tree cover among landholders in the treatment group. These counterfactual changes are predicted based on the estimated relationship between landholder characteristics at baseline and tree cover changes in the control group.

assignment provides a counterfactual for the importance of self-selection. Theoretically, those with a lower cost of conservation should have submitted a lower "willingness to accept" bid in the auction and thus have been more likely to be enrolled in the program relative to the full population of landholders. Higher tree survival in the auction group is a signature of self-selection on the cost of conservation, since conservation costs should be lower, on average, among self-selected landholders than among landholders selected at random. (In the contract offered in the AFFOR-Malawi case, payments under the contract were per surviving tree, so the assumption from the conceptual framework that landholders always comply, conditional on enrolling, does not apply as directly in this case. Higher tree survival under the contract is associated with lower conservation costs since households choose how many trees to keep alive at the per-tree payment level offered by the contract.)

Fig. 5 provides evidence that tree survival outcomes are indeed higher when landholders self-select into the program, consistent with costs of conservation affecting enrollment decisions.

Evidence on Other Costs of Enrollment. The correlation between auction bids and observable landholder characteristics offers suggestive evidence on the sources of enrollment costs. Bids are negatively correlated with past experience with the implementing organization, which is consistent with a greater willingness to participate among those with greater trust in the program. Past experience with the NGO may also reflect interest in tree planting and costs of conservation. Trust in outsiders is negatively correlated with bids, but insignificantly.

Evidence on How Enrollment Costs Affect Additionality. We next examine how observable characteristics of landholders, measured during the baseline survey, relate both to bids and to tree survival outcomes. As illustrated by Fig. 1, at any given price, self-selection will lead to greater take-up among those with lower costs. Bids offer a proxy for the total of both enrollment and conservation costs, with higher bids implying higher costs. For landholders in the auction treatment group, we rank bids from highest to lowest, so that a higher rank implies a lower total cost of enrollment. We correlate bid rank with baseline observable characteristics, measured in SDs relative to the mean for the baseline sample, and plot the resulting correlation coefficients on the vertical axis in Fig. 6. A positive correlation coefficient

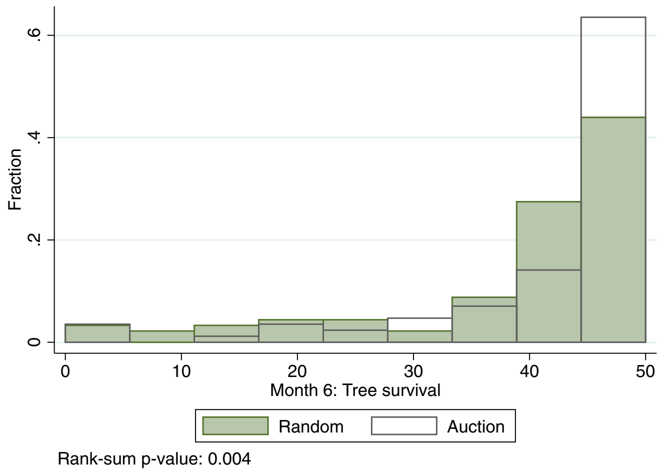

Fig. 5. AFFOR-Malawi: Tree survival outcomes. Histograms of tree survival outcomes after 6 mo, for landholders randomly assigned a contract and those who self-selected into a contract (auction).

means that the characteristic is associated with a higher bid rank, and therefore a lower total cost of participating in the program.

We then turn to the lottery treatment group and correlate baseline characteristics with tree survival outcomes, which proxy for conservation costs alone. We plot the resulting correlation coefficients on the horizontal axis in Fig. 6. A positive correlation coefficient means that the characteristic is associated with greater tree survival, and therefore a lower cost of conservation.

If conservation costs are the primary determinant of both bid rank (self-selection) and tree survival, we would expect to see a positive association between these two sets of correlations. This would indicate that variables associated with higher tree survival are also associated with more competitive bids (higher bid rank) and that conservation costs are paramount in enrollment decisions. Instead, we observe a slightly negative association that is not significantly different from zero ($P = 0.54$). This suggests either that enrollment costs play an important role in determining bidding and tend to be negatively correlated with costs of conservation, or that unobservable characteristics are an important factor in both.

Targeting on Enrollment Costs

The evidence above suggests that enrollment costs can be important in PES programs, and we now turn to the implications for policy design. The additional source of heterogeneity that we highlight—and refer to as "enrollment costs"—affects a program's cost-effectiveness by changing the level and composition of enrollment. While in the examples above improvements in cost-effectiveness from the unfamiliarity of contracts or the upfront cost of seedlings were inadvertent, these extra costs can, in principle, be manipulated by a policy maker. We refer to this as targeting: intentional design decisions aimed at changing the composition of enrollees. When these changes in composition are due to voluntary choices by potential enrollees, this is often referred to as "self-targeting."

Returning to the conceptual framework discussed above, consider a policy maker who faces case B or C (Fig. 2 *B* and *C*)—where the cost of conservation and enrollment cost are either uncorrelated or positively correlated. In this case, it is valuable to reduce the enrollment costs and minimize this force that is exacerbating the nonadditionality problem.

Alternatively, the program designer can try to encourage enrollment based on characteristics other than the conservation cost if they happen to be negatively correlated with the conservation cost. Consider a policy maker in case A with no enrollment costs (Fig. 2*A*). The policy maker can intentionally introduce an enrollment cost dimension that is known to be negatively correlated with counterfactual conservation. For example, while the contract complexity in DEFOR-Uganda was inadvertent, a policy maker could intentionally introduce this complexity, knowing that doing so dampens the level of enrollment but screens out some nonadditional participants. This then switches the program from being in case A to case D (Fig. 2), improving cost-effectiveness. (If there are fixed costs of the program, then this statement becomes ambiguous because the higher benefit per enrollee could be outweighed by the lower enrollment rate, with the fixed cost spread across fewer enrollees.)

To our knowledge, intentionally increasing or diminishing hurdles to enrollment to improve targeting has not been a central feature in the design of PES programs to date. However, this sort of design is not uncommon in other social sectors, as we discuss below.

A close analog of targeting PES to landholders who would not have otherwise conserved is directing a free or subsidized good or service—such as financial aid to attend college or chlorine to purify drinking water—to the truly needy. For example, if someone would have purchased chlorine without a subsidy, then the subsidy is irrelevant to the purchase decision and creates no "additionality" of chlorine usage or clean water. As is the case with PES, the policy designer cannot readily observe additionality, which makes targeting on observable characteristics difficult.

Financial aid for college provides an example of intentionally adjusting program enrollment costs to affect the composition of who takes up free or subsidized services. A study analyzed an intervention that offered low-income parents of high-school seniors in the United States assistance and a streamlined process to complete the federal financial aid application (14). In this case, lowering enrollment costs increased not only financial aid take-up (the analog of PES take-up) but also college-going (the analog of forest cover): Three years later, high-school seniors whose parents received the treatment were 29% (eight percentage

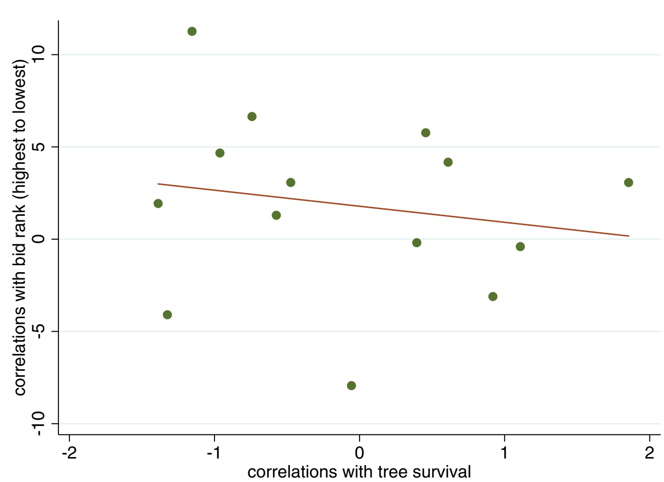

Fig. 6. AFFOR-Malawi: Observable characteristics, bids, and tree survival. The figure plots correlation coefficients between baseline characteristics and landholder bids (bid rank, where a lower value means a higher bid) in the auction group on the vertical axis and between baseline characteristics and tree survival outcomes in the lottery group on the horizontal axis. Baseline characteristics are measured in SDs of the baseline mean and include education, household size, access to credit, number of fields, number of crops cultivated, any cash crops, distance between fields and crops, casual labor income, participation in labor-sharing groups, past tree planting, past contact with NGO, willingness to try new technologies, and risk aversion.

points) more likely to have completed at least 2 y of college. This seems to correspond to case C of our conceptual framework, where lowering enrollment costs improves the composition of enrollees.

In other cases, like in case D of our conceptual framework, enrollment costs might have beneficial effects on the composition of who takes up the program. This idea has often been discussed in social welfare programs, where a program goal is to lift households out of poverty and where the counterpart to additionality is directing assistance to households that otherwise would have remained in poverty. The public economics literature has proposed that enrollment costs can help target a universal program to the needy (15). Examples include workfare programs that give welfare payments in exchange for work, used in the New Deal in the United States and currently in India's employment guarantee scheme.

Another example of enrollment costs improving the composition of enrollees was seen in a study in Kenya that distributed free chlorine solution to treat drinking water (16). In one treatment, households received vouchers for a free bottle of chlorine per month, redeemable at a shop. In the other treatment, the free bottles were delivered to people's homes. Not surprisingly, take-up was lower when the household had to go to the shop (about 40% take-up) than when the chlorine was delivered (100% take-up). More interestingly, despite the lower take-up, the total improvement in water purification was similar in the two groups; in other words, there was a higher improvement per enrollee under the voucher system. The hassle of picking up the product selected for people who needed the chlorine and were going to use it. Similarly, a study in Indonesia found that creating an application process for the government's conditional cash transfer program led to decreases in enrollment among better-off households (17).

These examples from other social programs focus mostly on targeting transfers to the poor. Targeting on poverty might be easier than targeting on counterfactual conservation because experience and economic theory provide guidance on how being poor will affect program take-up. For example, the hourly wage is lower for the poor, so a time cost might impose a smaller burden on them. Similarly, certain in-kind goods are "inferior goods" that are relatively less demanded by the rich. If the traits that determine or are associated with a landholder's counterfactual conservation are less regular and predictable in the population, or less separable from their costs of conservation, then adjusting enrollment costs to implicitly choose enrollees with higher additionality will be more difficult. Nonetheless, we believe that there may be scope for intentionally adjusting enrollment costs to improve the effectiveness of PES programs.

Conclusion

When considering whether to enroll in a PES program, landholders weigh the benefits (payments under the contract) against their own private costs of participating. To date, the literature has focused on the costs of conservation as a key determinant of the enrollment decision, and one that will tend to adversely affect the cost-effectiveness—that is, conservation benefits per dollar spent—of the program. This is because landholders who were going to conserve anyway and thus have a zero cost of complying with the program rules will both want to take up and not provide any additional conservation relative to what they would have provided in the absence of the program. We discuss the possibility that landholders may also face other costs of enrollment, and that these other costs may help or hurt the relationship between self-selection into the program and the cost-effectiveness of the program.

Our case studies highlight that these enrollment costs can be have important implications for program benefits. In the DEFOR-Uganda case, for example, if the one-third of landholders who chose to enroll had simply been those with the lowest cost of conservation, the program would have had no impact on deforestation instead of the sizable impact observed. Social programs around the world have used these ideas for targeting transfers of subsidized or free goods or services to the poor. Incorporating lessons learned from these experiences into PES programs may help improve cost-effectiveness.

The existence of enrollment costs also reinforces that there are few shortcuts to accurate measurement of the impacts of PES. If conservation costs are the only determinant of take-up, then a simple comparison of enrollees to nonenrollees will always overstate the impacts of a PES program; this naïve approach at least provides an upper bound on benefits. However, if unobserved enrollment costs also influence participation, then a naïve comparison of enrollees and nonenrollees delivers a biased estimate of program impacts where even the direction of the bias is unknown.

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