SPECIAL FEATURE

Can community monitoring save the commons? Evidence on forest use and displacement

Sabrina Eisenbarth[a,b,1,2], Louis Graham[c,1], and Anouk S. Rigterink[d,1,2]

[a]University of Exeter Business School, University of Exeter, Exeter EX4 4PU, United Kingdom; [b]Land, Environment, Economics and Policy (LEEP) Institute, University of Exeter, Exeter EX4 4PU, United Kingdom; [c]Busara Center for Behavioral Economics, Nairobi 00100, Kenya; and [d]School of Government and International Affairs, Durham University, Durham DH1 3TU, United Kingdom

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Rapid deforestation is a major driver of greenhouse-gas emissions (1). One proposed policy tool to halt deforestation is community forest management. Even though communities manage an increasing proportion of the world's forests, we lack good evidence of successful approaches to community forest management. Prior studies suggest that successful approaches require a number of "design conditions" to be met. However, causal evidence on the effectiveness of individual design conditions is scarce. This study isolates one design condition, community-led monitoring of the forest, and provides causal evidence on its potential to reduce forest use. The study employs a randomized controlled trial to investigate the impact of community monitoring on forest use in 110 villages in Uganda. We explore the impact of community monitoring in both monitored and unmonitored areas of the forest, using exceptionally detailed data from on-the-ground measurements and satellite imagery. Estimates indicate that community monitoring does not affect our main outcome of interest, a forest-use index. However, treatment villages see a relative increase in forest loss outside of monitored forest areas compared to control villages. This increase is seen both in nonmonitored areas adjacent to treatment villages and in nonmonitored areas adjacent to neighboring villages not included in the study. We tentatively conclude that at least part of the increase in forest loss in nonmonitored areas is due to displacement of forest use by members of treatment villages due to fear of sanctions. Interventions to reduce deforestation should take this potentially substantial effect into consideration.

common pool resources | forest conservation | deforestation | community monitoring | community forest management

Deforestation is associated with increased greenhouse-gas emissions (1) and species loss (2, 3). It also affects households (HHs) in the developing world that rely on income generated from forests (4). One proposed policy tool to halt deforestation is community forest management (5–7), which involves the statutory recognition of local communities' rights to manage forests (8). In contrast to centralized forest management by an external party (e.g., a government agency), community forest management relies on input and investment from within the community. Given its promise for improving forest management, community forest management has become widespread, with 28% of forests across Africa, Asia, and Latin America officially designated to be managed by local communities and Indigenous People (9).

However, the theoretical underpinning behind community forest management has historically been controversial. Early studies focused on community forest management in light of the "tragedy of the commons" and argued that overexploitation is an inevitable consequence. Subsequent influential work by Elinor Ostrom (10, 11) changed this narrative, suggesting that sustainable community management is possible if a set of specific "design conditions" are met. From Ostrom's case studies, those design conditions include community involvement in rule making, community-led forest monitoring, graduated sanctions, and low-cost dispute resolution.

Whether and when community forest management is effective in halting deforestation is uncertain. While a number of recent studies document that community forest management can reduce deforestation (7, 12, 13), few studies employ a rigorous methodology for causal identification (8). Additionally, we still lack a full understanding of what makes community forestry a success. In particular, rigorous evaluations of design conditions through randomized controlled trials (RCTs) are extremely rare (8). Case studies and laboratory experiments provide a growing evidence base on successful approaches to the management of common pool resources (14), but we need a better understanding of the scalability and external validity of insights from these studies.

This paper provides a large-N causal evaluation of a key design principle: community monitoring of common pool resources. Community monitoring is important to study, as it is arguably a precondition for graduated sanctioning and dispute resolution. Without community monitoring to collect information on overuse, sanctioning and dispute resolution would be less feasible.

The present study documents displacement resulting from an intervention aiming to improve community forest management.

SUSTAINABILITY SCIENCE

Significance

To halt deforestation, communities are increasingly being given the authority to manage their own forests. Although standard economic theory predicts that community management leads to overexploitation, field studies have reported that communities can sustainably manage their forests if specific conditions are present. One condition that is correlated with successful common pool forest management is community-led monitoring of the forest. However, whether such monitoring causes improvements in forest conditions is unclear. Using a randomized controlled trial, we provide causal evidence about the impact of community-led monitoring on forest use. Unlike prior studies, we estimate the effects of monitoring on both monitored and unmonitored forests. The results suggest that monitoring may simply displace forest loss to unmonitored forests, rather than reduce it.

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[1]S.E., L.G., and A.S.R. contributed equally to this work.

[2]To whom correspondence may be addressed. Email: anouk.rigterink@durham.ac.uk or S.Eisenbarth@exeter.ac.uk.

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A growing literature studies local displacement from forest-conservation programs (15) and highlights substantial heterogeneity in the existence, magnitude, and even the direction of local displacement. Several studies find displacement only when they look at heterogeneous effects (16, 17). To date, these studies have focused on protected areas or national parks (16), payments for ecosystem services (17, 18), and zero-deforestation certification schemes (19, 20). In contrast to most empirical research on displacement, we conduct a RCT that follows a preregistered study design to provide causal estimates of this displacement.

Study Design

Under a community-monitoring treatment, six community members in each village were incentivized to measure forest use and threats to the forest on a monthly basis over the period of a year. These monitors then communicated this new information on collective forest use to the wider community through village meetings, thus providing an opportunity for discussions. The monitors also displayed their findings on a poster in a public place in the village. Our main hypothesis is that community monitoring decreases forest use.

The community-monitoring treatment consisted of three essential components: the creation of new information on forest use, discussion at the community level, and direct patrolling with the potential to catch rule breakers in the act.

We hypothesize three main causal channels that may drive changes in forest use by the treatment villages: an increase in sanctioning, a change in unwritten norms related to resource use, and a change in official forest-use rules. The first channel may affect forest use through users' fear of being caught, and the second and third through users' coordinated self-restraint in harvesting. These channels are similar to those developed by Ostrom and later literature (10, 21), in which the role of enforcement (underlying the first channel) and information sharing (underlying the second and third channels) are stressed.

Sanctioning and local enforcement (the first channel) have been shown to be important drivers for the success of community forest management (22, 23). In the context of community monitoring, the most direct (though rare) route for sanctioning and enforcement is through patrolling, in which monitors catch rule breakers in the act. Additionally, community discussion of aggregate forest use could lead to rule breakers being outed by others in the community, and sanctioned.

Unwritten norms (the second channel) may be changed by improved information provision and discussion. Results from laboratory experiments suggest that giving participants information about collective harvesting rates, as well as the opportunity to discuss these, decreases overharvesting (14, 24–26). In some laboratory studies, when communication is introduced, harvesting declines as much as (24, 25) or more than (14) in conditions that include imperfectly enforced external regulation. The gains from communication are higher if harvesters have full information about the resource and others' harvesting (27, 28). However, it is worth noting that these studies focus on contexts in which all resource use is monitored, and hence do not speak to displacement of use to unmonitored areas.

Information provision and discussion could also shift official forest rules (the third channel). For example, in the face of new information stating that deforestation and forest degradation are occurring more quickly than was believed, a community may collectively decide to restrict use more than previously. Various studies document that groups are able to agree on norms and rules through discussion and that this is related to decreased resource use (14, 29).

If reductions in forest use are driven by a fear of being caught rather than self-restraint, community members could merely displace forest use outside of the monitored areas and accelerate deforestation in adjacent areas.

The study is located in 110 villages in Central, West, and Southwest Uganda with de jure management rights over a common pool forest. HHs at baseline used the forest to harvest fuelwood, poles for construction, medicinal plants, and a range of other forest products, mostly for domestic use. Although forest-use rules forbade the cutting of whole trees in all villages, this did take place. At baseline, the rate of forest loss in areas of the forest adjacent to the village exceeded the national average, and large-scale clearing of stretches of forest was recorded in more than one-third of the villages.

Most of Ostrom's design principles for successful management of common pool resources were satisfied fully or partly in the study villages at baseline (see *SI Appendix*, section S1*D* for more details). Common pool forest boundaries and user groups were clearly defined. Forest-use rules were set through negotiation between organizations of forest users within the community and an external agency, the National Forest Authority. Graduated sanctioning mechanisms for violations of forest-use rules and clearly defined conflict-resolution mechanisms were in place. Sanctioning could be informal—for example, HHs scolding each other for violations of forest-use rules. HHs also reported violations to the local village head, the forest-management organization, and, less frequently, the National Forest Authority. Formal sanctions were mostly imposed externally by the National Forest Authority and usually included the confiscation of forest products, fines, and imprisonment.

Ostrom's community-monitoring design condition was not met in the study villages at baseline (10). Monitoring of the forest did occur, but the monitors were not part of or accountable to the community. According to case-study data, such community involvement and accountability are the essential aspects of Ostrom's community-monitoring design condition (21). At baseline, monitoring took place at least once a week in three out of every four study villages. However, this monitoring was conducted primarily by external actors. At baseline, only 8% of villages reported that village inhabitants volunteered to monitor. Hence, baseline monitoring was a component of centralized forest management rather than community forest management.

In turn, centralized monitoring at baseline did not lead to information flows and opportunities for communication: 46% of surveyed village members at baseline agreed that it was difficult for them to assess the size of the forest, a fairly basic indicator of its state. This was likely driven by two factors: Forest-governance meetings were held at the centralized level with limited community involvement, and community meetings did not need to discuss forest-related information (see *SI Appendix*, section S1*B* for details).

A total of 110 villages were selected from eligible Ugandan villages with de jure forest-management rights (573 in total). We ensured that villages included in the study were not contiguous to avoid contamination from the treatment to the control group (*SI Appendix*, section S1*C*). The 110 study villages were randomized in 50 control villages, 50 community-monitoring treatment villages, and 10 villages which received a combination of the community-monitoring treatment and another treatment, which is covered in ref. 30. See *SI Appendix*, section S1*E* for details.

This study designed a two-part community-monitoring treatment. First, in each selected treatment village, six community members underwent a training in which they learned to measure forest use along forest transects (existing paths into the forest). Community monitors were recruited with the help of the village leadership and were selected for their literacy, numeracy, availability to execute community monitoring, residency, and possession of a mobile phone. The community monitors were paid to independently measure forest use along transects into the forest on a monthly basis for 1 y. This monitoring was designed to detect a number of forest-use activities, including the cutting of whole trees, cut branches, domestic animal grazing, and charcoal production. The second part of the community-monitoring treatment focused on communication. Monitors were required to present the results of their monitoring at a community meeting each month, aided by a poster designed to communicate findings to a population with low literacy rates. Once the monitors had presented the poster, they facilitated a discussion around forest use, clear-cutting activities, and the sustainability of forest use in the community.

In comparison to the pretreatment institutional setups in study villages (see *SI Appendix*, section S1*B* for details), the treatment ensured that members of the community monitored the forest, that additional information on forest use became available, and that this information on forest use was discussed in regular meetings.

The main outcome of interest is forest use, which was measured by using exceptionally detailed data from on-the-ground assessments, satellite imagery, and an HH survey (31). On-the-ground assessments measured forest use on two transects (paths) into the forest, starting at a point on the forest edge close to the village center. Satellite imagery captured the disappearance of tree cover in a pixel of the image, which we will refer to as forest loss. Forest loss is a consequence of geographically concentrated forest use without replanting, so the two concepts are related, but not the same. Finally, HH surveys at baseline and endline captured self-reported forest use, intermediate outcomes, and HH exposure to the treatment.

Our main outcome indicators are two standardized indices of forest use: an index of on-the-ground and satellite measures at the village level, and an index of survey and satellite measures at the HH level (*SI Appendix*, section S2*B*). Unless otherwise indicated, these analyses were specified prior to the execution of this study in a Pre-Analysis Plan (PAP). *SI Appendix*, section S6 details all deviations from the PAP.

Exploiting the spatial dimension of our data, we prespecified analyses to investigate whether community monitoring shifted forest use from monitored to unmonitored areas. We define the "monitored area" as the area surrounding the transects subject to on-the-ground assessment (see Fig. 2). In treatment villages, community monitors were instructed to monitor these transects each month. In control villages, no monitoring took place, but on-the-ground assessments defined a commensurate area. We hypothesize that community monitoring might increase forest use in several less monitored areas (see Fig. 2). First, forest use may increase in areas of the forest adjacent to the village ("wider" area*). There may have been some monitoring in these areas, as community monitors were instructed to also monitor two transects adjacent to the village at their discretion. Those transects may have been either in the monitored area or in the wider area. Second, forest use may increase in areas of the forest adjacent to neighboring villages ("neighbor" area). Those neighboring villages were not part of the study sample (*SI Appendix*, section S1*C*), and they may or may not have had de jure management rights for the forest (*SI Appendix*, section S5*H*). Third, community monitoring may increase forest use on private land in the village ["around HHs" area].

Finally, we prespecified analyses investigating displacement of forest use to less visible parts of the monitored area. Specifically, we hypothesized that community monitoring might decrease forest use along the forest border, which is easily visible from the village, but increase forest use in the less visible interior of the forest.

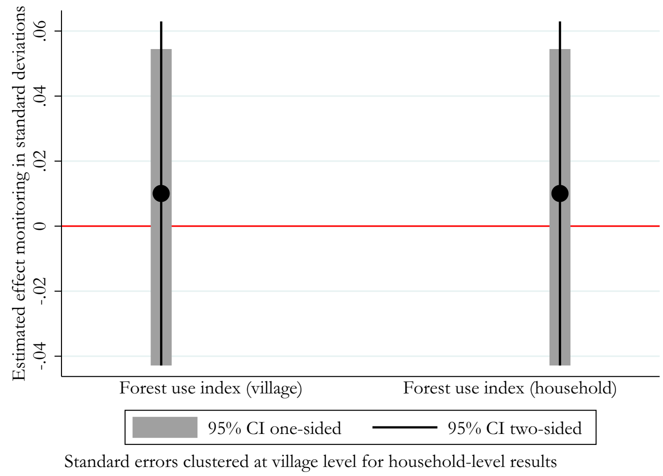

Fig. 1. Effect of community monitoring on forest use, in SDs. The dependent variable is an index capturing forest use at the village and HH level, respectively.

Results

The community-monitoring treatment increased forest monitoring, the dissemination of information, and opportunities for discussion. Nevertheless, we found no evidence that it decreased overall forest use. However, forest loss in unmonitored areas increased in treatment villages compared to control villages, suggesting that community monitoring shifted forest use.

The treatment successfully affected monitoring, information flows, and discussion relating to the forest (*SI Appendix*, Table S10). Monitors reported results to the research team an average of 9 times over a 12-mo study period, and 46 percentage points more HH respondents in treatment villages reported that somebody measured the forest in their village than in control villages (74% vs. 28%). There was also a significant, but imperfect, correlation between cut trees reported by monitors, and endline transect and satellite measurements. Most (68%) of all HH respondents in treatment villages reported receiving information about forest use either through a meeting, the poster, or another channel. The majority of HHs agreed that the monitors provided information that would not have been available to them otherwise. Attendance at forest-related meetings was 12 percentage points higher in treatment villages (49% vs. 37%), providing additional opportunities for discussions.

Nevertheless, the treatment did not demonstrably reduce forest use, as measured by the forest-use indices. The main effect† of the community-monitoring treatment on standardized indices of forest use is not statistically significantly different from zero (Fig. 1). Estimated effects are small: less than 1/10th of an SD. The effect of the treatment did not vary with baseline levels of forest monitoring (*SI Appendix*, section S5*L*) or with the ease with which HHs can decrease forest use, as measured by shocks to HH income, the availability of alternatives to forest products, and access to credit and savings (*SI Appendix*, section S5*C*). Furthermore, we found no evidence that community monitoring had a statistically significant effect on any of the individual components of the forest-use indices (*SI Appendix*, section S5*E*). The single exception was the number of trees cut on transects, which was higher in treatment villages than in control villages,

*The distinction between the wider and monitored areas was not prespecified, but dictated by practical challenges during treatment implementation. See *SI Appendix*, section S6 for details.

†All effects are conditional on control variables, the baseline level of the dependent variable, and randomization-cluster fixed effects.

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contrary to what was hypothesized. This puzzling result is explored in *SI Appendix*, section S5H. However, this result is not robust to adjusting the SE for multiple comparisons.

The estimated effect of the community-monitoring treatment on the forest-use indices might obscure differential effects in monitored and unmonitored areas of the forest. Particularly, the village-level forest-use index lumps together measurements taken in the monitored and wider area adjacent to the study villages, and does not include measurements for areas adjacent to neighboring nonstudy villages.

We found tentative evidence suggesting that forest loss decreased in the monitored area in treatment villages (Fig. 2). The probability that a satellite pixel in the monitored area had been deforested at endline was half as large in treatment villages as in control villages (0.2% vs. 0.4%, $p = 0.06$ in a one-tailed test). This amounts to a modest 450 m^2 of forest conserved per treatment village. However, this result is sensitive to correcting SEs for spatial autocorrelation (*SI Appendix*, section S5J). We found no evidence for displacement of forest loss to any private forested areas within the village.

Compared to control villages, forest loss in treatment villages is significantly higher in the less frequently monitored wider area adjacent to the village and in the unmonitored area adjacent to neighboring villages (the neighbor area) not included in the study. The probability that a pixel was deforested was approximately 1.82% higher in the neighbor area and 0.68% higher in the wider area. This means that forest loss in these areas is an estimated 1.5 times higher in the wider area and 3 times higher in the neighboring area if we compare villages subject to the monitoring treatment to the control villages (see *SI Appendix*, Table S26 for control means). Forest loss in the wider and neighbor area represented an estimated additional 12,600 m^2 of forest lost per village.

As the increase in forest loss in unmonitored areas outweighs the decrease in monitored areas, the estimated net effect of the treatment is an increase in forest loss. This is surprising: If displacing forest use comes at a cost (e.g., of carrying harvested products farther), we would expect users to harvest less after displacement. We conducted exploratory analysis, which was not prespecified, to offer two possible explanations. First, the observed overall effect can partially be an artifact of outliers, as neighbors to two treatment villages experienced extremely high levels of forest loss. The estimated overall effect (in the monitored, wider, and neighbor areas combined) of the community-monitoring treatment when excluding these villages is substantially lower, though still positive and statistically significant at the 10% level (Fig. 2).[‡] Second, inhabitants of the neighboring villages might themselves increase forest use in response to treatment, compounding any increase in forest loss due to inhabitants of study villages relocating their forest use. *SI Appendix*, section S5H shows that the effect of the treatment in neighboring villages was higher in the absence of forest-management institutions in those neighboring villages.

Prespecified analyses did not find evidence that community monitoring displaced forest use away from the forest edge to less visible areas in the interior of the forest. However, exploratory analysis of satellite and on-the-ground data for the monitored area provides tentative evidence for such displacement (*SI Appendix*, section S5I). Displacement to less visible areas suggests that users feared detection by other village inhabitants who could easily observe the forest edge more than they feared detection by monitors who patrolled the transects in the forest interior once a month.

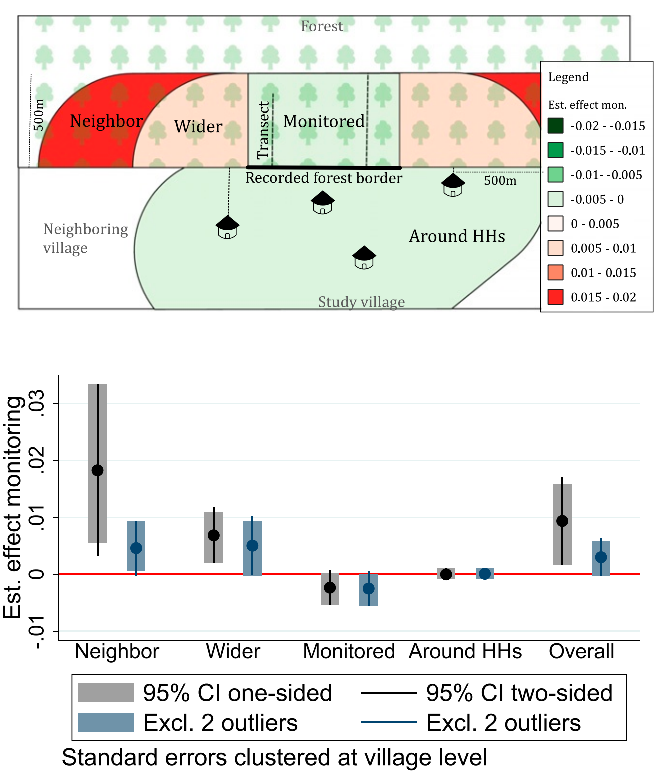

Fig. 2. Effect of community monitoring (in percentage points) on the probability of forest loss at the pixel level. *Upper* shows the estimated effect of community monitoring on the probability that a pixel is deforested, for four different areas. *Lower* shows the same effect and its CI for these four areas, and the overall effect across the monitored, wider, and neighbor areas combined. *Lower* also shows results obtained when excluding two villages that are outliers in terms of the rate of forest loss in the villages neighboring them.

Mechanisms

We hypothesized that community monitoring leads to a reduction in forest use among HHs in treatment communities through three nonexclusive channels: an increase in sanctioning, changes in unwritten norms related to forest use, and changes in official use rules. In this section, we explore how these channels could drive a shift in forest use from monitored to less monitored areas. The results suggest that a fear of sanctions may drive part of the displacement of forest use by members of the treatment villages. There are also indications that the treatment may have inadvertently increased forest use by members of neighboring villages not in the study.

There is scant evidence that community monitoring changed norms or rules related to forest use. HHs in treatment villages were only 2 percentage points ($p = 0.7$ in a one-sided test) less likely to think that it is acceptable to break forest-use rules than control HHs (*SI Appendix*, Table S34). Hence, these results point to a small change in norms. Similarly, control HHs are just as likely as treatment HHs to think that community members should reduce forest use for the sake of future generations (*SI Appendix*, Table S35). The effect of the community-monitoring treatment on norms does not vary across HHs in treatment villages that did and did not attend forest-related meetings (Fig. 3 and *SI Appendix*, Tables S34 and S35). Official rules for forest conservation did not change in the villages studied.

To investigate the importance of sanctioning, we estimated the impact of the community-monitoring treatment on the

[‡]Considering the around-HHs area as part of the overall area results in an estimated effect of community monitoring on forest loss in the overall area that is near zero and tightly estimated.

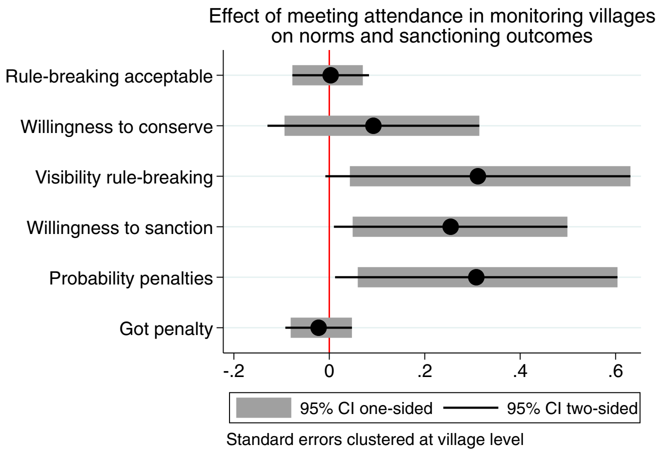

Fig. 3. Estimated effect of meeting attendance in monitoring villages on outcomes related to sanctioning, listed on the left-hand side. Coefficients show a comparison between HHs in treatment villages who attended at least one forest-related meeting during the study period and HHs in treatment villages who did not attend any such meeting.

sanctioning outcomes shown in Fig. 3.[§] We hypothesized that any change in sanctioning is more likely to result from community meetings than from monthly forest monitoring, which is unlikely to catch many rule breakers in the act. Meetings plausibly raise the (perceived) probability of detection since they help village inhabitants collectively infer who violated forest-use rules. Therefore, in addition to analyzing the effect for all HHs, we conducted a mediator analysis comparing HHs in treatment villages who attended at least one forest-related meeting during the study period to HHs in treatment villages who did not attend any such meeting (*SI Appendix*, section S5K). Results shown in Fig. 3 highlight the effect of meetings above and beyond forest patrols. Since HHs self-selected into attending meetings, the results in Fig. 3 are exploratory and not strictly causal.

While the treatment did not affect sanctioning outcomes for HHs in the treatment villages overall, the results suggest that community monitoring raised the (perceived) probability of sanctions among HHs who attended forest-related meetings. Conditional on breaking forest-use rules, the probability of sanctioning is a function of the visibility of rule-breaking and the community's willingness to sanction rule breakers. We found evidence that all these outcomes were affected by the community-monitoring treatment among HHs who attended forest-related meetings. Within treatment villages, HHs who attended meetings thought that their neighbors were significantly more likely to notice infringements on forest-use rules. Moreover, those HHs were more likely to scold or report others for breaking forest-use rules, and they considered penalties for rule-breaking more likely (Fig. 3 and *SI Appendix*, Tables S36–S38). There are two possible explanations for these results. Meetings may provide a forum to detect overusers, mete out informal sanctions to them, and raise the likelihood of penalties. Alternatively, these results could be due to self-selection, if individuals who are willing to sanction others or rate penalties as likely are also more likely to attend meetings. This perception of a higher probability of sanctions is not matched by an actual increase in the number of penalties (Fig. 3). Penalties are rare in the communities we study, and we would not necessarily expect penalties to increase if violations of forest-use rules do not increase or are displaced to less visible areas.

We tentatively conclude that members of treatment villages displace their forest use to unmonitored areas due to an increase in the probability of sanctions without an accompanying change in norms or official rules. Without the self-restraint implied by the latter two channels, treatment HHs could simply shift their activities outside the areas in which monitoring has been implemented. Other mechanisms could also drive this shift in forest use. Inhabitants of the neighboring villages might themselves increase forest use in response to the treatment, compounding any increase due to inhabitants of study villages relocating their forest use (and even driving an increase in overall forest use).

Conclusion

This paper tests an intervention to reduce forest use in common pool forests. The intervention successfully facilitated regular community-led forest monitoring and the dissemination and discussion of information on forest use. Estimates suggest that the intervention did not reduce forest use, beyond a possible small decrease in forest loss in monitored areas. However, the treatment led to an increase in forest loss in unmonitored forest areas, both adjacent to the treatment villages and adjacent to the nonstudy villages neighboring them.

This study documents and quantifies displacement from an intervention based on Ostrom's design principles. We suspect that the increase in forest loss in unmonitored areas is, at least to some extent, driven by displacement of forest use by members of treatment villages due to fear of sanctions. In addition, inhabitants of neighboring villages might contribute to the increase in forest use in areas adjacent to their villages. However, we cannot rule out that other mechanisms are at work. Further research is needed to shed light on mechanisms driving the results and to see how this study's findings translate to different contexts. This would help to improve the design of conservation programs based on monitoring.

If displacement is driven by a fear of sanctions, the design of a monitoring intervention might be improved if monitoring was more widespread or if community members could not predict which parts of the forest were unmonitored. This would raise the probability of detection and sanctions in larger stretches of forest and reduce displacement.

Furthermore, monitoring and information sharing might be more successful if changes in forest use were driven by community self-restraint. This could be facilitated through changes in informal norms and official rules around forest use. The monitoring intervention did not achieve norm shifts, possibly due to the short duration of the study of only 1 y. Future research from the field should investigate how to facilitate such norm shifts among forest users. This is particularly important in the context of ongoing efforts to decentralize forest management. When communities are put in charge of forest management, they cannot necessarily draw on long-established norms or institutions around forest use.

Materials and Methods

Community-Monitoring Treatment. The study received ethical approval from the Ugandan National Council for Science and Technology (SS4331). *SI Appendix*, section S7A includes the protocol for the recruitment and training of community monitors.

Indices for Forest Stock and Forest Loss. *SI Appendix*, section S2B lists the variables used to construct the forest-loss indices in Fig. 1 and details the method of index construction.

On-the-Ground Measurements. Four components of the village-level forest-use index were gathered through on-the-ground assessments of two transects, or paths into the forest. These components were the number of cut trees, animals grazing, charcoal kilns, and cut branches per 100 m of transect. We recorded the location of the border between the village and the common pool forest for 2 km on either site of a central point in the

[§] All outcomes were prespecified. However, "Willingness to sanction others" and "Visibility" were prespecified as outcome variables for the evaluation of the second treatment arm.

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village, using a global-positioning-system device. Two existing paths into the forest starting at this border were selected as transects.

Household Survey. The sample for the HH survey consisted of 10 stratified randomly selected HHs per village, selected from a list provided by local government, and oversampling forest-bordering HHs. Consent statements for survey respondents can be found in *SI Appendix*, section S7A. Attrition between baseline and endline was 10.7%. Attrition is balanced across treatment conditions ($p = 0.55$). *SI Appendix*, section S1C provides more details.

Satellite Data. Satellite imagery stems from the Sentinel-2 satellite. We used a Classification and Regression Tree (CART) classifier (32) to establish the presence or absence of tree cover for each pixel. Areas in Fig. 2 are defined as follows. The monitored area is the minimum bounding box around the recorded forest border and transects that overlaps with the common pool forest. The wider area is defined as a 500-m forest-overlapping buffer around the forest border between the two farthest outlying surveyed HHs in the village, minus the monitored area. The neighbor area is defined similarly as the wider area, but adding 500 m of forest border on either side of the farthest outlying HHs and subtracting the wider area. The area around HHs is a 500-m buffer around the convex hull around surveyed HHs that does not overlap with the common pool forest.

Estimation. Figs. 1 and 2 display β_1 obtained from estimating following specification using Analysis of Covariance:

$$Y_{ijmt=1} = \alpha_m + \beta_1 \text{Monitoring}_j + \beta_2 \text{Monitoring}_j^* \text{T2}_j + \beta_3 Y_{ijmt=0} + \delta X_{ijt=0} + \epsilon_{ijm} \quad [1]$$

Y_{ijmt} represents the outcome for unit i (HH, plot, or transect) in village j in randomization block m at time t. For village-level regressions, subscript j is redundant. α_m is a set of randomization-block fixed effects. Monitoring_j and T2_j equal one if a village is assigned to the community-monitoring and second treatment, respectively. $X_{ijt=0}$ is a vector of control variables, selected because they have high power to predict $Y_{ijmt=0}$ or because treatment was unbalanced across this variable at baseline (see *SI Appendix*, section S2G for details). SEs are clustered at the village level, except for village-level regressions, for which heteroskedasticity consistent SEs were calculated.

Data Availability. Anonymized data have been deposited in the Open Science Foundation repository (https://osf.io/td2p3/).

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