Motivation

- Behavioural interventions as a (low cost) opportunity to reduce deforestation?

- RCT in 110 community managed forests in Uganda

- Intervention: SMS reminders of forest use rules
Research question

Can SMS reminders of communal forest use rules induce compliance with those rules?

Channels
• Attentiveness and knowledge
• Scrutiny and sanctioning
Preview of results

• Increase in self-reported knowledge of forest use rules

• Increase in the *perceived* probability of penalties
  • Actual scrutiny and sanctioning are largely unchanged

• Little evidence of reductions in forest use
• Behavioural interventions in environmental economics
  • Allcott (2011), Allcott (2014), Grasmick (1991), reviews by Carlsson and Johansson-Stenman, 2012; Brent et al., 2017; Schubert, 2017
Contributions to the literature

• Behavioural interventions in environmental economics
  • Allcott (2011), Allcott (2014), Grasmick (1991), reviews by Carlsson and Johansson-Stenman, 2012; Brent et al., 2017; Schubert, 2017

• Insights on common pool resource management from an RCT
  • Ostrom (1990) and related work

• Changes in scrutiny and sanctioning as intermediate outcomes
  • Bateson et al., 2013; Nettle et al., 2013
Contributions to the literature

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  • Allcott (2011), Allcott (2014), Grasmick (1991), reviews by Carlsson and Johansson-Stenman, 2012; Brent et al., 2017; Schubert, 2017

• Insights on common pool resource management from an RCT
  • Ostrom (1990) and related work

• Changes in scrutiny and sanctioning as intermediate outcomes
  • Bateson et al., 2013; Nettle et al., 2013

• Use text messages to change contribution to a public good
  • Dale and Strauss (2014); Karlan et al. (2016); Schoar (2011); Larochelle et al., (2019)
Setting

- Study set in 110 villages in Central, West and South-West Uganda
- Community managed forest
- Rules and sanctioning mechanisms in place
- Infringements are frequent

Image source: Global Forest Watch
Forest use and forest use rules at baseline

[Graph showing the frequency and rules for various forest uses such as fuelwood, water, poles, construction, medicine, mushrooms, charcoal, vegetables, fruits, poles for fencing, honey, seeds, bushmeat, wood products, whole trees, and nuts. The graph includes bars indicating collection, breaks rule, and bans.]
Pre-registered hypotheses

SMS reminders of forest use rules:

• increase knowledge of forest use rules
• increase attentiveness to forest use rules

• increase **actual** scrutiny and the willingness to sanction other forest users

• increase the **perceived** scrutiny and the perceived probability of sanctions by others upon breaking forest use rules

• increase compliance with forest use rules
• reduce forest use
Experimental design
The treatment – SMS text message reminders

• Monthly reminders
• Community-specific rules
• 10 treatment villages
• 70 SMS recipients

Dear [name], please remember that community members can only collect firewood on Wednesdays and Saturdays. Thank you for obeying your community's rules.
Number of SMS reminders by type of forest use rule

- Fuelwood: 10
- Water: 0
- Poles, construction: 21
- Medicine: 5
- Mushrooms: 0
- Charcoal: 6
- Vegetables: 0
- Fruits: 0
- Poles, fencing: 20
- Honey: 0
- Seeds: 0
- Bushmeat: 3
- Wood products: 8
- Whole trees: 14
- Nuts: 0
- Forest entry: 16
- Tools: 6
- Grazing: 10
- Agriculture: 13
- Other: 15
Community forest monitoring as additional treatment

• 6 community members measure forest use and threats to the forest on a monthly basis
• Report findings of collective forest use in village meeting
• Display findings on a poster in a public place in the village
Sample and randomization

- 110 villages that do not border each other
- 11 forests

|                  | Villages | Survey respondents (endline) | Attrition |
|------------------|----------|-----------------------------|-----------|
| Control          | 50       | 533                         | 4.9%      |
| Monitoring       | 50       | 527                         | 4.0%      |
| Monitoring & Rules | 10     | 207                         | 6.0%      |
| Total            | 110      | 1,267                       |           |

- Block randomization based on forest cover, forest cover loss and forest ID
- Attrition is strongly balanced across treatments
Measurement of outcomes

• Knowledge of forest use rules and attentiveness to rules
• Actual and perceived scrutiny and sanctioning
• Non-compliance and self-reported forest use
• Normalized outcomes (z-scores) or indices of z-scores
• Household level forest cover loss rate (satellite)
• Villages level forest use (on-the-ground measures, robustness)
Estimating equation

• $Y_{ijm1} = \alpha_m + \beta_1 \text{Monitoring}_j + \beta_2 \text{Monitoring}_j \ast \text{Rules}_j$

$$+ \gamma Y_{ijm0} + \delta X_{ij0} + \epsilon_{ijm1}$$

• $Y_{ijm1} =$ Outcome for household $i$ in village $j$ in randomization block $m$ at time $t=1$ (endline)

• Standard errors clustered at the village level
Effect of treatment on SMS recipients

\[ Y_{ijm1} = \alpha_m + \beta_1 \text{Monitoring}_j + \beta_2 \text{Monitoring}_j \ast \text{Rules}_j + \beta_3 \text{Monitoring}_j \ast \text{Rules}_j \ast \text{SMS recipient}_{ij} + \gamma Y_{ijm0} + \delta X_{ij0} + \epsilon_{ijm1} \]

• SMS recipient\(_{ij}\)=1 if household received the SMS reminder

• Not causal since SMS recipients were not randomized within rules treatment villages
| Variable                        | (1) Mon, t=0 | (2) Rules, t=0 | (3) Mon, t=1 | (4) Rules, t=1 | (5) Diff. t=0 | (6) Diff. t=1 |
|--------------------------------|--------------|----------------|--------------|----------------|--------------|--------------|
| **Knowledge and attentiveness**|              |                |              |                |              |              |
| Knowledge                      | 0.079        | 0.090          | 0.011        |                |              |              |
|                                | (0.560)      | (0.495)        | (0.046)      |                |              |              |
| Attentiveness                   | 0.036        | -0.008         | -0.044       |                |              |              |
|                                | (0.008)      | (0.084)        | (0.083)      |                |              |              |
| **Scrutiny and sanctioning**   |              |                |              |                |              |              |
| Scrutiny of others             | -0.008       | -0.082         | -0.073       |                |              |              |
|                                | (0.859)      | (0.807)        | (0.071)      |                |              |              |
| Sanctioning of others          | -0.010       | -0.046         | -0.036       |                |              |              |
|                                | (0.730)      | (0.699)        | (0.060)      |                |              |              |
| Scrutiny by others             | 0.076        | 0.034          | -0.042       |                |              |              |
|                                | (0.985)      | (0.973)        | (0.083)      |                |              |              |
| Sanctioning by others          | -0.028       | -0.041         | -0.013       |                |              |              |
|                                | (0.623)      | (0.612)        | (0.052)      |                |              |              |
| **Non-compliance and forest use**|            |                |              |                |              |              |
| Non-compliance                 | 0.009        | -0.005         | 0.033        | 0.048          | 0.003        | 0.015        |
|                                | (0.283)      | (0.189)        | (0.321)      | (0.273)        | (0.267)      | (0.026)      |
| Non-compliance 2               | -0.028       | 0.032          | 0.053        | 0.075          | -0.006       | 0.022        |
|                                | (0.319)      | (0.588)        | (0.512)      | (0.491)        | (0.398)      | (0.042)      |
| Forest use                     | -0.025       | 0.017          | 0.011        | -0.063         | -0.008       | -0.074**     |
|                                | (0.319)      | (0.592)        | (0.413)      | (0.334)        | (0.384)      | (0.032)      |
| Forest use (village)           | 0.389        | 0.063          | 0.091        | 0.010          | -0.326       | -0.081       |
|                                | (1.015)      | (0.378)        | (0.543)      | (0.754)        | (0.327)      | (0.201)      |

The table reports average outcomes for households receiving only the monitoring treatment (Mon) and villages receiving both the community monitoring and rules SMS reminder treatment (Rules) at baseline (t=0) and at endline (t=1). Columns (5) and (6) report differences in means at baseline and endline, respectively. The values in parentheses show standard deviations for the means (Column 1-4) and standard errors for differences (Columns 5-6). * p<0.1, ** p<0.05, *** p<0.01.
Results
Effect of SMS reminders on HH in treatment communities

- Raise **knowledge** of, but not attentiveness to forest use rules
- No evidence of an increase in **scrutiny or sanctioning of others**
- Significant increase in the **perceived probability of sanctions by others**
- No increase in **compliance** or systematic reduction in forest use
Within treatment communities SMS recipients have:

- Better **self-reported knowledge** of forest use rules
- Higher **attentiveness** to forest use rules
- Are more likely to **scrutinize or sanction others** for violations of forest use rules
- Feel more closely **scrutinized by others**
- No evidence that SMS reminders increased **compliance** or reduced forest use amongst users.
Community monitoring did not reduce forest use overall. Displacement from monitored to unmonitored areas is likely driven by fear of sanctions.
Conclusion

RCT to test the effectiveness of rules reminders on compliance with rules and forest use

• Increase knowledge of forest use rules but not attentiveness

• Increase in the *perceived* likelihood of penalties

• Limited evidence of reduction in forest use
Lessons for policy-makers

• Program needs to ensure take-up
• Nudges can be context-specific
• Program design should reduce leakage risk
Open research question

• Can nudges work in a developing country or communal resource use context?
• (How) can we best improve management of communal resources through external interventions?
• What are the constraints that prevent successful conservation in a developing country context and how can we alleviate those along with conservation interventions?
Thank you for your attention!

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Effects on knowledge and attentiveness
Measuring knowledge and attentiveness through household surveys

• Knowledge index capturing
  • Self-reported knowledge of forest use rules
  • 5 point Likert scale where higher values indicate better knowledge

• Objective knowledge of forest use rules
  • Index based on a household’s ability to identify whether rules limit the collection of forest products or entry into the forest

• Attentiveness
  • proxied by the frequency with which households discuss forest use rules
Table 2: Knowledge of and attentiveness to forest use rules

|                         | (1) Knowledge | (2) Self-reported | (3) Objective | (4) Attentiveness |
|-------------------------|---------------|-------------------|---------------|------------------|
| Monitoring              | 0.124*        | 0.142**           | 0.138         | 0.143**          |
|                         | (0.067)       | (0.065)           | (0.090)       | (0.067)          |
| Monitoring × Rules      | 0.221         | 0.267*            | 0.225         | -0.124           |
|                         | (0.147)       | (0.144)           | (0.192)       | (0.152)          |
| $\beta_1 + \beta_2$    | 0.345         | 0.409             | 0.363         | 0.019            |
| $\beta_1 + \beta_2$ p-value | 0.024         | 0.007             | 0.070         | 0.897            |
| Control mean            | 0.002         | 0.101             | -0.009        | -0.019           |
| Lag dep. var.           | No            | Yes               | No            | No               |
| Controls                | Yes           | Yes               | Yes           | Yes              |
| Observations            | 915           | 570               | 915           | 916              |

Standard errors (clustered at the village level) in parentheses
* $p<0.1$, ** $p<0.05$, *** $p<0.01$
Effects on scrutiny and sanctioning
Measuring scrutiny and sanctioning of others

• Scrutiny of others
  • Households patrolled the forest frequently
  • Households consider it likely that they would notice infringements by neighbours

• Sanctioning of others
  • Hypothetical: Imagine your neighbor broke a forest use rule. How likely is it that you would scold them/report them to authorities?
  • Actual: Have you scolded/reported someone for breaking forest use rules.
# Measuring scrutiny and sanctioning of others

| Outcome variable | Component household survey questions |
|------------------|--------------------------------------|
| Scrutiny of others | In the past 12 months, have you or members of your household voluntarily patrolled the common pool forest? [Yes=1] |
|                   | Imagine your neighbour broke a rule relating to forest use. How likely is it that you would notice that your neighbour did this? (Likert scale, very likely=5) |
| Sanction others   | Hypothetical Imagine your neighbour broke a rule relating to forest use. How likely is it you would scold your neighbour? (Likert scale, very likely=5) |
|                   | Hypothetical Imagine your neighbour broke a rule relating to forest use. How likely is it you would report your neighbour to (i) the local government (ii) a community-based organisation responsible for common pool forest (iii) the NFA? (Likert scale, very likely=5) |
|                   | Actual At times, people in this village may break the rules relating to forest use. In the past year, have you personally (i) scolded someone in the villages for breaking the rules? [Yes=1] (ii) reported someone in the village to the LC1, the CFM or CLA or the NFA, for breaking the rules? [Yes=1] |
|                          | (1)                      | (2)                      |
|--------------------------|--------------------------|--------------------------|
|                          | Scrutiny of others       | Sanctioning others       | H.                       |
| Monitoring               | 0.040 (0.046)            | 0.027 (0.042)            |
| Monitoring × Rules       | -0.131 (0.116)           | -0.023 (0.095)           |
| β₁ + β₂ p-value          | 0.410 (0.416)            | 0.964 (0.964)            |
| Control mean             | -0.034 (0.034)           | -0.017 (0.017)           |
| Lag dep. var.            | No                       | No                       |
| Controls                 | Yes                      | Yes                      |
| Observations             | 914                      | 916                      |

Standard errors (clustered at the village level) in parentheses

* p<0.1, ** p<0.05, *** p<0.01
Table 3: Scrutiny and sanctioning of others

|                      | (1) Scrutiny of others | (2) Sanctioning others | (3) Hypothetical | (4) Actual |
|----------------------|------------------------|------------------------|------------------|------------|
| Monitoring           | 0.040                  | 0.027                  | 0.016            | 0.046      |
|                      | (0.046)                | (0.042)                | (0.049)          | (0.048)    |
| Monitoring × Rules   | -0.131                 | -0.023                 | -0.054           | 0.043      |
|                      | (0.116)                | (0.095)                | (0.116)          | (0.110)    |
| $\beta_1 + \beta_2$ | -0.091                 | 0.004                  | -0.038           | 0.089      |
| $\beta_1 + \beta_2$ p-value | 0.410                 | 0.964                  | 0.731            | 0.429      |
| Control mean         | -0.034                 | -0.017                 | -0.022           | -0.005     |
| Lag dep. var.        | No                     | No                     | No               | No         |
| Controls             | Yes                    | Yes                    | Yes              | Yes        |
| Observations         | 914                    | 916                    | 915              | 916        |

Standard errors (clustered at the village level) in parentheses

* p<0.1, ** p<0.05, *** p<0.01
Measuring perceived scrutiny and sanctions by others

• **Perceived** scrutiny by others
  • Imagine you broke a rule relating to forest use. How likely is it that your neighbour would notice that you did this? [very likely=5]

• **Perceived** probability of sanctions by others
  • Hypothetical:
    • If a household in this village breaks a rule about forest use, how likely is it that they will receive a penalty? [very likely=5]
  • Actual:
    • In the past 12 months, have you or members of your household been scolded/received penalties for violating forest use rule. [Yes=1]
|                          | (1)          | (2)          |
|--------------------------|--------------|--------------|
|                          | Scrutiny by others | Sanctioning by others |
| Monitoring               | 0.112        | 0.004        |
|                          | (0.069)      | (0.039)      |
| Monitoring × Rules       | -0.159       | 0.149**      |
|                          | (0.151)      | (0.072)      |
| $\beta_1 + \beta_2$     | -0.048       | 0.153        |
| $\beta_1 + \beta_2$ p-value | 0.732        | 0.040        |
| Control mean             | -0.002       | -0.010       |
| Lag dep. var.            | No           | No           |
| Controls                 | Yes          | Yes          |
| Observations             | 907          | 916          |

Standard errors (clustered at the village level) in parentheses

* p<0.1, ** p<0.05, *** p<0.01
Table 4: Scrutiny and sanctioning by others

|                     | (1)          | (2)          | (3)          | (4)          |
|---------------------|--------------|--------------|--------------|--------------|
|                     | Scrutiny by others | Sanctioning by others | Hypothetical | Actual       |
| Monitoring          | 0.112 (0.069) | 0.004 (0.039) | -0.077 (0.059) | 0.042 (0.048) |
| Monitoring × Rules  | -0.159 (0.151)| **0.149** (0.072) | **0.393*** (0.132) | 0.033 (0.076) |
| \(\beta_1 + \beta_2\) | -0.048       | 0.153        | 0.316        | 0.075        |
| \(\beta_1 + \beta_2\) p-value | 0.732 | 0.040 | 0.022 | 0.374 |
| Control mean        | -0.002       | -0.010       | 4.401        | -0.020       |
| Lag dep. var.       | No           | No           | Yes          | No           |
| Controls            | Yes          | Yes          | Yes          | Yes          |
| Observations        | 907          | 916          | 876          | 916          |

Standard errors (clustered at the village level) in parentheses

* p<0.1, ** p<0.05, *** p<0.01
Effect on compliance and forest use
Measuring non-compliance and forest use

- **Non-compliance index**
  - Higher values if households self-report collection of (several) forest products even though collection is completely banned

- **Non-compliance index 2**
  - Compliance with those forest use rules that were specifically targeted by the SMS reminders

- **Forest use**
  - Self-reported and forest loss from satellite images
|                      | (1) Non-compliance | (2) Non-compliance 2 | (3) Forest use |
|----------------------|--------------------|----------------------|----------------|
| Monitoring           | 0.015 (0.020)      | 0.017 (0.036)        | 0.026 (0.022)  |
| Monitoring × Rules   | 0.074* (0.040)     | 0.081 (0.081)        | -0.065 (0.064) |
| $\beta_1 + \beta_2$ | 0.089              | 0.098                | -0.038         |
| $\beta_1 + \beta_2$ p-value | 0.027            | 0.208                | 0.554          |
| Control mean         | 0.001              | 0.009                | 0.011          |
| Lag dep. var.        | Yes                | Yes                  | Yes            |
| Controls             | Yes                | Yes                  | Yes            |
| Observations         | 910                | 960                  | 963            |

Standard errors (clustered at the village level) in parentheses
* p<0.1, ** p<0.05, *** p<0.01
Non-compliance with harvesting bans by forest product

Coefficient estimate for Monitoring x Rules

Note: Figure shows the coefficient estimate for the treatment indicator “Monitoring x Rules”
Forest use by forest product

Fuelwood
Vegetables
Mushrooms
Nuts
Honey
Seeds
Bushmeat
Charcoal
Medicine
Poles, construction
Poles, fencing
Whole trees
Water
Cleared
Forest loss (satellite)

Coefficient estimate for Monitoring x Rules
### Village level forest use

|                           | (1) |               |               |
|---------------------------|-----|---------------|---------------|
|                           | Forest use |               |               |
| Monitoring                | 0.095| (0.101)       |               |
| Monitoring*Rules          | -0.078| (0.229)       |               |
| Control mean              | 0.012|               |               |
| $\beta_1 + \beta_2$      | 0.017|               |               |
| $\beta_1 + \beta_2$ p-value | 0.939|               |               |
| Lagged dependent variable | Yes  |               |               |
| Controls                  | Yes  |               |               |
| Observations              | 110  |               |               |
## Village level forest use

|                | (1) Forest use | (2) Cut trees | (3) Animals | (4) Kilns | (5) Cut branches | (6) Forest loss 1 | (7) Forest loss 2 |
|----------------|----------------|---------------|-------------|-----------|------------------|-------------------|-------------------|
| Monitoring     | 0.095          | 0.947**       | -0.018      | -0.024    | 0.047            | -0.002            | 0.016             |
| (0.101)        | (0.449)        | (0.015)       | (0.038)     | (0.043)   | (0.006)          | (0.028)           |                   |
| Monitoring*Rules| -0.078         | -2.037**      | -0.119      | -0.003    | 0.032            | -0.003            | -0.013            |
| (0.229)        | (0.907)        | (0.104)       | (0.045)     | (0.052)   | (0.019)          | (0.058)           |                   |
| Control mean   | .012           | 1.66          | .045        | .041      | .034             | .013              | .032              |
| (0.047)        | (0.907)        | (0.104)       | (0.045)     | (0.052)   | (0.019)          | (0.058)           |                   |
| $\beta_1 + \beta_2$ | 0.017         | -1.090        | -0.137      | -0.027    | 0.079            | -0.005            | 0.003             |
| $\beta_1 + \beta_2$ p-value | 0.939         | 0.215         | 0.204       | 0.327     | 0.230            | 0.785             | 0.960             |
| Lagged dependent variable | Yes            | Yes           | Yes         | Yes       | Yes              | Yes               | Yes               |
| Controls       | Yes            | Yes           | Yes         | Yes       | Yes              | Yes               | Yes               |
| Observations   | 110            | 102           | 102         | 102       | 102              | 97                | 98                |

Standard errors (clustered at the village level) in parentheses

* p<0.1, ** p<0.05, *** p<0.01
Results for SMS recipients
Table D.7: Knowledge and attentiveness - SMS recipients

|                      | (1) Knowledge | (2) Self-reported | (3) Objective | (4) Attentiveness |
|----------------------|---------------|-------------------|---------------|------------------|
| Monitoring           | 0.110*        | 0.097             | 0.134         | 0.034            |
|                      | (0.062)       | (0.062)           | (0.083)       | (0.065)          |
| Monitoring × Rules   | 0.239         | -0.070            | 0.302         | -0.066           |
|                      | (0.148)       | (0.112)           | (0.190)       | (0.126)          |
| SMS recipient        | 0.086         | 0.700***          | -0.083        | 0.623***         |
|                      | (0.087)       | (0.180)           | (0.123)       | (0.198)          |
| $\beta_1 + \beta_2 + \beta_3$ | 0.434        | 0.728             | 0.353         | 0.591            |
| $\beta_1 + \beta_2 + \beta_3$ p-value | 0.011       | 0.001             | 0.131         | 0.004            |
| Control mean         | -0.031        | 0.000             | -0.053        | -0.000           |
| Lag dep. var.        | Yes           | Yes               | Yes           | Yes              |
| Controls             | Yes           | Yes               | Yes           | Yes              |
| Observations         | 1205          | 1184              | 1205          | 1206             |

Standard errors (clustered at the village level) in parentheses

* p<0.1, ** p<0.05, *** p<0.01
|                           | (1)                      | (2)                      | (3)                      | (4)                      |
|---------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|                           | Scrutiny of others       | Sanctioning others       | Hypothetical             | Actual                   |
| Monitoring                | 0.015                    | -0.010                   | -0.015                   | -0.001                   |
|                           | (0.048)                  | (0.046)                  | (0.055)                  | (0.047)                  |
| Monitoring × Rules        | -0.127                   | -0.108                   | -0.096                   | -0.129*                  |
|                           | (0.081)                  | (0.068)                  | (0.092)                  | (0.075)                  |
| SMS recipient             | 0.520***                 | 0.507***                 | 0.470***                 | 0.579***                 |
|                           | (0.150)                  | (0.103)                  | (0.107)                  | (0.161)                  |
| $\beta_1 + \beta_2 + \beta_3$ | 0.408                    | 0.390                    | 0.359                    | 0.449                    |
| $\beta_1 + \beta_2 + \beta_3$ p-value | 0.004                    | 0.000                    | 0.000                    | 0.011                    |
| Control mean              | -0.029                   | -0.002                   | -0.001                   | -0.000                   |
| Lag dep. var.             | Yes                      | Yes                      | Yes                      | Yes                      |
| Controls                  | Yes                      | Yes                      | Yes                      | Yes                      |
| Observations              | 1204                     | 1206                     | 1205                     | 1206                     |

Standard errors (clustered at the village level) in parentheses

* p<0.1, ** p<0.05, *** p<0.01
|                                      | (1) Scrutiny by others | (2) Sanctioning by others | (3) Hypothetical | (4) Actual  |
|--------------------------------------|------------------------|---------------------------|------------------|-------------|
| Monitoring                           | 0.070                  | -0.029                    | -0.051           | -0.017      |
|                                       | (0.060)                | (0.042)                   | (0.064)          | (0.044)     |
| Monitoring × Rules                   | -0.034                 | 0.005                     | 0.165            | -0.072      |
|                                       | (0.134)                | (0.070)                   | (0.130)          | (0.065)     |
| SMS recipient                        | 0.348***               | 0.050                     | 0.166            | -0.002      |
|                                       | (0.100)                | (0.078)                   | (0.129)          | (0.090)     |
| \(\beta_1 + \beta_2 + \beta_3\)    | 0.384                  | 0.026                     | 0.280            | -0.090      |
| \(\beta_1 + \beta_2 + \beta_3\) p-value | 0.012                  | 0.805                     | 0.132            | 0.377       |
| Control mean                         | 0.000                  | -0.001                    | 4.388            | -0.005      |
| Lag dep. var.                       | Yes                    | Yes                       | Yes              | Yes         |
| Controls                             | Yes                    | Yes                       | Yes              | Yes         |
| Observations                         | 1195                   | 1206                      | 1193             | 1206        |

Standard errors (clustered at the village level) in parentheses

* \(p<0.1\), ** \(p<0.05\), *** \(p<0.01\)
|                                | (1) Non-compliance | (2) Non-compliance 2 | (3) Forest use |
|--------------------------------|--------------------|----------------------|----------------|
| Monitoring                     | 0.033*             | 0.034                | -0.011         |
|                                | (0.019)            | (0.037)              | (0.028)        |
| Monitoring \times Rules        | 0.061*             | 0.044                | -0.101         |
|                                | (0.035)            | (0.084)              | (0.062)        |
| SMS recipient                  | 0.027              | 0.070                | 0.013          |
|                                | (0.040)            | (0.064)              | (0.045)        |
| $\beta_1 + \beta_2 + \beta_3$ | 0.122              | 0.148                | -0.099         |
| $\beta_1 + \beta_2 + \beta_3$ p-value | 0.023            | 0.188                | 0.116          |
| Control mean                   | -0.000             | 0.017                | 0.018          |
| Lag dep. var.                  | Yes                | Yes                  | Yes            |
| Controls                       | Yes                | Yes                  | Yes            |
| Observations                   | 1205               | 1265                 | 1266           |

Standard errors (clustered at the village level) in parentheses

* p<0.1, ** p<0.05, *** p<0.01
Effect of community monitoring treatment
Effect on forest loss
Effect on forest loss

![Graph showing effect on forest loss with error bars and significance levels.](image)

- Standard errors clustered at village level

Legend:
- 95% CI one-sided
- 95% CI two-sided
- Excl. 2 outliers
- Excl. 2 outliers
Effect of meeting attendance in monitoring villages on norms and sanctioning outcomes

- Rule-breaking acceptable
- Willingness to conserve
- Visibility rule-breaking
- Willingness to sanction
- Probability penalties
- Got penalty

95% CI one-sided
95% CI two-sided
Standard errors clustered at village level