

# Interest-based Negotiation over Natural Resources: Experimental Evidence from Liberia

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# Motivation

- 2003: FAO estimates 120 mil hectares (2×France) needed for food production  
Demand amplified by (expected) subsidies for biofuels and carbon storage
- **Demand concentrated** in developing countries, esp. Africa and Latin America:  
Liberia among the top 20 target countries (Nolte et al. 2016)
- **External investment** in natural resources presents an **opportunity**:  
increased productivity, market integration, formal employment, tax revenues

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- **Demand concentrated** in developing countries, esp. Africa and Latin America:  
Liberia among the top 20 target countries (Nolte et al. 2016)
- **External investment** in natural resources presents an **opportunity**:  
increased productivity, market integration, formal employment, tax revenues
- **Reality has often fallen far short:**
  - The World Bank: “Instead of generating sustainable benefits, [many land investments] contributed to asset loss and **left local people worse off than they would have been without the investment.**”
- What can be done to address this imbalance?
  - UN Special Rapporteur: “**Negotiation capacity is vital.** And that capacity cannot be of governments alone. **Local communities must also be empowered [...]**”

# Research Questions

- 1 Does interest-based negotiation (IBN) training enable more effective negotiation?**
- 2 What negotiating mistakes does IBN training help to correct?**

# Common negotiation mistakes and IBN

Intensive 12-hour training based on courses offered in MBA/MPP programs:

- focusing on interests and identifying positive-sum (“win-win”) agreements
- preparation, assessing the best alternative to a negotiated agreement (BATNA)
- maintaining a positive relationship with one’s counterpart

# Common negotiation mistakes and IBN

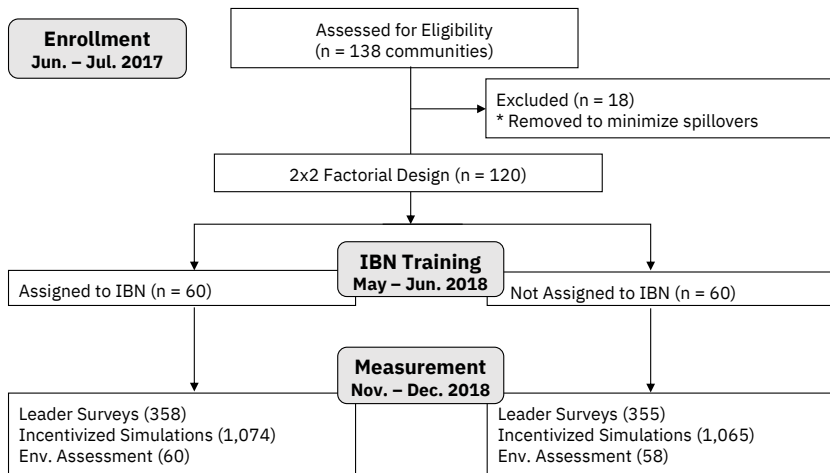
Intensive 12-hour training based on courses offered in MBA/MPP programs:

- focusing on interests and identifying positive-sum (“win-win”) agreements
- preparation, assessing the best alternative to a negotiated agreement (BATNA)
- maintaining a positive relationship with one’s counterpart

IBN (if successful) helps trainees avoid two mistakes:

- 1** (adversarially) fixating on a single, zero-sum dimension  
Capacity constraints  $\rightsquigarrow$  deals that do not maximally advance parties’ interests
- 2** losing sight of the counterfactual (i.e., the alternative to an agreement)  
Cognitive bias  $\rightsquigarrow$  deals inferior to just walking away

# Research Design



## Sampling:

- 1 target individuals who could represent the community in negotiations
- 2 achieve some gender diversity among participants

## Negotiation Simulations:

- Comprehension check
- Max of 10 mins. with reminder: “you can always walk away”
- Simulation order was randomized





- 1 Does interest-based negotiation (IBN) training enable more effective negotiation?**
- 2 What negotiating mistakes does IBN training help to correct?**

# Knowledge and Deployment of IBN Skills

| Outcome  | ATE    | Std. Error | p    | N    |
|--|--------|------------|------|------|
| <b>MNP: Manipulation Checks*</b>               | 11.637 | (0.252)    | 0.00 | 705  |
| Attended Negotiation Training <sup>o</sup>     | 0.916  | (0.021)    | 0.00 | 705  |
| <b>H1: Knowledge of Negotiation Skills*</b>    | 0.335  | (0.068)    | 0.00 | 705  |
| Correctly Defines IBN <sup>o</sup>             | 0.128  | (0.031)    | 0.00 | 705  |
| Recognizes Potential for Win-Win <sup>o</sup>  | 0.125  | (0.035)    | 0.00 | 705  |
| <b>H2: Knowledge of Inter-personal Skills*</b> | -0.082 | (0.076)    | 0.28 | 705  |
| <b>H3: Deployment of IBN Skills*</b>           | 0.214  | (0.084)    | 0.01 | 705  |
| <b>H4: Deployment of Inter-personal Skills</b> | 0.025  | (0.014)    | 0.06 | 2115 |

\*: Mean-effects index; o: Selected components of mean-effects index.

- + Excellent treatment compliance
- + Improvements in knowledge and deployment of IBN skills (0.2–0.3 SDs)
- ~ No/negligible change in inter-personal skills

# Success Negotiating

In control:

- 27% of individuals have a negative average surplus
- 47% of individuals do not earn a positive surplus in *any* simulation

| Outcome                     | ATE   | Std. Error | p    | N    |
|-----------------------------|-------|------------|------|------|
| <b>H5: Positive Surplus</b> | 0.060 | (0.023)    | 0.01 | 2115 |
| <b>H6: Total Surplus</b>    | 2.742 | (1.472)    | 0.07 | 2115 |

- + 6 p.p. (27%) increase in probability of achieving a positive surplus
- + \$2.74 (42%) increase total surplus
- + Conditional on agreeing, trainees' surplus is \$4.85 (37%) larger than the average surplus of control individuals who also reach agreements

# Effects on Community Forest Use at Endline

| Outcome  | ATE    | Std. Error | p     | N   |
|--|--------|------------|-------|-----|
| <b>Forest Use by External Actors*</b>            | -0.265 | (0.135)    | 0.052 | 705 |
| <b>Benefits from External Forest Use*</b>        | 0.054  | (0.136)    | 0.691 | 705 |
| <b>Engagement around Forest Use</b>              |        |            |       |     |
| Rule in Community against Logging w/o Permission | 0.091  | (0.029)    | 0.002 | 703 |
| Does <i>Not</i> Want to Reduce Logging Activity  | 0.031  | (0.020)    | 0.136 | 705 |

Exploratory analysis. \*: Mean-effects index; o: Selected components of mean-effects index.

- Trainees say they would demand 15% more to clear their forest  
But they are not more opposed to logging
- Increased engagement around and regulation of forest use
- Reduction in external forest use, but no change in associated material benefits

- 1 Does interest-based negotiation (IBN) training enable more effective negotiation?
- 2 **What negotiating mistakes does IBN training help to correct?**
  - Mediation analysis
  - Structural model

# Measuring Capacity and Appraisal Skills

- Create two knowledge indexes:
  - 1 knowledge of possible deals (e.g., recognizing the potential for a win-win)
  - 2 knowledge of outside option (e.g., invoking one's bottom line)
- Motivated by theory but was not pre-specified.

Throwing in all the variables and using PCA:

  - $\text{cor}(\text{PC}_1, \text{knowledge of possible deals}) = 0.67$
  - $\text{cor}(\text{PC}_2, \text{knowledge of outside option}) = 0.99$

# Mediation

| Mediation Analysis | Effect of IBN on Knowledge Indexes             |                                     |
|--------------------|--|-------------------------------------|
|                    | Possible Deals                                 | Outside Option                      |
|                    | 0.31<br>(0.07)                                 | 0.25<br>(0.06)                      |
|                    | Indirect Effects of Knowledge Index on Surplus | Direct Effect                       |
|                    | 0.15<br>(0.04)                                 | 0.02<br>(0.01)      -0.01<br>(0.07) |

- IBN training had a positive effect on both knowledge indexes:  $\sim 0.3$  SD
- Knowledge of possible deals mediates most (90%) of the total effect  
The indirect effect of the second index is many times smaller
- Increasing knowledge of outside option does not improve negotiation outcomes
  - because trainees cannot apply this knowledge when negotiating
  - because knowledge is noisily measured  $\rightsquigarrow$  attenuation bias

# Decision-theoretic Model

## Setup:

- Let  $D_i \in \{0, 1\}$  indicate whether an individual received the IBN training
- Individuals differ in the deals they can negotiate:  $\theta_i(D_i) = \theta_i + D_i k$   
And vary in how they value the outside option:  $\beta + u_i(D_i)$ , where  $u_i(D_i) \sim F_D(\cdot)$

## Decision Rule:

- They agree to the negotiated deal iff the value exceeds their outside option:

$$\text{In the control group: } \theta_i \geq \beta + u_i(0)$$

$$\text{In the treated group: } \theta_i + k \geq \beta + u_i(1)$$

- IBN training can affect their **capacity** to negotiate a better deal through  $k$  or it can affect their **appraisal** of their outside option through  $u_i(D_i)$



# Structural Estimates

| Mediation Analysis   | Indirect Effects of Knowledge Index on Surplus |                                | Direct Effect |
|----------------------|--|--------------------------------|---------------|
|                      | 0.15<br>(0.04)                                 | 0.02<br>(0.01)                 |               |
| Structural Estimates | Effect of IBN on Model Parameters              |                                |               |
|                      | Capacity ( $\hat{k}$ )                         | Appraisal ( $\hat{\delta}_1$ ) |               |
|                      | 3.49<br>(1.77)                                 | -0.11<br>(0.08)                |               |

- IBN training increases capacity, but has no significant effect on appraisal
- Reinforces our mediation analysis; this null finding on appraisal cannot be attributed to measurement error in the mediators
- Trainees can identify more valuable deals  
They are not more choosy about the deals they accept

## 1 Does interest-based negotiation (IBN) training enable more effective negotiation?

- 12-hour IBN introduces concepts that individuals recall and deploy 6 months later.
- Trainees are 27% more likely to realize beneficial agreements. When they conclude deals, those agreements deliver a payoff that is 37% larger.
- Exploratory analysis uncovers evidence of community-level changes: reductions in logging, increased regulation of forestland

## 2 What negotiating mistakes does IBN training help to correct?

- Trainees' improvements attributable to improved capacity to identify valuable deals but not an ability to better appraisal their outside option

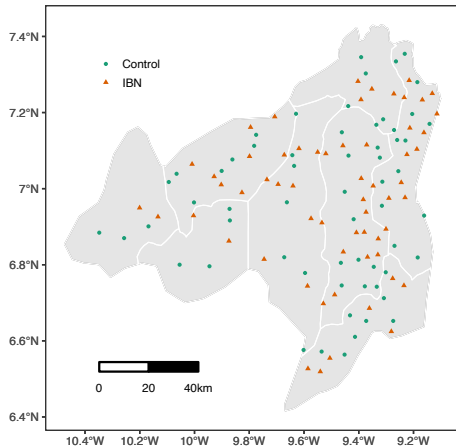
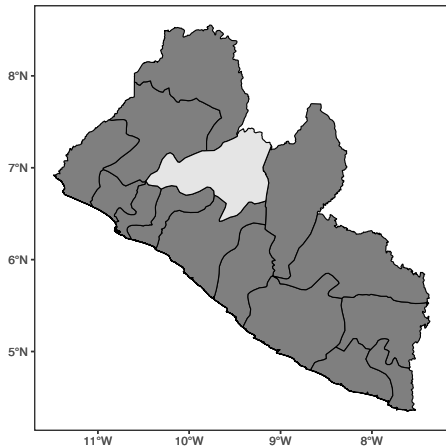
## 3 How should the training be amended?

- $\exists$  win-win  $\nRightarrow$  all deals are worth making
- complemented with information on the value of their forest stock

# Appendix



# Sample Map



# Community Characteristics (2008 Census)

| Feature             | Mean   | Median | SD      | Min   | Max      | Missing | N     |
|---------------------|--------|--------|---------|-------|----------|---------|-------|
| <b>Liberia</b>      |        |        |         |       |          |         |       |
| Population          | 259.40 | 53.00  | 1177.74 | 1.00  | 41182.00 | 0       | 13365 |
| Urban               | 0.04   | 0.00   | 0.19    | 0.00  | 1.00     | 0       | 13365 |
| Under 18            | 0.46   | 0.48   | 0.12    | 0.00  | 1.00     | 0       | 13365 |
| Literate            | 0.35   | 0.33   | 0.23    | 0.00  | 1.00     | 0       | 13365 |
| No School           | 0.74   | 0.76   | 0.21    | 0.00  | 1.00     | 0       | 13365 |
| Wealth Index        | 0.93   | 0.80   | 0.75    | 0.00  | 2.56     | 0       | 13365 |
| Displaced by War    | 0.47   | 0.43   | 0.41    | 0.00  | 1.00     | 0       | 13365 |
| <b>Bong County</b>  |        |        |         |       |          |         |       |
| Population          | 125.04 | 39.00  | 693.58  | 1.00  | 30380.00 | 0       | 2667  |
| Urban               | 0.02   | 0.00   | 0.15    | 0.00  | 1.00     | 0       | 2667  |
| Under 18            | 0.46   | 0.48   | 0.11    | 0.00  | 0.80     | 0       | 2667  |
| Literate            | 0.27   | 0.24   | 0.20    | 0.00  | 1.00     | 0       | 2667  |
| No School           | 0.82   | 0.86   | 0.18    | 0.00  | 1.00     | 0       | 2667  |
| Wealth Index        | 0.76   | 0.60   | 0.67    | 0.00  | 2.56     | 0       | 2667  |
| Displaced by War    | 0.37   | 0.13   | 0.41    | 0.00  | 1.00     | 0       | 2667  |
| <b>Study Sample</b> |        |        |         |       |          |         |       |
| Population          | 300.04 | 127.75 | 437.27  | 12.50 | 2639.00  | 0       | 120   |
| Urban               | 0.05   | 0.00   | 0.21    | 0.00  | 1.00     | 0       | 120   |
| Under 18            | 0.46   | 0.47   | 0.06    | 0.12  | 0.65     | 0       | 120   |
| Literate            | 0.31   | 0.31   | 0.14    | 0.03  | 0.63     | 0       | 120   |
| No School           | 0.78   | 0.80   | 0.14    | 0.48  | 1.00     | 0       | 120   |
| Wealth Index        | 0.73   | 0.59   | 0.49    | 0.00  | 2.41     | 0       | 120   |
| Displaced by War    | 0.36   | 0.25   | 0.34    | 0.00  | 1.00     | 0       | 120   |

# Demographics

For Negotiation Sample:

| Feature           | Mean  | Median | SD    | Min | Max | Missing | N   |
|-------------------|-------|--------|-------|-----|-----|---------|-----|
| Female            | 0.35  | 0      | 0.48  | 0   | 1   | 8       | 705 |
| Age               | 52.23 | 52     | 14.15 | 19  | 99  | 8       | 705 |
| Any Edu.          | 0.50  | 0      | 0.50  | 0   | 1   | 8       | 705 |
| Any Sec. Edu.     | 0.28  | 0      | 0.45  | 0   | 1   | 8       | 705 |
| Born in Community | 0.81  | 1      | 0.39  | 0   | 1   | 8       | 705 |
| Owens Land        | 0.55  | 1      | 0.50  | 0   | 1   | 8       | 705 |
| Christian         | 0.99  | 1      | 0.08  | 0   | 1   | 16      | 697 |
| Kpelle            | 0.89  | 1      | 0.31  | 0   | 1   | 8       | 705 |
| Bassa             | 0.06  | 0      | 0.23  | 0   | 1   | 8       | 705 |

For Households in Sampled Communities:

| Feature           | Mean  | Median | SD    | Min | Max | Missing | N   |
|-------------------|-------|--------|-------|-----|-----|---------|-----|
| Female            | 0.26  | 0      | 0.44  | 0   | 1   | 0       | 476 |
| Age               | 43.35 | 42     | 12.43 | 18  | 85  | 0       | 476 |
| Any Edu.          | 0.63  | 1      | 0.48  | 0   | 1   | 0       | 476 |
| Any Sec. Edu.     | 0.34  | 0      | 0.47  | 0   | 1   | 0       | 476 |
| Born in Community | 0.79  | 1      | 0.41  | 0   | 1   | 0       | 476 |
| Owens Land        | 0.45  | 0      | 0.50  | 0   | 1   | 0       | 476 |
| Christian         | 0.99  | 1      | 0.08  | 0   | 1   | 9       | 467 |
| Kpelle            | 0.88  | 1      | 0.32  | 0   | 1   | 0       | 476 |
| Bassa             | 0.05  | 0      | 0.22  | 0   | 1   | 0       | 476 |

# Balance

- We did not conduct a baseline survey.
- We use publicly available pre-treatment data to assess balance.

| Measure                            | Control Mean | Control SD | IBN     | Standard Error | p           | N   |
|------------------------------------|--------------|------------|---------|----------------|-------------|-----|
| Population 2012 (Landsat)          | 807.68       | (1510.67)  | -232.51 | (207.08)       | 0.26        | 120 |
| Nightlights 2013 (NOAA)            | 0.11         | (0.69)     | -0.09   | (0.1)          | 0.37        | 120 |
| Nightlights 2012 (NOAA)            | 0.07         | (0.53)     | -0.07   | (0.07)         | 0.33        | 120 |
| Elevation (Worldclim)              | 249.45       | (55.09)    | 7.16    | (6.46)         | 0.27        | 120 |
| Precipitation (Worldclim)          | 2140.07      | (151.07)   | -30.25  | (18.73)        | 0.11        | 120 |
| Temperature (Worldclim)            | 254.20       | (5.4)      | -0.64   | (0.46)         | 0.17        | 120 |
| Forest Loss (Global Forest Change) | 0.14         | (0.03)     | -0.01   | (0.01)         | 0.23        | 120 |
| Distance to Monrovia               | 160.02       | (32.66)    | 4.07    | (2.9)          | 0.16        | 120 |
| Distance to Primary Road (LISGIS)  | 9.97         | (7.96)     | 1.31    | (1.19)         | 0.27        | 120 |
| Distance to Any Road (LISGIS)      | 2.11         | (2.72)     | 0.82    | (0.48)         | <b>0.09</b> | 120 |
| Longitude                          | -9.53        | (0.31)     | 0.04    | (0.02)         | 0.12        | 120 |
| Latitude                           | 6.96         | (0.21)     | 0.01    | (0.03)         | 0.59        | 120 |

Estimated using community-level data.

# Within-Community Spillovers

We randomly sampled four households (non-trainees) in each community

| Outcome                                      | ATE    | Std. Error | p     | N   |
|--|--------|------------|-------|-----|
| <b>Benefits from External Forest Use*</b>    | 0.073  | (0.167)    | 0.662 | 476 |
| <b>Satisfaction with Leadership</b>          |        |            |       |     |
| Overall satisfaction                         | -0.028 | (0.040)    | 0.434 | 476 |
| Satisfaction related to the community forest | -0.013 | (0.033)    | 0.690 | 476 |

Exploratory analysis. \*: Mean-effects index.

- Changes in material benefits from external forest use are similar to trainees
- No change in satisfaction with leadership:
  - In control communities, 10.5% of HHs report being unsatisfied with leadership
  - In communities with IBN trainees, 11.6% of HHs



# Full PAP Analysis

| Outcome  | ATE    | Std. Error | p    | N    |
|--|--------|------------|------|------|
| <b>MNP: Manipulation Checks</b>                          |        |            |      |      |
| Mean-effects Index                                       | 11.637 | (0.252)    | 0.00 | 705  |
| Attended Negotiation Training                            | 0.916  | (0.021)    | 0.00 | 705  |
| Correctly Reports Length of Training                     | 0.930  | (0.02)     | 0.00 | 705  |
| Correctly Reports Location of Training                   | 0.926  | (0.02)     | 0.00 | 705  |
| <b>H1: Knowledge of IBN</b>                              |        |            |      |      |
| Mean-effects Index                                       | 0.335  | (0.068)    | 0.00 | 705  |
| Correctly Defines IBN                                    | 0.128  | (0.031)    | 0.00 | 705  |
| Distinguishes Interest and Position                      | 0.039  | (0.038)    | 0.31 | 705  |
| Count of IBN Concepts Invoked                            | 0.105  | (0.04)     | 0.01 | 705  |
| Recognizes Potential for Win-Win                         | 0.125  | (0.035)    | 0.00 | 705  |
| <b>H2: Knowledge of Inter-personal Skills</b>            |        |            |      |      |
| Mean-effects Index                                       | -0.082 | (0.076)    | 0.28 | 705  |
| Count of Tactics Listed to Build a Positive Relationship | 0.029  | (0.059)    | 0.62 | 705  |
| Acknowledges Importance of Positive Relationship         | -0.078 | (0.038)    | 0.04 | 705  |
| <b>H3: Deployment of IBN Skills</b>                      |        |            |      |      |
| Mean-effects Index                                       | 0.214  | (0.084)    | 0.01 | 705  |
| Count of IBN Skills Used in Peanut-Farmer Simulation     | 0.135  | (0.071)    | 0.06 | 705  |
| Count of Questions asked about Buyer                     | 0.037  | (0.058)    | 0.52 | 705  |
| Count of Solutions Discovered in Woodbuyer Simulation    | 0.125  | (0.046)    | 0.01 | 705  |
| <b>H4: Deployment of Inter-personal Skills</b>           |        |            |      |      |
| Does Not Display Anger or Frustration                    | 0.025  | (0.014)    | 0.06 | 2115 |
| <b>H5: Positive Surplus</b>                              |        |            |      |      |
| Achieves Surplus Greater than Zero                       | 0.060  | (0.023)    | 0.01 | 2115 |
| <b>H6: Total Surplus</b>                                 |        |            |      |      |
| Surplus Achieved   | 2.742  | (1.472)    | 0.07 | 2115 |
| <b>H7: Moderated-Mediator</b>                            |        |            |      |      |
| Differential Effect of Agreement on Surplus for Trainees | 4.845  | (2.41)     | 0.05 | 2115 |

Standard errors clustered on community.

# Control-group Levels

| Outcome  | Mean | SD    | Min | Max | N   |
|--|------|-------|-----|-----|-----|
| <b>H1: Knowledge of IBN</b>                              |      |       |     |     |     |
| Correctly Defines IBN                                    | 0.67 | 0.47  | 0   | 1   | 186 |
| Distinguishes Interest and Position                      | 0.55 | 0.50  | 0   | 1   | 186 |
| Count of IBN Concepts Invoked                            | 0.58 | 0.50  | 0   | 1   | 186 |
| Recognizes Potential for Win-Win                         | 0.63 | 0.48  | 0   | 1   | 186 |
| <b>H2: Knowledge of Inter-personal Skills</b>            |      |       |     |     |     |
| Count of Tactics Listed to Build a Positive Relationship | 2.14 | 0.78  | 1   | 5   | 186 |
| Acknowledges Importance of Positive Relationship         | 0.47 | 0.50  | 0   | 1   | 186 |
| <b>H3: Deployment of IBN Skills</b>                      |      |       |     |     |     |
| Count of IBN Skills Used in Peanut-Farmer Simulation     | 0.97 | 0.81  | 0   | 4   | 186 |
| Count of Questions asked about Buyer                     | 0.56 | 0.65  | 0   | 2   | 186 |
| Count of Solutions Discovered in Woodbuyer Simulation    | 0.28 | 0.50  | 0   | 2   | 186 |
| <b>H4: Deployment of Inter-personal Skills</b>           |      |       |     |     |     |
| Does Not Display Anger or Frustration                    | 0.93 | 0.26  | 0   | 1   | 558 |
| <b>H5: Positive Surplus</b>                              |      |       |     |     |     |
| Achieves Surplus Greater than Zero                       | 0.22 | 0.41  | 0   | 1   | 558 |
| <b>H6: Total Surplus</b>                                 |      |       |     |     |     |
| Surplus Achieved   | 6.55 | 26.21 | -50 | 60  | 558 |

# Measurement

## Instruments:

- 1 Trainee surveys (713)
- 2 Environmental assessments (118)
- 3 **Incentivized simulations** (2,139)

All measured 6 months after training



## **Negotiation Simulations:**

- Comprehension check
- Max of 10 mins. with reminder: “you can always walk away”
- Simulation order was randomized



# Example Simulation

## **Script:**

*You own property that is 4 lots in total. 1 of those lots is not good for farming. There is a rocky hill on this lot where nothing grows. You make 100 USD per year growing crops on the part of the property you can use for farming.*

*Gbarnga Telecom Company (GTC) has been leasing land to construct new cell-phone towers to improve their network coverage. A cell-phone tower takes up one lot. GTC approaches you about leasing your land to build a new tower. You agree to meet with them to discuss this situation.*

*If you can reach an agreement that leaves you better off, you will earn a small bonus. You have 10 mins. You can always walk away from a bad deal.*

---

## **Enumerator's (Buyer's) Instructions:**

- Never offer more than \$60 USD for the lease.
- You only need 1 lot and will pay \$60 USD for that 1 lot.
- You do not offer information about your needs unless directly asked.

# Example Simulation

## Script:

*You own property that is 4 lots in total. 1 of those lots is not good for farming. There is a rocky hill on this lot where nothing grows. You make 100 USD per year growing crops on the part of the property you can use for farming.*

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*If you can reach an agreement that leaves you better off, you will earn a small bonus. You have 10 mins. You can always walk away from a bad deal.*

---

- Max Gain:  $\$160 = \text{Lease payment} + \text{BATNA} (\$100 \text{ in crop sales})$
- Max Loss:  $-\$40 = \text{Lease payment} - \text{BATNA}$
- Enumerators also record whether respondent asked questions, displayed anger

# Full PAP Analysis without Covariate Adjustment

| Outcome  | ATE    | Std. Error | p    | N    |
|--|--------|------------|------|------|
| <b>MNP: Manipulation Checks*</b>               | 11.728 | (0.267)    | 0.00 | 713  |
| <b>H1: Knowledge of IBN*</b>                   | 0.385  | (0.076)    | 0.00 | 713  |
| <b>H2: Knowledge of Inter-personal Skills*</b> | -0.073 | (0.071)    | 0.31 | 713  |
| <b>H3: Deployment of IBN Skills*</b>           | 0.267  | (0.085)    | 0.00 | 713  |
| <b>H4: Deployment of Inter-personal Skills</b> | 0.032  | (0.014)    | 0.02 | 2139 |
| <b>H5: Positive Surplus</b>                    | 0.068  | (0.023)    | 0.00 | 2139 |
| <b>H6: Total Surplus</b>                       | 3.166  | (1.472)    | 0.03 | 2139 |
| <b>H7: Moderated-Mediator</b>                  | 4.578  | (2.283)    | 0.05 | 2139 |

\*: Mean-effects index. Standard errors clustered on community.  
Models estimated without pre-specified covariate adjustment.

# Spatial Spillovers

- Restrict attention to control communities
- Measure distance to nearest IBN community (mean = 6.2 km)
- Estimate  $Y_{sic} = \alpha_s + \beta \text{ Distance to IBN} + \varepsilon_{sic}$

| Outcome  | Estimate ( $\hat{\beta}$ ) | Std. Error | p    | N*    |
|--|----------------------------|------------|------|-------|
| <b>H1: Knowledge of IBN*</b>                   | -0.003                     | (0.016)    | 0.87 | 355   |
| <b>H2: Knowledge of Inter-personal Skills*</b> | 0.003                      | (0.015)    | 0.84 | 355   |
| <b>H3: Deployment of IBN Skills*</b>           | 0.028                      | (0.022)    | 0.24 | 355   |
| <b>H4: Deployment of Inter-personal Skills</b> | 0.003                      | (0.002)    | 0.32 | 6,333 |
| <b>H5: Positive Surplus</b>                    | 0.003                      | (0.005)    | 0.60 | 6,333 |
| <b>H6: Total Surplus</b>                       | 0.066                      | (0.230)    | 0.78 | 6,333 |
| Expl: Forest Use by External Actors            | -0.011                     | (0.028)    | 0.71 | 351   |

\* Mean-effects index. Standard errors clustered on community.

\* Sample restricted to control communities.



# HTEs for Women

| Outcome  | ATE    | HTE    | SE      | p    | N    |
|--|--------|--------|---------|------|------|
| <b>H1: Knowledge of IBN*</b>                   | 0.329  | 0.051  | (0.147) | 0.73 | 705  |
| <b>H2: Knowledge of Inter-personal Skills*</b> | -0.081 | 0.314  | (0.157) | 0.05 | 705  |
| <b>H3: Deployment of IBN Skills*</b>           | 0.208  | -0.320 | (0.173) | 0.07 | 705  |
| <b>H4: Deployment of Inter-personal Skills</b> | 0.027  | -0.053 | (0.031) | 0.09 | 2115 |
| <b>H5: Positive Surplus</b>                    | 0.058  | -0.021 | (0.039) | 0.58 | 2115 |
| <b>H6: Total Surplus</b>                       | 2.626  | -1.111 | (2.591) | 0.67 | 2115 |

\*: Mean-effects index. Standard errors clustered on community.  
Covariates: Education, Age, Gender, Buyer, Seller, Peanut-first, Simulation.

# HTEs for Above Primary Education

| Outcome  | ATE    | HTE    | SE      | p    | N    |
|--|--------|--------|---------|------|------|
| <b>H1: Knowledge of IBN*</b>                   | 0.335  | 0.018  | (0.176) | 0.92 | 705  |
| <b>H2: Knowledge of Inter-personal Skills*</b> | -0.082 | 0.021  | (0.18)  | 0.91 | 705  |
| <b>H3: Deployment of IBN Skills*</b>           | 0.214  | -0.090 | (0.247) | 0.72 | 705  |
| <b>H4: Deployment of Inter-personal Skills</b> | 0.025  | 0.015  | (0.036) | 0.67 | 2115 |
| <b>H5: Positive Surplus</b>                    | 0.060  | -0.032 | (0.055) | 0.57 | 2115 |
| <b>H6: Total Surplus</b>                       | 2.742  | -1.004 | (3.423) | 0.77 | 2115 |

\*: Mean-effects index. Standard errors clustered on community.

# Analysis of Remotely Sensed Deforestation

Measurement notes:

- No formal maps of the community forest exist
- We use a circular area centered on activities detected in the EA
- We chose the area based on the distances covered in the EAs (in control)

| Outcome                                  | ATE     | Std. Error | p     | N   |
|--|---------|------------|-------|-----|
| Deforestation in CF (Area = 0.17 sq km.) | 7.959   | (19.247)   | 0.680 | 120 |
| Deforestation in CF (Area = 0.79 sq km.) | -16.011 | (41.915)   | 0.703 | 120 |
| Deforestation in CF (Area = 1.85 sq km.) | -16.607 | (60.515)   | 0.784 | 120 |

Specification includes covariates for forest stock and pre-treatment deforestation.

- Outcome is the count of deforested pixels (30 m<sup>2</sup> / pixel)
- Control level in mid-sized buffer = 212  $\rightsquigarrow$  7.5% reduction (not significant)

# Measuring Capacity and Appraisal

- Re-group variables in H1–2 (knowledge) and H3–4 (skill use) to create indexes for capacity and appraisal:
  - ex. 1: Recognizing potential for a win-win  $\rightsquigarrow$  **capacity** to find positive-sum deal
  - ex. 2: Invoking one's bottom line  $\rightsquigarrow$  **appraisal** of outside option

This re-grouping was motivated by theory but was *not pre-specified*.

- Using PCA, first component loads more on variables we related to appraisal; the second component loads on variables we related to capacity:
  - $\text{cor}(\text{PC}_1, \text{appraisal}) = 0.67$
  - $\text{cor}(\text{PC}_2, \text{capacity}) = 0.99$

# Mediation

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## Decomposition of the Total Effect of IBN on Std. Surplus

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|                      |                    |                            |                     |
|----------------------|--------------------|----------------------------|---------------------|
| <b>Total Effect</b>  | 0.169<br>(0.078)** | <b>Indirect: Capacity</b>  | 0.154<br>(0.037)*** |
| <b>Direct Effect</b> | -0.005<br>(0.065)  | <b>Indirect: Appraisal</b> | 0.020<br>(0.010)**  |

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Estimated using individual-level data with standard errors clustered on community.

Significance: \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

- Effect of training on surplus mediated by capacity and appraisal
- Capacity mediates much more ( $\sim 5\times$ ) of the total effect than appraisal
- Causal interpretation assumes sequential ignorability, independent mediators

# Mediation with PCA indices

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## Panel A: First-Stage Estimates

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|           | <b>Appraisal</b> | <b>Capacity</b>  | <b>Surplus</b>   |
|-----------|------------------|------------------|------------------|
| Treatment | 0.237<br>(0.071) | 0.268<br>(0.104) | 0.069<br>(0.079) |
| Capacity  |                  |                  | 0.368<br>(0.243) |
| Appraisal |                  |                  | 0.005<br>(0.126) |

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## Panel B: Decomposition of the Total Effect of IBN on Std. Surplus

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|               |                  |                            |                  |
|---------------|------------------|----------------------------|------------------|
| <b>Total</b>  | 0.169<br>(0.085) | <b>Indirect: Capacity</b>  | 0.099<br>(0.082) |
| <b>Direct</b> | 0.069<br>(0.079) | <b>Indirect: Appraisal</b> | 0.001<br>(0.027) |

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Estimated using individual-level data with bootstrapped standard errors in parentheses are clustered at the community level.

# Mediation of Forest Use

# Lee Bounds

| Age <sup>+</sup> | Edu <sup>+</sup> | Fem | N     | Lower Bound | $\hat{k}'$ | Upper Bound |
|------------------|------------------|-----|-------|-------------|------------|-------------|
| All              | All              | All | 1,070 | 0.62        | 2.43       | 5.88        |
| ✓                | ✓                | ✗   | 65    | 18.49       | 20.11      | 30.39       |
| ✓                | ✗                | ✓   | 240   | 1.16        | 4.48       | 6.74        |
| ✗                | ✓                | ✗   | 210   | 4.94        | 6.05       | 7.19        |
| ✗                | ✗                | ✗   | 198   | 0.62        | 2.43       | 5.88        |
| ✓                | ✗                | ✗   | 195   | -6.41       | 0.00       | 9.02        |
| ✗                | ✗                | ✓   | 128   | -4.60       | 0.05       | 6.02        |

Age<sup>+</sup>: Above Median Age (52); Edu<sup>+</sup>: Above Primary Education

■  $\hat{k}'$ : difference in means between IBN and control individuals who reach agreements

■ Lee (2009) bounds:

- 1 Assume that treatment increases the rate of agreement (monotonicity)
- 2 Estimate effect of treatment on the probability of agreement,  $q$
- 3 Remove share  $q$  from top and bottom of treatment group distribution and re-estimate

Intuition: suppose the share who agree due to treatment have the best and worst observed outcomes, and then remove these observations to construct bounds



## Descriptive on participation in/influence over decisions about community forest (CF) use in the control group

| Age <sup>+</sup> | Edu <sup>+</sup> | Fem | Town Chief | Landlord or Elder | 1(Member CF) | Number meetings CF | Chat CF | 1(Property rights for land) |
|------------------|------------------|-----|------------|-------------------|--------------|--------------------|---------|-----------------------------|
| ✓                | ✓                | ✗   | 0.08       | 0.32              | 0.11         | 0.58               | 2.91    | 0.74                        |
| ✓                | ✗                | ✓   | 0.00       | 0.04              | 0.06         | 0.24               | 0.39    | 0.51                        |
| ✗                | ✓                | ✗   | 0.08       | 0.17              | 0.06         | 1.03               | 4.58    | 0.63                        |
| ✗                | ✗                | ✗   | 0.19       | 0.12              | 0.10         | 0.29               | 0.52    | 0.70                        |
| ✓                | ✗                | ✗   | 0.17       | 0.46              | 0.06         | 0.43               | 1.47    | 0.74                        |
| ✗                | ✗                | ✓   | 0.03       | 0.00              | 0.06         | 0.28               | 0.24    | 0.62                        |

Age<sup>+</sup>: Above Median Age (52); Edu<sup>+</sup>: Above Primary Education  
Table only includes observations from control group.