

Do conservation incentives increase the effectiveness of protected areas?

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Context

- ▶ Protected areas reduce deforestation worldwide
 - ▶ Nelson and Chomitz (2011)
- ▶ Multiple-use reserves work better than strictly protected reserves
 - ▶ Nelson and Chomitz (2011)
- ▶ Protected areas with PES schemes reduce deforestation versus non-protected areas
 - ▶ Honey-Rosés et al. (2011)

Research question

Do conservation incentives increase
protected area effectiveness?

Case study

Bolsa Floresta Program

- ▶ Sustainable Amazon Fund (FAS)
- ▶ Worlds largest conservation incentive program (10 M hectares)
- ▶ In 15 sustainable use reserves
- ▶ With one reserve being the first certified Brazilian REDD project
- ▶ Inhabitants are highly reliant on forest and fish resources.

See also: Börner et al. (2013)

Bolsa Floresta Program components

- ▶ Bolsa Floresta Família (family component)
 - ▶ Conditional cash transfer
- ▶ Bolsa Floresta Social (social component)
 - ▶ Improve public services
- ▶ Bolsa Floresta Associação (association component)
 - ▶ Communities allocate funds freely
- ▶ Bolsa Floresta Renda (income component)
 - ▶ Production line investments

Bolsa Floresta's potential impact mechanisms on welfare and conservation

- ▶ Improved living conditions
 - ▶ Cash transfers and development programs
- ▶ Reduced internal pressures
 - ▶ Opportunity costs of rule-compliance
 - ▶ Monitoring and enforcement
- ▶ Reduced external pressures
 - ▶ Building local conservation alliances

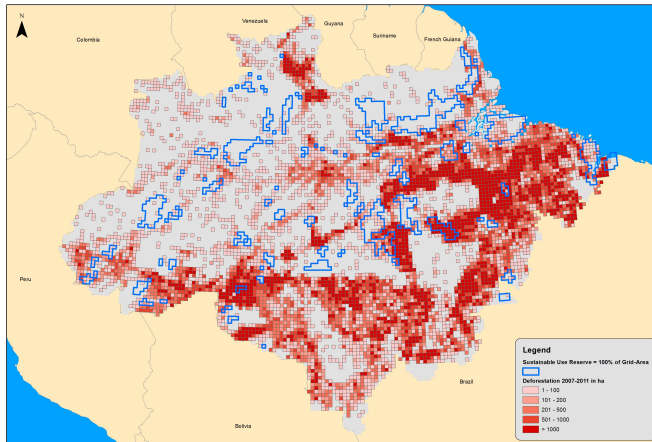
See: Börner et al. 2013

Study design

- ▶ Spatial information on sustainable use reserves
- ▶ Sustainable use reserves with Bolsa Floresta
- ▶ Yearly data on deforestation
- ▶ Yearly data on set of controls

Sustainable use reserves and deforestation

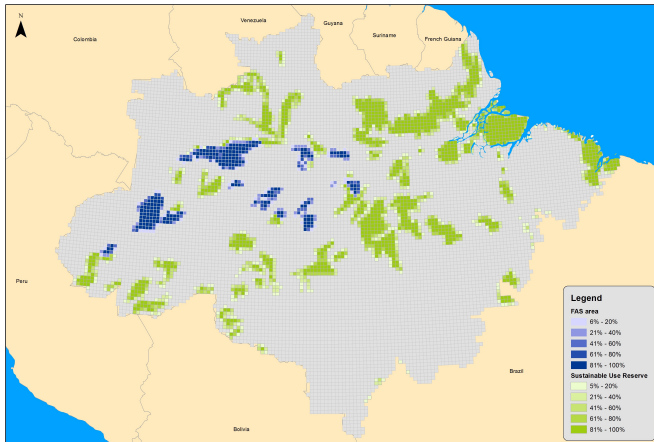
Unit of analysis: 20 x 20 km grid cells (2007-2011)



Source: Calculations from J. Schielein (ZEF) based on data from PRODES project (INPE)

Bolsa Floresta Program

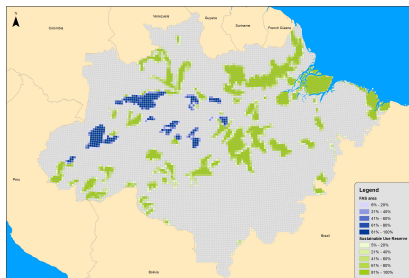
Unit of analysis: 20 x 20 km grid cells (2007-2011)



Source: Calculations from J. Schielein (ZEF) based on data from IBAMA and FAS

Base sample

- ▶ 100% protected areas in 2007 (5% tolerance)
→ 658 controls
- ▶ 100% BFP treated areas in 2011 (5% tolerance)
→ 125 treated
- ▶ Buffer around treated excluded
- ▶ Brazilian border cells excluded



Empirical Strategy

Average treatment effect on the treated (ATT):

- ▶ $\mathbf{E}[Def_{1i} - Def_{0i} | BFP_i = 1]$

Conditional independence assumption:

- ▶ $\mathbf{E}[Def_{0i} | X_i, BFP_i = 1] = \mathbf{E}[Def_{0i} | X_i, BFP_i = 0]$

Impact estimation:

- ▶ Regression, Matching mean comparison, Post-matching treatment regression

Control variables

- ▶ (G) Grid cell characteristics
 - ▶ Initial forest (2007), past deforestation (1999-2006), market distance, remoteness indices, land use classes (2008)
- ▶ (G + N) Neighboring cells' characteristics
 - ▶ Neighboring initial forest, neighboring past deforestation
- ▶ (G + N + B) Border characteristics
 - ▶ Neighboring sustainable use reserve status

Sources: PRODES project & TerraClass - INPE, IBAMA, SIPAM, IBGE.

Treatment prediction on observables

Log-likelihood estimation (logit); Dep. variable: Dummy on BFP treatment status

	(1)	(2)	(3)
Init. forest	3.520*** (0.585)	0.330 (0.907)	0.330*** (0.907)
Past deforestation	-0.270*** (0.047)	-0.138*** (0.042)	-0.138 (0.042)
Market distance	-0.042*** (0.005)	-0.062*** (0.006)	-0.063*** (0.006)
Distance to rivers	-0.012*** (0.003)	-0.017*** (0.003)	-0.017*** (0.003)
Distance to roads	0.027*** (0.002)	0.028*** (0.002)	0.028*** (0.002)
Agricultural area	-0.005** (0.002)	-0.004** (0.002)	-0.004** (0.002)
Pasture area	-0.005*** (0.001)	-0.005*** (0.001)	-0.005*** (0.001)
Secd. vegetation	0.002*** (0.000)	0.002*** (0.000)	0.002*** (0.000)
Neigh. init. forest		0.063*** (0.000)	0.063*** (0.012)
Neigh. past deforest.		-0.003*** (0.077)	-0.003*** (0.000)
Neigh. US reserve			-0.027 (0.311)
Controls group	G	G + N	G + N + B

Mean comparison of deforestation

	Mean Control	Mean Treated	Difference T - C	log Diff. T - C
Deforestation (ha)	50.95 (4.04)	1.56 (0.35)	-43.06*** (9.28)	-0.812*** 0.078
Observations	3290	625	3915	3915
Groups	658	125	783	783

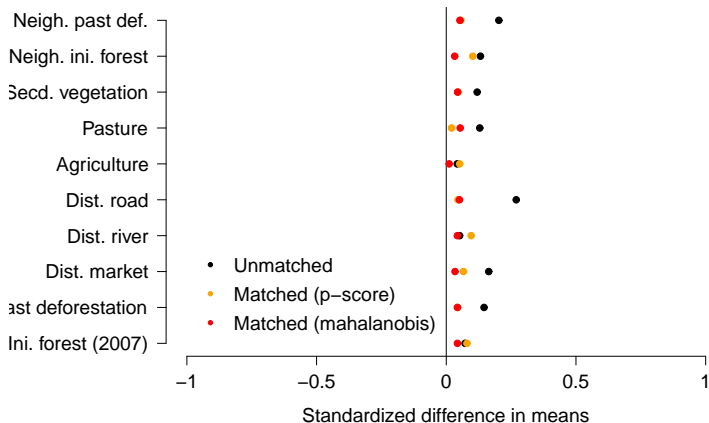
The effects of Bolsa Floresta on deforestation

Mean comparison after matching: In Yearly Deforestation

	Without calipers		With calipers (0.75 SD)	
	Estimate	Pairs/ Treated	Estimate	Pairs
Controls group G				
P-score matching	-0.147** (0.058)	4,750 625	-0.147** (0.058)	4,750 625
Mahalanobis matching	-0.197*** (0.065)	3,915 625	-0.167*** (0.064)	2,875 575
Controls group G + N				
P-score matching	0.067 (0.049)	4,575 625	0.068 (0.047)	4,775 615
Mahalanobis matching	-0.125* (0.068)	3,125 625	-0.188*** (0.068)	2,825 565
Controls group G + N + B				
P-score matching	0.070 (0.048)	4,575 625	0.071 (0.047)	4,775 615
Mahalanobis matching	-0.061 (0.068)	3,050 625	-0.045 (0.059)	2,600 535

Matching covariate balance

Before and after matching on covariates $G + N$, without caliper



Source: Calculations from J. Schielein (ZEF) based on data from IBAMA and FAS

Post-Estimation strategy

Average treatment effect on the treated (ATT) with panel data:

$$\blacktriangleright \mathbf{E}[Def_{1i,t} - Def_{0i,t} | X_{i,t}, BFP_{i,t} = 1]$$

The effects of Bolsa Floresta on deforestation

Weighted cluster-robust OLS estimates; Dep. variable: In Yearly Deforestation

	Before Matching (1)	(2)	After Matching (3)	(4)
Bolsa Floresta treatment	-0.112** (0.056)	-0.108 (0.069)	-0.138** (0.067)	-0.155** 0.079
Controls G	Yes	Yes	Yes	Yes
Controls N	Yes	Yes	Yes	Yes
Controls B	-	-	-	Yes
Year effects	-	-	Yes	Yes
Clouds	-	-	Yes	Yes
R-sq	0.49	0.29	0.30	0.31
N	3915	1250	1250	1250
Groups	783	250	250	250

Main findings

- ▶ Results:
 - ▶ Deforestation decreased where the Bolsa Floresta Program is implemented.
 - ▶ 12 - 20% yearly avoided deforestation corresponds to 133 - 243 ha between 2007 and 2011.
 - ▶ ICDP/PES schemes can additionally conserve forests within protected areas.
 - ▶ Evidence of detrimental effects at the borders of reserves.

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- ▶ Further research:
 - ▶ 20x20 km grid cells
 - ▶ Analysis on buffer areas

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 - ▶ ICDP/PES schemes can additionally conserve forests within protected areas.
 - ▶ Evidence of detrimental effects at the borders of reserves.
- ▶ Further research:
 - ▶ 20x20 km grid cells
 - ▶ Analysis on buffer areas
- ▶ Caveats:
 - ▶ Selection on unobservables (ex. RDS, APA, AM)

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