This work was funded with the generous support of the American people through the Leader with Associates Cooperative Agreement No.EPP-A-00-06-00014-00 for implementation of the TransLinks project. The contents of this report are the responsibility of the author and do not necessarily reflect the views of the United States government.

Forest Conservation and Slippage:

Evidence from Mexico's National Payments for Ecosystem Services Program

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THE IMPACT OF PAYMENTS FOR ECOSYSTEM SERVICES ON DEFORESTATION IN MEXICO: PRELIMINARY LESSONS FOR REDD

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Thank yous

- We are grateful to Stefano Pagiola (WB) and to all the people at the Mexican National Forestry Commission (CONAFOR) who have helped us, including but not limited to:

- Gerencia de Servicos Ambientales:
  - Ing. Leonel Iglesias Gutiérrez
  - José Armando Alanís de la Rosa
  - Paola Bauche Petersen
  - Gemelina Ramírez
  - Jesús Gutiérrez Cacique
  - Rodolfo Valdez Garcia
  - Silvia Martinez

- Gerencia de Inventario Forestal y Geomática:
  - Rigoberto Palafox Rivas
  - Carmen Meneses Tovar

Motivation: PES and REDD

- Changes in land use account for 15-20% of greenhouse gas emissions worldwide
- Many countries experimenting with “PES” as a way to achieve “REDD” goals:
  - PES = payments for ecosystem services
  - REDD = reducing emissions from deforestation and forest degradation
  - Mexico, Costa Rica, China, Ecuador, Vietnam, Brazil. . .

Does PES reduce deforestation?

- Empirical evidence to date is limited:
  - See recent reviews by Pagiola and Xiang 2010, Pattanayak, Wunder and Ferraro *REEP* 2010

- Two main concerns:

  1) PES might be selecting landowners who would have conserved even in the absence of payments

  2) Effectiveness could be undermined by spillovers of deforestation to other areas

Paper preview:

- Analyze deforestation among recipient properties in comparison to a plausible counterfactual group
  - Significant but small avoided deforestation gains for 2004 PSAH
- Develop a theoretical framework, which suggests that in an imperfect markets setting, deforestation may spill over:
  - Within properties as recipients invest the transfers into new production
  - Between properties as output prices increase from reductions in potential agricultural land, or from income effects
- Test empirically for evidence consistent with these spillovers

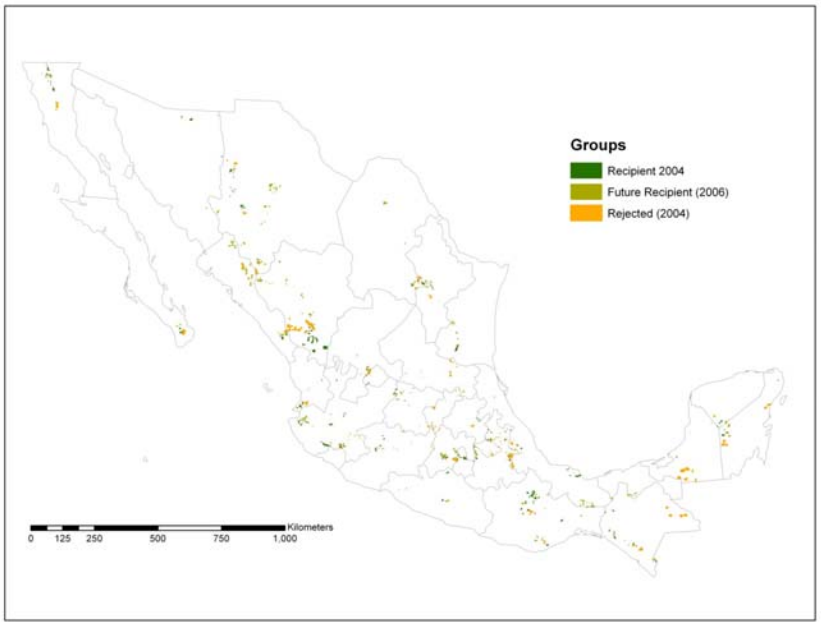
Mexico's PSAH – program

- Payments for Hydrological Services
  - Began in 2003
  - Goal: prevent deforestation in order

  to improve hydrological services
  - 5 year contracts
  - Yearly payments contingent on no deforestation
  - Random monitoring both by satellite and field visits

Estimating impact

PSAH 2004 y Controles Potenciales



- Draw controls from applicant pool
  - Rejected properties, future enrollees
  - Ensures controls are similar with respect to a key unobservable: desire to enroll in the program
- Match enrolled properties to controls
  - Adjust for remaining differences
    - Bias-adjusted matching estimator
    - Regression

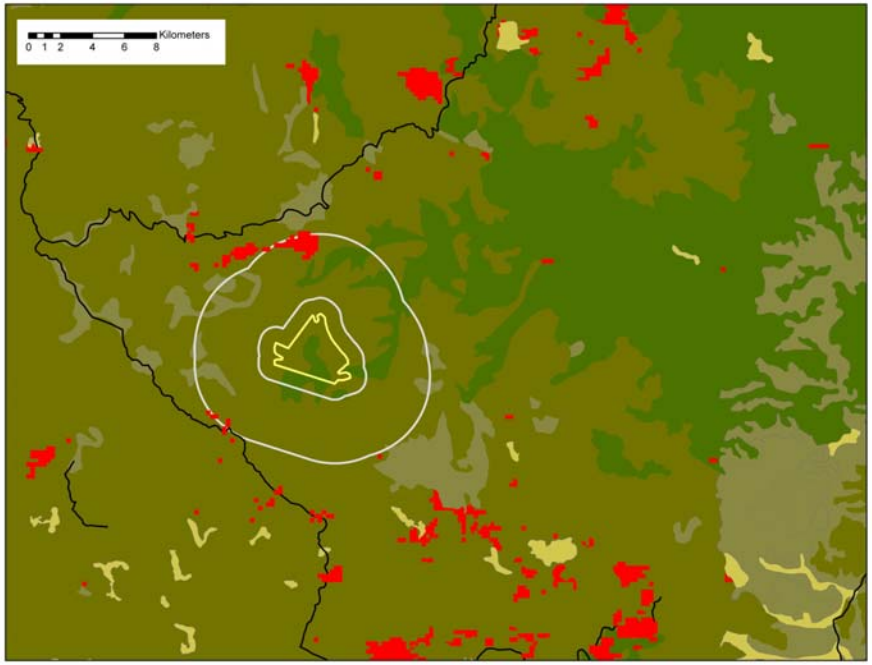
- Covariates include: parcel area, slope and elevation, vegetation type (% semi-deciduous, % selva), region, access to market (density of roads in a 50 km buffer), type of property (communal/private)

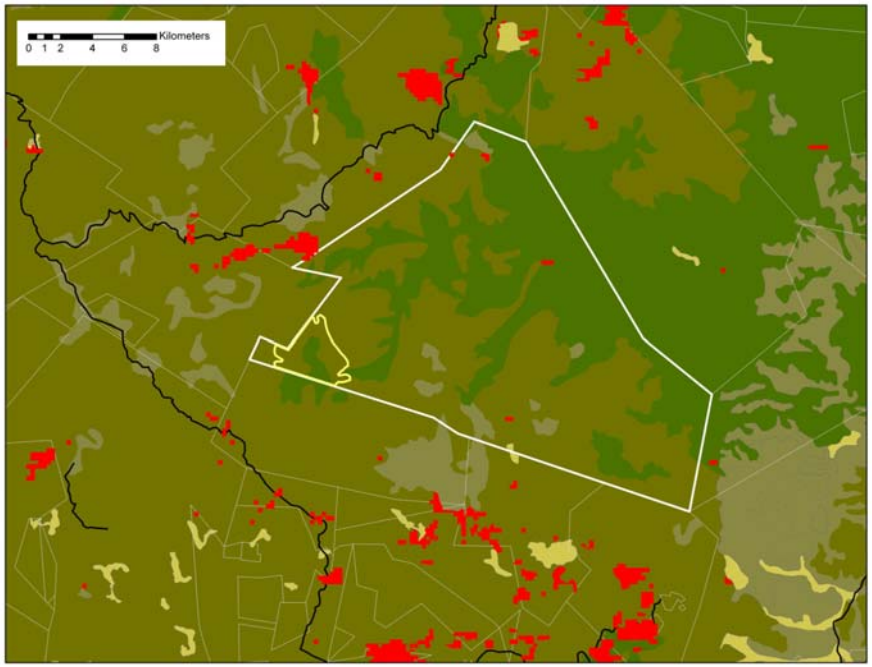
Measuring deforestation is hard!

- Two indicators of deforestation:
  - Monitoreo Forestal (2003-2006)
    - Based on MODIS satellite data (250 m resolution)
    - National coverage from CONAFOR, calibrated by them using field data from National Forest Inventory
    - NDVI change = deforestation *indicator*
    - Tobit to correct for censoring
  - Imágenes SPOT (2003 – 2005 or 2006)
    - Manually selected and interpreted SPOT images (10 m resolution)
    - Coverage is limited by availability of images
    - Phenology a significant problem: deforestation indicator

We calculated deforestation indicators for both recipient and control parcels:

- Inside the parcel (yellow)
- In 1km and 5km buffers around the parcel
- And/ or inside the boundaries of the property (if a common property)





Data – summary statistics

Table 3: Summary statistics on recipients and non-recipients (best 80% matches)

Variable	Recipients	Non-Recipients	Test for difference	Normalized difference
Enrolled area	5.53	5.78	.40	-.002
Proportion ejidos	0.65	0.595	1.46	
Average slope of enrolled area	2.46	2.45	0.216	0.013
Average elevation of enrolled area	2.19	2.11	1.25	0.06
Proportion enrolled area semideciduous	0.192	0.237	1.55	-0.16
Proportion enrolled area selva	0.316	0.275	1.34	0.13
Ln(road density)	6.70	6.64	1.32	0.083
Proportion in region 1	0.215	0.273	1.69	
Proportion in region 2	0.159	0.220	1.99	
Proportion in region 3	0.361	0.326	0.98	
Proportion in region 4	0.263	0.182	2.52	
Proportion with suspected deforestation	0.223	0.252	0.55	
Ln(1+area deforested)	0.040	0.073	2.45	
Observations	341	315		

Impact analysis results

- Significant but small reduction in indicated deforestation
- Bias adjusted matching estimator (Table 4)

	Mahalonobis metric		
Dependent variable	Ln(1+area deforested)	Deforest (0/1)	Ln(1+area defor)| Deforest > 0
	(1)	(2)	(3)
Treatment effect	-.0488***	-.105**	-.1136**
	(-3.169)	(-2.459)	(-1.973)
Observations	656	656	160

- Regression with controls for observables (Table 6)

Marginal effects	
Pr(d>0)	-.063**
	(.031)
Ln(d|d>0)	-.020**
	(.009)

Economic framework: spillovers

- Insights from Wu 2000, Roberts and Bucholtz 2005
  - Adapting to developing country context: imperfect mkts
- Simple household model
  - Households allocate land to forest or agriculture
  - Ag production requires a variable input
  - Some households are credit constrained
- PES program gives payment conditional on no deforestation in some parcels of land
  - Limits land that can be transformed into agriculture

Two types of spillovers

- Substitution (within property)*:*
  - Landowner removes one parcel from potential production; shifts production to another parcel

  → Observable where markets are imperfect

- Output price effects (across property):
  - Supply side: removal of multiple parcels from production increases market prices of agricultural goods
  - Demand side: payments increase incomes and consumption, increases market prices of agricultural goods

  → Observable where markets are localized

Spillover estimation

- Substitution spillovers:
  - Use matching to assess if more deforestation in non-enrolled areas of common properties
  - Or in 1km and 5km buffers
- Price spillovers:
  - More deforestation where there is greater regional enrollment in the PSAH program? (ha enrolled within a 50 km buffer)
- Yes: see paper

Conclusions: Lessons for REDD?

1. PSAH program produced a significant but small avoided deforestation impact
   - Early cohort, little targeting on risk
2. Impacts vary by region and quality of infrastructure
   - Additional analysis could improve targeting
3. Evidence consistent with both substitution and price spillovers
   - Important to accounting for REDD at the regional or national level, not project-based approach
4. Annual national deforestation monitoring systems urgently needed—much to learn from Mexico's system