HARVARD ENVIRONMENTAL ECONOMICS PROGRAM

Research Workshop
for
Pre-Doctoral Fellows and Alumni

Thursday-Friday, September 19 – 20, 2019
Harvard Kennedy School
Cambridge, Massachusetts

The value of water quality:
Separating amenity and recreational benefits

Yusuke Kuwayama, Sheila Olmstead, and Jiameng Zheng

HEEP Workshop

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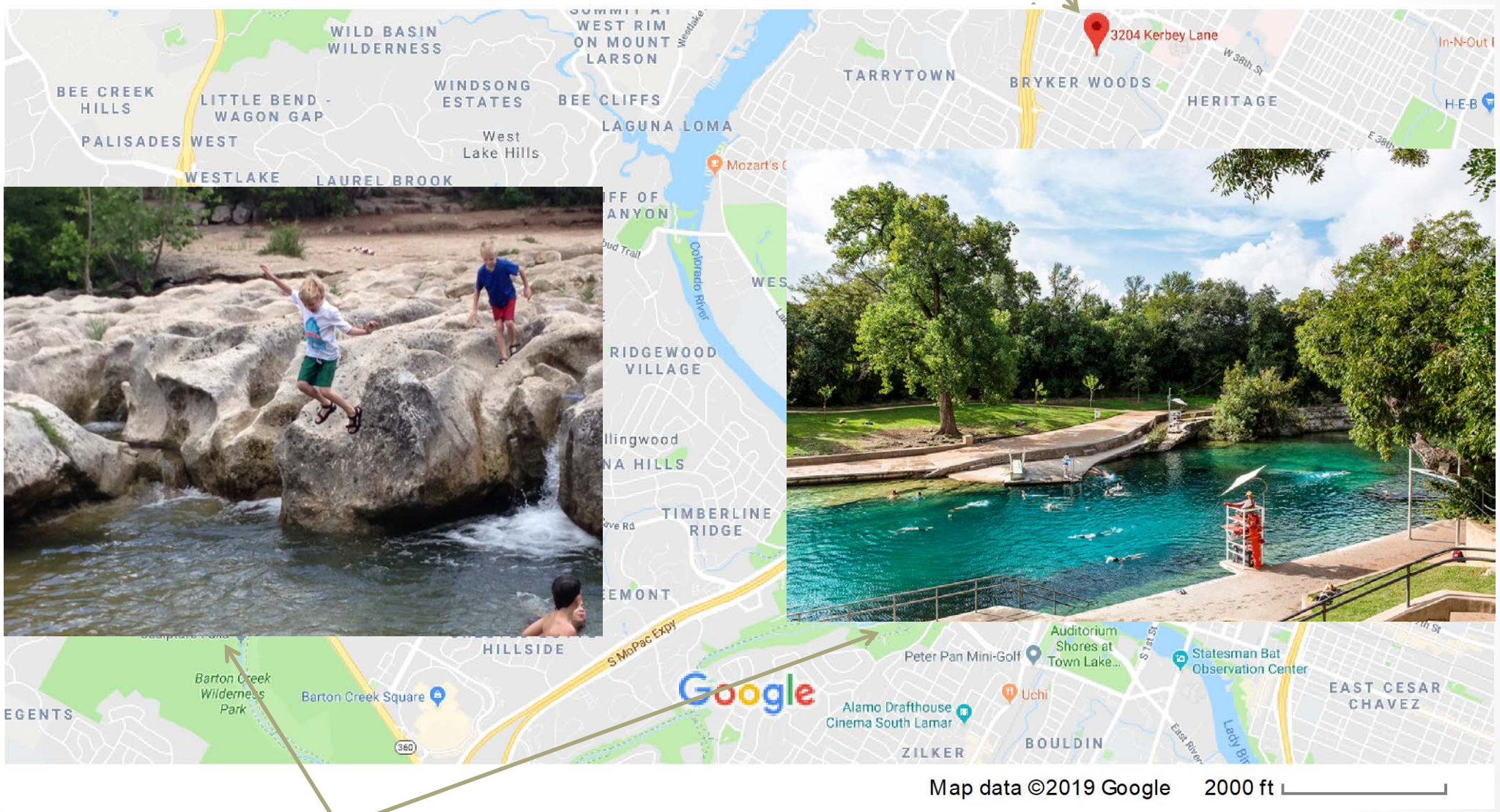
Motivation

- Recent work highlights the relatively unfavorable benefit-cost ratios for major U.S. ambient water quality regulations, in comparison to air quality and drinking water quality regulations (Keiser, Kling & Shapiro 2019).

- Though many papers in the literature value water quality improvements using recreational demand models, hedonics and CV, these values may have been inadequately monetized:
  - Small number of well-identified estimates of recreational and amenity benefits
  - Hedonic estimates likely capture amenity value, but perhaps not recreational value.
  - Recreational demand estimates capture recreational value only.

One example...

Sheila's house

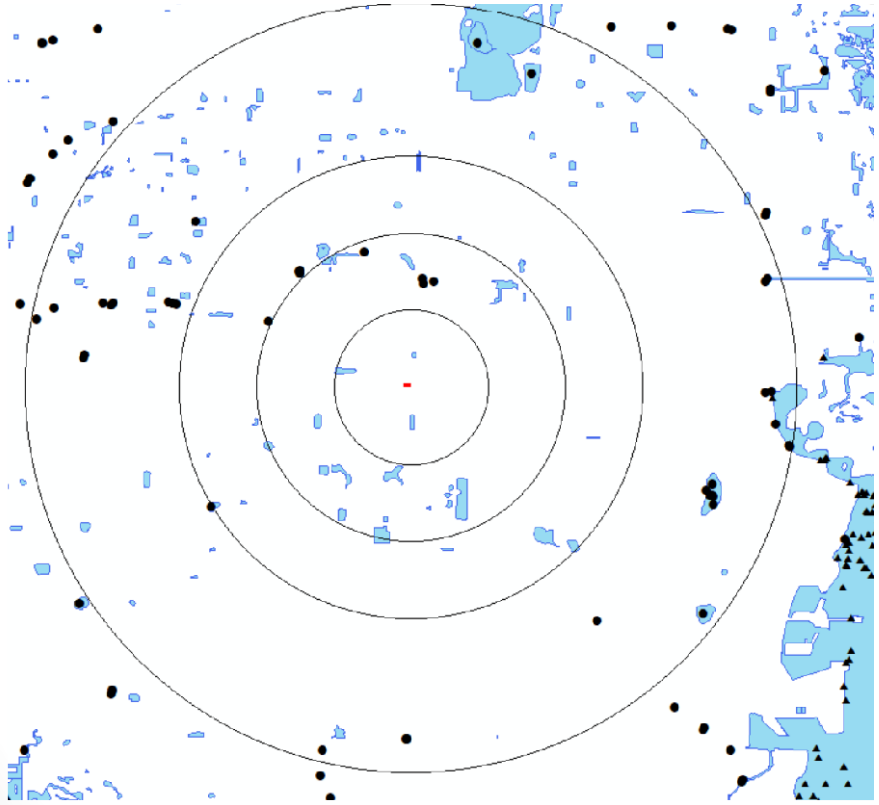


Sheila's swimming spots

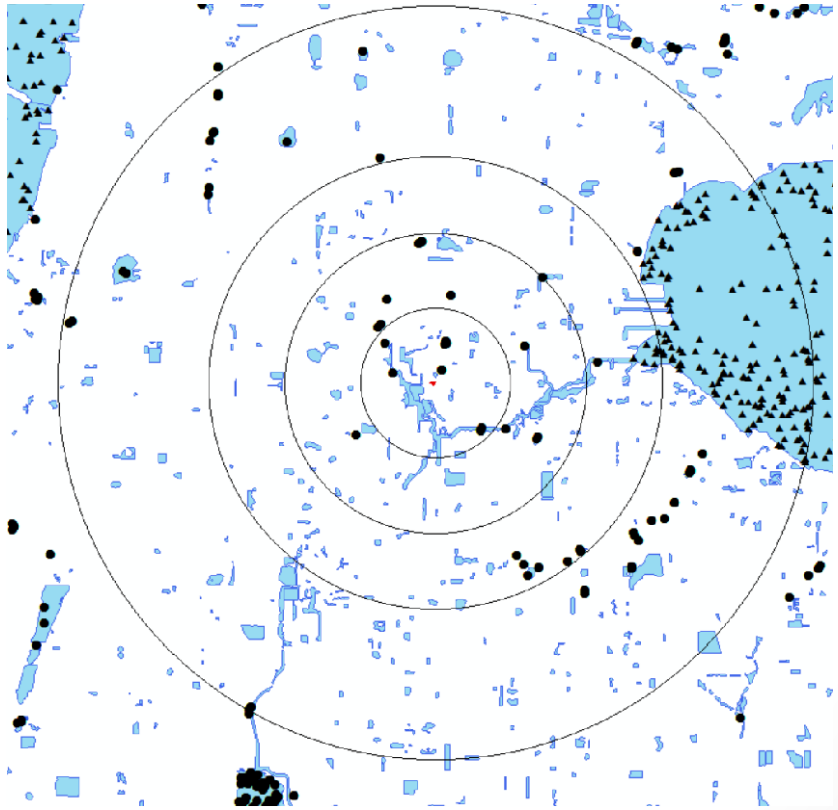
Standard hedonic model may obscure recreational values

- Households have some small MWTP for water quality improvements in local streams, but may have no WTP for similar improvements in non-local streams.

- If small, local waterbodies comprise most water quality observations, then regressing housing prices on water quality may wash out effects of major recreational waters.

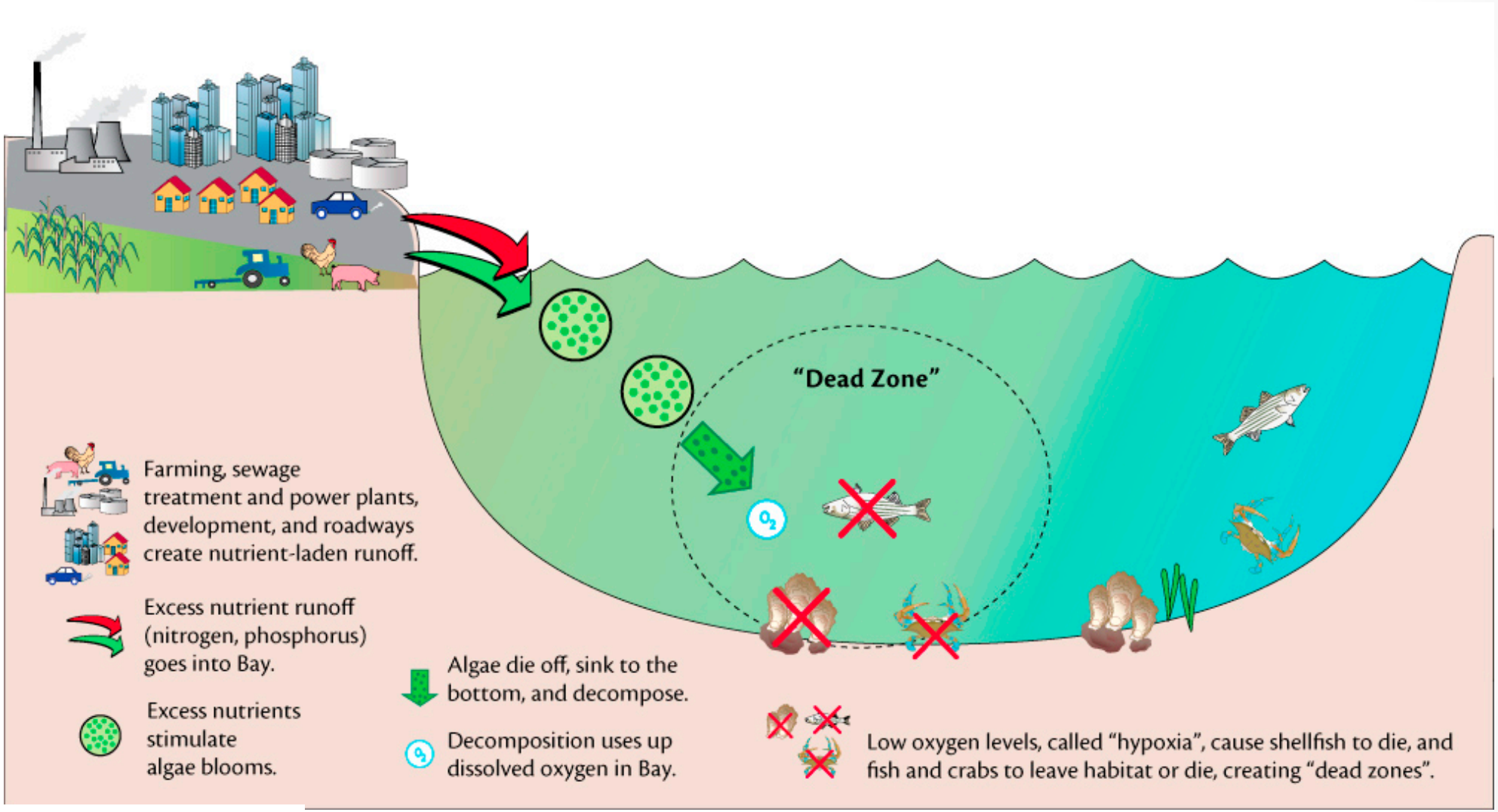


(a) An inland property



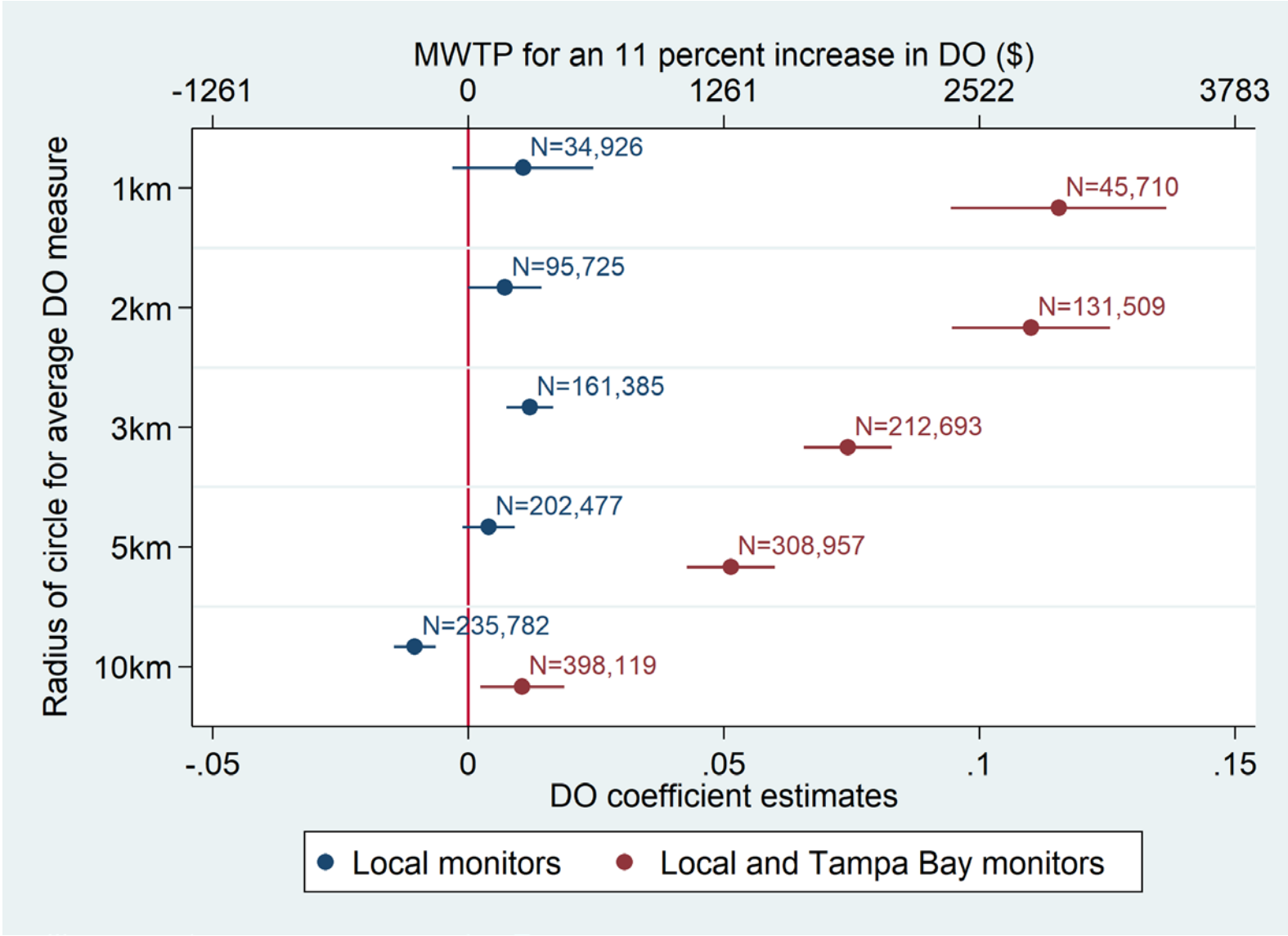
(b) A property near Tampa Bay

What we study: nutrient pollution in Tampa Bay



LBJ Lyndon B. Johnson School of Public Affairs

Coefficient estimates and MWTP for DO from typical hedonic approach



LBJ Lyndon B. Johnson School of Public Affairs

Methods in a nutshell

- Following Phaneuf et al. (2008), we nest estimates from a recreational demand model within a hedonic property model to estimate marginal willingness to pay (MWTP) for water quality.

- First stage: random utility model using conditional logit, with alternative-specific constants to control for time-invariant site characteristics.
  - This gives us an estimate of average compensating variation per fishing trip, a function of RECREATIONAL water quality at 85 fishing sites in Tampa Bay.
  - We sum over individuals in a zip-code-year to obtain our recreational utility index.

- Second stage: hedonic property model with property fixed effects to control for time-invariant property characteristics.
  - This model includes LOCAL water quality very close to properties, which gives us MWTP for local water quality.
  - It also includes the regional recreational utility index from the first stage. Using coefficient estimates from the first and second stage, we obtain MWTP for recreational water quality.

Benefits vs. costs

- Our baseline benefit estimates for the 11% average increase in Tampa Bay watershed DO observed from 1998-2014 range from $1.8 billion to $23 billion, depending on what one assumes about the geographic scope of the affected market.
  - Estimates of MWTP for local DO are in line with previous literature.
  - Estimates of MWTP for recreational water DO (the new stuff) = very large.

- Using our most conservative estimates, benefits are $0.5 - $9 billion, again depending on the geographic scope of "benefiting" property market.

- A very rough estimate of total cost for the hundreds of nitrogen management projects implemented in the Bay area 1998-2014 = $0.6 billion.

- B:C ratio could be very favorable, compared to others in the literature on economics of water quality.

Are PES a win-win for conservation and development?

KATHARINE SIMS

ASSOCIATE PROFESSOR OF ECONOMICS

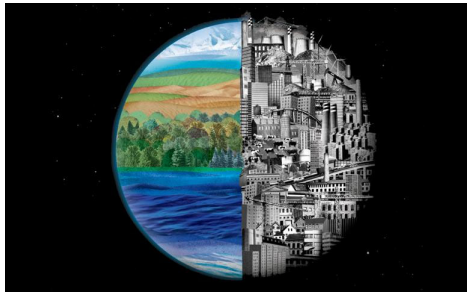
ECONOMICS DEPARTMENT AND ENVIRONMENTAL STUDIES

AMHERST COLLEGE, AMHERST, MA

HEEP: Shared premise

Global crises: environmental threats, poverty and inequality

Economic tools can play an important role in solutions



Doug Chayka

HEEP
Harvard Environmental Economics Program

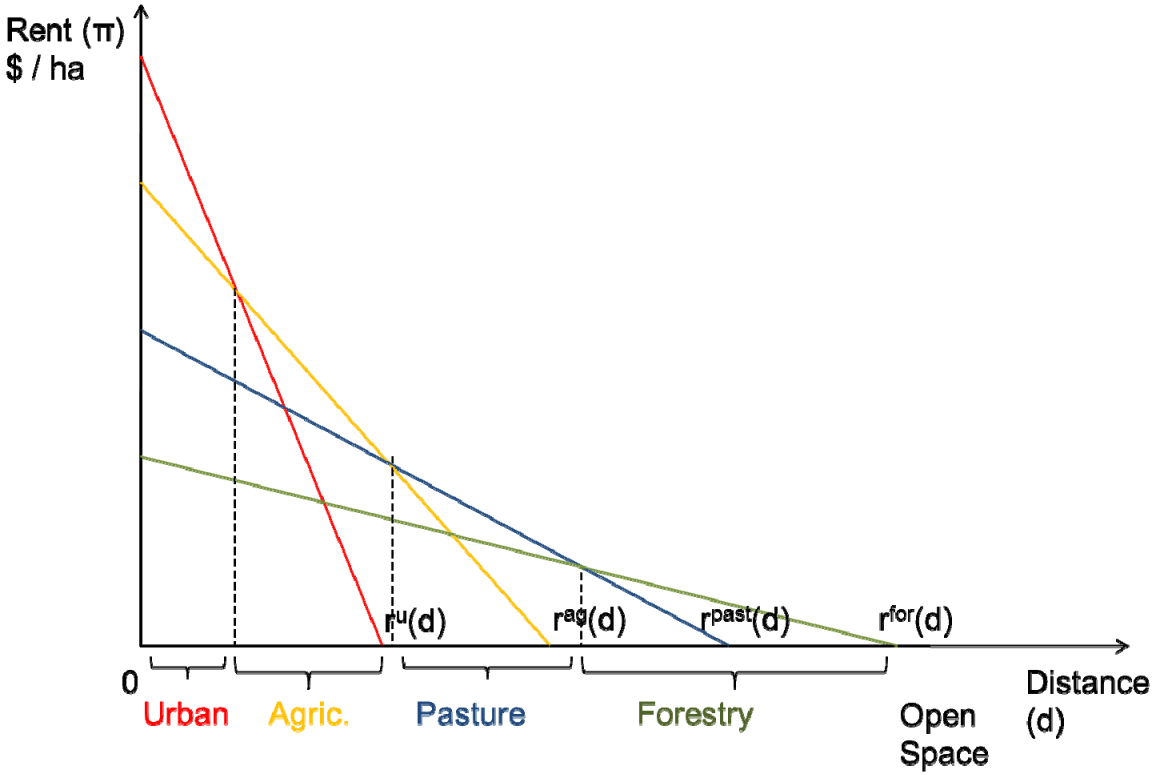
Ramesh Mahindrakar

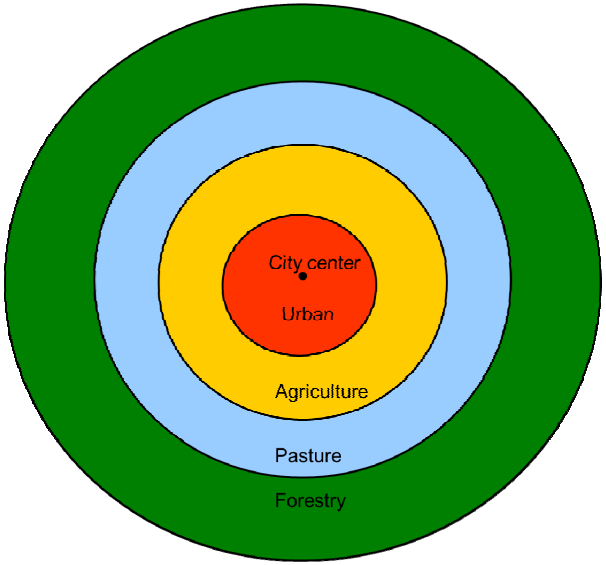
Payments for Ecosystem Services

Incentive-based, voluntary land conservation policy

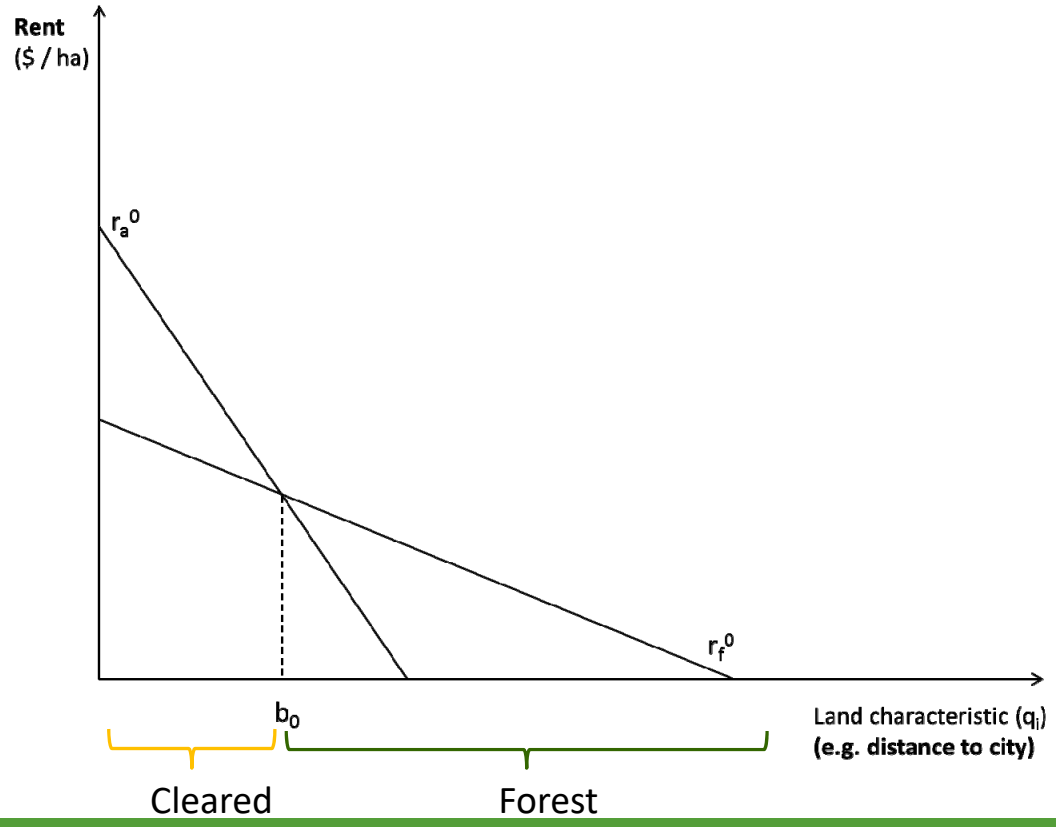
Can PES deliver for conservation **and poverty alleviation?**

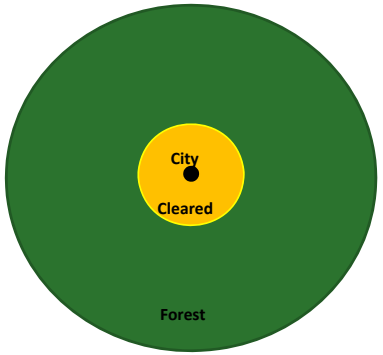
Basic theory: von Thünen land rents models



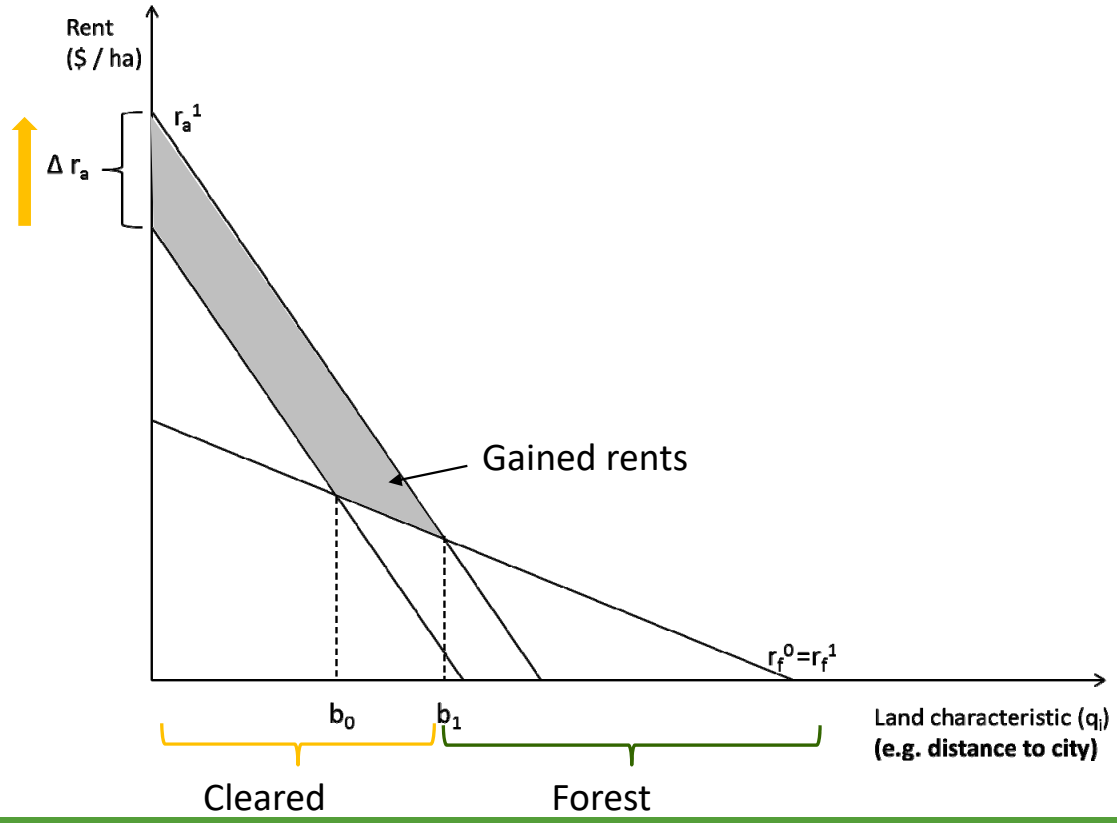


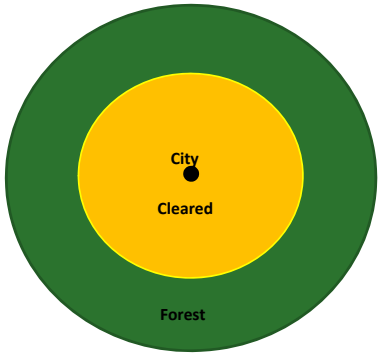
Cleared vs. forest



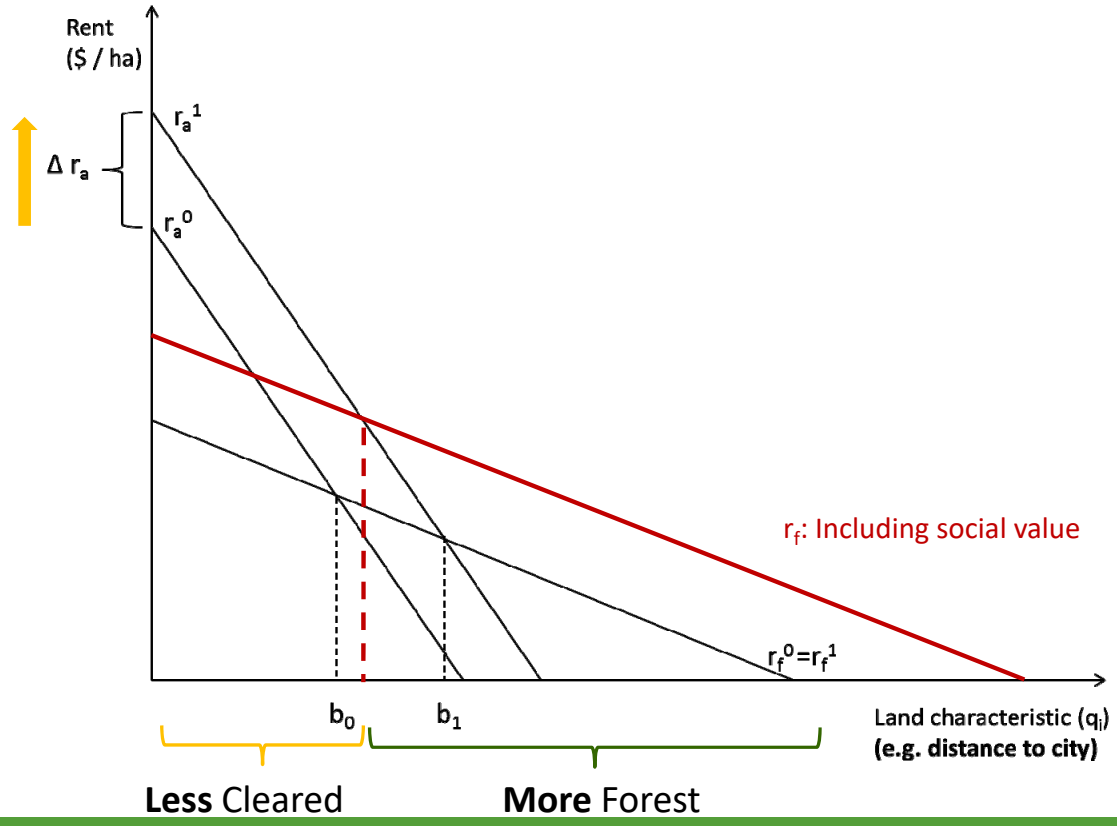


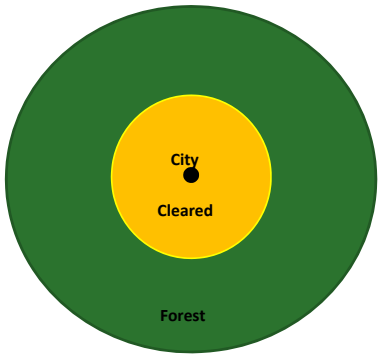
Increase in r_a : expected deforestation



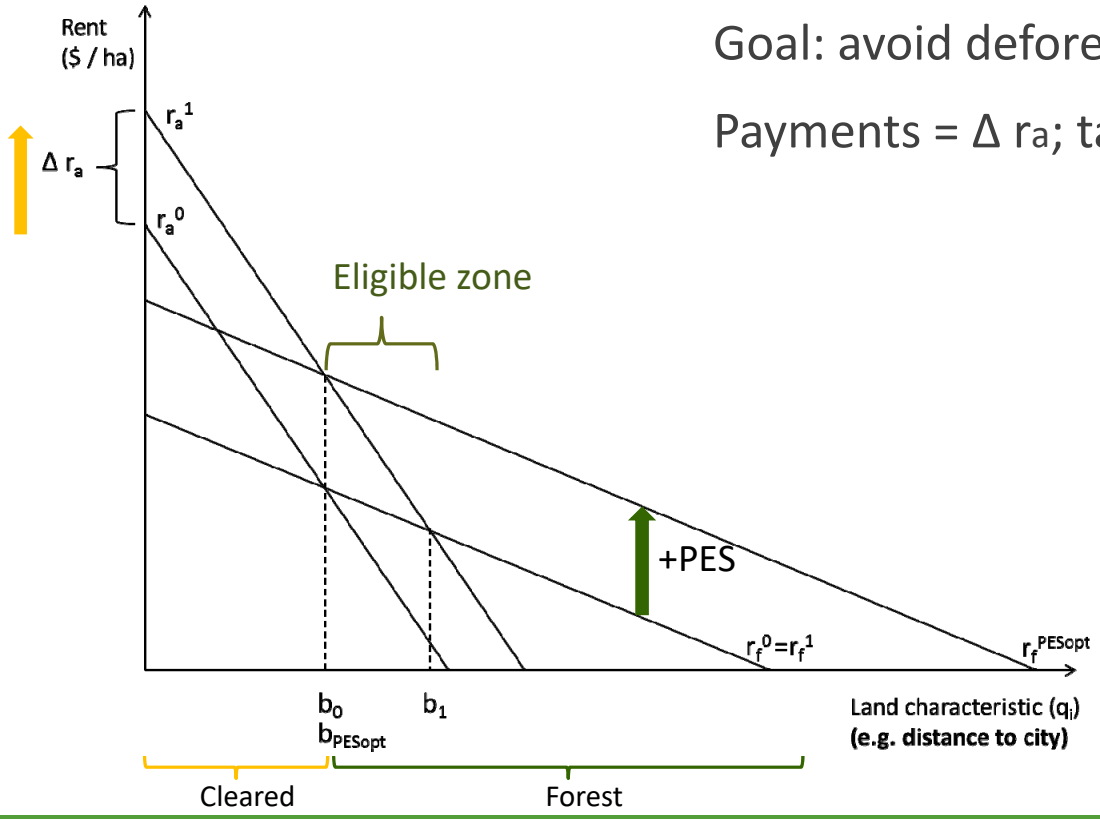


Social values motivate slowing transition



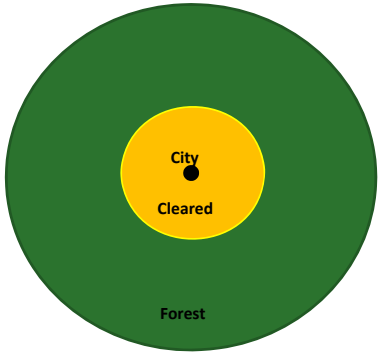


PES: increases rents to forest

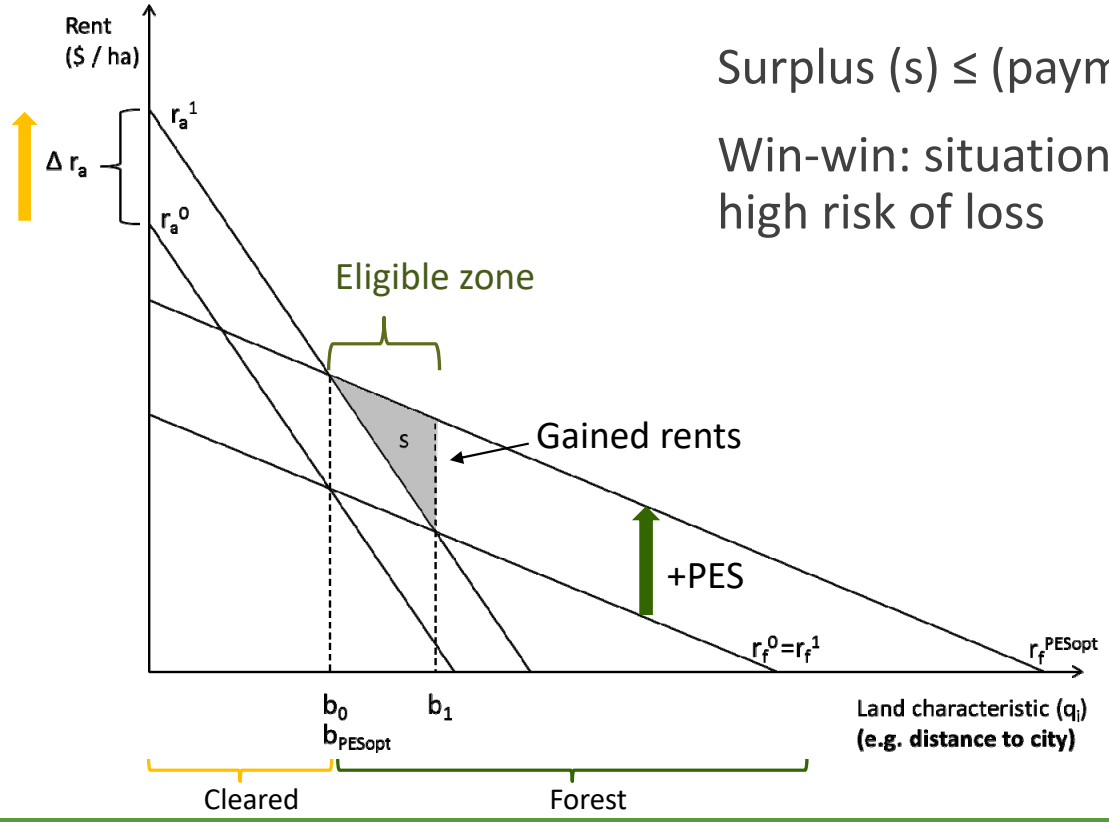


Goal: avoid deforestation at low cost

Payments = Δ r_a; target to zone b_0 to b_1



Win-win is possible but not guaranteed



Surplus (s) ≤ (payments – opportunity costs)

Win-win: situations where poor own forest at high risk of loss

Lower risk of defor
Higher poverty

E.g. Joint outcomes of PES in Mexico

(Alix-Garcia, Shapiro and Sims 2013 *Land Econ*, Alix-Garcia, Yanez-Pagans and Sims 2015 *AEJ Econ Policy*, Sims et al. 2014 *Con Bio*, Sims and Alix-Garcia *JEEM* 2017, Alix-Garcia and Sims et al. 2018 *PNAS*)

Run by MX National Forestry Commission

- 2003- present; all states
- Goals: protect watersheds and biodiversity, support rural livelihoods

Landowners choose parcels to submit

- Private and common property owners
- 5 year contracts: yearly payments contingent on maintaining forest or existing land cover

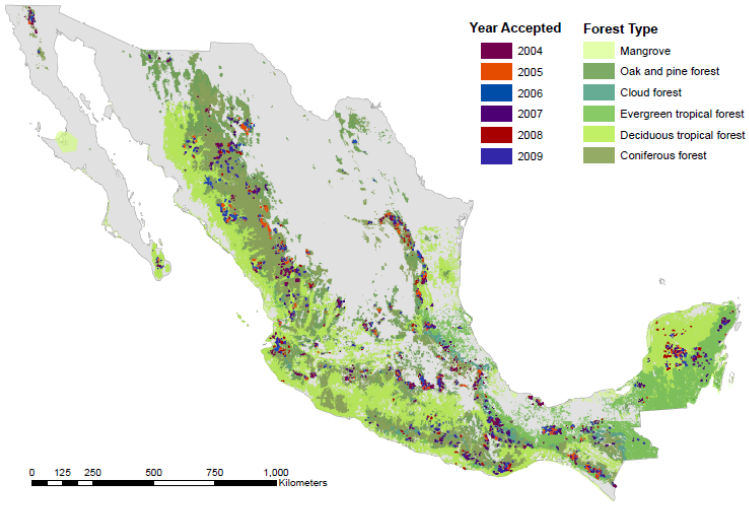
Current zones and payments ($20-$80/ha)

Table 1: Current payment schedule

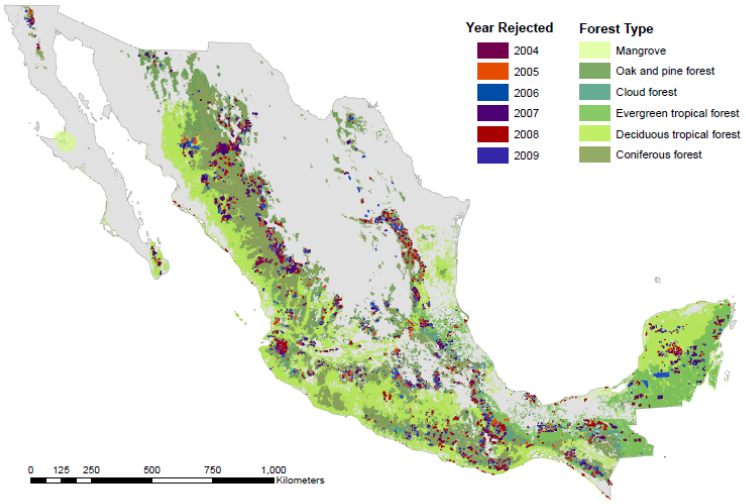
Modality	Zone	Ecosystem	Deforestation risk	Payment per ha in pesos	% eligible area
Hydrological					
	1	Cloud forest	Very high	1,100	0.13
	2	Cloud forest	High, medium, low	700	2.9
	3	Rainforest	All risk levels	550	11.6
	4	Conifer, oak, Dry tropical forest	All risk levels	382	39.7
Biodiversity					
	5	Dry tropical forest, mangroves	Very high, high All risk levels	382	8.9
	6	Dry tropical forest Arid and semi-arid	Medium, low, very low All risk levels	280	36.8

Quasi-experimental methods: matching, DiD, RD

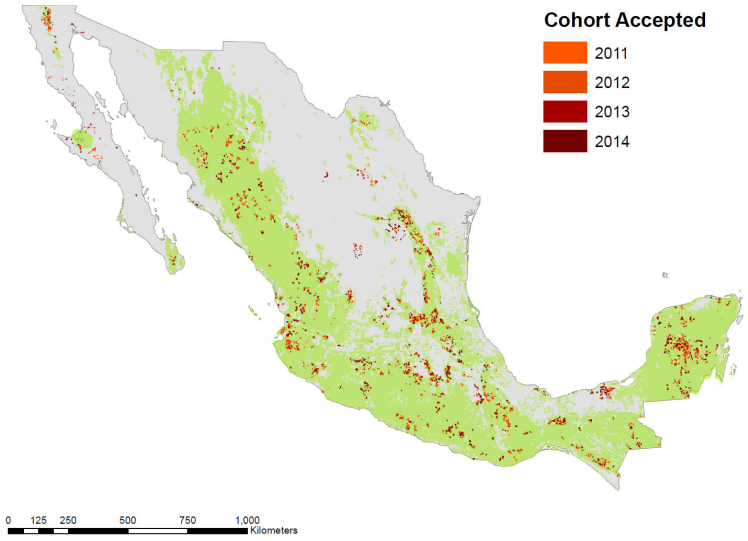
Compare participants vs. similar rejected applicants



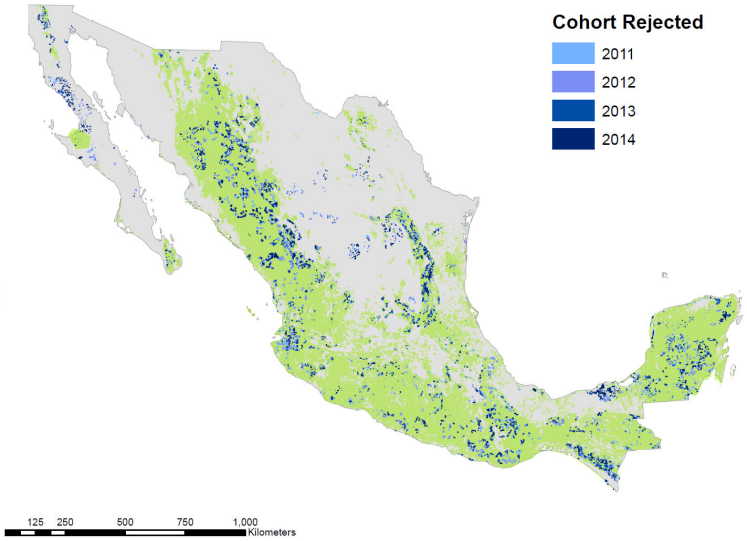
Program participants



Rejected program applicants



Program participants



Rejected program applicants

Spatial overlay of data

Program data (2003-2015 cohorts)

Land cover change indicators

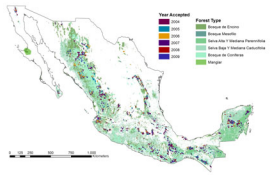
- Interpreted satellite data (primary/secondary)

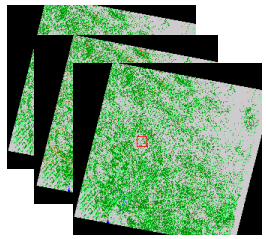
Socioeconomic indicators

- Primary: household and community surveys
  - 2011: 12 states, 233 props; leaders and households
  - 2016: 12 states, 862 props; leaders and households
- Secondary: locality poverty index 1990, 2000, 2010 for 105,632 localities (Mexican census)

Controls

- Baseline geographic/market distance
- Forest characteristics, states, slope/elev, rainfall, water scarcity, muncipial poverty, majority indigenous, region, etc.

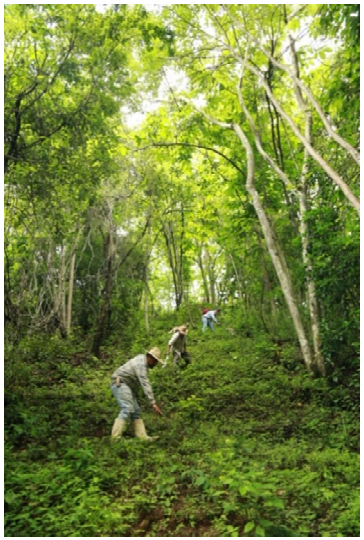




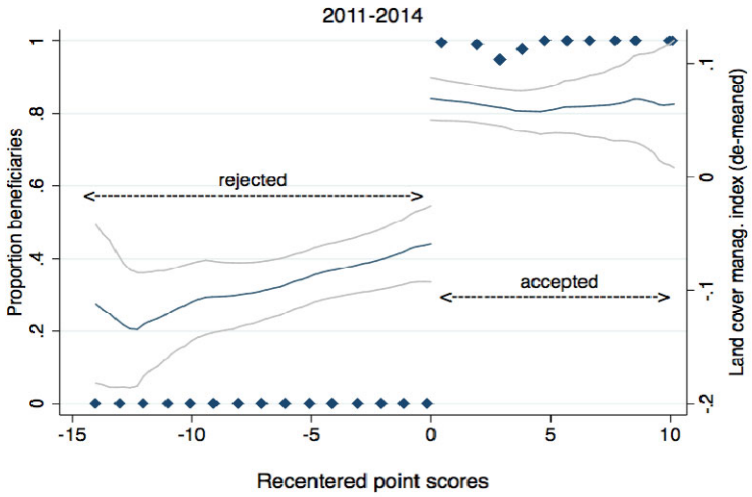
Environmental impacts

PES can substantially reduce land cover change

- Increased land-cover management (+50%)
- Avoided land-cover loss (20-50% across studies)



Participation and land management



Targeting important for impact

Overall low rates of change: ~0.2-0.3% land area/yr

→ Target more to areas where risk of loss is high

- E.g. communal properties ("ejidos/comunidades"), closer to cities, lower slope, Yucatan peninsula, borders of protected areas

Win-win?

- Targeting to communal properties: higher risk, higher poverty

Economic impacts: PES supported livelihoods

Reached marginalized households

No reduction in food consumption, staple crops

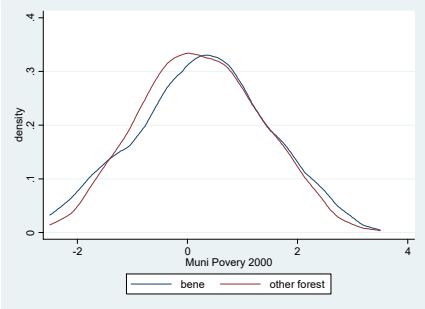
Early cohorts: small positive impacts on assets, educational attainment, locality wealth indices

- Gains higher for HH at low risk of deforestation

Later cohorts: no significant impacts

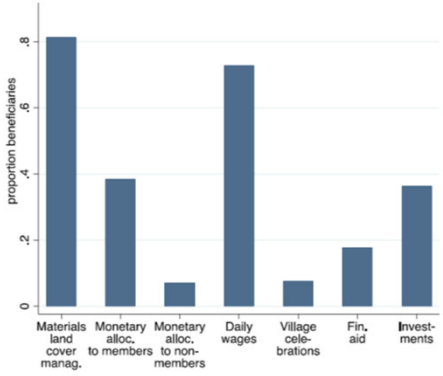
- Requirements to use funds for forest management, erosion of value of payments

Poverty of recipients vs. all other forested



Municipal poverty index from CONAPO (2000).

Reported uses of funds



Many conservationists uneasy with PES

"Payments for ecosystem services and the fatal attraction of win-win solutions" *(Conservation Letters)*

"In markets we trust?" *(Ecological Economics)*

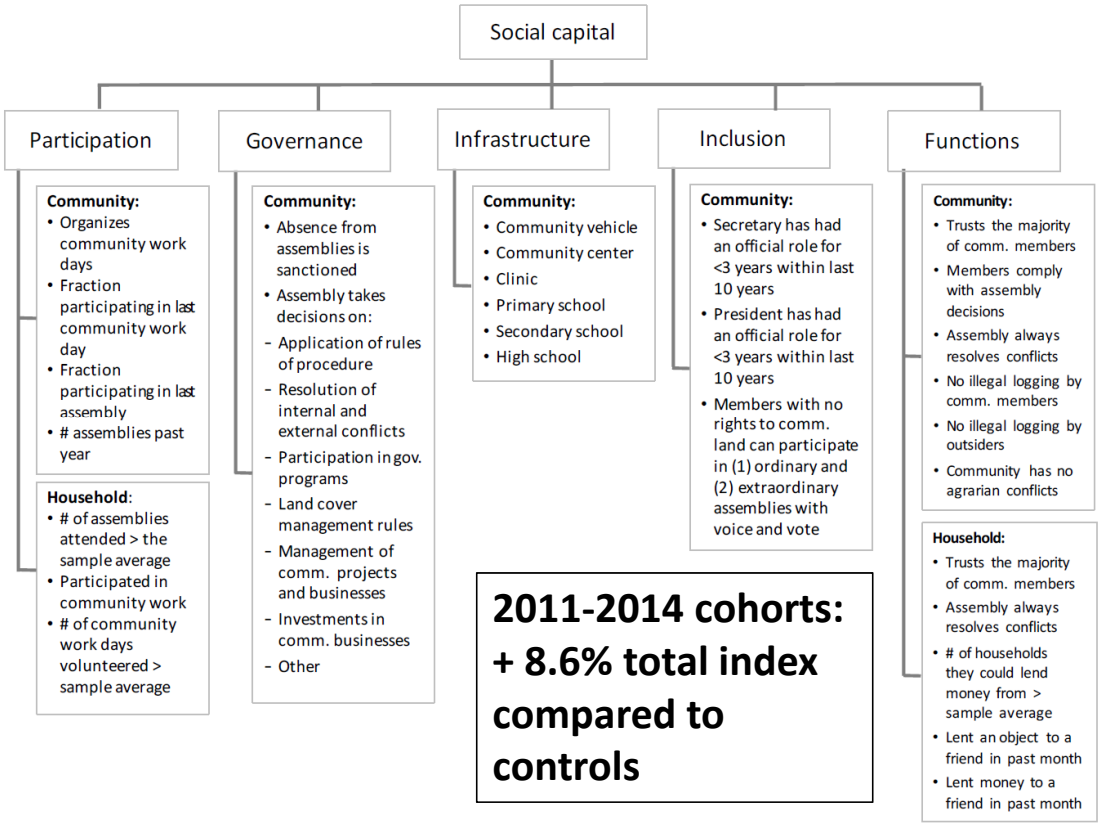
"Payments for ecosystem services as commodity fetishism" *(Ecological Economics)*

"Ecosystem services as a contested concept" *(Conservation Letters)*

"Paying for Ecosystem Services--Promise and Peril" *(Science)*

"Selling out on nature" *(Nature)*

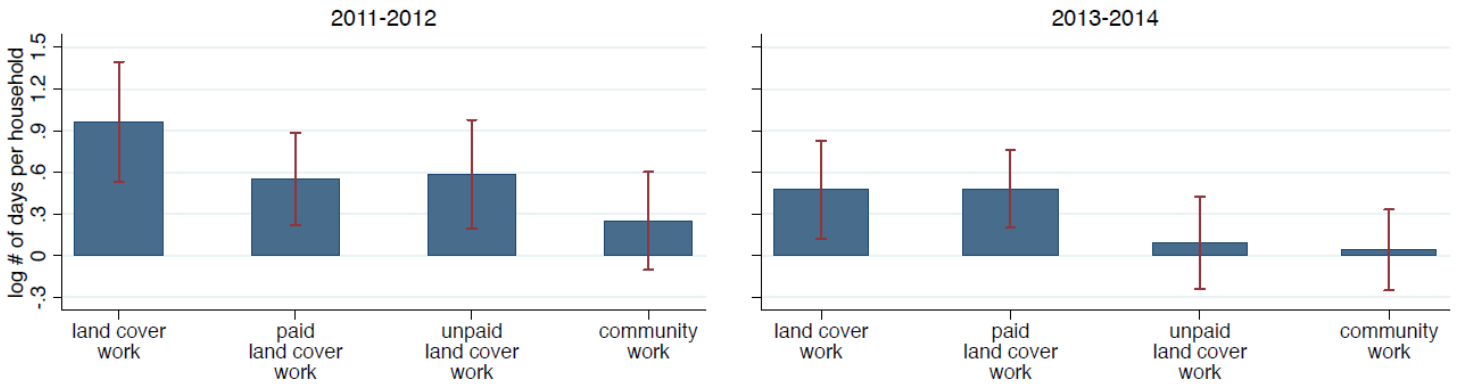
Social impacts: PES supported social capital



PES did not crowd out other voluntary work

PES increased paid land cover work

- Did not reduce unpaid land cover work
- Did not reduce other community work



Blue bars: estimated impacts; Red bars: 95% CIs

PES and poverty/inequality

Authors	Location	Household wealth indicators / Poverty alleviation
Arriagada et al. 2015, Robalino et al. 2014	Costa Rica	neutral
Alix-Garcia et al. 2015, 2018, Sims and Alix-Garcia 2018, Jones et al. 2018	Mexico	+ / neutral
Phan et al. 2018	Vietnam	+
Jayachandran et al. 2017	Uganda	neutral
Liu and Lan 2018, Liu et al. 2012, Uchida et al. 2009, 2007	China	+ / neutral
Jones et al. 2017	Ecuador	neutral
Hedge and Bull 2011	Mozambique	+
Adjognon et al. (in progress)	Burkina Faso	+
Wiik et al. (in progress)	Bolivia	?

Taking stock

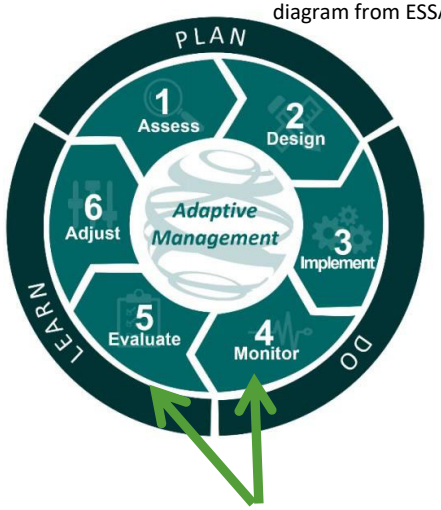
Win-win is possible, but not guaranteed

- Careful targeting, assess overlap of risk/poverty
- Adaptive management for changes in risk

Research still needed

- Institutional mechanisms for equity
- Long term impacts—forest and livelihood trajectories
- Landscape scale configurations

Adaptive management diagram from ESSA



"Counterfactual Monitoring"

Thank you!

Thank you to the many gracious people who have taken time to answer surveys and to the pilot and survey teams. Thank you for time/funding from CONAFOR, CONEVAL, the World Bank DIME/i2i, Chapingo University, the Carnegie Corporation of NY, Amherst College, University of Wisconsin-Madison, Oregon State University.







Mexico PES publications / reports

Alix-Garcia, J.M., Phaneuf, D. and K.R.E. Sims **(2019)**. Using referenda to improve targeting and decrease costs of environmental conditional cash transfers." ***Journal of Public Economics***, accepted article.

Alix-Garcia et al. **(2018)**. Payments for environmental services supported social capital while increasing land management. ***PNAS***, 115: 7016-7021.

Sims, K.R.E., & Alix-Garcia, J.M. **(2017)**. Parks versus PES: Evaluating direct and incentive-based land conservation in Mexico. ***Journal of Environmental Economics and Management***, *86*, 8-28.

Alix-Garcia, J.M., Sims, K.R.E., & Yañez-Pagans, P. **(2015)**. Only one tree from each seed? Environmental effectiveness and poverty alleviation in Mexico's Payments for Ecosystem Services Program. ***American Economic Journal: Economic Policy***, *7*(4), 1-40.

Sims, K.R.E., Alix-Garcia, J., Shapiro-Garza, E., Fine, L., Radeloff, V., Aronson, G., Ramirez-Reyes, C. & Yañez-Pagans, P. **(2014)**. Improving environmental and social targeting through adaptive management in Mexico's payments for hydrological services program. ***Conservation Biology***, *28*(5), 1151-1159.

Alix-Garcia, J.M., Shapiro, E.N., & Sims, K.R.E. **(2012).** Forest conservation and slippage: Evidence from Mexico's national payments for ecosystem services program. ***Land Economics***, *88*(4), 613-638.

Can Environmental Cash Transfers Reduce Deforestation and Improve Social Outcomes? A Regression Discontinuity Analysis of Mexico's National Program (2011-2014). **(2019)** ***WB Policy Research Working Paper***

Evaluation of Mexico's Payments for Environmental Services Program 2011-2014. **(2018)** ***Policy report for CONAFOR, CONEVAL.***

Evaluation of CONAFOR's Payments for Hydrological Services Program, 2003-2010. **(2012)** ***Policy report for the Mexican National Forestry Commission.***

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