Ecosystem service tradeoffs and ecological-economic production possibilities frontier: A case study in Costa Rica

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How to analyze ES interactions?



• Different approaches can describe ecosystem services interactions differently

Application in Costa Rica

- Modeling of 6
 ecosystem services
 using InVEST (Sharp et al. 2014)
- 4 observed land-use maps in 1986, 1996, 2001 and 2008
- 32 contrasting land-use scenarios



Frontier and envelope curves

carbon storage					1
		the second se	Bur.		and the second
-0.73***	nitrogen retention		A state of the sta		\int
-0.64***	0.83***	phosphorus retention			
-0.76***	0.81***	0.71***	agricultural production		
-0.47***	0.47***	0.42***	0.52***	sediment retention	Sec.
-0.24***	0.27***	0.24***	0.23***	0.047	water yield
	-0.73*** -0.64*** -0.76*** -0.47*** -0.24***	-0.73*** nitrogen retention -0.64*** 0.83*** -0.76*** 0.81*** -0.47*** 0.47*** -0.24*** 0.27***	-0.73*** nitrogen retention -0.64*** 0.83*** phosphorus retention -0.64*** 0.83*** 0.71*** -0.76*** 0.81*** 0.71*** -0.47*** 0.47*** 0.42*** -0.24*** 0.27*** 0.24***	-0.73*** nitrogen retention Image: Constraint of the second of the	-0.73*** nitrogen retention Image: Construction Image: Construction Image: Construction -0.64*** 0.83*** phosphorus retention Image: Construction Image: Construction Image: Construction -0.76*** 0.81*** 0.71*** agricultural production Image: Construction -0.76*** 0.47*** 0.42*** 0.52*** sediment retention -0.24*** 0.27*** 0.24*** 0.23*** 0.047

- Frontier curves exist only for tradeoffs (in red)
- Threshold effects in moderate and non-monotonic tradeoffs
- Frontier curves poorly reflect the range of possible ecosystem services levels
- Envelope curves are more generalizable (in black)

Position of observed land-uses



- Observed situations \rightarrow far from optimal
- Not explained by rational optimization (social constraints)
- Possibility sets include socially unacceptable situations
- How to consider these constraints in the analysis?