

Ecosystem services: Keeping our promise to connect nature with people

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Gund Institute for Environment

Mobilize scholars and leaders to understand and solve the world's critical environmental problems.



Fellows, Affiliates

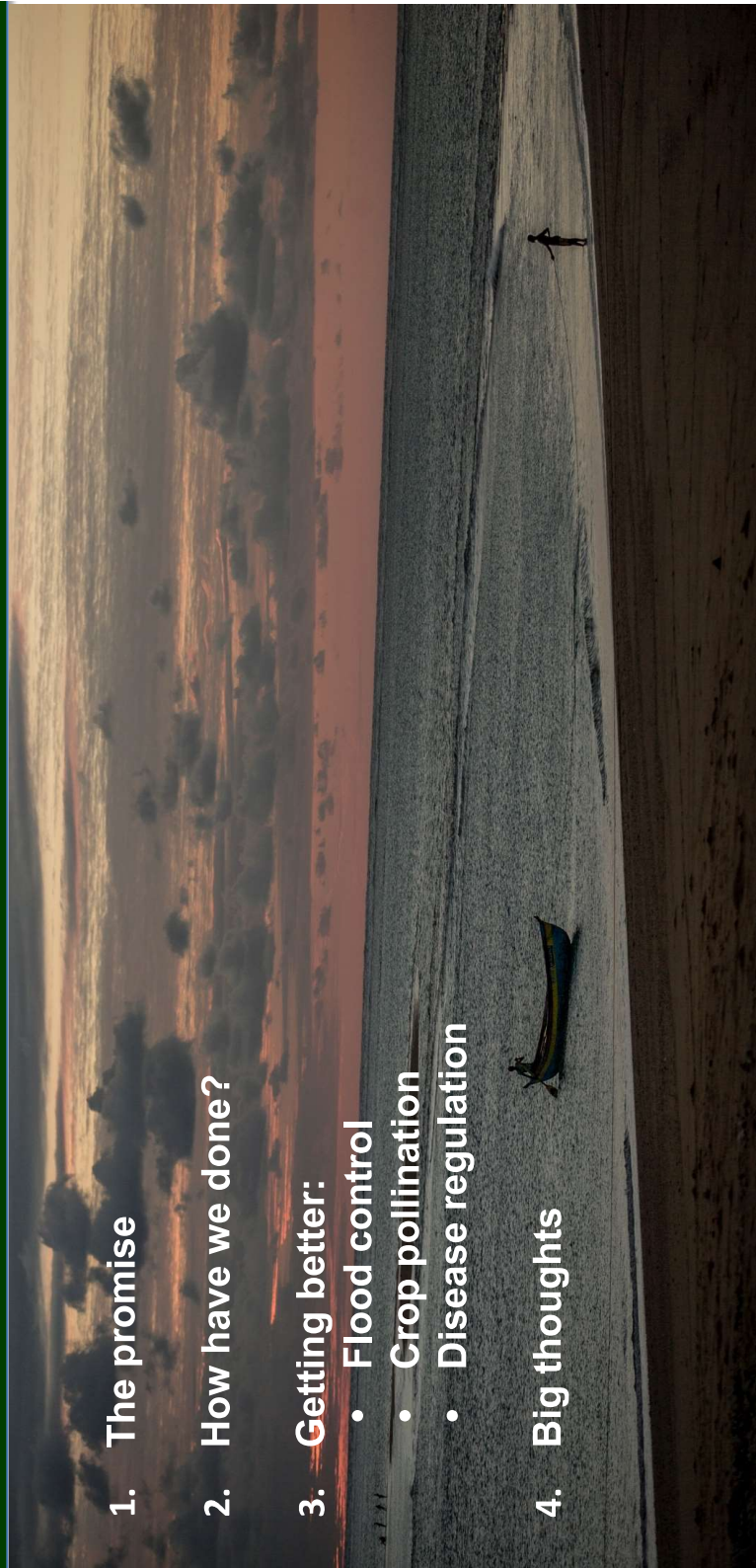


Postdocs, students



Keeping our promise to connect nature with people

1. The promise
2. How have we done?
3. Getting better:
 - Flood control
 - Crop pollination
 - Disease regulation
4. Big thoughts



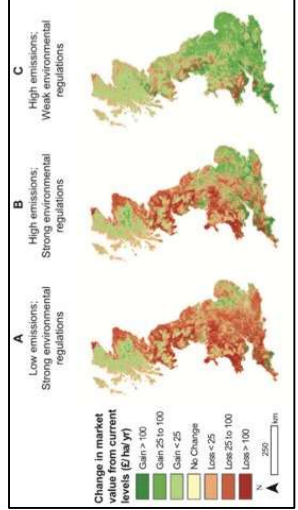
Ecosystem Services



- Connect ecological and social systems
- Nature can support human wellbeing



Growing focus for conservation, policy



M-16-61

MEMORANDUM FOR EXECUTIVE DEPARTMENTS AND AGENCIES

October 7, 2015

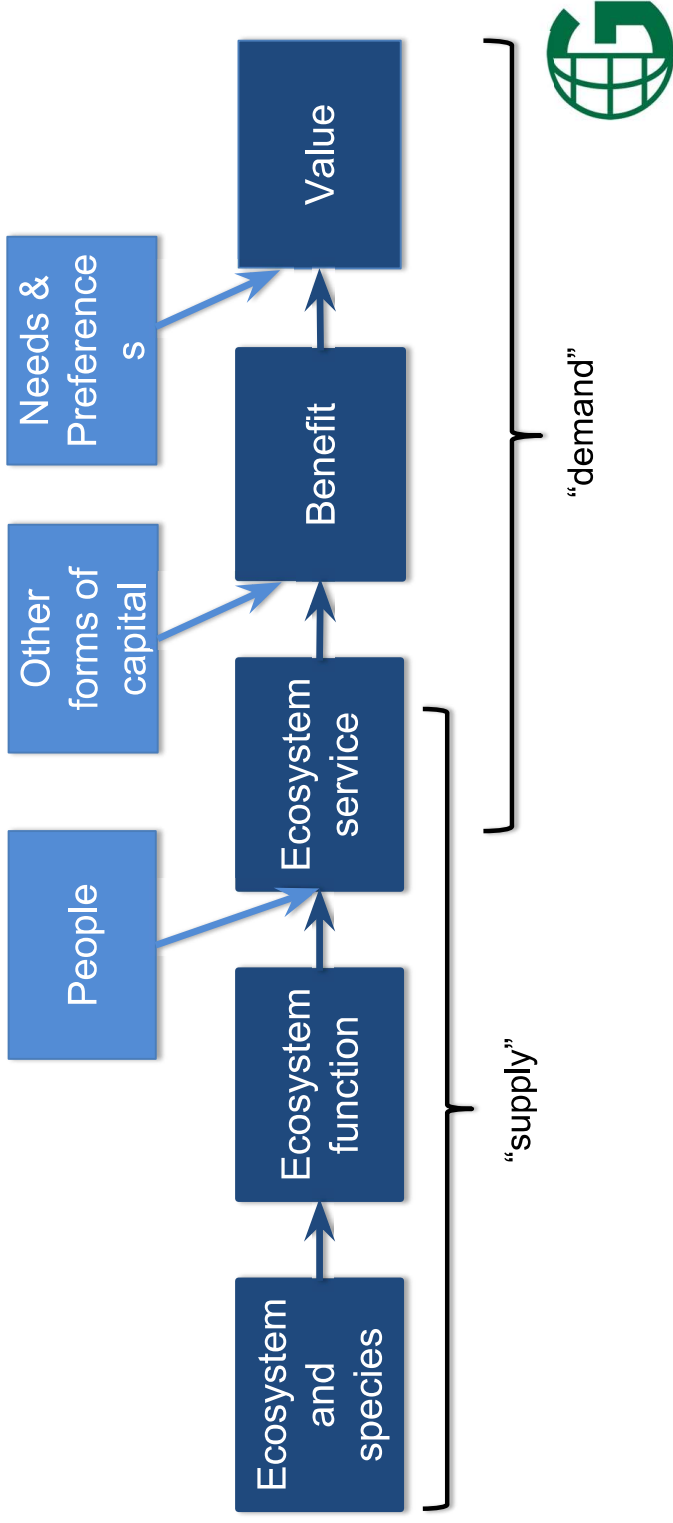
FROM: *Shawn Stevenson, Director*
Office of Management and Budget

TO: *Clayton Goldfish, Assistant Secretary*
Department of the Interior

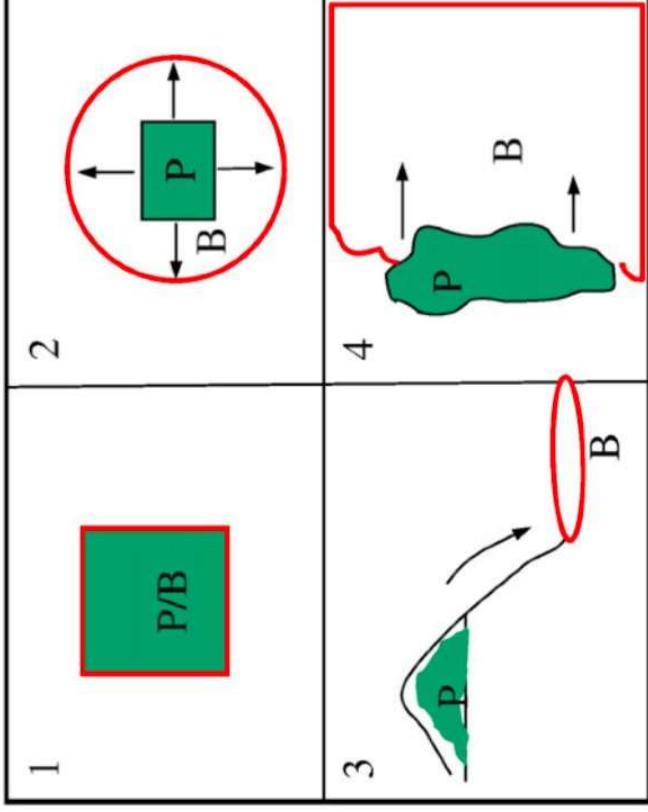
1. *John P. ...*
Office of Science and Technology Policy

SUBJECT: Incorporating Ecosystem Services into Federal Decision Making

What do we need to know?



Who are the beneficiaries?



Differences in:

- Location
- Preferences
- Socio-economics
- Vulnerability



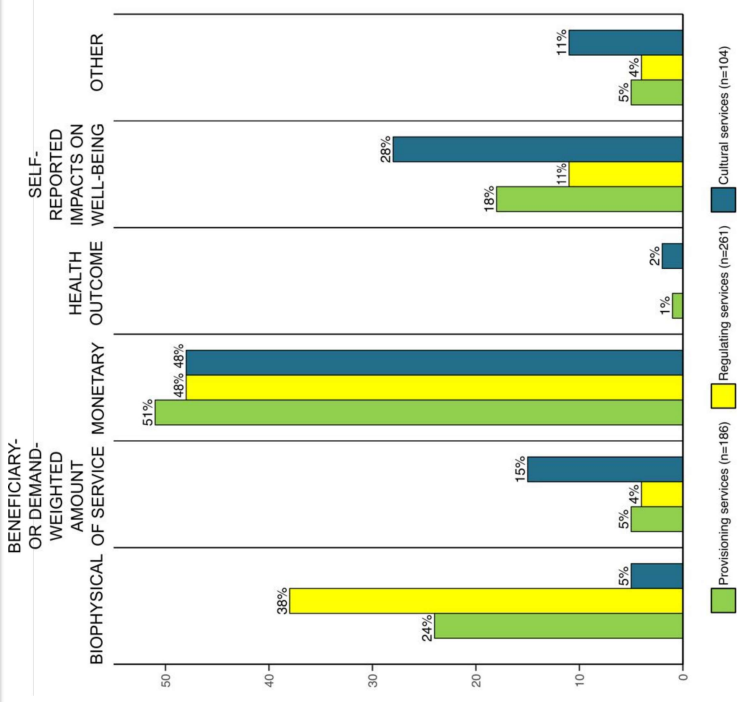
How have we done so far?

Review of 1000 recent papers

How are benefits measured?

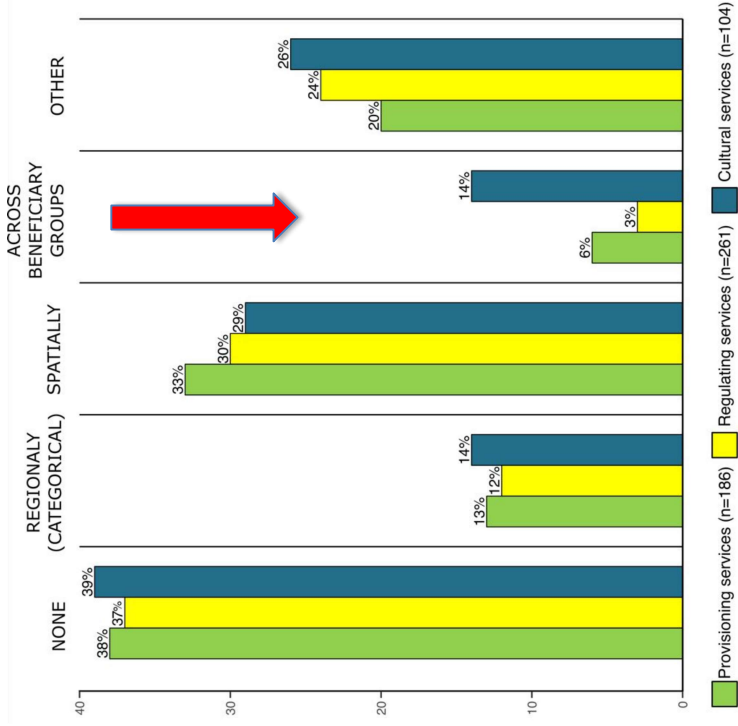


Mandle et al, in review. *PNAS*.

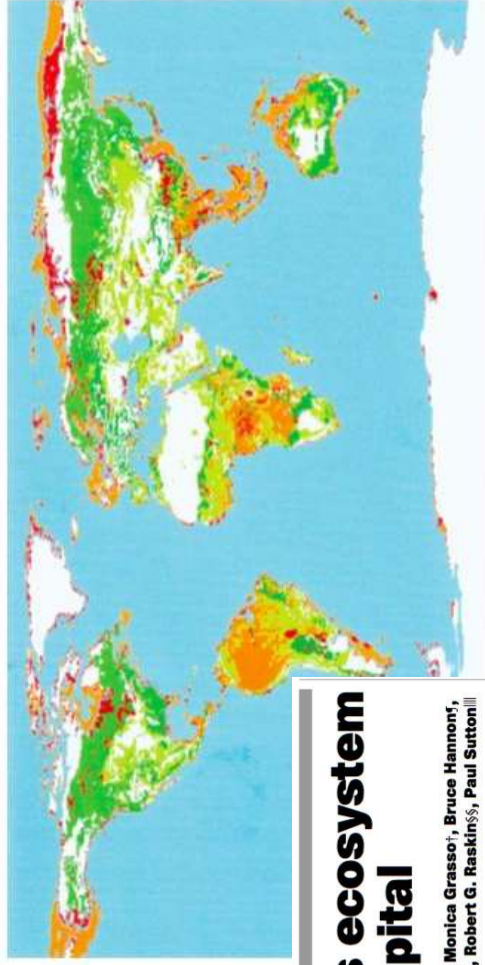


How are benefits disaggregated?

~6% disaggregate beneficiary groups



The planet

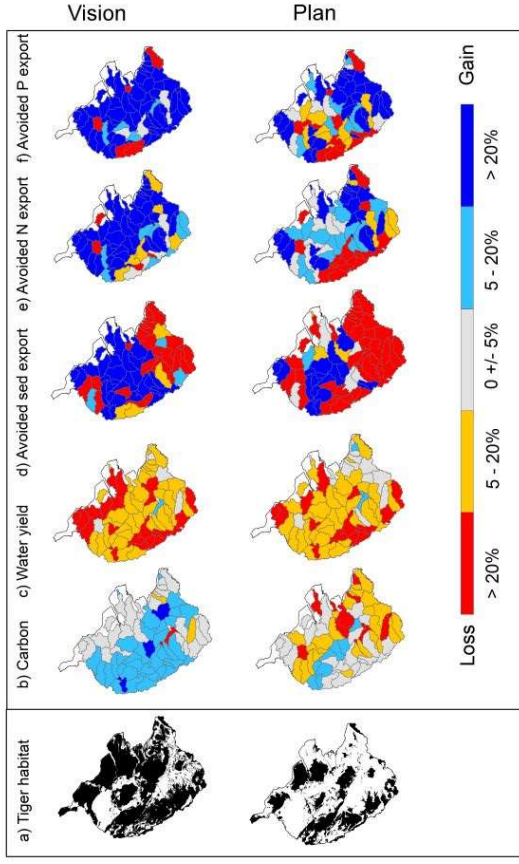
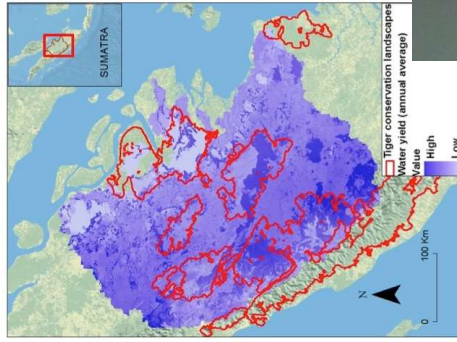


The value of the world's ecosystem services and natural capital

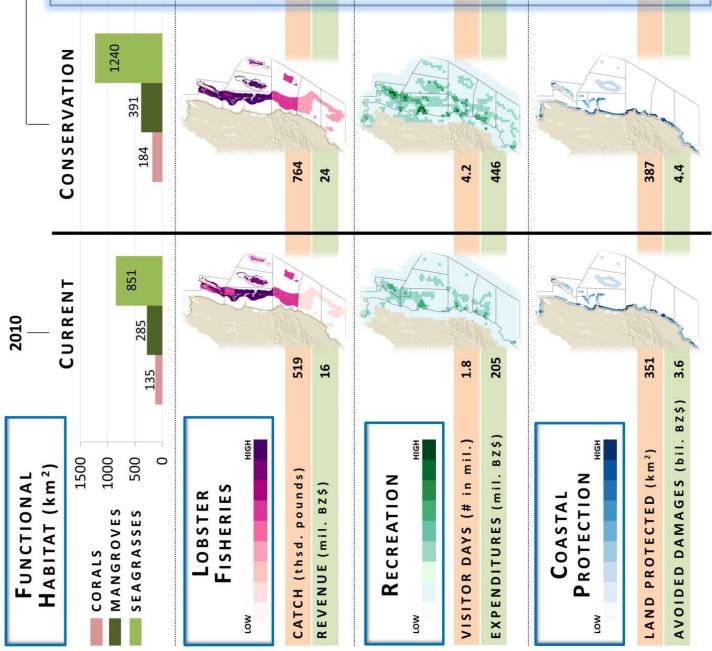
Robert Costanza^{††}, Ralph d'Arge[‡], Rudolf de Groot[§], Stephen Farber[†], Monica Grasso[†], Bruce Hannon[†], Karin Limburg^{‡*}, Shahid Naeem^{**}, Robert V. O'Neill^{††}, Jose Paruelo^{‡‡}, Robert G. Raskin^{§§}, Paul Sutton^{||} & Marjan van den Belt^{§§}

Costanza et al. 1997. *Nature*.

Central Sumatra



Coastal Belize



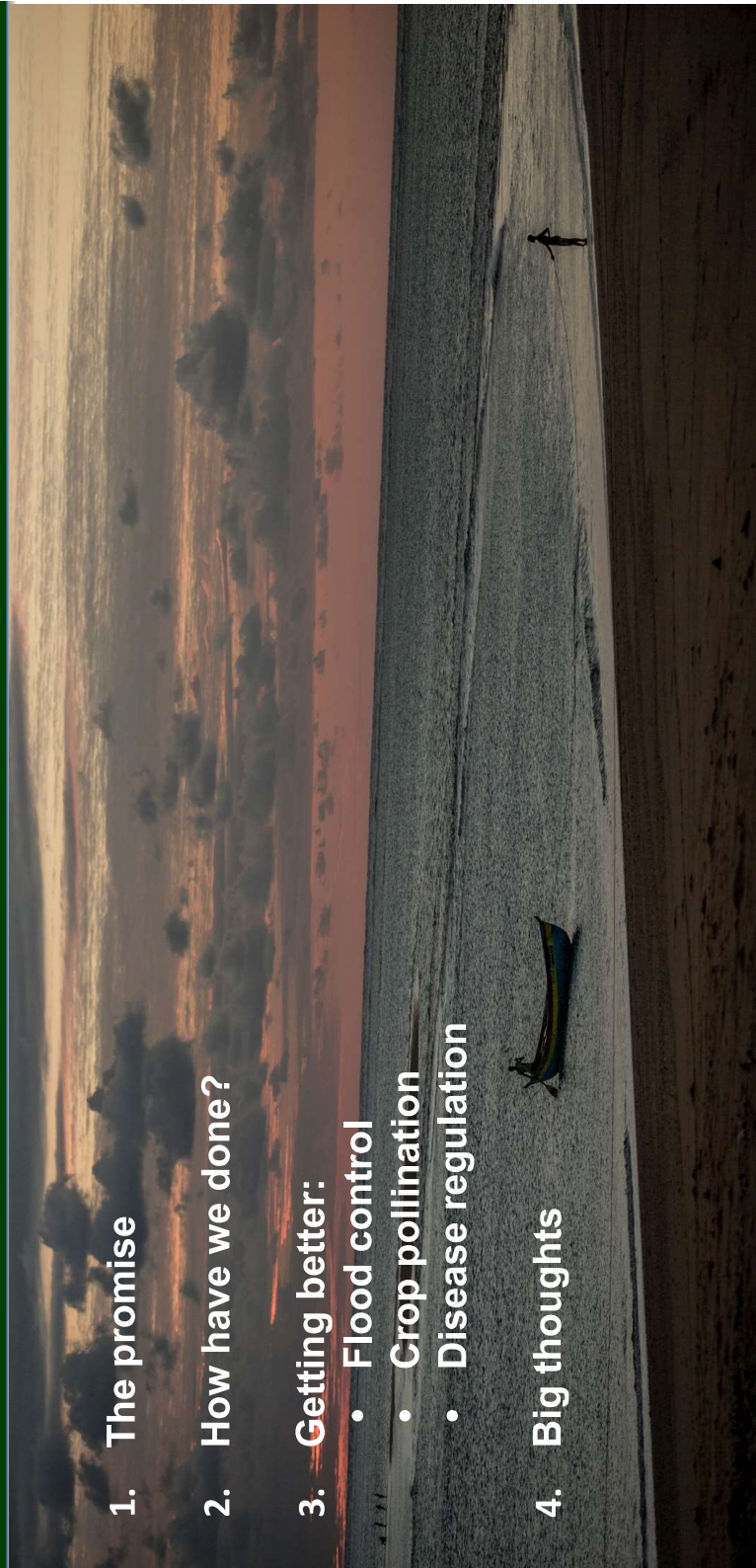
Widely recognized goal

- “It remains unclear how fully the field of ES science has delivered on its promise to illuminate when, why, and how changes to ecosystems affect human well-being.” – Mandle et al. in review
- “[This is one of] three critical frontiers essential to understanding the relationship between changes in nature and well-being, where current tools fall short of meeting the needs of decision-makers.” - Reib et al. 2017



Keeping our promise to connect nature with people

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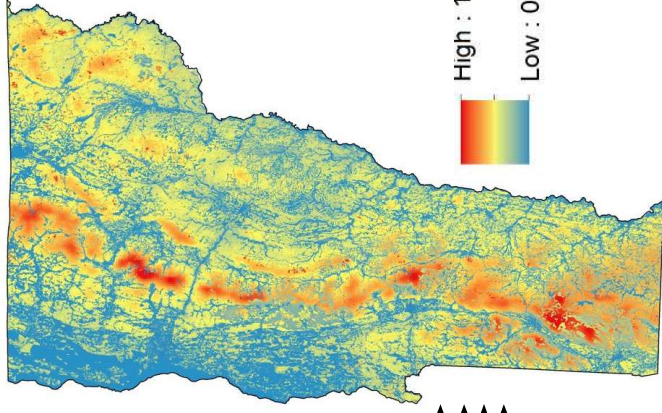
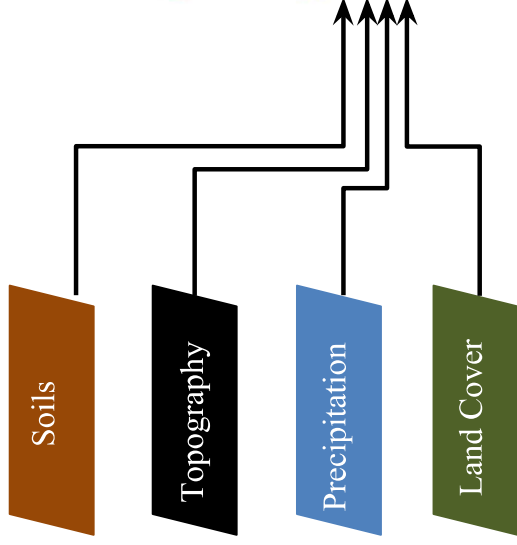


Flood control

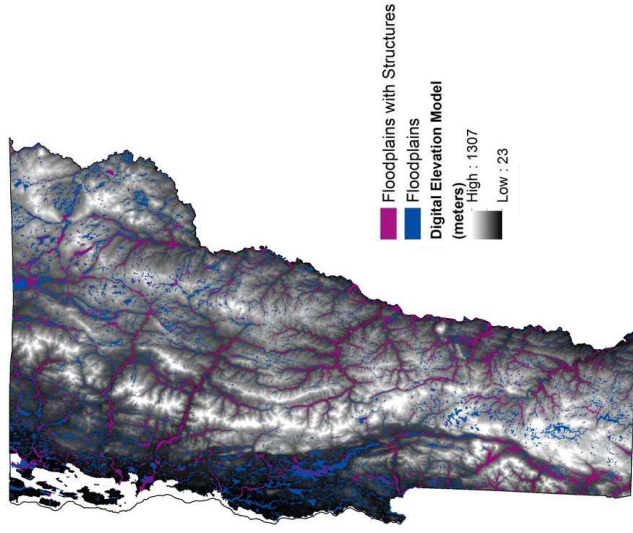
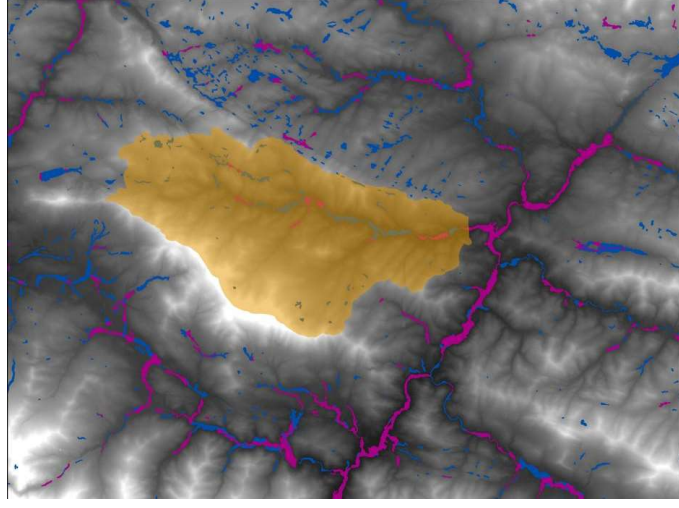
How do beneficiaries shift spatial distributions
and priorities for ecosystem services?



Supply: retention of quickflow



Demand: location of at-risk structures

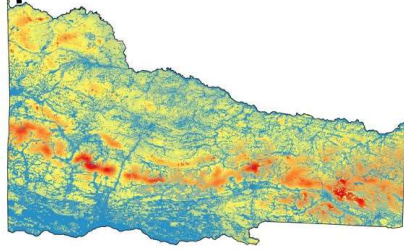


Watson et al. in press. *Cons. Biol.*.



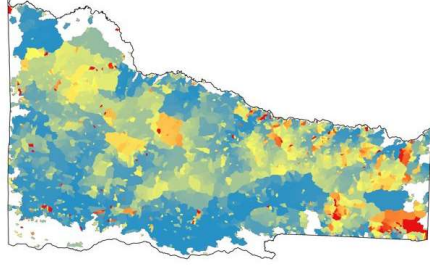
Supply * Demand = Benefit

Supply



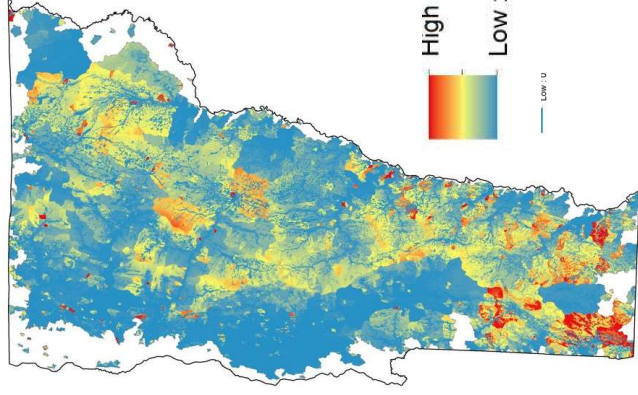
$\Delta LU \rightarrow \Delta \text{Runoff}$

Demand



$\Delta \text{Runoff} \rightarrow \Delta \text{Flooding}$

Benefit

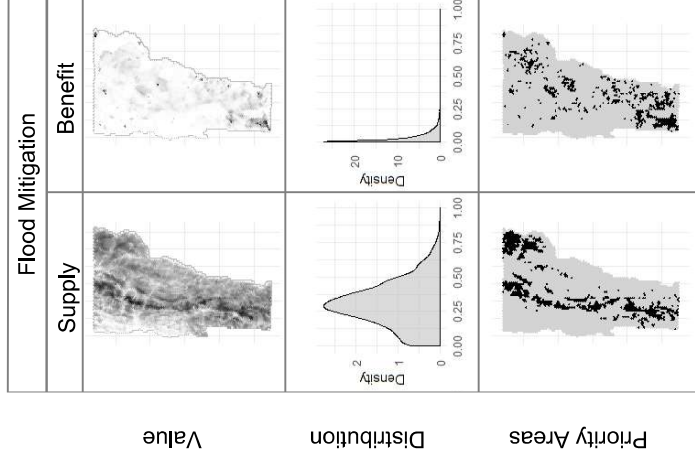


$\Delta LU \rightarrow \Delta \text{Flooding}$

Watson et al. in press. *Cons. Biol.*.



Demand shifts spatial distributions



Value

Distribution

Priority Areas



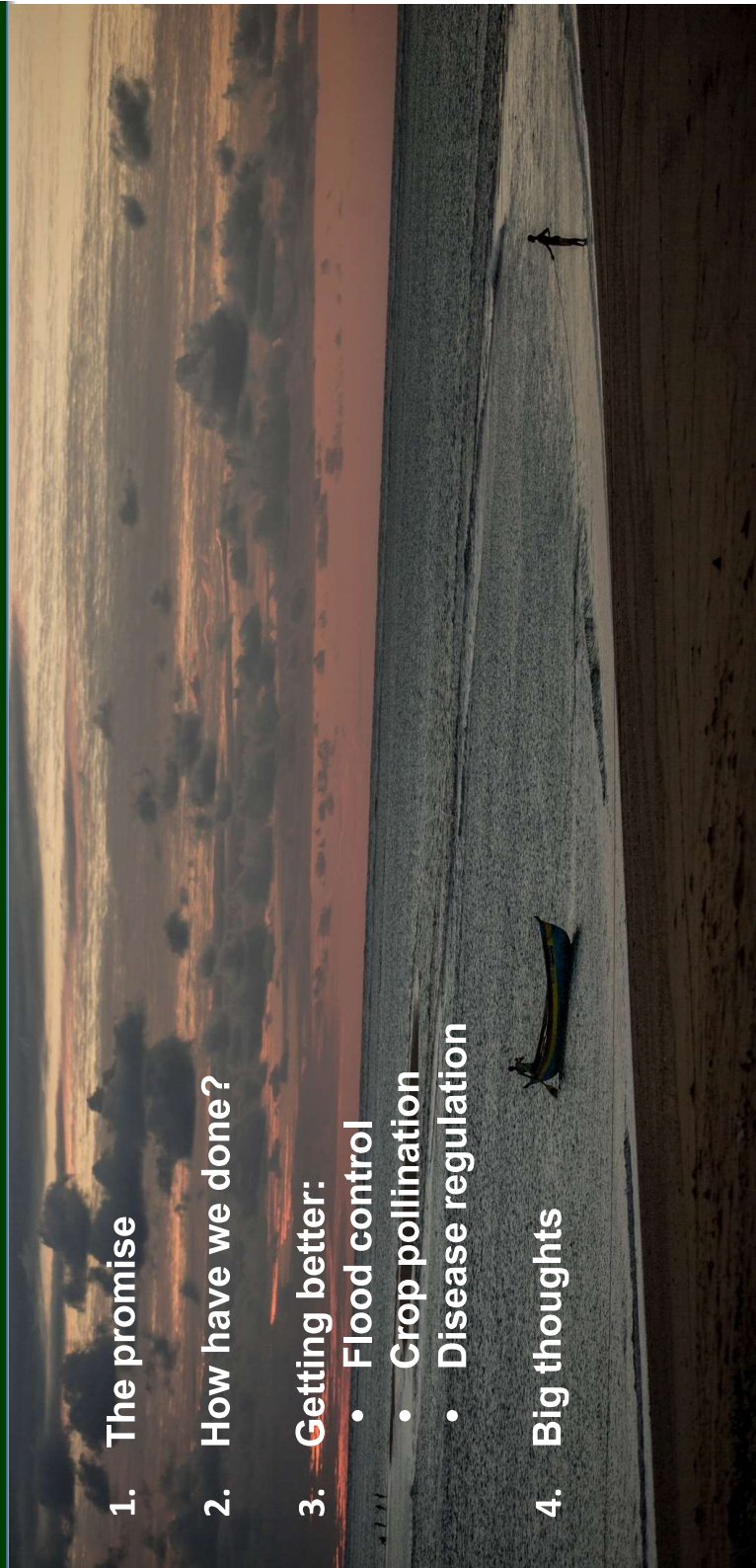
Take homes

- Beneficiaries shift ES distributions and priorities
- Supply NOT a good proxy for benefits
- [doesn't reduce biodiversity co-benefits]



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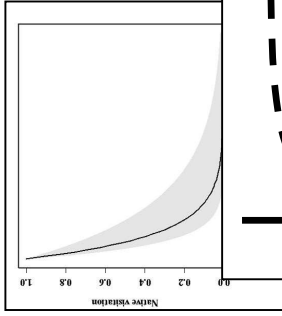
Crop pollination

Where would deforestation most threaten ecosystem services, and for whom?



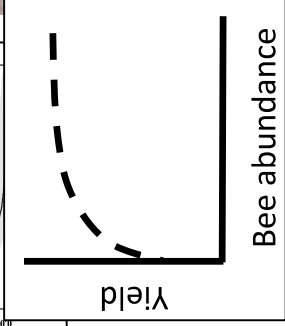
Landscape model

Pollinator source
abundance

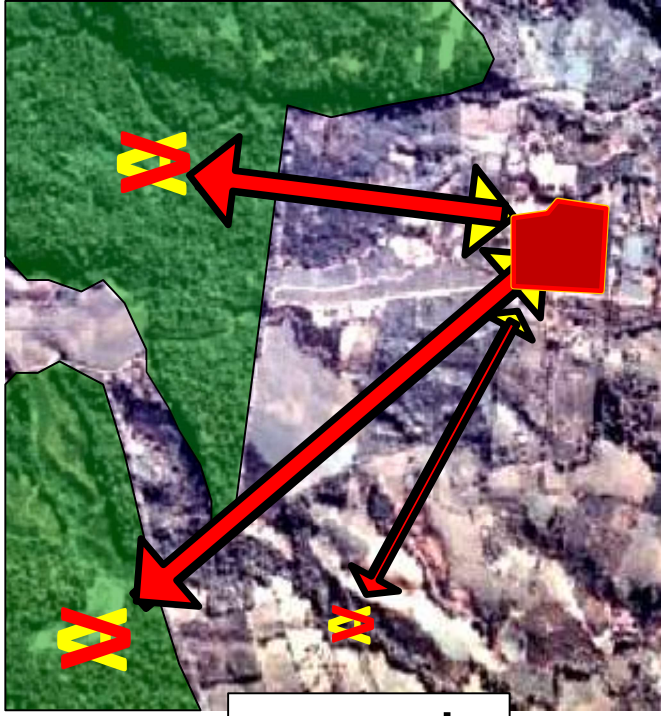
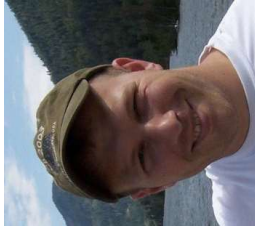


Fly to pollinate coffee

Effect on coffee yield

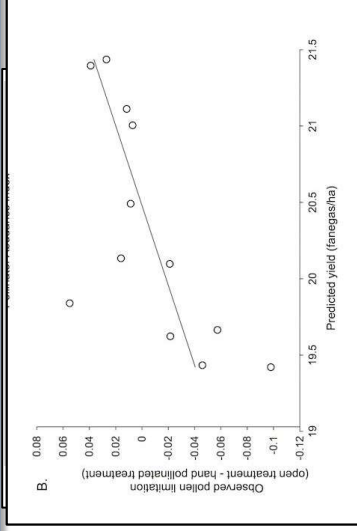


Distribute value to source



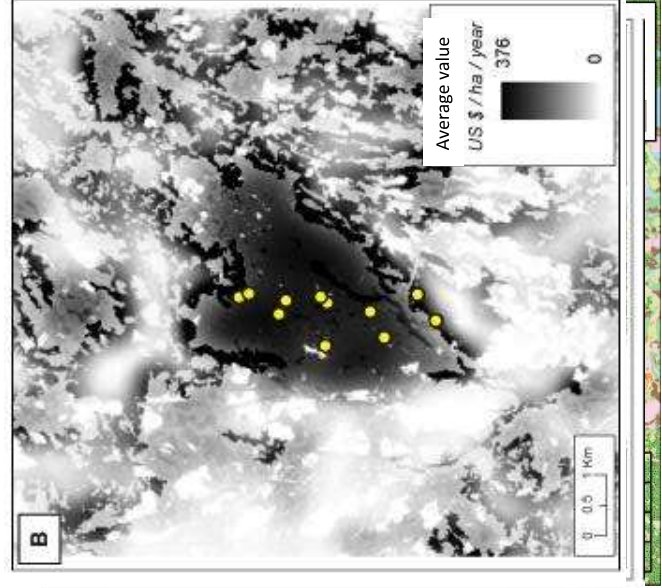
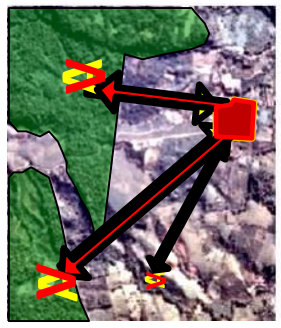
Kremen, et al. 2007. *Ecology Letters*
Lonsdorf, et al. 2009. *Annals of Botany*

Application in Costa Rican coffee



Ripstein et al. 2009. *Annals of Botany*

Lonsdorf, et al. 2009. *Annals of Botany*

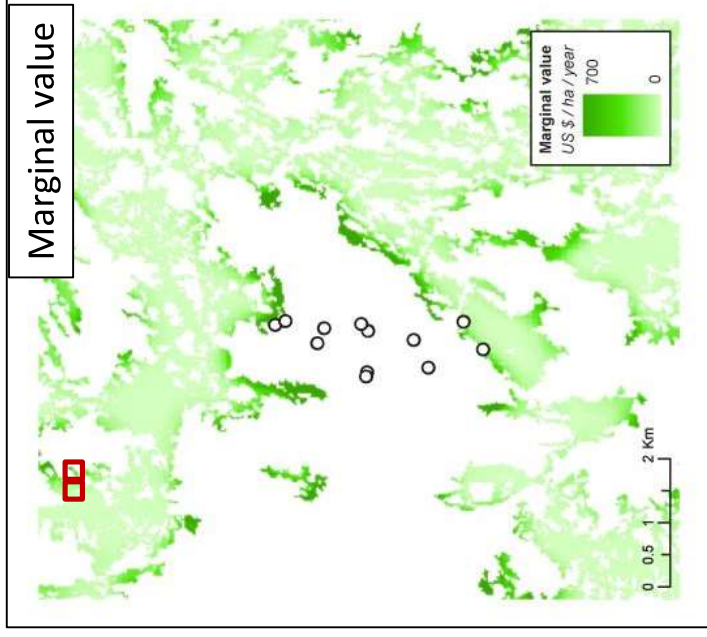


Where is deforestation most costly?

- Destroy forest parcels in turn
- Record resulting change in value over landscape

High marginal value:

- Good bee habitat
- Lots of coffee nearby
- Few substitutes



Ricketts & Lonsdorf, 2013. *Ecol. Apps.*

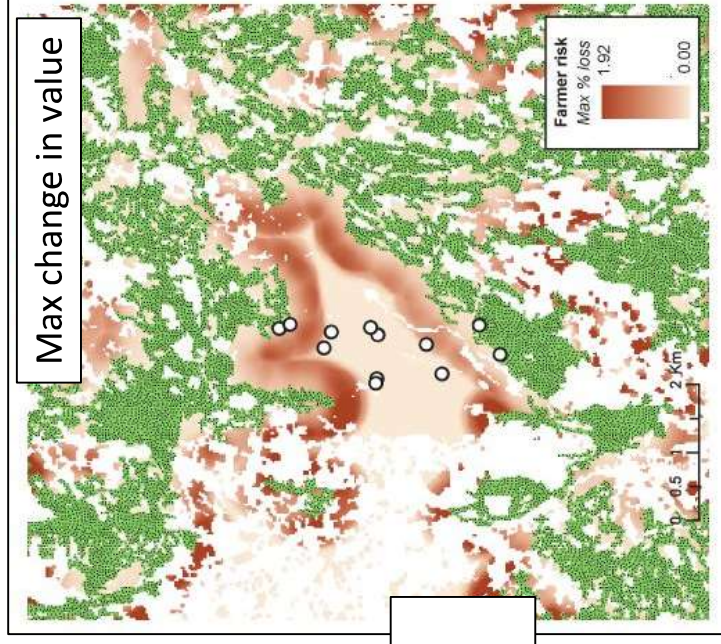


Where are farmers most vulnerable?

- Destroy forest parcel in turn
- Record change in production value at each farm parcel

High risk:

- Near forest
- Few substitutes



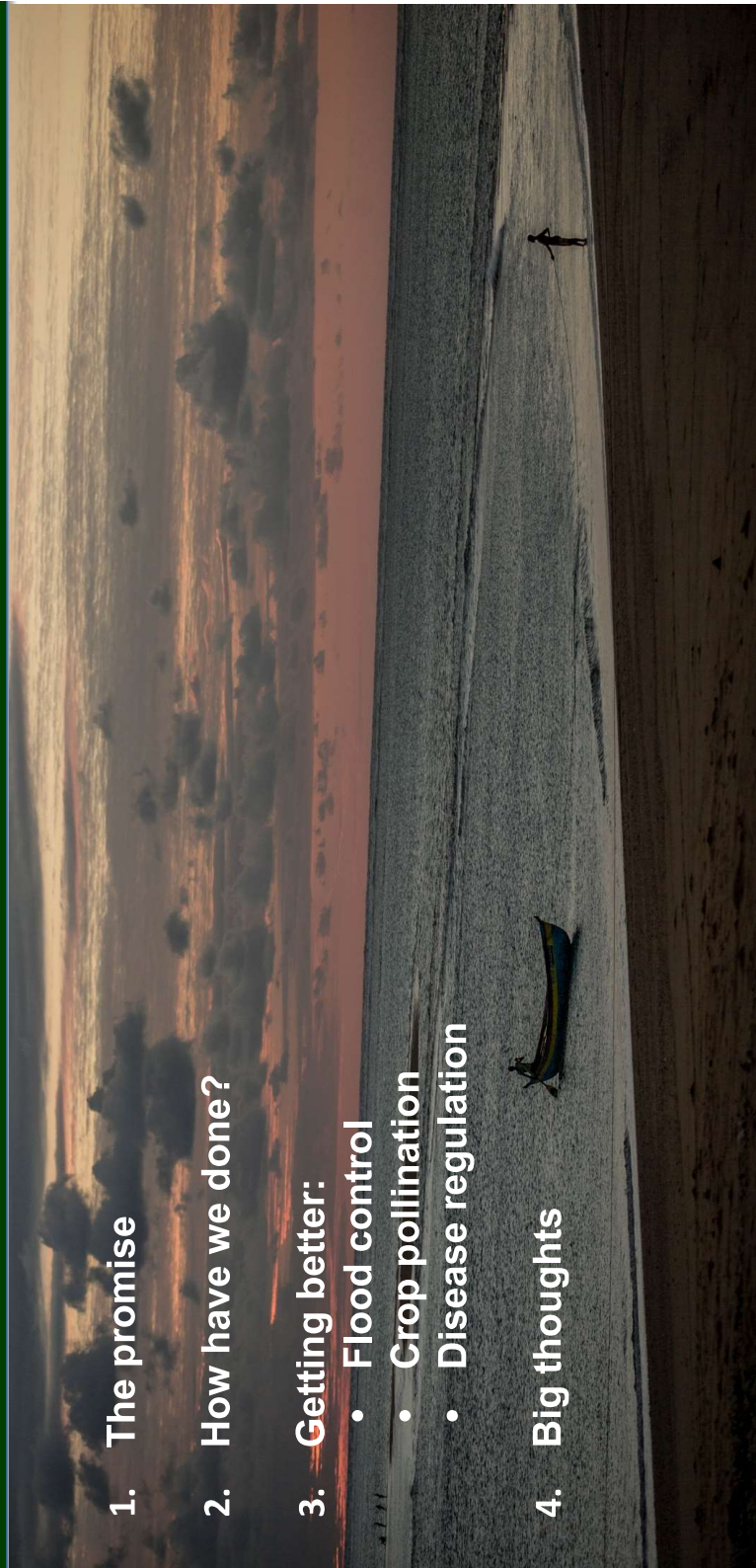
Take homes

- Value of ES depends on supply and demand
- Benefits of conservation borne unevenly
- Mapping beneficiaries can help target conservation efforts



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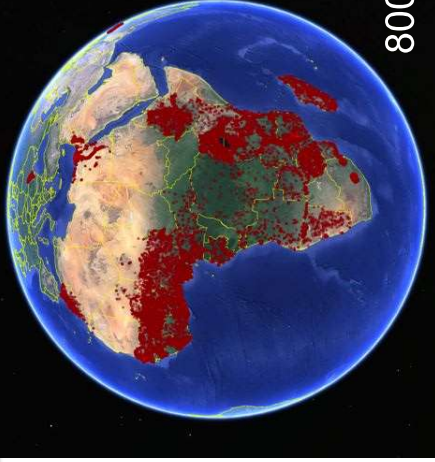


Disease regulation

How does watershed condition affect downstream diarrheal disease among children?



The data



800K kids



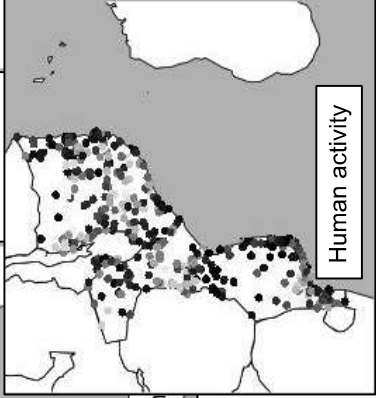
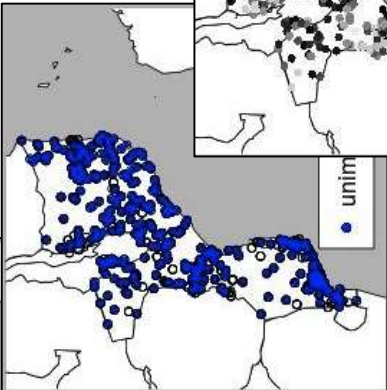
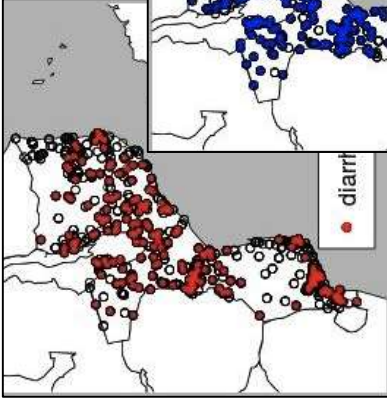
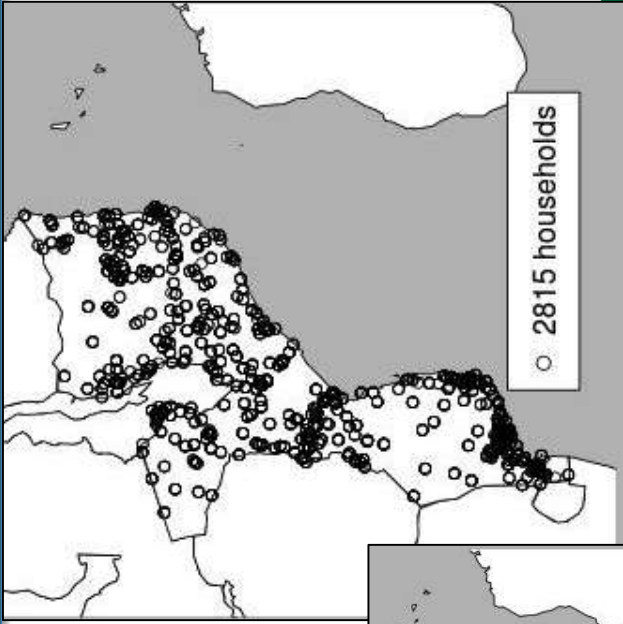
49 countries



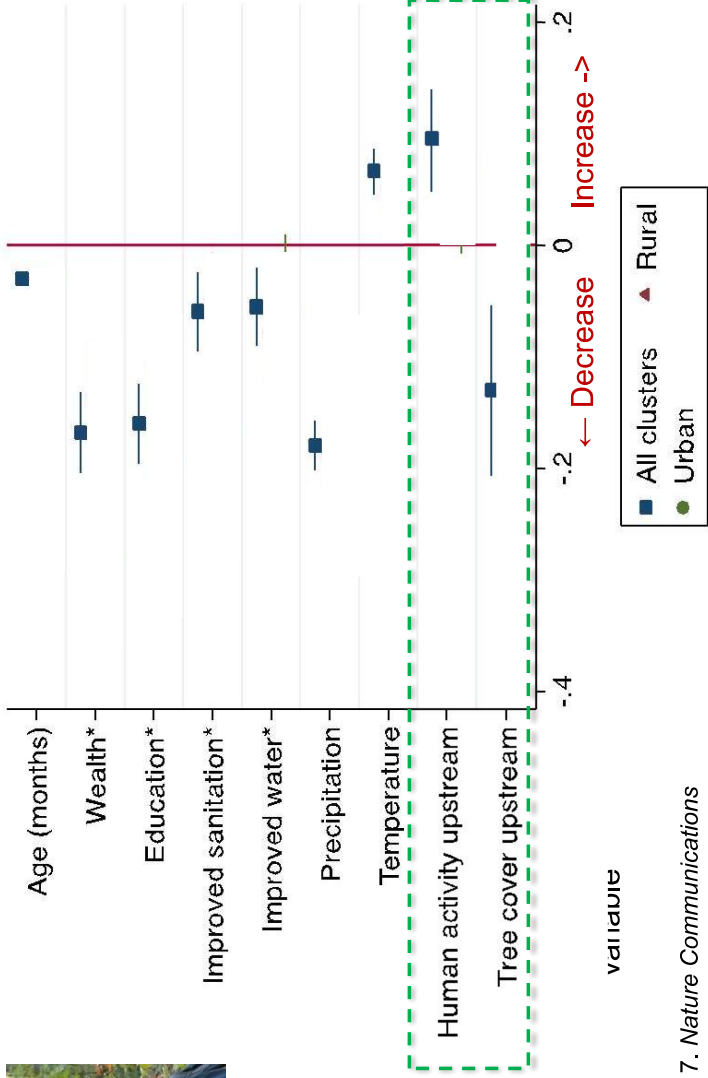
- Health outcomes (stunting, diarrhea, ...)
- Social factors (wealth, education, ...)
- Sanitation factors (water source, toilet type, ...)
- Natural features (climate, land use, ...)
- Watershed condition (human activity, forest cover ...)



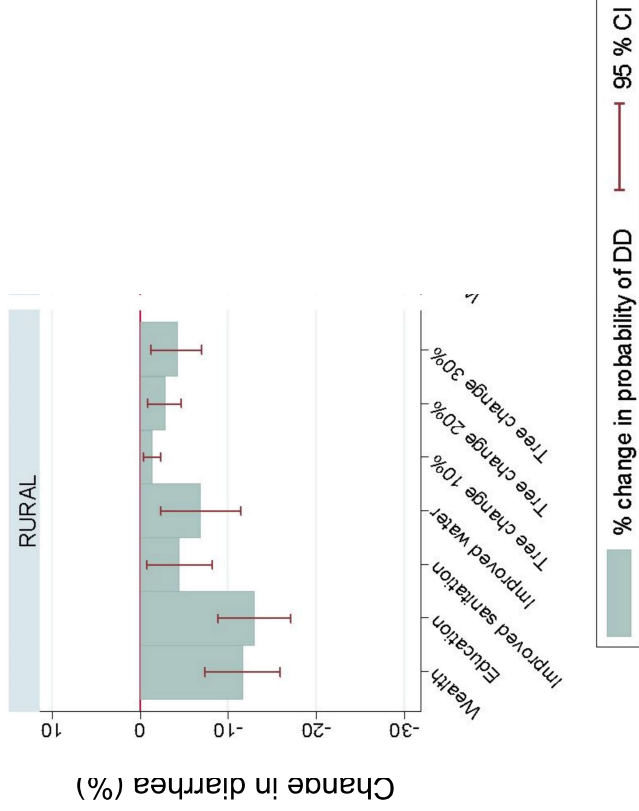
e.g., Mozambique



What impacts childhood diarrhea?



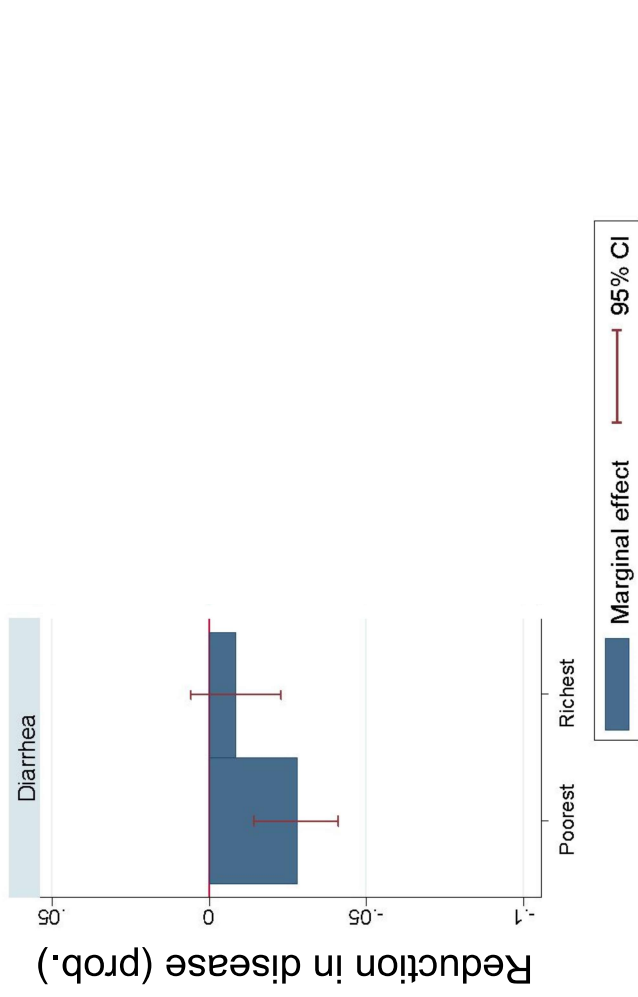
Comparing potential interventions



Herrera, et al. 2017. *Nature Communications*



Forest effects: multiple outcomes



Fisher, et al. in press. *Lancet Planetary Health*



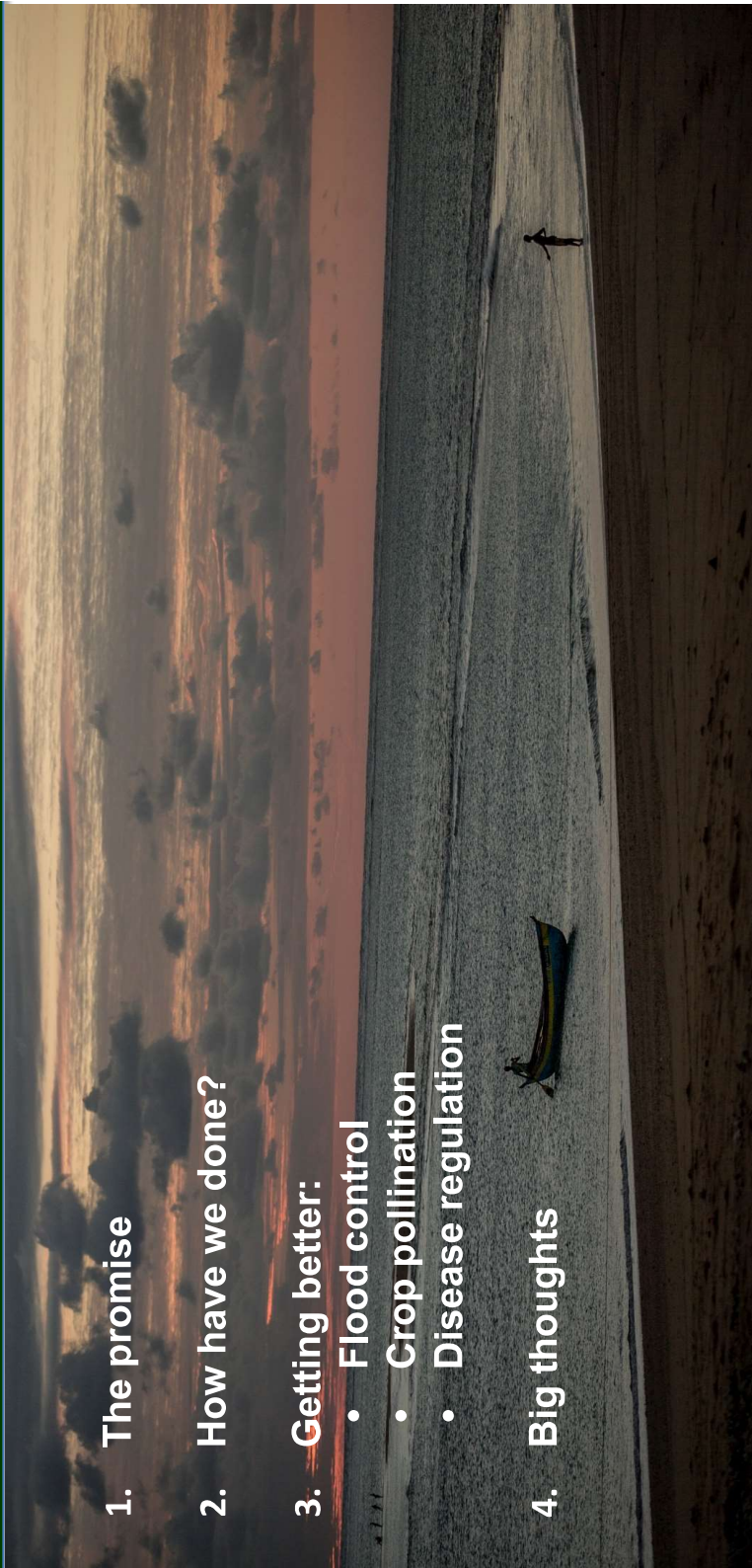
Take homes

- Nearby forests can help reduce childhood disease
- Higher benefit for more vulnerable communities
- General results complement case studies



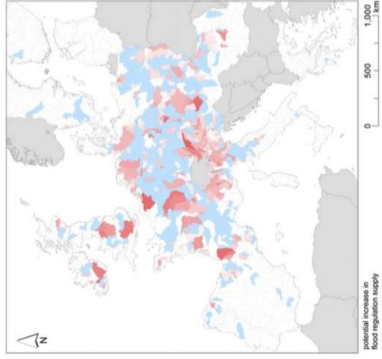
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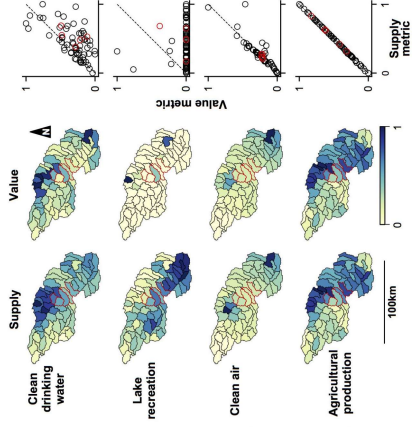


Picking up speed

J. Sturk et al. / Ecological Indicators 48 (2014) 199–211



Sturk, et al. 2014.



Keeler, et al. in press.

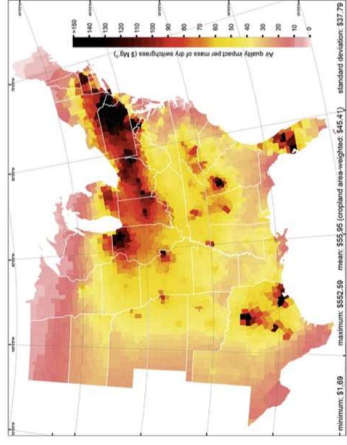
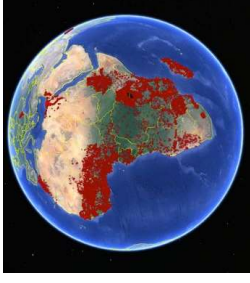
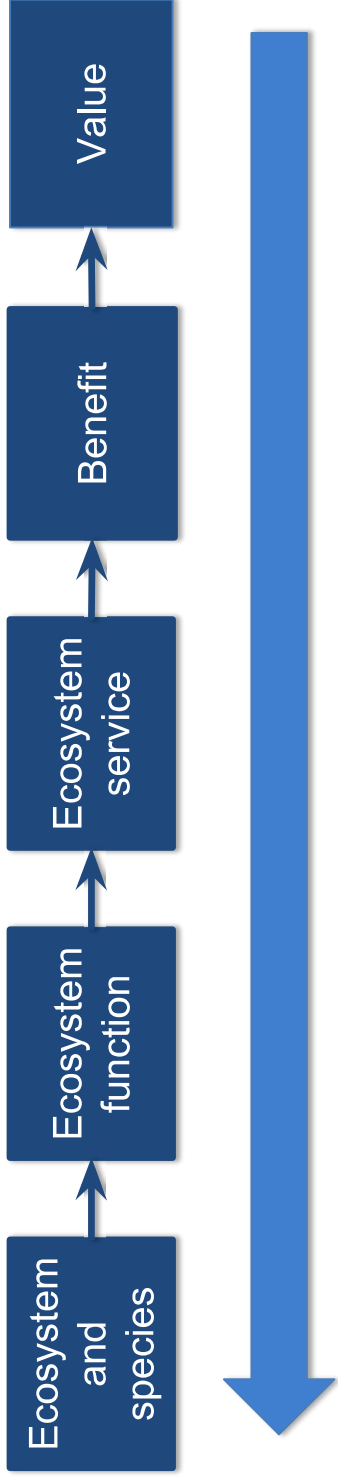


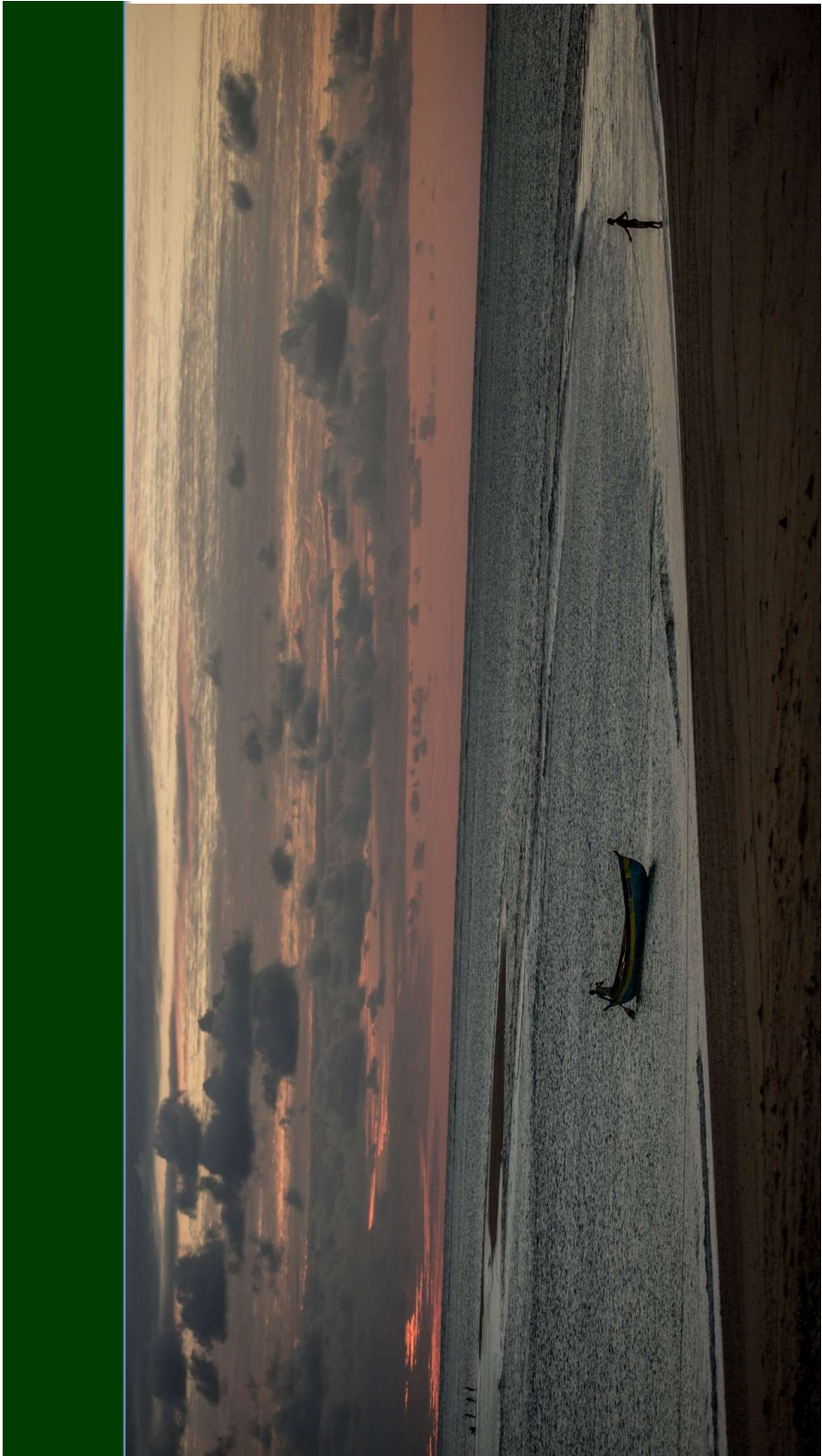
Fig. 2. Total ammonized air quality impacts of methylenamine production (yield: 20 Mg ha⁻¹; fertilization rate: 100 kg ha⁻¹; 4% to zero).

Thackrar, et al. 2018.



Start right, move left





Thanks

Collaborators

Alicia Ellis

Brendan Fisher

Diego Herrera

Insu Koh

Eric Lonsdorf

Lisa Mandle

Sam Myers

Steve Polasky

Ranaivo Rasolofoson

Laura Sonter

Keri Watson

Integrated Crop Pollination

Planetary Health Alliance

Natural Capital Project

Gund Institute

Support

USDA-SCRI

USDA-NIFA

NSF-NCEAS

NSF-SESYNC

WWF Luc Hoffmann Institute

USAID - BRIDGE

Moore Foundation

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Services provide benefits to people

