InVEST: Quantifying ecosystem services

Taylor Ricketts
Emily McKenzie

Natural Capital Project
World Wildlife Fund – U.S.
Challenge: mainstreaming ES

- “You can only manage what you can measure.”
- Provide tools to incorporate ecosystem services into decisions and policies
- Questions:
  - Where do ES come from?
  - Who do they benefit (or not)?
  - How will they change in future?
- Evaluate choices, quantify tradeoffs
The Natural Capital Project

- Develop tools to map, value ecosystem services
- Test & apply tools in critical regions
- Support policies to maintain / pay for services
InVEST
Multiple ecosystem services

Carbon storage
Non-timber forest products
Sediment retention
Water purification
Coastal storm protection
Crop pollination
Fish production
A Tiered Approach

Models

Simple

Data

Complex

Tier 1

Tier 2

Tier 3
Informing decisions

- Stakeholders
  - Scenarios (mapped)
    - Policy -- Climate
    - Biophysical Models
    - Valuation Models
      - Maps
      - Tradeoffs

InVEST
Demonstration Sites

- Test InVEST with field partners and experts
- Advance concrete policy goals
- Roll up / share lessons
Central Sumatra

- Island-wide land-use planning
  - Now at district scale

- Governors’ commitment
  - Planning
  - Incentives

- Our role:
  - map sources of ES
  - Recommend options to capture values
Scenarios of change

2008

2020
Existing plan

2020
Sumatra Vision
Change in carbon stored

2008

2020
Existing plan

2020
Sumatra Vision
Accounting for carbon changes
Tradeoff analyses

Sarolangun

- Summed habitat quality score / 100
- Water yield runoff depth (mm/yr)
- Avoided erosion (tons / yr) / 10000
- Carbon stock over 50 yrs (Mt)
- Natural habitat (km²) / 100
- Plantation area (km²) / 100

Avoided erosion

0 1 2 4 Km

Dams
Cities
Sediment export (vision - plan) tons/ha
High: 19818.210938
Low: -25994.689453
Production function

• Carbon storage

\[ \sim f(\text{veg}, \text{storage/ha}, \text{harvest}, \text{decay}) \]

• **Inputs**: land use/cover, C densities, harvest rates, decay rates of harvested wood.

• **Outputs**: C stored/ha

• **Valuation**: damage costs avoided

Sediment retention

\[ \sim f(\text{soil}, \text{slope length}, \text{veg}, \text{rain}, \text{neighbors}) \]

• **Inputs**: land use/cover, topography, soils, precip, basins

• **Outputs**: tons sediment retained/ha

• **Valuation**: replacement costs avoided (dredging)
Other projects

- Range of policy contexts
- TEEB case studies
Capacity building

(MA Sub-global assessment, ProEcoServe)
Engaging people
InVEST attributes

- Multiple services and tradeoffs
- Spatially explicit (mapped)
- Production functions
- Evaluate CHANGE: choices, tradeoffs
- Simple
- Open source – many contributors, updates
- To date: subnational, but early national trials
Challenges

– Data – even for tier 1 models
– Capacity to interpret and apply
– Water-related services
– Governmental silos
How can InVEST* help?

- Identify key sources of ES (Kirk)
- Make ES “visible” in Nat. Accounts (Glenn-Marie)
- Demonstrate value, regardless of capture (Pavan)
- Quantify, map externalities (Kirk)
- Retain spatial data within national accounts (G-M)

* Or similar approaches
People
Andrew Balmford
Nirmal Bhagabati
Neil Burgess
Gretchen Daily
Brendan Fisher
Peter Kareiva
Eric Lonsdorf
Guillermo Mendoza
Shadrack Mwakalila
Robin Naidoo
Erik Nelson
Nasser Olwero
Steve Polasky
Jim Regetz
Amy Rosenthal
Mathieu Rouget
Mary Ruckelshaus
Heather Tallis
Buzz Thompson
Kerry Turner
...

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NSF-NCEAS
NASA
Leverhulme Trust
Google
Packard Foundation
MacArthur Foundation
Summit Foundation
Roger and Vicki Sant
Peter and Helen Bing
...

Thanks...
## What are we measuring?

<table>
<thead>
<tr>
<th></th>
<th>Timber Production</th>
<th>Crop Pollination</th>
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</thead>
<tbody>
<tr>
<td><strong>Supply</strong></td>
<td>Standing stock of wood (cubic feet ha(^{-1}))</td>
<td>Insect abundance (# insects ha(^{-1}))</td>
</tr>
<tr>
<td><strong>Use-intermediate service</strong></td>
<td>None</td>
<td>Insect abundance contributing to crop (# of insects ha(^{-1}))</td>
</tr>
<tr>
<td><strong>Use-final service</strong></td>
<td>Harvested wood (cubic feet ha(^{-1}))</td>
<td>Crop yield due to insects (kg crop ha(^{-1}))</td>
</tr>
<tr>
<td><strong>Value</strong></td>
<td>NPV of harvested timber ($ ha(^{-1}))</td>
<td>NPV of additional crop yield ($ ha(^{-1}))</td>
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