

Applying InVEST: Incorporating Ecosystem Services and Natural Capital into National Accounts

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The Natural Capital Project: Mainstreaming ecosystem services



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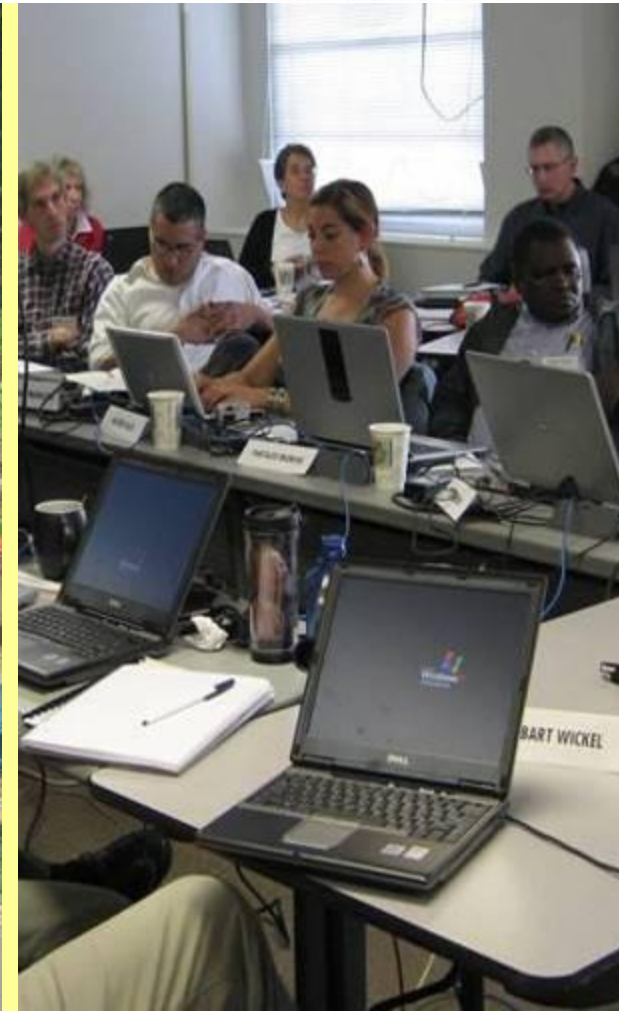


The Nature
Conservancy



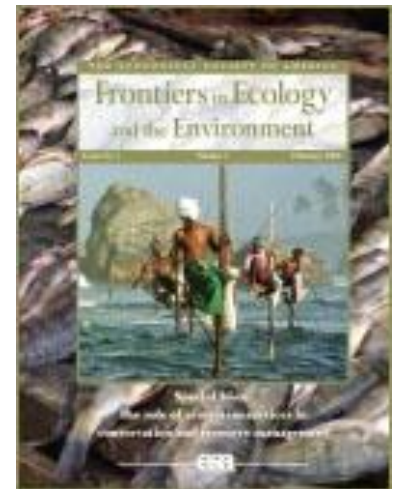
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“InVEST”
Integrated Valuation of **E**cosystem
Services and **T**radeoffs

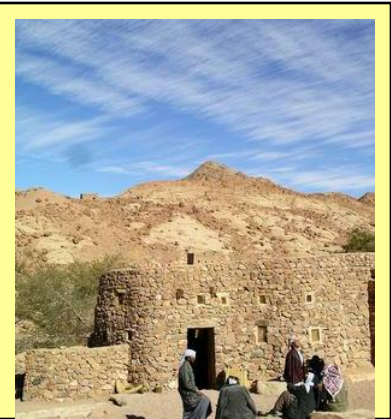
<http://www.naturalcapitalproject.org/InVEST.html>



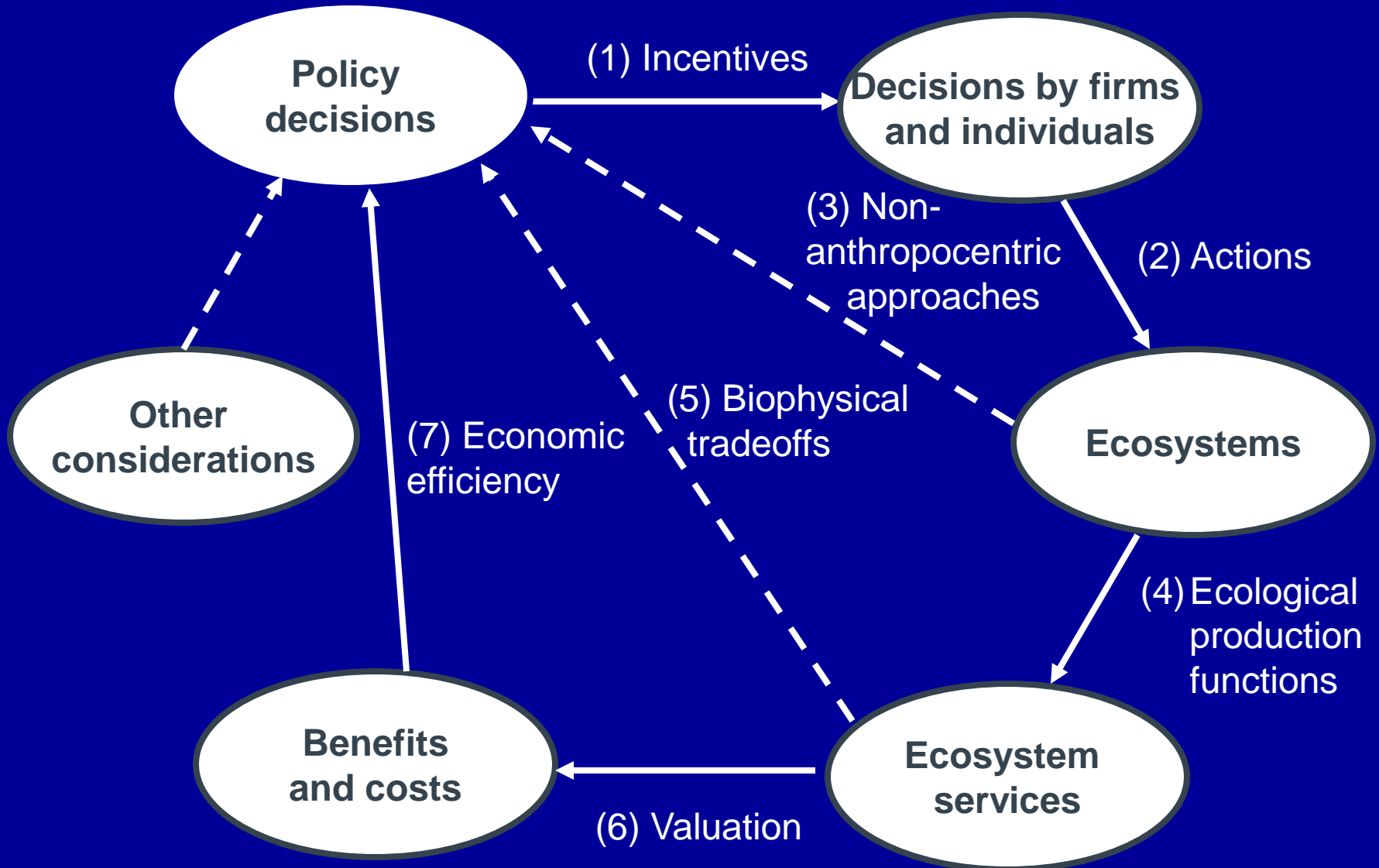
Frontiers of Ecology
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InVEST

- Set of computer-based models
- Biodiversity and multiple ecosystem services
- Driven by future scenarios
- Spatially explicit
- Biophysical and economic outputs
- Flexible and transferable



A research agenda for ecosystem services



Using InVEST

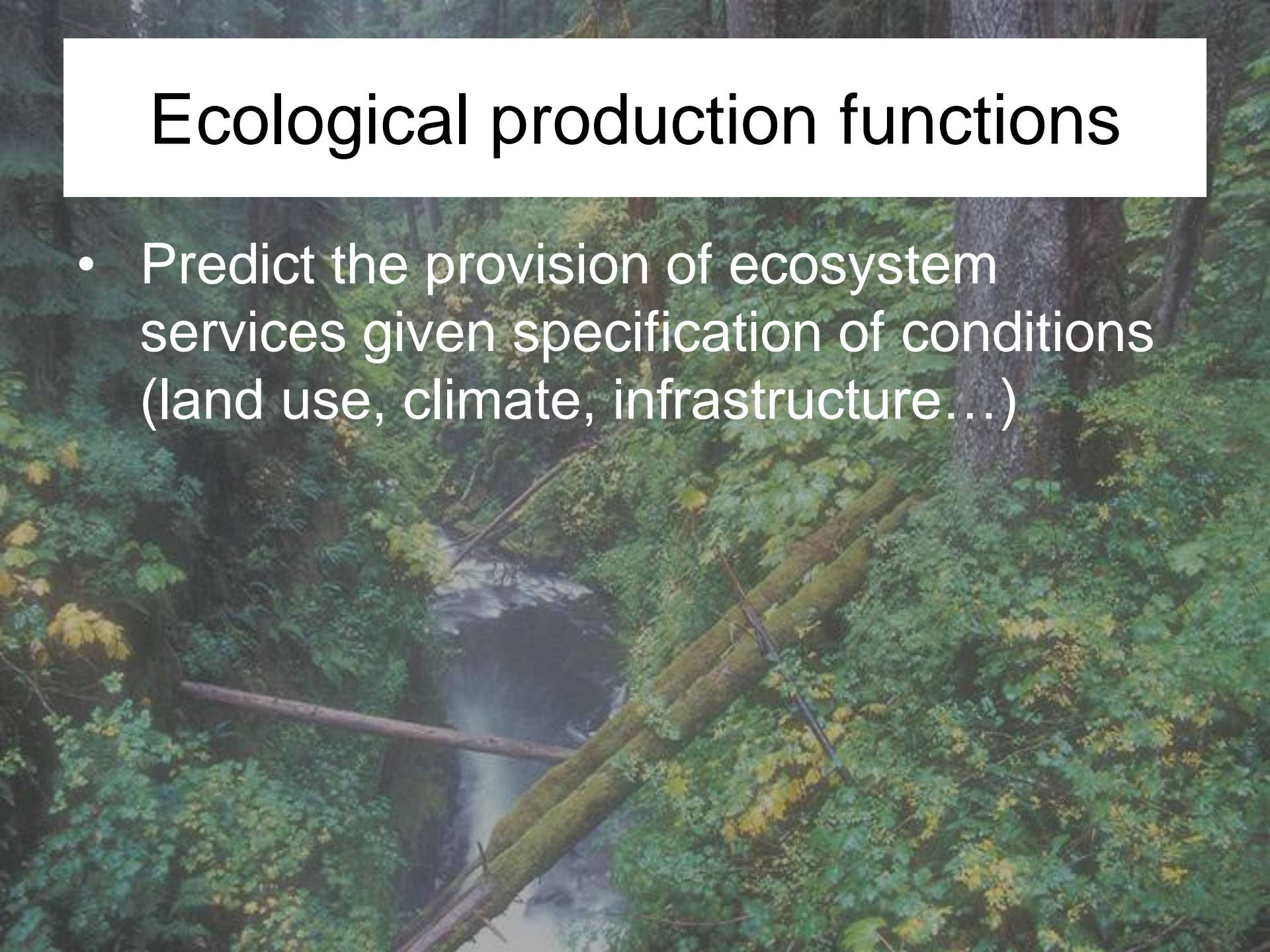
- Typical use of InVEST: value the bundle of ecosystem services from landscapes and be able to show how these values change under different management choices
- But you also can use InVEST for national income and wealth accounting

Using InVEST

- Illustrate approach for two services
 - Carbon sequestration for climate regulation
 - Water quality improvement for drinking water supply
- Two important steps
 - Ecological production functions (quantities)
 - Valuation (prices)

Ecological production functions

- Predict the provision of ecosystem services given specification of conditions (land use, climate, infrastructure...)



Valuation

- How much is the provision of an ecosystem service worth?
- Economic valuation tools – provide estimates of the value of ecosystem services in monetary terms

Value of ecosystem services for national income accounting

- InVEST calculates:
 - Quantities necessary to calculate the flow of ecosystem services
 - Value of an additional unit of service
- Estimate of the value of the flow of ecosystem services
- Value of flow of services in a year is what is needed for income accounting

Value of natural capital for wealth accounting

- Problem with income accounts is that they are not necessarily sustainable
 - High flow of services may be due to high extraction and depletion of natural capital (e.g., overfishing)
- Can use InVEST to calculate present value of flow of services through time
- Present value calculations can be used to estimate the value of natural capital for inclusive wealth accounts

Carbon sequestration

- Accounts for carbon stored in various pools
 - Above-ground biomass
 - Below-ground biomass
 - Soil
 - Litter
 - Harvested wood products
- Use data on carbon stored by land use and parcel characteristics (e.g., forest type, stand age, soil type...) to estimate carbon storage at each location in a landscape
- Carbon sequestration is the change in carbon storage

Valuing carbon

- What is the value of sequestering (storing) carbon
 - Carbon stored is not carbon in the atmosphere
 - Reduce the intensity of climate change
 - Reduce future damages associated with climate change

Valuing carbon

- “Social cost of carbon” – estimate of the reduction in future damages from climate change by reducing CO₂ emissions by one metric ton
 - Huge range of estimated values
 - Tol (2009): mean estimate on the order of around ~\$60 per ton C (<\$20 per ton CO₂)
- Is the value of reduced emissions equal to the value of permanent storage?
 - Emissions have finite life in the atmosphere
 - After finite life is the CO₂ then permanently stored?

Valuing carbon

- Cap-and-trade market prices:
- Price of emissions permit reflects the marginal cost of meeting the cap not necessarily the benefits of reduced carbon
 - Only if the marginal cost equals the marginal benefit will the marketable permit price reflect value
 - There is no guarantee that the cap will be set optimally so that marginal cost equals marginal benefit
 - Price will depend on stringency of cap
- Example: carbon prices in January 2008
 - European Exchange: 21.03 €/metric ton (or \$30.86/metric ton)
 - Chicago Climate Exchange: \$2.30/metric ton

Water quality

- InVEST predicts the loadings of P, N into water bodies
 - Export of N, P by land parcel as a function of land use and management practices
 - Retention of nutrients by parcels (net export)



Valuing water quality

- Water quality contributes to many ecosystem services
 - Drinking water supply
 - Recreation
 - Aesthetics
 - Fishery productivity
- What is the value of improved water quality for drinking water supply

Valuing water quality

- In developed countries: calculate the avoided treatment cost from improved water quality
- In developing countries (assuming no water treatment): calculate the change in disease incidence with improved water quality, or reduction in averting behavior
- Issue: to calculate the value of services provided we need to know the “no service” alternative
 - Not necessarily clear what this is in the case of water quality
 - Could zero out retention and assume that all inputs of N, P end up in water supply

Total versus marginal value

- If ecosystem services are essential for life support then the total value of services is equal to all wealth (or infinity)
- Toman (1998): Costanza et al. (1997) estimate of \$33 trillion value for earth's ecosystem services is a "serious underestimate of infinity"