

Monetary and non-monetary approaches to valuing ecosystem services and natural capital

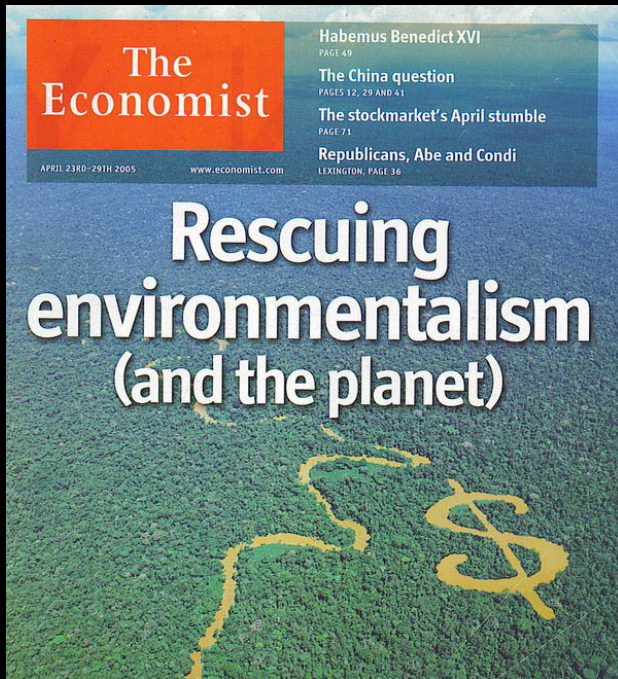
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Four questions

1. Why is valuation of ecosystem services (and natural capital) important?
2. Is it better to measure the value of ecosystem services in monetary terms or non-monetary terms?
3. What do monetary measures of value mean and how can they best be done?
4. What do non-monetary measures of value mean and how can they best be done?

Why is valuation important?



Why valuation is important

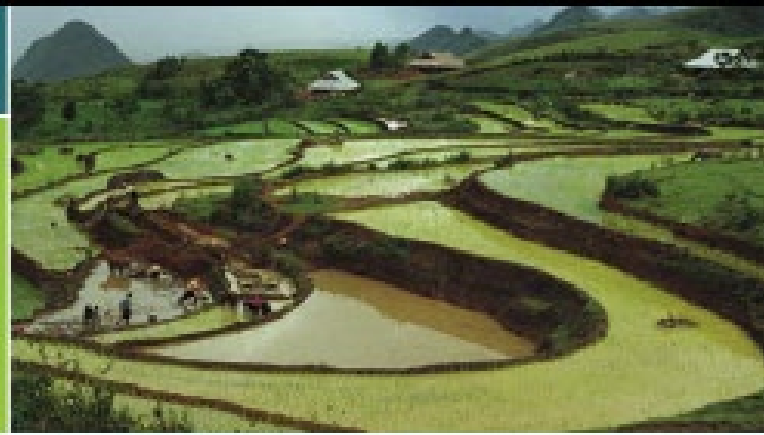
- Valuation provides useful information about ecosystem services and natural capital:
 - Shows how an increase in ecosystem services or natural capital contributes to current and future human well-being
- Can improve decision-making yielding improved outcomes for nature and people
 - Starting from a position of zero attributed value, accurately valuing ecosystem services and incorporating them into decision-making will lead to greater conservation of nature and improved human well-being
 - Note: Greater conservation and improved human well-being do not always align...

Federal Decision Making: EOP memorandum on ecosystem services (2015)

- This memorandum outlined the rationale for integrating ecosystem services “into Federal decision making due consideration of the full range of benefits and tradeoffs among ecosystem services associated with potential Federal actions, including benefits and costs that may not be recognized in private markets because of the public-good nature of some ecosystem services.”

Federal Decision Making: EOP memorandum on ecosystem services (2015)

- “An ecosystem-services approach can:
 1. More completely inform planning and decisions
 2. Preserve and enhance the benefits provided by ecosystems to society
 3. Reduce the likelihood of unintended consequences
 4. Where monetization is appropriate and feasible, promote cost efficiencies and increase returns on investment.
- Adoption of an ecosystem-services approach is one way to organize potential effects of an action within a framework that explicitly recognizes the interconnectedness of environmental, social, and, in some cases, economic considerations, and fosters consideration of both quantified and unquantified information.”



ECOSYSTEMS AND HUMAN WELL-BEING

Synthesis



MILLENNIUM ECOSYSTEM ASSESSMENT

Service	Sub-category	Status	Notes
Provisioning Services			
Food	crops	▲	substantial production increase
	livestock	▲	substantial production increase
	capture fisheries	▼	declining production due to overharvest
	aquaculture	▲	substantial production increase
	wild foods	▼	declining production
Fiber	timber	+/-	forest loss in some regions, growth in others
	cotton, hemp, silk	+/-	declining production of some fibers, growth in others
	wood fuel	▼	declining production
Genetic resources		▼	lost through extinction and crop genetic resource loss
Biochemicals, natural medicines, pharmaceuticals		▼	lost through extinction, overharvest
Fresh water		▼	unsustainable use for drinking, industry, and irrigation; amount of hydro energy unchanged, but dams increase ability to use that energy
Regulating Services			
Air quality regulation		▼	decline in ability of atmosphere to cleanse itself
Climate regulation	global	▲	net source of carbon sequestration since mid-century
	regional and local	▼	preponderance of negative impacts
Water regulation		+/-	varies depending on ecosystem change and location
Erosion regulation		▼	increased soil degradation
Water purification and waste treatment		▼	declining water quality
Disease regulation		+/-	varies depending on ecosystem change
Pest regulation		▼	natural control degraded through pesticide use
Pollination		▼ ^a	apparent global decline in abundance of pollinators
Natural hazard regulation		▼	loss of natural buffers (wetlands, mangroves)
Cultural Services			
Spiritual and religious values		▼	rapid decline in sacred groves and species
Aesthetic values		▼	decline in quantity and quality of natural lands
Recreation and ecotourism		+/-	more areas accessible but many degraded

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You get what you pay for

and

You don't get what you don't pay for

The Impact of Land Use Change on Ecosystem Services, Biodiversity and Returns to Landowners: A Case Study in the State of Minnesota



Photo by Raymond Gehman, National Geographic

Polasky, Nelson, Pennington, Johnson. 2011. *Environmental and Resource Economics* 48(2): 219-242

Impacts of land use change scenarios

- Compare the impact on ecosystem services & biodiversity from:
 - Actual land use change from 1992- 2001
 - Alternative land use change scenarios
- Alternative land use scenarios:
 - No agricultural expansion
 - No urban expansion
 - Agricultural expansion into highly productive soils
 - Forestry expansion into highly productive forest parcels
 - Conservation: low productivity ag land and ag land within a 100 m buffer of waterways in MN River watershed were converted to pre-settlement vegetation

Annual value under land use alternatives

	Actual land use	No ag expansion	No urban expansion	Ag expansion	Forest expansion	Conser- vation
Change in total value: carbon, water quality, ag & forest production, urban using actual prices (M1992 \$)	\$3,328	\$3,407	\$3,040	\$2,742	\$3,300	\$3,380
Change in returns to landowners: ag & forest production, urban using actual prices (M1992 \$)	\$3,320	\$3,343	\$3,027	\$3,418	\$3,292	\$3,221



Why valuation is important?

- Typical policy or management decisions involve choosing among alternatives with many different dimensions
- It is rare for a one alternative to dominate all other alternatives on all dimensions
- So choosing among alternatives involves tradeoffs
- Make a good choices about tradeoffs requires value judgement that weigh the relative value of impacts in different dimensions



Monetary or non-monetary valuation?



Federal Decision Making: EOP memorandum on ecosystem services (2015)

- Monetization shows up in Point 4 (not in points 1 , 2 or 3): “Where monetization is ***appropriate and feasible***, promote cost efficiencies and increase returns on investment.”

Monetary valuation attracts critical attention

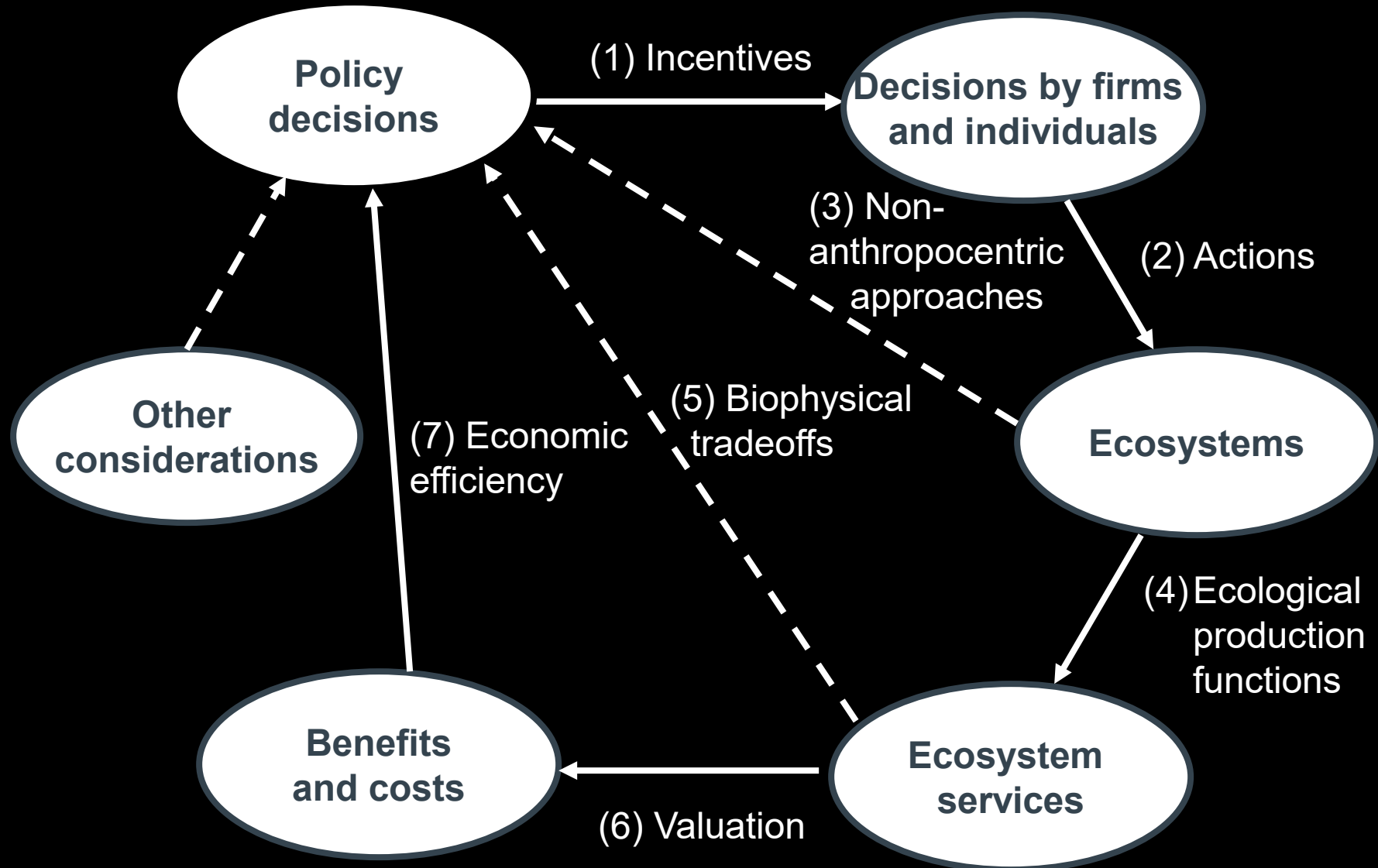


But is only part of the story....

Vertical Lightning At Sunset" by Christian Meyn

FreeDigitalPhotos.net

Valuation in context



Monetary vs. non-monetary valuation

- Environmental economists have developed a variety of methods to value environmental benefits and costs including both market and non-market valuation techniques that measure all impacts in terms of a common monetary metric
 - Putting everything in a common (monetary) metric allows decision-makers to easily compare the net benefits of alternatives
- But economic methods may require strong assumptions, or require data not currently available, making their application problematic
 - In such cases, it may be preferable to use non-monetary indicators, such as measures of health impacts or environmental indicators, of direct policy concern

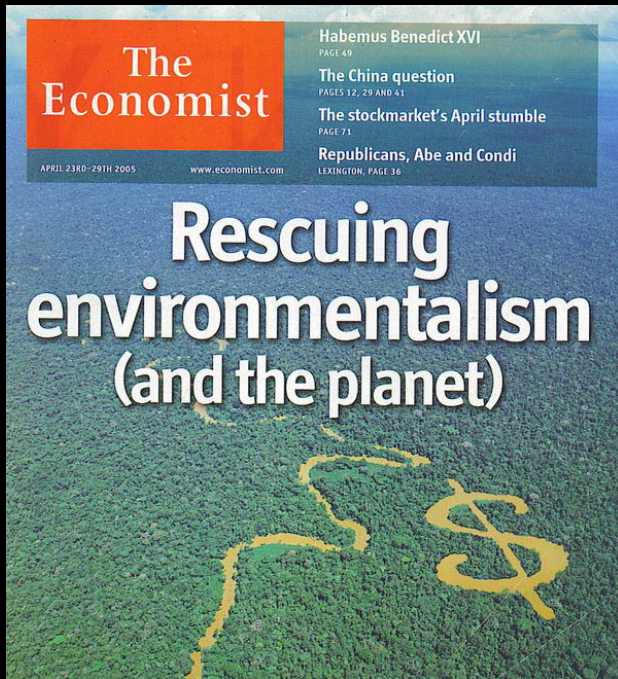
Monetary vs. non-monetary valuation: Communications aspects

- Who is the audience/decision maker? What terms resonate with them?
 - Treasury Department/World Bank
 - Conservation NGO
 - General public...
- Example: Health impacts of air pollution
 - 1,000 premature mortalities annually
 - \$8 billion annually

Monetary vs. non-monetary valuation: Practical considerations

- Is valuation *appropriate and feasible*
- Well done economic valuation study is time and resource intensive
- Are values amenable to economic valuation methods
 - Existence, spiritual and cultural values
 - Or recreation value, impact on marketed goods...

Monetary valuation



Advantages of economic approach to monetary valuation

- Economic valuation is derived in a consistent and logical manner from basic principles –application of welfare economics
- Monetary measures of value can be reported in a single (monetary) metric that makes it easy to compare relative value of different ecosystem services
- Large body of literature
 - Theory and methods: NRC 2005, US EPA 2009, TEEB 2010, Freeman et al. 2014, Champ et al. 2017
 - Empirical data bases: Carson 2011, Van der Ploeg and de Groot 2010, ESP 2017
- Application of well-understood methods

Economic valuation methods applied to measure the monetary value of ecosystem services

1. Market values for goods and services
2. Valuing ecosystem services as inputs into marketed goods
3. Revealed preference methods: Hedonic property price models, random utility models, averting behavior
4. Stated preference methods: choice experiments
5. Cost-based approaches*

Market values for goods and services

- Some ecosystem services are traded in markets and have observed prices (commercially harvested fish, timber, crops...)
- Value of increasing supply of an ecosystem service
 - For small changes: price minus marginal cost of supply
 - For larger changes: price itself will adjust, use measures of change in consumer and producer surplus

Valuing ecosystem services as inputs into marketed goods

- Production function approach: how does an increase in input lead to an increase in marketed product (marginal product)
- Value of ecosystem input: Marginal product times price

Example: Economic value of tropical forest to coffee production (Ricketts et al. PNAS 2004)

- Calculate the increased coffee yield and quality by being close to patch of natural habitat (coffee yields by 20% within 1 km of forest)
- Use market prices for coffee to estimate the increased value of natural habitat for coffee growers
- During 2000–2003, pollination services from forest fragments translated into \$60,000 (U.S.) per year for one Costa Rican farm



Non-market valuation: Revealed preference methods

- Revealed Preference: use observed choices of individuals to infer how they value ecosystem services
 - Hedonic approach (hedonic property price studies, hedonic wage studies)
 - Discrete choice random utility models (“travel cost”)
 - Averting behavior

Example: Valuing Urban Wetlands

- Mahan, B et al. 2000. Valuing urban wetlands: a property price approach. *Land Economics* 76(1): 100-113.
- House sale price as a function of:
 - Structural characteristics
 - Neighborhood characteristics
 - Environmental characteristics
 - Wetlands characteristics (distance, size and type of closest wetland)
- Results:
 - Increasing the nearest wetland by one acre: \$24.39
 - Reducing the distance to the nearest wetland by 1,000 feet: \$436.17 (\$1643.78 for lakes)



Non-market valuation: Stated Preference Approaches

- Choice experiments: survey asking individual to make choices
 - Contingent valuation: offer a choice about whether individual would pay a specified price for a specified increase in an ecosystem service
 - Conjoint analysis: offer bundles of services and price and ask which is preferred

Cost-based Methods

- Cost-based methods:
 - Replacement cost
 - Avoided damages
 - Marketable permit prices
- Cost-based methods are often used in ecosystem valuation
- Example: Catskills/New York City water supply
- Economists are skeptical about cost-based methods



Replacement cost

- What would it cost to replace an ecosystem service with human engineered solution?
- To be valid, must meet three conditions:
 - Human engineered solution provides equivalent quality/quantity of service
 - Solution is least cost alternative of providing the service
 - Individuals in aggregate would be willing to incur the cost if ecosystem service were not available



Summary of monetary valuation

- For many ecosystem services, economic methods can be applied to generate meaningful estimates of value
- Large body of literature
- Makes it relatively easy to compare to value of other costs and benefits



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Non-monetary valuation



Criticisms of the application of economic valuation to ecosystem services

- Monetary valuation of ecosystem services has come under intense scrutiny and criticism. Criticisms include:
- Fundamental objection to thinking about value of nature in terms of ecosystem services (intrinsic value arguments; ethical arguments)
- Framing things in terms of monetary values changes how people think about ecosystem services and nature, and therefore changes the very values that are attempting to be measured (Slovic, Sandel)
- Fairness and equity concerns: willingness to pay determined by ability to pay (wealth)
- Inability to satisfactorily capture non-material benefits (spiritual, cultural, psychological)

Non-monetary indicators of value

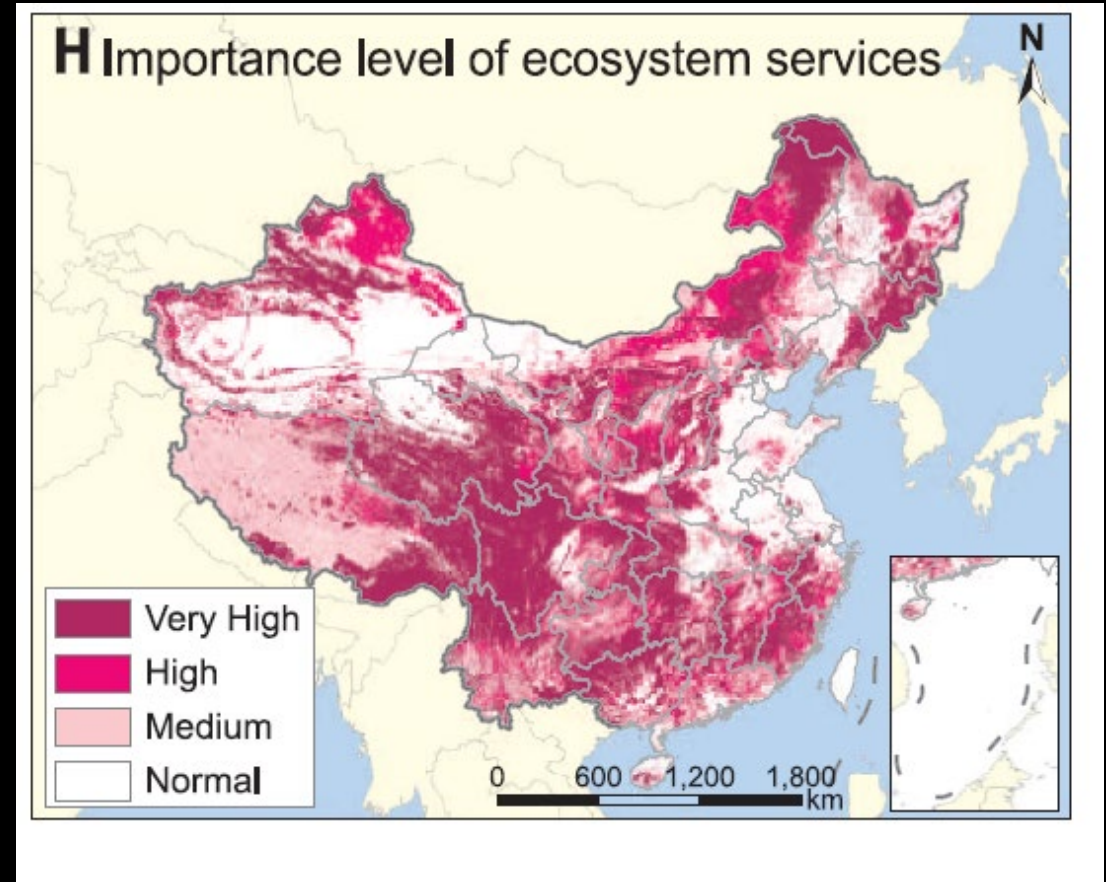
- In some cases, non-monetary indicators may be preferred to monetary value estimates either because of philosophical or practical concerns about monetary valuation
- Range of non-monetary indicators can be useful in decision-making
- Such indicators include:
 - Health impacts (e.g., Disability Adjusted Life Years)
 - Environmental impacts such as whether an environmental policy objective is met (e.g., reduction in impaired waters, protection of endangered species)
 - Other “benefit-relevant indicators” for impacts on human well-being

Example: Improvements in ecosystem services from investing in natural capital

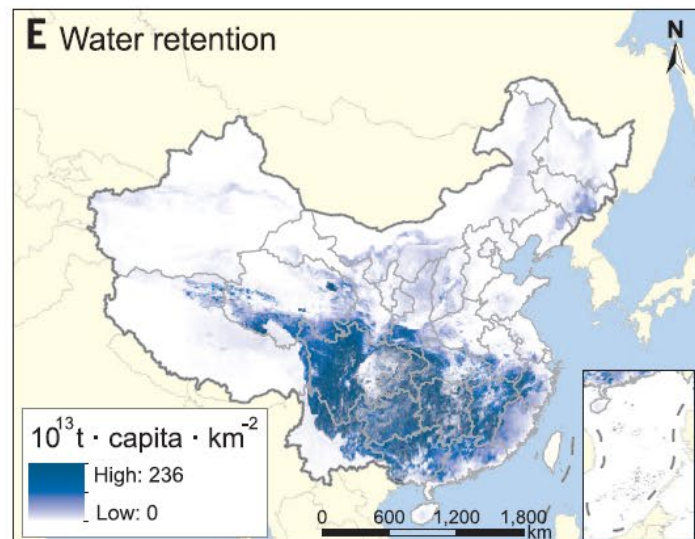
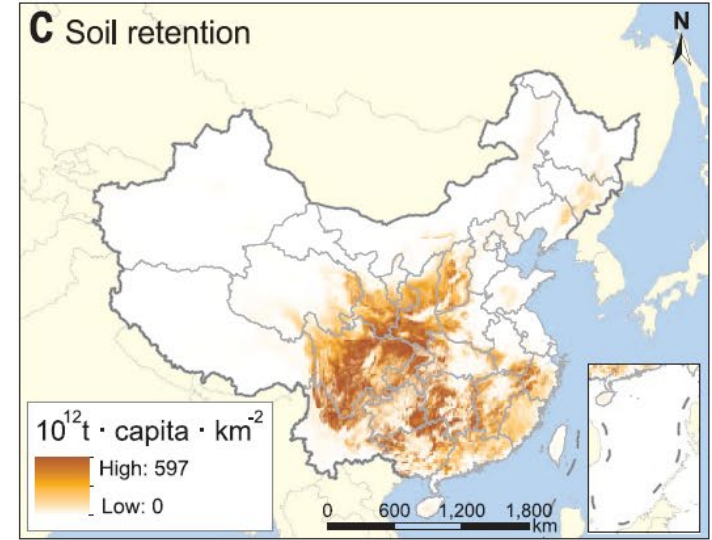
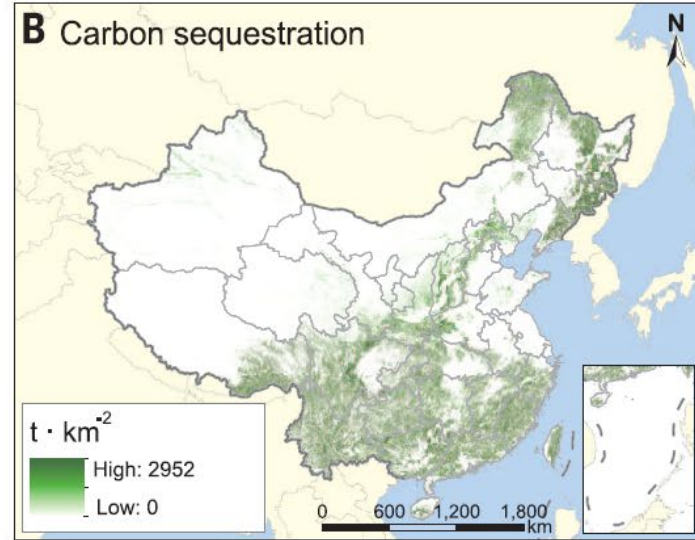
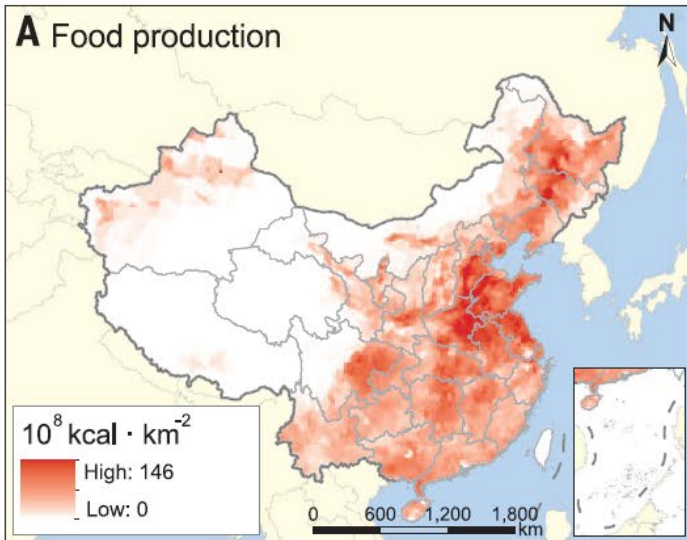


Context

- Yangtze River flood in 1998 killed thousands of people, left 13.2 million people homeless and caused ~\$36 billion in damage
- China began investing in protecting and restoring natural capital
 - Natural Forest Conservation Program(NFCP)
 - Sloping Land Conversion Program (SLCP)
 - Cumulative total investment >\$50 billion
- What benefits has China received from this investment?



Spatial pattern of ecosystem service provision



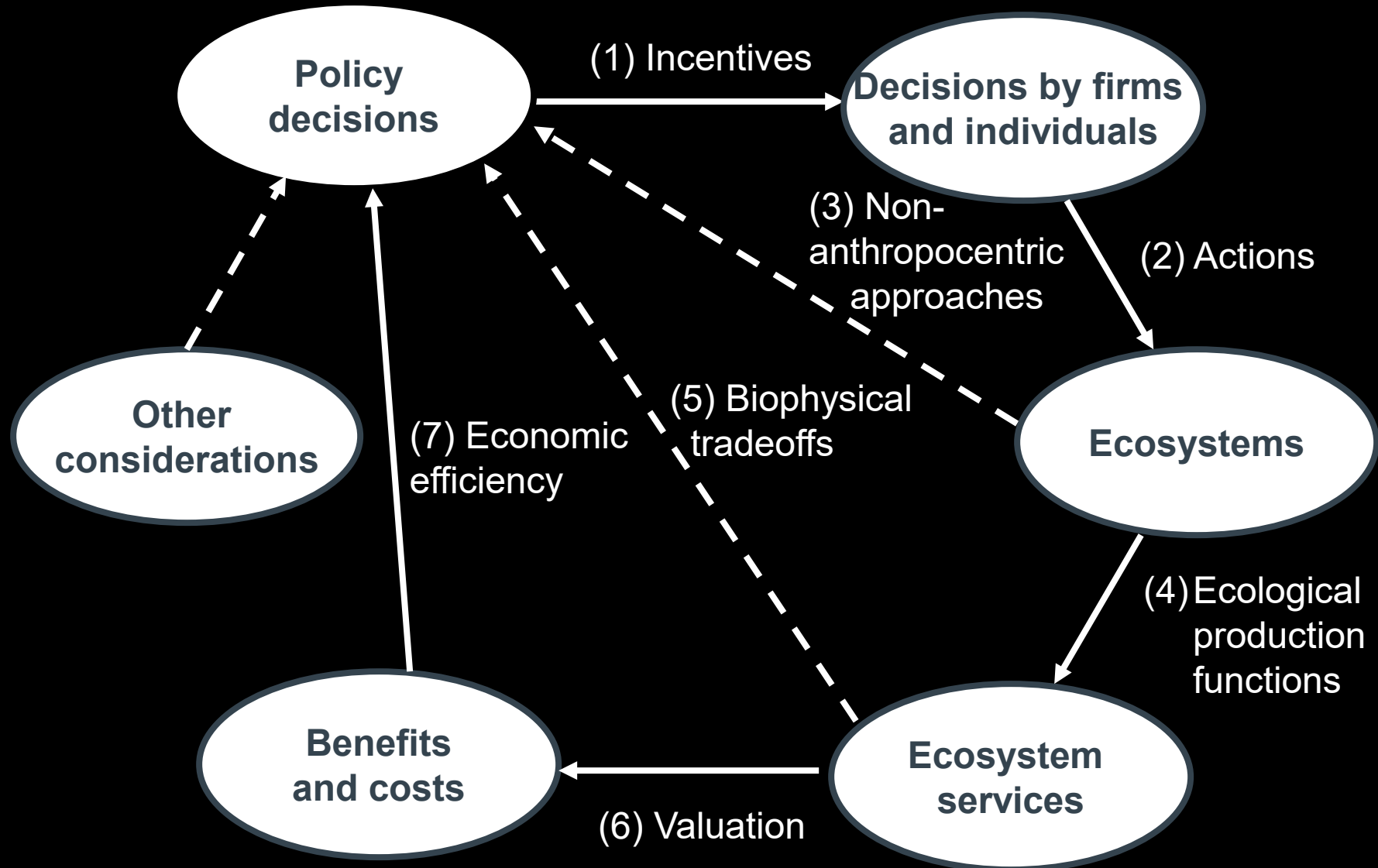
Practical considerations



Theory and practice

- In principle: we know how to do each step in logic chain through to value

Theory and practice



Mind the gap between theory and practice

- In practice, it is hard:
 - To estimate correctly the response to changes in policies, market conditions
 - To estimate ecological production functions (more generally production functions that combine natural, manufactured, human and social capital) to know about supply of ecosystem services
 - To estimate the value of ecosystem services – their impact on human well-being
- “In theory there is no difference between theory and practice.
- In practice there is.”

Yogi Berra (among others... “Attributed to multiple people. It’s so true that it doesn’t matter who said it.”)

Other practical issues

- Is the benefit of a primary valuation study worth the cost?
- Use of benefits transfer methods
- Distributional issues
- Discounting
- Seamlessly linking ecological studies of production of services with economic studies of value

Four questions revisited

1. It is important to value ecosystem services (and natural capital)
2. Consideration in deciding when to use monetary or non-monetary measures of ecosystem service values
3. Good approaches for measuring monetary values
4. Good approaches for measuring monetary values
 - Existing methods provide fertile ground for rapidly expanding the implementation of ecosystem services into many contexts
 - Doing so promises to improve outcomes in terms of environmental performance and human well-being for current and for future generations



Thank you